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## FOREWORD

It was a great honour for Latvia University of Life Sciences and Technologies to welcome you all to the conference that is so important in general and for me personally. If I could say it this way - the child was born 25 years ago and I was very close to this event in May, 1995. During its childhood the conference changed names each year. In 2000 among the participants of conference named 'Science – Latvia – Europe', first time were quests from other countries.
But from 2001 it became traditional 'RESEARCH FOR RURAL DEVELOPMENT'. The history of the conference states that there are 2141 presentations in total and 1456 publications at the proceedings.

In the celebration of the Annual 25th International Scientific Conference 'Research for Rural Development 2019' held at the Latvia University of Life Sciences and Technologies, in Jelgava, from 15 to 17 May, participants with different backgrounds from 12 countries did 156 presentations, enjoyed welcome dinner with Latvian folk songs and dances as well as tasted a special cake. During a social programme of the conference, the participants visited a malt production plant, Rundāle palace and had farewell lunch.

In the retrospect, four months later, we consider the Conference a great success in terms of interdisciplinary studies and networking opportunities. The sessions of the conference were structured so as to give all participants the opportunity to contribute to the primary purpose of the conference, which is discussion of important current issues facing rural development.
Thank you for your participation! We are sure that you have learned from the presentations and discussions during the conference and you can use the outcomes in the future.

The interdisciplinary proceedings of the Annual 25th International Scientific Conference 'Research for Rural Development 2019' (two volumes since 2010) are intended for academics, students and professionals. The subjects covered by those issues are as follows: crop production, animal breeding, agricultural engineering, agrarian and regional economics, food sciences, veterinary medicine, forestry, wood processing, water management, environmental engineering, information and communication technologies. The papers are grouped according to the sessions in which they have been presented.

Finally, I wish to thank Organizing and Scientific Committee for their great support to the conference and proceedings.

Ausma Markevica
Chairperson
Annual 25th International Scientific Conference
'Research for Rural Development 2019'

## CONTENTS

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# ABOVE-GROUND AND SEED BANK WEED BIODIVERSITY COMPARISON IN CONVENTIONAL AND ORGANIC FARMING SYSTEMS IN POLAND

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**Abstract**
The assessment and conservation of agricultural biodiversity is one of the current goals of European Union policies, which is reflected in European Biodiversity Strategy. The biodiversity of soil seed bank and above-ground weed flora were investigated in spring cereals in organic and conventional farming system. The study was carried out between 2012 and 2014. Species of above-ground wild flora were counted on a surface of $1m^2$ in the field. Soil for seed bank evaluation was taken from the field and evaluated by seedling emergence method in a greenhouse. There were no significant differences in number of species between two communities. Biodiversity of weed community, described by Shannon's diversity index and Simpson's dominance index, was significantly better maintained in the soil seed bank than in above-ground flora in both farming systems. A strong, positive correlation between the number of species, Shannon's diversity index, Simpson's dominance index of soil seed bank and above-ground weed species was found in both farming systems, while abundance of seeds and above-ground weeds was significantly, positively correlated only in the conventional farming system. Qualitative composition of weed flora depended more on the type of community (soil seed bank or above-ground weed communities) than the farming system.
**Key words**: weeds, soil seed bank, farming systems, segetal flora.

## Introduction

Biological diversity of agricultural land is created by diversity of crops and accompanying wild plants (weeds), but also diversity of microorganisms, invertebrates and other organism, for which agricultural ecosystem creates an excellent living environment. A high biodiversity of agricultural land can be beneficial for farmers as it provides a number of ecosystem services which result in an increased stability of ecosystem and reduced costs of production due to lower demand for chemical plant protection products. Biodiversity conservation is one of the major objectives of the European Union policies, which is reflected in the European Biodiversity Strategy (European Commission, 2011). The strategy applies also to agricultural areas of Europe, where it aims at reducing the loss of biological diversity and linked ecosystem services. Sustainable, both highly efficient and environmentally friendly, agriculture cannot exist without a wide range of ecosystem services, which ensure high fertility of soils, proper water management, biological protection, nutrient cycles and a high productivity of agro-ecosystems (Clergue *et al.*, 2005).

The soil seed bank is closely related to the actual weed infestation visible on the field surface. The population of many weed species consists to a greater extent of seeds present in the soil than from the plants present on the surface of fields (Harper, 1977). The total number of seeds in the soil, especially in the case of arable lands, is very large and can amount to several hundred thousand per square meter (Cavers, 1983; Pawłowski & Wesołowski, 1980, 1989; Wojciechowski & Sowiński, 2007). Thus, the soil seed bank is a reservoir that can restore populations of both short-lived and perennial weeds (Baker, 1989).

Soil seed bank is the beginning of the life cycle and the only way to preserve the continuity of the species for annual plants. Most of seeds in the soil die within the first few years, but seeds of some weed species can survive for several dozen years under appropriate conditions (Cavers, 1983). In addition, seeds present in the soil can remain viable even after a change in the type of use, for example after forest succession (Woch, 2012). Thus, the soil seed bank is a kind of 'memory' of the ecosystem, in which the seeds of the majority of the previously living species are contained. The soil seed bank may prove valuable also for farmers. For example, it could be very important when 'superweeds' occur on the field (weeds resistant to herbicides due to irrational use of herbicides). In this case, sensitive genotypes of plants stored in the soil seed bank should be allowed to germinate for a few years. Thanks to intra-species competitiveness, sensitive ecotypes will naturally supplant resistant ecotypes.

The aim of the study was to compare biological diversity of above ground and soil seed bank weed communities in two farming systems – organic and conventional.

## Materials and Methods

The study was carried out in the years 2012-2014. Both above-ground and soil seed bank weed flora were investigated annually between 10$^{th}$ of June and 5$^{th}$ of July. The total sample size was 30 spring cereal fields cultivated under the conventional farming system conditions and other 30 spring cereal fields cultivated under organic farming. All fields were located in the Lubelskie region, one of the easternmost regions of Poland. All fields were located in the valleys of Wieprz, Tysmienica and Bug rivers, in the vicinity

of NATURA 2000 areas. Most fields were located on light, sandy soils (most common in Poland).

Organic and conventional fields were chosen as pairs, to minimize the impact of the local soil and weather conditions. Above-ground weed flora species and their abundance were counted on a surface of 1 $m^2$ on each field. There were 5 samples (replications) on each cereal field with 10 m spacing between the samples. Soil samples were collected from the direct vicinity of above-ground samples, with the soil cylinder of a 8 cm diameter (surface of about 50 $cm^2$), from the soil layer of 0 – 20 cm. Collected soil samples were placed in pots filled partially with sand (drainage). Emerging seeds were counted and assigned to the species during the 12-month exposition in the greenhouse (seedling emergence method).

The number of species, their abundance, Shannon's diversity index (H') and Simpson's dominance index (SI) were chosen as indicators describing biological diversity of both above-ground and soil seed bank weed communities. Spearman's correlation coefficient also was used to find the correlation between these two communities. As most of the biodiversity parameters were deviated from the normal distribution, the significance of differences was determined by Mood's test (comparison of medians) at a significance level of $\alpha$=0.05. Cluster analysis using Sorensen's similarity coefficients were used to assess the quantitative and qualitative similarity of the tested weed communities. The analysis was done by MVSP 3.1 Software.

**Results and Discussion**

*Number of species and their abundance*

In total, there were 165 weed species observed in both above-ground and soil seed bank weed flora during the 3-year study period (Table 1). One hundred fifty one species were found in the above-ground weed community, while 96 were found in the soil seed bank weed community. Eighty two species were common for both communities, while 69 species were found only in the above ground flora and other 14 only in the soil seed bank. Interestingly, when the organic and conventional farming systems were compared, it was visible that more unique species were observed for the soil seed bank of conventional farming system (38) than for organic farming system (17). This makes soil seed bank an important weed biodiversity reservoir, especially in the farming systems which are unfavourable for wild flora due to intensive weed management. In those systems, soil seed bank plays the role of 'agroecosystem memory'.

There were no statistically significant differences between the number of weed species in the above-ground flora and in soil seed bank, both in organic and in conventional farming system (Figure 1). According to the literature study, species composition of the above-ground weed flora is more susceptible to weather conditions and agrotechnical practices than weed community of soil seed bank. Hence, it is difficult to clearly describe the relationship between species composition of above-ground and the soil seed bank (Wesołowski, 1984; Zhang *et al.*, 1998; Feledyn-Szewczyk, 2003; Rahman, James, & Grbavac, 2006). Zhang *et al.* (1998) believe that there is no basis for determining the exact, quantitative and qualitative relationship between segetal flora on the field and the soil seed bank. This is due to the fact that only a small part of seeds find suitable conditions for germination under field crop conditions. As a result, the number of species observed in the above-ground weed flora is always lower than the actual number of species deposited as seeds in the soil. In addition, soil seed bank contains species from neighbouring phytocoenoses, which are not characteristic of agricultural ecosystems (Froud-Williams, Chancellor, & Drennan, 1983). In the presented study, a trend has been observed that the number of species in the soil seed bank was slightly lower than in above-ground flora, but no significant differences were found. Vandvik *et al.* (2016), based on their own research and literature review, found that species composition of the current weed infestation is dependent on the species composition of the soil seed bank. The authors found that the species richness is always greater in the soil seed bank than in the above-ground weed flora, and any possible deviations from this rule result from the inaccuracy

Table 1

**Total number of species (2012-2014) found in above-ground and soil seed bank weed flora in different farming systems**

| Parameters | Farming system and type of community | | | | | |
|---|---|---|---|---|---|---|
| | Organic | | Conventional | | Organic + Conventional | |
| | above-ground | seed bank | above-ground | seed bank | above-ground | seed bank |
| Total species | 133 | 86 | 116 | 96 | 151 | 96 |
| Unique species | 64 | 17 | 58 | 38 | 69 | 14 |
| Common species | 69 | | 58 | | 82 | |
| Median weed density (plants $m^{-2}$) | 297 | - | 170 | - | 233 | - |
| Median seed density (seeds $m^{-2}$) | - | 9300 | - | 5300 | - | 7300 |

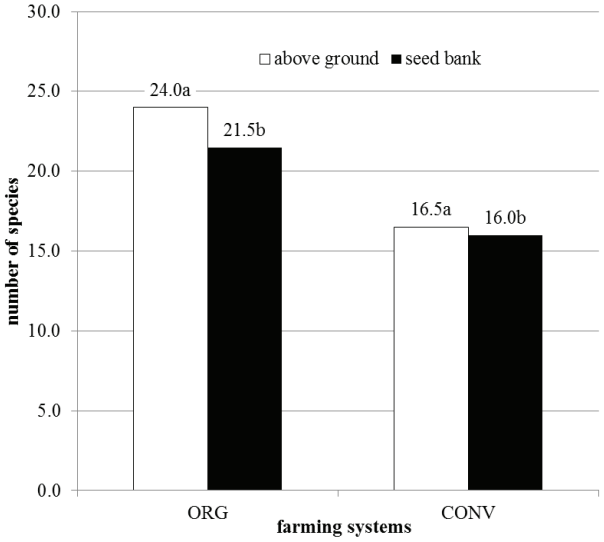


Figure 1. Average number of species of above-ground and soil seed bank weed communities (medians for the years 2012-2014).
a, b – different letters indicate statistically significant differences between soil seed bank and above-ground weed communities.

of the methods chosen for the assessment of the soil bank or/and above-ground seeds and flora. In the presented study, the number of above-ground species and their abundance were counted on a surface of 1 $m^2$, while soil samples were taken from a surface of 50 $cm^2$, which is 200 times smaller area. It is also worth mentioning that in the presented study the number of species was more stable and less susceptible to external disturbances in the soil seed bank than in above-ground weed flora community. The differences between different farming systems are mainly due to chemical weed management. Those management practices strongly decrease the population of sensitive species, while not affecting herbicide-resistant species (Turner *et al.*, 2007; Graziani *et al.*, 2012). Species of soil seed bank could also be affected by crop rotation. Organic farms usually have more complex crop rotations, which creates favorable conditions for various weeds to germinate, flower and release the seeds (Teasdale *et al.*, 2004; Murphy *et al.*, 2006; Graziani *et al.*, 2012).

*Shannon's diversity index (H') and Simpson's dominance index (SI)*

Shannon's diversity index indicated a high value of weed biodiversity for both weed communities in both farming systems. This index for the three-year study period for soil seed bank community reached significantly higher values than for the above-ground flora (H'=2.31 for soil seed bank versus H'=1.88 for above ground flora for organic farming, and H'=1.92 versus H'=1.60 in conventional farming system, respectively) (Figure 2). Also Simpson's dominance index reached low values in both farming systems and in both weed communities, which again indicated a good biodiversity conservation status in the research area. Median values of Simpson's index (SI) for soil seed bank community were significantly lower than for above-ground flora in both farming systems (SI=1.88 for soil seed bank versus SI=2.31 for above ground flora for organic farming, and SI=1.60 versus SI=1.92 in conventional farming system, respectively), which confirmed that biodiversity of weeds in soil seed bank is less dominated by single species than community of above-ground flora (Figure 3). Feledyn-Szewczyk & Duer (2007) found that values of Shannon's diversity indices were higher, while Simpson's dominance indices were lower for soil seed bank than for above-ground weed flora in most farming systems. Only the organic farming system had a similar biodiversity of the above-ground weed flora and soil seed bank weed flora. Authors also found that the range of values for Shannon's diversity indices and Simpson's dominance indices was more similar for soil seed bank than for above ground weed flora, which was also confirmed in the presented study. This proves the theory that the seed bank weed communities are more resistant to external disturbances. Chick *et al.* (2018) also found that both the soil seed bank and above ground vegetation can be affected by climatic factors, but species turnover of the above-ground communities is more likely to be also affected by the disturbance factors, while soil seed bank seems to be more resistant to those factors. The comparison of biodiversity of above-ground and soil seed bank community in subsequent study years of the presented study showed that soil seed bank was more stable over time, while above-ground weed flora was more susceptible to external disturbances. According to many authors, soil seed bank ensures

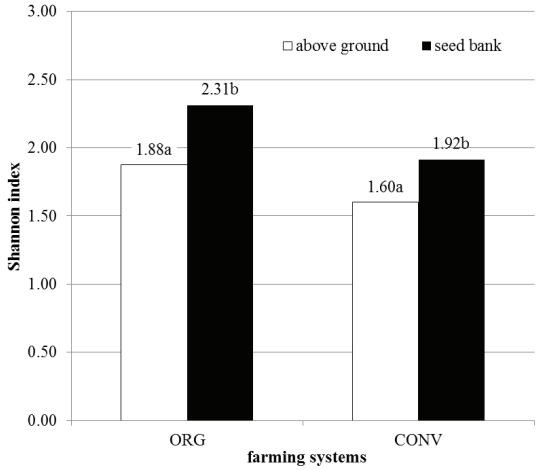


Figure 2. Shannon's diversity index of above ground-and soil seed bank weed communities (medians for the years 2012-2014).
a, b – different letters indicate statistically significant differences between soil seed bank and above-ground weed communities.

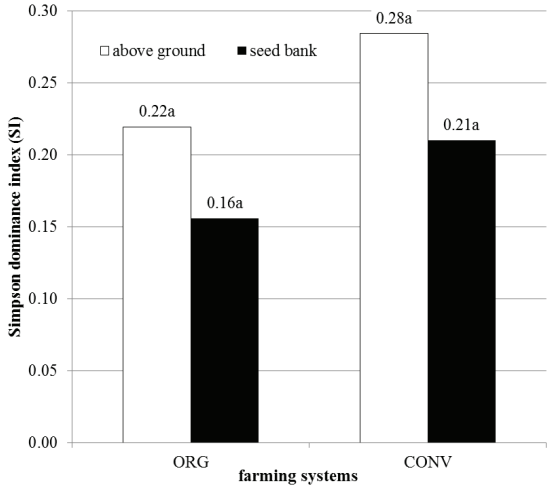


Figure 3. Simpson's dominance index of above ground-and soil seed bank weed communities (medians for the years 2012-2014).
a, b – different letters indicate statistically significant differences between soil seed bank and above-ground weed communities.

the survival of species and stabilizes the agricultural ecosystem, as it is the 'evolutionary memory of fields', formed by a history much longer than the duration of the experiment (Simpson, Leck, & Parker, 1989; Zanin, Mosca, & Catizone, 1992; Radosevich, Holt, & Ghersa, 1997; Doucet *et al.*, 1999; Faist, Ferrenberg, & Collinge, 2013; Vandvik *et al.*, 2016).

*Above-ground and soil seed bank correlation*

The results of research showed a strong, positive correlation between above-ground and soil seed bank weed communities for most tested parameters (number of species, abundance of weeds/seeds, Shannon's diversity index, Simpson's dominance index) in both farming systems. Although the correlation occurred in both farming systems, it was stronger in the organic system than in conventional one (with the exception for the abundance of weeds and abundance of seeds correlation, where there were no correlation in organic farming system) (Table 2). Rahman, James & Grbavac, (2006) also proved a strong linear relationship between the quantitative biodiversity of those two communities. Yasari & Golafshan (2012) believe that the strength of the relationship between current weed infestation, visible in the field and the number of seeds accumulated in the soil also depends on the date of the test and it is higher at the beginning of vegetation, and then decreases.

*Qualitative and quantitative similarity*

Sorensen's qualitative similarity index for soil seed bank and above-ground weed flora for both farming systems showed that these weed communities were quite similar (66.1%), while quantitative similarity

Table 2

**Spearman's correlation coefficient values ($R_s$) for number of species, abundance of weeds and seeds, Shannon's diversity and Simpson's domination indices for organic and conventional farming system**

| Correlation of soil seed bank and above ground weed communities | Farming system | |
|---|---|---|
| | organic | conventional |
| Number of species | 0.66* | 0.44* |
| Abundance | -0,03 | 0.45* |
| Shannon's index | 0.56* | 0.46* |
| Simpson's index | 0.46* | 0.38* |

*statistically significant correlations between soil seed bank and above-ground weed communities.

Table 3

**Quantitative and qualitative similarity indices (%) of tested weed communities**

| Quantitative similarity index (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Qualitative similarity index (%) | Farming systems and weed communities | | ORG | | CONV | | Seed bank | Quantitative similarity index (%) |
| | | | Above ground | Seed bank | Above ground | Seed bank | | |
| | ORG | Above ground | × | 5.6 | 63.0 | 8.0 | 5.8 | |
| | | Seed bank | 65.1 | × | 4.0 | 70.2 | | |
| | CONV | Above ground | 77.6 | 62.9 | × | 6.1 | | |
| | | Seed bank | 65.7 | 80.5 | 63.5 | × | | |
| | ABV.GROUND | | 66.1 | | | | | |
| | Qualitative similarity index (%) | | | | | | | |

was much lower (5.8%), which resulted from much greater abundance of species in the soil seed bank (Table 3). Sorensen's coefficients also showed that both soil seed bank and the above-ground weed communities of the two tested farming systems had a relatively high level of similarity, both qualitative (80.5% and 77.6%, respectively) and quantitative (70.2% and 63.0%, respectively). Above-ground organic weed flora was at similar qualitative level of similarity to both organic and conventional soil seed bank (Sorensen's coefficient of about 65%). At the same time, it was more similar to conventional above-ground flora (77.6%). Correspondingly, above-ground conventional weed communities were qualitatively more similar to above-ground organic weed communities (77.6%) than to both organic and conventional soil seed bank (qualitative similarity at a level of around 63%). Hald (1999) found that the weed flora of organic fields is more similar to other organic fields than to conventional fields. In turn, the presented study shows that the observed qualitative composition of weed flora depends to a greater extent on the type of community (soil seed bank or above-ground weed community) than the farming system.

**Conclusions**

1. No significant differences were found in the number of weed species in the above-ground flora and soil seed bank.
2. Shannon's diversity index values were greater for soil seed bank than for above-ground weed flora in both farming systems, which indicates the importance of soil seed bank as a reservoir of biodiversity and 'evolutionary memory' of the agro-ecosystem.
3. Simpson's dominance index had lower values in the soil seed bank than above-ground weed community, which indicates that this community is less sensitive to dominance by a single species, which might be important for the ecological stability of agro-ecosystem.
4. Above-ground and soil seed bank weed communities are closely related to each other, which was proven by strong, positive correlation of the number of species, Shannon's diversity index and Simpson's dominance index for those two communities.
5. Sorensen's qualitative coefficient showed a greater similarity within the tested communities (above-

ground and soil seed bank) than within farming systems (organic and conventional).
6. Qualitative similarity (species) of both weed communities and both farming systems was generally higher than quantitative similarity (abundance).

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# THE ECONOMIC IMPACTS OF THE 2013 REFORM ON THE HUNGARIAN AGRICULTURE

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**Abstract**
The impacts of agricultural policies are decisive on the agricultural sector, especially in the case of the European Union's (EU) Common Agricultural Policy (CAP). The 2013 CAP reform introduced several new measures. In budgetary terms, basic payment and greening were the most significant ones. Besides, coupled supports, young farmer and small farmers scheme should be mentioned. To reveal the changes caused by these measures, the time horizon of the study is 2013-2017. Since the subsidies represent a significant part of the income generated in the agricultural sector, the basic hypothesis of the study is that the production units concerned (individual farms, private enterprises) gave economically rational answers. In practice, this means trying to fully adapt to the changes to maximize support. Based on the analysed datasets (Hungarian Central Statistical Office and Hungarian State Treasury), it became evident that farmers responded rationally: splitting up farms against capping, moving towards the lowest resistance to comply with greening, plus associating them with the extra support of coupled payments. Generational renewal is a key issue; however, the present form of young farmers scheme needs to be refined to be more effective. Small farmers scheme is a good opportunity for farmers with less than 5.5 ha and most of the concerned farmers chose well. However, there are about 6,000 farms that are too small for the standard system, while 772 farms that are too large for the small farmers scheme.
**Key words**: basic payment, degressivity and capping, greening, coupled support, young and small farmers scheme.

## Introduction

The Common Agricultural Policy (hereinafter CAP), introduced in 1962, was the only integrated policy in Europe for a long time (EC, 2012). Its initial form was highly productive due to the needs and expectations of that time, which has caused serious problems (e.g. overproduction, expensive operation) after achieving self-sufficiency. To deal with this, first an adjustment was made, followed by 5 substantive reforms (1992, 2000, 2003, 2008 and 2013). The article analyses the impact of the measures of the most recent reform on Hungarian agriculture, which took place under the control of commissioner Dacian Ciolos.

Possible pro-active adaptation to agricultural policy changes is a key issue in the growing, European level competition. It must be aware of the different requirements and meet the eligibility criteria. This is particularly important in Hungary, as the aggregate income generated by the agricultural sector was 715.5 billion HUF in 2017 where the share of different EU supports, mostly direct payments, was nearly 60% (423.8 billion HUF) (HCSO, 2019a). Knowing the support system and readiness to future changes to the highest possible extent are essential in case of this level of dependency.

One of the most significant innovations of the 2013 CAP reform was greening, but it is questionable how many environmental benefits it resulted with compared to its initial form. That is the reason why it has been criticized in advance. In this context, Matthews (2013) highlighted its expected low impact and competing nature with cross-compliance and agri-environmental measures. According to one of the European Court of Auditors' (ECA) study, this is essentially a further extension of cross-compliance, although that has not yet achieved the desired effect (ECA, 2008). Basically, due to the measurability problems and the causal relationship, we can call it greenwashing (Alons, 2017). It is also worth noting that compliance with greening did not require substantial efforts from most farmers (EC, 2017). For example, nearly half of the farms and 89% of the farmers are not covered by it (Greer, 2017). One of the intended aims of greening was to increase positive externality or to decrease negative externality. However, Solazzo and his fellows were able to demonstrate that it resulted in only a 1.5% decrease in greenhouse gas emissions in Italy (Solazzo *et al*., 2016). Due to the significant number of exceptions (Agri-Environment Scheme, organic production, farm size, etc.), as well as the cause-and-effect problems, the environmental impact was lower than planned.

Degressivity was also criticized. Several Member States (for example, the Czech Republic, the United Kingdom, Germany, Italy and Romania) have rejected it because the measure discriminates based on farm size (Sahrbacher *et al.*, 2015). Therefore, member states with large farms, having a significant role in the production, were more deeply affected. Besides, it had hardly any impact, for example, only EUR 109 million was collected at the EU level in 2015, 2/3 of which was withdrawn from Hungary (DG IP, 2016). Thirdly, the distribution of support was not necessarily more equitable, because smaller farms have off-farm income and the reduction of subsidies results in a less competitive agricultural structure for large farms (Matthews, 2017). Fourthly, it can be said that only

nine Member States have capped direct payments (Austria, Belgium, Bulgaria, the United Kingdom – except for England, Greece, Ireland, Poland and Italy) and most of the Member States introduced only the 5% degressivity over 150,000 EUR (Matthews, 2018). Besides, it should not be forgotten that the effects of the measure can even be eliminated by splitting large production units into smaller ones. For this reason, the Ciolos reform has had a significant impact on the Hungarian farm structure, especially on large farms, due to the so-called dual production system of the country. This is disadvantageous for competitiveness, as large farms are undoubtedly the engines of production and growth in the European Union (Mizik, 2019).

The young farmers scheme aims to promote generation renewal in the agricultural sector. Based on Eurostat data, this is important because the proportion of 65 years or older people in the EU-28 is 2.4%, but 9.0% in agriculture (Eurostat, 2017). There are huge differences between the member states, very high levels in Portugal (41.6%), followed by Ireland (21.7%) and the United Kingdom (18.6%), while this is not a significant problem in Spain or Poland (1.8% and 3.2%, respectively) (Eurostat, 2017). The empirical results are mixed, although the positive effect of the measure is undeniable, its impact at the EU level is questionable, and it is worth analysing it as a part of the small-scale producer problem in the Central and Eastern Europe (Zagata & Sutherland, 2015). Based on the scenario analysis of Bartolini and Viaggi (2013), specialised farms managed by young farmers are the most resistant to even significant changes of the CAP, however, a significant budget cut would result in an increased concentration.

The major aim of the study is to evaluate the economic impacts of the latest CAP reform. Different reform elements have had different impacts on the Hungarian farms. The basic research question of the analysis is whether the agricultural farms gave rational, economically adequate answers to these changes or not.

**Materials and Methods**

The basis of the article is a detailed literature review on the expected and factual effects of the Ciolos reform (more details on the CAP reforms, including this latest one, can be found in Swinnen, 2015). Based on it, different data sources are used to demonstrate these effects on Hungarian agriculture. Changes in production structure can be traced back by different datasets of the Hungarian Central Statistical Office (HCSO). The source of the support data is the Hungarian State Treasury (HST), the accredited paying agency. Labour data come from the Eurostat database. Based on these data, basic statistical calculations (averages, distribution) were used to reveal the effects of the reform on the agricultural production units. The initial hypothesis of the article is that producers gave a rational response to the analysed changes, so, they have made all efforts to get as much support as possible, as well as to comply with the regulations in the simplest possible way.

**Results and Discussion**

The last CAP reform took place in 2013. Its major elements were (EU, 2013):

- The basic payment is the most significant element of the reform in financial terms. Two connecting terms are degressivity (5% obligatory reduction over 150,000 EUR direct payment per farm) and capping (an option to limit direct payments over a certain amount);
- Every member state had to allocate 30% of direct payments to greening including three simultaneous criteria – crop diversification, maintenance of permanent grasslands and ecological focus areas;
- Coupled support with production requirement with the option of coupled protein support;
- Young farmers scheme for agricultural producers below 40 years;
- Small farmers scheme provides a lump-sum payment of 500 – 1250 EUR year$^{-1}$ under simplified administration.

The financial allocation of the Hungarian envelope is as follows: 53.83% basic payment, 30% greening, 13 + 2% coupled support, 0.62% young farmers support and 0.55% small farmers payment (Algeier, 2015). Besides the highest possible share of voluntary coupled support, the major characteristic of the Hungarian model is the maximum (100%) capping over 176,000 EUR per individual farm (physical farm size is 1200 ha).

Since the basic payment is the most significant element of the national envelope (almost 54%, or approximately 50,000 HUF per ha), only this payment is affected by the reduction and maximization. This amount is high enough, therefore the adaptation of the production units concerned was the most significant to reduce the level of withdrawal. Of course, the effects of land law change should not be overlooked. The CXXII land law (Act, 2013) in 2013 introduced the land ownership and land use limits (basically 1,200 ha and 1,800 under certain preferential conditions like livestock farms or seed producers). Based on HCSO data, the number of farmers over 2,500 ha and the total area used by them decreased by 12 – 13% between 2010 and 2013, but in the following 3 years their number dropped to almost half, while their utilised agricultural area (UAA) fell by 40% (HCSO, 2016). Examining this at the level of farms receiving direct payments, the number of farms above 1,200 ha UAA

decreased from 477 in 2012 to 259 in 2016, and, on the contrary, the number of farms with 600 – 1,200 ha UAA increased from 556 to 773 in the same period (Szerletics, 2018). In practice, this means that farms that use more than 1,200 ha agricultural land started to split up to comply with the statutory requirements of the new land law and, on the other hand, not to lose their basic payment. In practice, it was an 'artificial' redistributive effect. In Italy, for example, switching from the single payment scheme to the basic payment scheme, due to the CAP 2013 reform, resulted in the decrease in the concentration of direct payments (Ciliberti & Frascarelli, 2018).

Regarding the greening, crop diversification means a basic diversification of production income, thereby providing some protection against the possible individual, mostly weather-related effects, as the co-production of different crops reduces the chances of each being equally affected. This type of diversification increases with the size of the cultivated area, i.e. it does not cause an insoluble problem. This is the same with the obligation to maintain permanent grassland. It can only be a problem if the farmer wants to intensify his production, for example, if the livestock population is reduced and there is no longer need for the same size of grassland. However, this type of important decision is a long-term one, and will not cause any serious problems to comply with it during a 7-year period (due to the late start, it is actually a 6-year period). The creation of ecological focus area meant some challenges, as it has certainly been a new requirement. To provide information to producers, the Hungarian Chamber of Agriculture (HCA) has developed a greening calculator that includes landscape features and other areas of ecological focus that can be used to achieve the 5% target value (HCA, 2019a). Practical experience shows that producers have moved towards the lowest resistance, e.g. the ecological focus area was typically developed within the agricultural production. According to the HST data, it can be stated that nitrogen-fixing crops, ecologically important catch crops and fallow area served this purpose, as they accounted for more than 90% of non-weighted EFA areas (FM, 2017). However, it is important to mention that, from 2018 onwards, no pesticides can be used on these areas, but it is positive that the weighting factor increased from 0.7 to 1 for areas with nitrogen-fixing crops (HCA, 2018a). However, the first one seems to be more important, which can significantly reduce the area of nitrogen-fixing crops, as the chances of pest control will be worse, which causes significant negative yield affect. At the same time, in the case of fallow areas and ecologically important catch crops, much smaller agrotechnical changes are required, so they are expected to replace nitrogen-fixing plants (HCA, 2018b). However, this effect can only be demonstrated later based on statistical data. According to the data of the HCSO, the two most important nitrogen-fixing crops in Hungary are lucerne and soybean, and their cultivation area started to grow after 2014 (HCSO, 2019b and 2019c). Since there was no significant shift in the previous years, the main reasons for this were likely to be the introduction of EFA area as a part of greening and the coupled protein support, which will be analysed in the next section.

In the case of coupled payments, it is possible to pay an advance payment, which provides substantial assistance in dealing with liquidity problems. Based on the data provided by the HST, there are significant differences in the use of financial resources between the different measures. In addition to animal-related measures, the four most important plant subsidies were protein crops and protein fodder, field vegetables and fruits. Table 1 shows the advance payments and the expected amount of payments for the major measures.

Majority of the coupled supports are used in the livestock sector, especially for milk. It is worth noting

Table 1

**Major coupled payment measures in Hungary, 2018 (HUF)**

| Name of the measures | Maximum of advance payment | Expected amount of payment |
|---|---|---|
| Coupled support for sheep | 5,621 | 8,030 |
| Coupled support for suckler cow | 32,145 | 45,921 |
| Coupled support for male bovine animal | 11,660 | 16,657 |
| Coupled support for milk (milking cow) | 73,576 | 105,108 |
| Coupled support for field vegetables | 44,794 | 63,992 |
| Coupled support for fruits (extensive-traditional) | 52,185 | 74,551 |
| Coupled support for fruits produced in intensive orchard | 92,633 | 132,333 |
| Coupled support for protein crops | 45,612 | 65,160 |
| Coupled support for protein fodder | 16,989 | 24,270 |

Source: Author's calculation based on Annex 1 of MA (2019) and Oláh (2018).

Table 2

**Number and share of agricultural employment by age groups, 2013-2017 (thousands and %)**

| | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| From 15 to 39 years | 66.9 | 68.6 | 74.6 | 78.4 | 77.2 |
| - share in the total 15 – 39 years employment | 3.7% | 3.7% | 4.0% | 4.2% | 4.2% |
| 65 years or over | 3.6 | 4.1 | 3.3 | 4.3 | 5.0 |
| - share in the total 65 years or over employment | 11.0% | 13.3% | 9.5% | 10.2% | 10.4% |

Source: Author's calculation based on Eurostat (2019) data.

that the role of subsidies in the cattle sector is crucial, the average rate of agricultural subsidy is ranging from 130 to 170% of the pre-tax profit (Czerván, 2017). For this reason, it is expected that the livestock population will grow. According to HCSO (2019c) data, it can be clearly seen as both cattle and milking cow population have increased in the past four years (2014-2017). It has a positive effect on cow milk production, which is further strengthened by an average 3% annual increase of the milk yield (HCSO, 2019d). With regard to the crops, the highest coupled support is allocated to protein crops and protein fodder crop production. The amount of payment is higher for the former one (Table 1), but the latter is more popular in terms of area (according to the data of the HST, it was 176,106 ha in 2018, compared to 81,412 ha in 2017).

Ageing is a crucial problem of not only the Hungarian but also the European agriculture. One of the pillars of improving the age structure is the young farmers scheme. However, young farmers support is relatively small, as only 67.9 EUR $ha^{-1}$ can be used for a period of up to 5 years for a maximum of 90 ha of UAA, and it is only for those who are not older than 40 (HCA, 2017). It can be effective in age renewal only if the agricultural production itself can generate profit. According to the data of HST, the number of recipients of payments increased from 10,031 in 2016 to 12,722 in 2017, however, the total payment decreased slightly, suggesting that new entrants into the young farmers scheme are utilising smaller areas on average. The initial effects of this scheme can be measured in the composition of the agricultural workforce. Table 2 shows the evolution and distribution of the number of people employed in agriculture by age categories. The table includes those aged 15 – 39 (eligible for young farmers support), 65 years of age and above, as well as the ratio of the respective category to the same age category in the national economy.

It can be seen from the table above that the size of the young age group in agriculture is increasing both in absolute terms and in the proportion of those aged 15 – 39. However, this does not entail a similar improvement in the age structure, as the number of people aged 65 and over has also increased throughout the period, although their share (in parallel with the increase in life expectancy) decreased somewhat in proportion to the same category of the national economy (from 11.0 to 10.4%). This is slightly above the EU-28 average of 9.0%. Of course, it should not be forgotten that the number of people in this category is influenced by the difference between the number of people aged 64 in the given years (who turns to 65 next year) and those who are permanently withdrawing from the agricultural sector.

Finally, small farmers scheme can be an optimal solution for those farmers who use small UAA. According to the support calculator of the HCA, the maximum amount of payment (1250 EUR) is equivalent to direct support (basic payment + greening) for approximately 5.5 ha of land, whereas for the minimum amount of 500 EUR it equals the direct support of 2.2 ha (HCA, 2019b). The system was only allowed to enter until 15 August 2015 to receive an annual lump-sum payment by 2020. However, the producers had to maintain the eligible area during that period. This was particularly advantageous for those who would not have received a direct payment of 500 EUR in the standard system, as it was rounded up to this minimum. Whichever producer entered the system, they could only receive this support in 2015 and could return to the standard system by 2016 at the earliest. The farmers' decision-making process was helped not only by the HCA support calculator but also by the local agricultural consultants. The most important characteristics of this support system can be seen by using the data of HST, especially the average and the largest supported area because these two values show how rational decision was made by the producers concerned (Table 3).

Table 3 shows that the size of the approved area decreases as the number of supported farmers decreases. This results in a decrease in the average supported area, and the value below 2 ha in 2017 shows rational producer behaviour. In such a small area, even the minimum amount of support may result in higher revenue than what would be possible in the standard system. At the same time, it can also be seen in 2015 that at least one farmer has made a wrong decision by choosing small farmers scheme. Having 54.41 ha UAA would result in far higher support in the standard system than the maximum ceiling of 1250 EUR here. However, it can be seen from the

Table 3

**Major characteristics of small farmers scheme, 2015-2017**

| | 2015 | 2016 | 2017 |
|---|---|---|---|
| Supported area (ha) | 109,579 | 82,725 | 59,554 |
| Supported farmers (persons) | 50,000 | 39,491 | 30,847 |
| Average supported area (ha) | 2.19 | 2.09 | 1.93 |
| The largest supported area (ha) | 54.41 | 9.86 | 9.86 |

Source: Author's calculation based on HST data.

table that this producer has withdrawn from the small farmers schemes in 2016 since the largest supported area dropped to 9.86 ha. Even with this UAA size, it is possible to have more support in the standard system, but on the one hand there would be no significant difference between them, and on the other hand, the lack of minimum administration and production constraints could compensate for this (for example, if the farmer does not want to maintain his permanent grassland).

However, the above data do not reveal the number of producers who chose the standard system, even though they would have been better off with the lump-sum support for small farmers. As far as the 'too large' farms are concerned, the HCA drew special attention to these producers. It is a fact that the first group contained about 6,000 farms (too small for the standard system), while the latter one (too large for the small farmers scheme) only 772 (HCA, 2015). Based on this, it is presumed that fewer farmers joined the small farmers support system, which was disadvantageous for them than who did not join, although it would have been more beneficial financially.

As the future of the CAP is expected to lead to a reduction in financial resources or a different structure, it is essential for producers to be aware of the expected changes and to take the necessary steps for adaptation as early as possible. Taking into consideration the high level of support dependency, Hungarian farmers are expected to be in a less advantageous environment without instant competitiveness actions (Mizik, 2017). Based on the results above, however, it can be clearly seen that farmers thought rationally and provided reasonable answers to the changes in the support/regulatory system.

**Conclusions**

The initial hypothesis of the article is that farmers have responded rationally to the changes in the support system. Based on practical experiences, it can be clearly seen that farmers thought rationally and provided reasonable answers to the changes in the support/regulatory system. It was confirmed that some of the farms above the eligibility level have reorganized their operations into smaller production units due to degressivity and capping. The number of farms above 2,500 ha has decreased and the number of farms under 1,200 ha has increased, but the area used by large farms hardly decreased. Thus, in practice, limiting basic payment to farm size has triggered the process of splitting up farms into smaller units. The 30% share of greening was also significant enough for the producers concerned to meet the necessary conditions. All in all, diversification is the interest of the producers, for ecological focus area creation obvious agricultural solutions were used (e.g. nitrogen-fixing crops), while maintaining permanent grassland was a long-term decision. The effects of coupled supports were twofold. In crop production, most of the support was paid after the production of protein grain and protein fodder crops. In this case, farmers received not only extra support but also met the EFA requirements. In livestock production, coupled support plays a key role, as the sector's income-generating capacity is worse than that of the crop production, resulting in a much higher average rate of agricultural subsidies to the pre-tax profits. The young farmers scheme aims to improve the agricultural age structure. The number of farmers under 40 years has increased as well as their share in total employees of the same age category. At the same time, however, the number of farmers aged 65 or over has also increased. Therefore, further actions will be needed in this area. As a matter of the small farmers scheme, the average farm size is around 2 ha, so the average entrants were thus financially better.

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# ASSESSMENT OF SPRING BARLEY POPULATIONS IN COMPARISON TO HOMOGENOUS VARIETIES

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**Abstract**
The necessity to increase genetic diversity in agriculture has been widely discussed during the last decades. Heterogeneous populations is one of the ways to increase genetic diversity in varieties of self-pollinating cereals. The aim of this research was to compare grain yield, its stability, foliar diseases severity and competitiveness against the weeds of spring barley (*Hordeum vulgare*) populations and homogenous varieties. Field trials consisting of three types of populations (simple, complex and composite cross populations – CCP) containing different levels of diversity and three check varieties were carried out during 2015-2018 under organic and conventional farming systems. No one of the populations had a significantly higher average yield than any of the check varieties. CCP1 showed a tendency to be more productive under organic growing conditions and can be characterized as widely adaptable to various growing conditions with a significantly higher yield as the average overall environments. One of the complex populations showed adaptability to favorable growing conditions and yield insignificantly higher than overall average. Other studied populations can be characterized with wide adaptability and various yield levels. For most of the populations under organic and conventional conditions, a significantly lower net blotch (caused by *Pyrenophora teres)* severity was observed in comparison with the most susceptible variety; infection with powdery mildew (caused by *Blumeria graminis)* lower than for check varieties was observed under organic growing conditions, whereas such trend was not observed under conventional conditions. All populations had a significantly lower crop ground cover and slightly lower competiveness against weeds than the variety with the best competitiveness.
**Key words**: populations, yield, yield stability, leaf diseases, competitiveness against weeds.

## Introduction

Since the first half of the past century, the trends in agriculture, plant breeding and variety legislation have tended towards an increased use of genetically uniform varieties. The genotypes selected for good performance under high-input conditions do not necessarily perform very well in marginal environments or in organic farming systems (Murphy *et al.*, 2005). Such genetically uniform varieties are inappropriate to overcome unpredictable environmental changes because their response to environmental fluctuations is not buffered by genetic diversity. Increasing genetic diversity in crops can ensure yield stability, reduce spread of diseases, and improve competitive ability against weeds. For the self-pollinating cereals the solution is creation of composite cross populations (CCP) which include high levels of diversity if compared to pure line varieties (Döring *et al.*, 2011). They are created by crossing a group of varieties in all possible combinations, then growing over years as a bulk population and exposed to natural selection. The varieties with different useful characteristics having potential to dynamic adaptation to growing conditions are used in crossing. The diversity of the genotypes in the population is not permanent. The number of plants with good adaptability over time is increasing and resulting in a better overall performance of CCP (Suenson, 1956; Döring *et al.*, 2011). Due to changes in populations, there is no possibility to obtain and market constant seed material (Brown, Caligari, & Campos, 2014).

At the beginning of the 20th century, Harry Harlan began to make CCPs from many diverse barley (*Hordeum vulgare*) varieties originating from the whole world. These populations were planted under standard agronomic conditions over a period of 50 years. Results from numerous studies on these populations show steady increases over generations in grain yield, disease resistance and yield stability, however, in comparison with commercial or control varieties the yield was only 78 – 85% (Soliman & Allard, 1991; Danquah & Barrett, 2002). CCPs based on 20 diverse winter wheat (*Triticum aestivum*) parents were developed in the UK starting from 2002, and they are researched in a number of studies in different countries now (Kassie, 2013; Döring *et al*., 2015; Brumlop, Pfeiffer, & Finckh, 2017). CCP's are created and investigated also in Italy (Raggi *et al.*, 2017). The results of these studies suggest that populations can ensure better yield stability, but there are different results regarding to disease control and competitiveness against weeds. However, in comparison with other topics on agriculture, there are only a few published research results on CCPs.

The aim of the study was to evaluate the yield, yield stability, foliar diseases severity and competitiveness against weeds of three types of barley populations: simple (cross of two parents), complex (more than two parents crossed step by step) and composite cross populations (CCPs) if compared with homogeneous varieties currently grown in organic farming in Latvia.

**Materials and Methods**

The study covers 11 populations of spring barley (*Hordeum vulgare*), including four simple (SPs), five complex (CPs) and two composite cross populations (CCPs), containing different levels of diversity (Table 1). To compare the yield, yield stability, foliar diseases severity, as well as competitiveness against weeds, three commercial check varieties bred in Latvia were used: 'Rubiola' – released for growing under organic conditions, 'Rasa' – control variety in official trials for testing of value for cultivation and use (VCU) under organic growing conditions, and 'Abava' – characterized as variety with good adaptability to various environments.

The field trials were carried out at Institute of Agricultural Resources and Economics in Priekuli (latitude 57.3148 ° N, longitude 25.3388 ° E) and Stende (latitude 57.1412 ° N, longitude 22.5367 ° E) during 2015-2018 under both conventional (C) and organic (O) growing conditions. Lattice experimental design with four replications was applied. Plot size was 12.3 $m^2$ in Priekuli and 5.2 $m^2$ in Stende, seed rate 400 untreated germinable seeds per $m^2$. The field trial in Stende under O growing conditions in 2015 was significantly damaged by heavy rainfall after sowing, but under C conditions in 2018 was not established. In overall, the data of seven C and seven O environments were obtained. The soil in all locations was sod-podzolic loamy sand (Kārkliņš, 2008). The agrochemical properties of the soil during investigations under C conditions were in range: pH KCL 5.3-6.1, organic matter content 1.8 – 2.3%, $K_2O$ 136-167 mg $kg^{-1}$, $P_2O_5$ 120-143 mg $kg^{-1}$; and under O conditions: pH KCL 5.7-6.3, organic matter content 1.9 – 2.4%, $K_2O$ 111-167 mg $kg^{-1}$, $P_2O_5$ 163-177 mg $kg^{-1}$. Pre-crop in all C environments had been potatoes (*Solanum tuberosum*); in O locations pre-crop in Priekuli had been grain legumes and in Stende – buckwheat (*Fagopyrum esculentum*) with one exception in 2015, when the pre-crop had been spring wheat (*T. aestivum*). Before sowing, in C sites complex mineral fertilizer was applied ensuring the following amounts of pure elements: in Priekuli N 95-108, $P_2O_5$ 55-70, $K_2O$ 45-93, in Stende N 75-80, $P_2O_5$ 75-80, $K_2O$ 75-80 kg $ha^{-1}$. In the plant tillering stage (GS 21-29), harrowing was performed in O growing sites with an aim to restrict weeds, but in C growing sites herbicide was applied. In Priekuli, in natural infection background during the vegetation period, the infection with foliar diseases was visually assessed as follows: powdery mildew caused by *Blumeria graminis* and net blotch caused by *Pyrenophora teres* in scores from 0 to 9, where 0 – no visible symptoms of disease, 9 – no green tissues of plants observed. The progress of the disease was described by the size of area under the disease progress curve (AUDPC) (Tratwal *et al.*, 2007). The assessment was started at the occurrence of the first disease symptoms with an interval of 7 to 9 days. To evaluate competitiveness against weeds under O growing conditions in Priekuli, in two barley development stages (GS 25-29, GS 29-31) the visual assessment of crop ground cover and in three barley development stages (GS 31-39, GS 59-65, GS 87-92) the visual assessment of weed ground cover was carried out. The weed suppression ability for each genotype was calculated as a difference between the weed ground cover in plots and maximum growth of weed in plots without crop, expressed in percentage (Hoad, Topp, & Davies, 2008).

The obtained data was processed by using analysis of variance ANOVA and General Linear Model. The data processing was performed using the software SPSS Statistic 17. The methodology used to evaluate the yield stability is based on Eberhart & Russel (1966) and Fox *et al.* (1990), and has been described in detail in our previous paper (Ločmele *et al*., 2017b).

Meteorological conditions during the investigation differed not only between the years, but also between the field trial locations. Conditions in 2015 and 2016 were described in the previous study (Ločmele *et al.*, 2017b). In 2017, cold and wet weather conditions in the last decade of April delayed sowing both in Priekuli and Stende, and it was started only in the early May. In Priekuli, there was an increased precipitation

Table 1

**Characteristics of populations**

| Population | Type of population | Number of parents and generation (F) in 2015-2018 |
|---|---|---|
| SP1; SP2 | simple | Two parents, $F_{12} – F_{15}$ |
| SP3; SP4 | simple | Two parents, $F_5 – F_8$ |
| CP1; CP4 | complex | Three parents, $F_6 – F_9$ and $F_5 – F_8$ |
| CP2; CP3 | complex | Seven and six parents, $F_6 – F_9$ |
| CP5 | complex | Eight parents consecutively crossed to male sterile sample, $F_4 – F_7$ |
| CCP1 | composite | Dialell crosses among group of 10 parents, bulked, $F_3 – F_6$ |
| CCP3 | composite | 10 parents crossed to 5 male sterile samples, bulked, $F_3$ – F6 |

during the whole vegetation period (11 – 153% above the long-term data (norm)), as well as lower average air temperature than the norm (by 0.1 – 3.3 °C). In July, the precipitation was in the form of several heavy rainfalls that caused early lodging of cereals. In general, the conditions prolonged the plant vegetation period, as well as made it more difficult to determine the actual occurrence of maturity. In Stende, over the vegetation period, the temperature deviations by decades were close to the norm. The precipitation was lower than norm, only in June it was at the level of long-term data. In 2018, the meteorological conditions had a significantly negative impact on the plant development. Both locations were characterized by low precipitation, reaching on average 64% of the norm in Priekuli and 35% in Stende over the growing season, causing drought stress to the plants. The air temperature was above the long-term observations on average by 3.6 °C in Priekuli and 2.7 °C in Stende.

**Results and Discussion**

*Yield and yield stability*

Significant differences were observed in yield levels between the growing sites ($p<0.05$); therefore the evaluation of population yield in comparison with check varieties has been analysed separately in each site. The yield of check varieties in both locations under O growing conditions was without significant differences, but under C growing conditions 'Rubiola' significantly out-yielded the others, with the exception in 2018, when the yield of 'Abava' was significantly higher.

Simple populations (SPs) under O growing conditions only in some cases slightly exceeded the yield of check varieties. In most cases they had lower yields than checks. For example, in Priekuli, SPs yield slightly exceeded the yield of variety 'Rasa' in nine cases out of 16 (4 sites × 4 populations = 16), but in comparison with the varieties 'Rubiola' and 'Abava' – in none of the cases (Table 2).

Under C growing conditions, the yield of SPs varied to a greater extent, showing in some cases a significant increase, but this was found in comparison with only one or rarely two check varieties, as well as in one particular site. Also under C conditions, in most cases the yield of SPs was lower than that of check varieties; it was particularly expressed in Stende, where SPs yield was significantly lower than that of the best yielding variety 'Rubiola' in all cases (Table 2). We have not found information in literature that such type of populations have been created and investigated. Two of the populations included in this study along with eight simple wheat populations were investigated by V. Strazdina with colleagues (Strazdiņa *et al.*, 2012), and she came to a conclusion that their yield varied between the yield of parent

Table 2

**Range of barley population yield, t ha$^{-1}$, and comparison with check varieties during 2015-2018**

| Growing site | Type of population | Yield* | Comparison with check variety | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Abava | | Rasa | | Rubiola | |
| | | | yield* | +/-** | yield* | +/-** | yield* | +/-** |
| Priekuli O&& n=4 | simple n=4 | 2.23-3.34 | 2.78 – 3.25 | -16 | 2.19 – 3.07 | -7; +9 | 2.20 – 3.59 | -16 |
| | complex n=5 | 2.21-3.53 | | -18(**4**)&;+2 | | -4;+16(**2**) | | -13(**1**);+7 |
| | CCP1 | 2.79-3.87 | | +4 | | +4(**1**) | | +4(**1**) |
| | CCP3 | 2.36-3.30 | | -3;+1 | | -2;+2(**1**) | | -3;+(**1**) |
| Stende O n=3 | simple n=4 | 2.23-4.01 | 2.25 – 4.12 | -8;+4 | 2.25 – 4.15 | -11;+1 | 2.46 – 4.71 | -11(**4**);+1 |
| | complex n=5 | 2.18-4.37 | | -8(**1**);+7 | | -8;+7(**1**) | | -10(**3**);+5 |
| | CCP1 | 2.71-4.58 | | -1;+2 | | -1;+2 | | -2;+1 |
| | CCP3 | 2.54-4.22 | | -2;+1 | | -2;+1 | | -2;+1 |
| Priekuli C&& n=4 | simple n=4 | 3.13-5.48 | 3.88 – 5.52 | -11(**1**);+5(**4**) | 3.57 – 5.39 | -9(**4**);+7(**2**) | 3.34 – 5.93 | -15(**11**);+1 |
| | complex n=5 | 3.15-5.54 | | -12(**3**);+8(**5**) | | -6;+14(**5**) | | -18(4);+(**2**) |
| | CCP1 | 4.39-5.78 | | +4(**1**) | | +4(**1**) | | -2(**1**);+2(**1**) |
| | CCP3 | 3.47-5.43 | | -2(**1**);+2(**1**) | | -2;+2(**1**) | | -3(**1**);+1 |
| Stende C n=3 | simple n=4 | 5.09-7.00 | 5.16 – 6.28 | -6;+6 | 5.57 – 6.40 | -7(**4**);+5(**1**) | 6.47 – 8.26 | -12(**12**) |
| | complex n=5 | 5.37-6.53 | | -2;+13(**6**) | | -7(**4**);+8(**2**) | | -13(**12**);+2 |
| | CCP1 | 6.04-6.81 | | +3(**2**) | | -1;+2 | | -3(**1**) |
| | CCP3 | 5.86-6.56 | | +3(**1**) | | -1;+2 | | -3(**1**) |

*min and max values; ** number of cases when yield was lower (-)/higher (+) than that of check variety; & in brackets in bold – number of cases when differences are significant ($p<0.05$); &&O – organic, C – conventional.

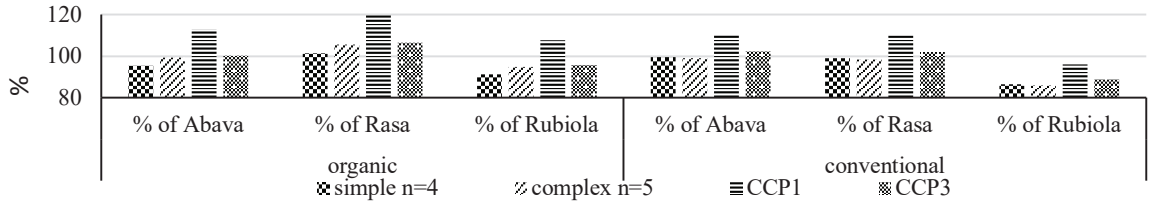


Figure 1. Comparison (in %) of average yield between populations and check varieties over organic (n=7) and conventional (n=7) sites during 2015-2018.

varieties, rarely insignificantly exceeding the yield of the best yielding parent variety. It could be explained with the relatively low diversity of these populations (Ločmele *et al.*, 2017a).

The yield of the complex populations (CPs) varied both in O and C growing conditions, showing some significant differences in comparison with the checks, but, the same as with SPs, differences were significant in comparison with one or rarely two varieties in one site of the trial. Only CP1 was significantly higher yielding than 'Abava' under C conditions in Stende in all three years, and if compared with 'Rasa' – in two years. In Priekuli, this population had a significantly higher yield than mentioned varieties in one out of four years of the trial. No information on creation and investigation of such type of populations has been found in literature.

Raggi *et al.* (2017) reported that two winter barley CCPs significantly out-yielded check varieties under O conditions, while no significant differences were observed under C conditions. In our investigation in Priekuli, CCP1 yielded more than all check varieties under O growing conditions, showing some significant differences ($p<0.05$) (Table 2). In Stende, its yield in some cases was insignificantly lower than the yield of check varieties under O conditions. Under C conditions, the yield of this population was higher than that of check varieties in most cases, showing some significant advantages (Table 2). Differences of CCP1 performance between both O locations can probably be explained by the fact mentioned in literature that growing the population under the particular growing conditions year by year leads to its adaptation to these conditions (Döring *et al.*, 2011). In Stende, this effect could not be observed because the seed for trial was prepared from the material grown in Priekuli. The yield of CCP3, like CPs, under O and C conditions varied in comparison with checks, showing some significant differences if compared to one or two check varieties. Döring *et al.* (2015) reported an average yield increase of wheat CCPs by 2.4% over 12 sites in comparison with the average yield of parent varieties. In our investigations, the average yield of SPs, CPs and CCP3 over seven O sites exceeded only the variety with the lowest yield – 'Rasa' by 1 – 7%. Whereas CCP1 exceeded all check varieties by 8 – 20% (Figure 1). Under C conditions, the average yield of SPs and CPs over seven environments was lower than that of all check varieties, but the average yield of CCP3 exceeded varieties 'Abava' and 'Rasa' by 2%. CCP1 also out-yielded 'Abava' and 'Rasa' under C conditions by 11% and 10%, respectively, but was slightly behind the variety 'Rubiola'.

The check varieties used in the study can be described as diverse regarding their adaptability: 'Rubiola' – with adaptability to high yielding sites (coefficient of regression $b>1$), 'Rasa' – with wide adaptability ($b=1$) and 'Abava' – with adaptability to low yielding sites ($b<1$), according to the data from 14 sites. The average yield of variety 'Rubiola' was significantly higher than average per 14 sites (4.16 t $ha^{-1}$), but that of varieties 'Rasa' and 'Abava' – at a level of average (Table 3). The significantly higher yield than overall average and a wide adaptability was found for CCP1. The results of other investigations demonstrate that barley and wheat CCPs can achieve more stable yield than pure line varieties (Soliman & Allard, 1991; Döring *et al*., 2015; Raggi *et al.*, 2017). Most of CPs and CCP3 also showed yield above the average and wide adaptability, whereas CP1 can be characterized as suitable for high yielding sites ($b>1$). The yield of other populations was below the average yield per 14 sites; SP1 and CP3 provided a significantly lower yield level (Table 3). When evaluating the yield stability by ranking method, 'Rubiola' and CP1 ranked at the top of genotype range in most of the C sites (Table 3), while being lower ranked in O sites; this is according to the previously described adaptability of these genotypes to high yielding sites. Under O growing conditions, 'Rubiola' in most of the cases was at the upper third of genotype range, but the population CCP1 was in the top range in all O sites; this demonstrates the specific adaptation of this population to O growing conditions. In general, comparing the types of populations, most of SPs and CPs rarely rank at the upper third of genotype range. The differences in the yield of the populations can probably be explained by different genetic material applied. In creation of CCP1, 10 parent genotypes were diallely crossed in all possible combinations, and it contains a greater genetic diversity than SPs and CPs (Mežaka & Legzdiņa, 2018). CCP3 theoretically can contain the greatest diversity in comparison with other populations included in this study because parent

Table 3

**Average yield of populations and check varieties over 14 sites, and the yield stability indicators**

| Genotype | Average yield, t ha$^{-1}$ | Coefficient of regression (b) | Deviation from regression ($s^2$ dj) | Number of rankings | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Organic (n=7) | | | Conventional (n=7) | | |
| | | | | I*** | II*** | III*** | I | II | III |
| CCP 1 | 4.52** | 0.93 | 0.08 | 7 | – | – | 5 | 2 | – |
| **Rubiola** | 4.51** | 1.22* | 0.14 | 5 | 1 | 1 | 5 | 2 | – |
| CP4 | 4.37 | 0.91 | 0.07 | 6 | 1 | – | 4 | 2 | 1 |
| CP1 | 4.34 | 1.19* | 0.09 | 2 | 5 | – | 5 | 1 | 1 |
| CP5 | 4.20 | 1.07 | 0.10 | 3 | 1 | 3 | 5 | 1 | 1 |
| CCP 3 | 4.17 | 1.01 | 0.03 | 2 | 4 | 1 | 2 | 5 | – |
| **Abava** | 4.17 | 0.84* | 0.10 | 5 | 1 | 1 | 2 | 2 | 3 |
| CP2 | 4.15 | 0.99 | 0.03 | 2 | 4 | 1 | 1 | 5 | 1 |
| **Rasa** | 4.11 | 1.01 | 0.10 | 1 | 4 | 2 | 3 | 2 | 2 |
| SP3 | 4.08 | 0.99 | 0.04 | – | 3 | 4 | 1 | 3 | 3 |
| SP4 | 4.07 | 1.01 | 0.05 | – | 6 | 1 | 2 | 3 | 2 |
| SP2 | 3.98 | 0.89* | 0.04 | 2 | 1 | 4 | – | 2 | 5 |
| SP1 | 3.82** | 0.89* | 0.05 | – | 3 | 4 | – | – | 7 |
| CP3 | 3.81** | 1.01 | 0.07 | – | 1 | 6 | – | 3 | 4 |

*significantly different from 1 ($p<0.05$); ** significantly different from average yield (4.16 t ha$^{-1}$) over 14 sites ($p<0.05$) ($LSD_{0.05}$=0.23); ***ranked in the upper (I), middle (II) and lower (III) third.

plants with male sterility possessing larger diversity themselves were used in crossings; during the first generations of population growing, thanks to the male sterility the cross-pollination was also possible (Ločmele *et al.*, 2017a). Differences in yields of both CCPs were probably influenced by the presence of low yielding male sterile plants and greater diversity of CCP3; in literature it is mentioned that a very large diversity causes competition between different plants that may negatively affect the yield (Döring *et al.*, 2011). The important factor is also the possible differences between the yield potential of parents used for creation of populations that can be greater for CCP1 (Ločmele *et al.*, 2017a). It is due to the fact that choice of parent plants for creation of populations determines their performance to a much greater extent than growing conditions to which these populations are subjected (Brumlop, Pfeiffer, & Finckh, 2017). Comparing the types of populations (simple, complex and CCPs) mutually, it was concluded that the average yield over 14 sites was significantly lower for SPs than for CPs and CCPs. Population types have different levels of genetic diversity, therefore we can conclude that greater genetic diversity in combination with appropriate parent yield potential can ensure better yield performance of the population.

*Foliar diseases*

The highest severity of net blotch was observed in 2015, when the average AUDPC value was 232 under C conditions, and 170 – under O conditions. During the other three years of investigation, it was on average 56 – 134 under C conditions and 31 – 53 under O conditions. The variety 'Abava' in most cases was infected significantly more than 'Rasa' and 'Rubiola'. Despite the differences in disease level between the years, populations were significantly less ($p<0.05$) infected in most cases if compared with check varieties, demonstrating a number of significant differences (Table 4).

Similarly, Maroof *et al.* (1983), while investigating barley CCPs created in the 20$^{th}$ century regarding thenet blotch and powdery mildew, has concluded that they can achieve higher resistance than the parent varieties. In contrast, for wheat CCPs, it was not found that the spread of foliar diseases decreases in populations in comparison with checks and mixture of parent varieties (Döring *et al*., 2015).

Infection with powdery mildew under O conditions in Priekuli was observed only in 2015. The disease severity was not significantly different between check varieties. Infection of the populations was insignificantly lower in most cases (data not shown), but, since the results were obtained only in one year, convincing conclusions cannot be made. Under C conditions, powdery mildew was observed in small amounts in three years out of four. In 2018, it was not observed due to warm and rainless weather conditions. In 2015, significant differences between the powdery mildew severity of check varieties were not observed under C conditions, but in 2016 and 2017, the variety 'Abava' was infected significantly more. Only SP2 was infected significantly higher than all

Table 4

**Range of population infection with foliar diseases and comparison with check varieties during 2015-2018**

| Growing site, Disease | Type of population | Range of AUDPC*^ | Comparison with check | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Abava | | Rasa | | Rubiola | |
| | | | AUDPC* | +/-** | AUDPC | +/- | AUDPC | +/- |
| Priekuli O&& n=4 net blotch | simple n=4 | 21–178 | 67 – 220 | -16(**15**)& | 39 – 197 | -16(**8**) | 32 – 184 | -16(**6**) |
| | complex n=5 | 23–176 | | -20(**19**) | | -19(**5**);+1 | | -18(**6**);+1 |
| | CCP1 | 13–160 | | -4(**3**) | | -4(**3**) | | -4(**3**) |
| | CCP3 | 28–184 | | -4(**2**) | | -4(**2**) | | -4(**1**) |
| Priekuli C&& n=4 net blotch | simple n=4 | 45–247 | 117 – 296 | -16(**16**) | 81 – 263 | -15(**10**);+1 | 67 – 220 | -7(**3**);+9 |
| | complex n=5 | 41–238 | | -20(**20**) | | -20(**10**) | | -11(**3**);+9 |
| | CCP1 | 53–214 | | -4(**4**) | | -4(**4**) | | -3(**1**);+1 |
| | CCP3 | 47–214 | | -4(**4**) | | -4(**4**) | | -4(**1**) |
| Priekuli C n=3 powdery mildew | simple n=4 | 3–151 | 11 – 61 | -6(**3**);+6(**2**) | 1 – 88 | -5;+7(**3**) | 0 – 82 | -5;+7(**2**) |
| | complex n=5 | 0–116 | | -12(**7**);+3 | | -9;+6(**1**) | | -9;+6(**1**) |
| | CCP1 | 6–118 | | -2;+1(**1**) | | +4(**1**) | | +3 |
| | CCP3 | 8–119 | | -2;+1(**1**) | | +3(**1**) | | +3 |

*min and max values; **number of cases when infection level was lower (–)/higher (+) than that of check variety; & in brackets in bold – number of cases when differences are significant ($p<0.05$); &&O – organic, C – conventional; ^ area under disease progress curve.

check varieties in all C growing sites. Obtained results for other populations varied, and the trend that any of populations is more resistant against powdery mildew was not observed (Table 4). Despite the different levels of genetic diversity of population types, we did not get any evidence that severity with net blotch and powdery mildew was affected by the types.

*Crop ground cover and weed suppression ability*

At the beginning of plant development, the crop ground cover is one of the most essential indicators related to good competitive ability against weeds (Hoad, Topp, & Davies, 2008). Significantly greater four-year-average crop ground cover among check varieties was observed for 'Abava' in GS 25-29 and GS 29-31: 15 and 22%, respectively. All populations in both growth stages, except CP4 in GS 25-29, showed a significantly lower crop ground cover if compared with 'Abava'. Crop ground cover of populations varied, either slightly exceeding or not reaching indicators of 'Rasa' and 'Rubiola' (data not shown). Kassie (2013) also has found a better crop ground cover for check varieties than for wheat CCPs. The weed suppression ability in GS 31-39 and GS 59-65 did not differ significantly between the check varieties, but in GS 87-92 it was significantly higher for the check variety 'Abava'. In GS 31-39 for all populations, insignificantly lower average weed suppression ability than that of 'Abava' and 'Rubiola' was observed, but in GS 59-65 and GS 87-92, it was slightly lower than that of variety 'Abava' (data not shown). It is possible that over generations of the populations their competiveness may improve, because Bertholdsson *et al.* (2016) concluded that traits of early vigour of plants were improved after five years. However, this contradicts another study where this parameter decreased over generations (Kassie, 2013).

There were no differences between types of populations regarding the crop ground cover and weed suppression ability, indicating that these traits were not affected by the level of diversity.

**Conclusions**

1. No population significantly out-yielded all check varieties in any of 14 sites. Significant differences were observed in some cases in comparison with one, or rarely two, check varieties within site. For CCP1 a trend was observed to out-yield the check varieties under organic growing conditions in location Priekuli.
2. CCP1was the most stable of 11 populations and ranked highest under organic growing conditions. The trend to produce above average and wide adaptability were observed also for two complex populations (CP4, CP5) and CCP3, whereas CP1 was characterized by an adaptability to high yielding environments.
3. For most of populations under both growing conditions a significantly lower severity of net blotch was observed in comparison with the most infected variety 'Abava', and in most cases it was insignificantly lower than that of 'Rasa'

and 'Rubiola'; severity of powdery mildew of one SP was significantly higher than that of all check varieties in C growing sites, but varied for other populations, not indicating that some of the populations would be more resistant against powdery mildew.

4. The crop ground cover of all populations was significantly lower, but the weed suppression ability – slightly lower if compared with the variety 'Abava'.
5. Populations containing a greater genetic diversity (CPs and CCPs) could ensure a better yield performance than populations with lower diversity level (SPs). Evidence that severity of foliar diseases and competiveness against weeds would be affected by population types was not observed.

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# YIELD AND QUALITY OF WINTER WHEAT, DEPENDING ON CROP ROTATION AND SOIL TILLAGE

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**Abstract**
Wheat (*Triticum*) grain is generally used for food due to its grain quality. The two-factorial trial was conducted in the Research and Study farm 'Pēterlauki', Latvia, with an aim of finding out the soil tillage and crop diversification in rotation effect on winter wheat grain yield and quality. Two soil tillage systems (traditional and reduced) and three crop rotation schemes with different winter wheat (*Triticum aestivum*) fore-crops (wheat, oilseed rape (*Brassica napus* ssp. *oleifera)*, faba bean (*Vicia faba*)) were used. The trial started in 2009. For this paper data from 2016/2017 and 2017/2018 growing seasons was used. Yields harvested in 2017 were significantly ($p<0.001$) higher than those in 2018 (on average 7.17 t $ha^{-1}$ in 2017, 6.18 t $ha^{-1}$ in 2018). The highest yield (8.06 t $ha^{-1}$) was gained in the variant where the fore-crop in 2017 had been faba bean. Crop rotation, including only repeated wheat sowings in both years, showed the lowest yield (on average 5.81 t $ha^{-1}$). Crop rotation with oilseed rape and wheat showed a significant wheat yield increase in the following two-year period in comparison to to repeated wheat sowings. A year as a factor had a significant ($p<0.05$) impact on crude protein content (%), Zeleny index, volume weight (g $L^{-1}$) and 1000 grain weight (g). Both, volume weight (g $L^{-1}$) and 1000 grain weight, were influenced ($p<0.05$) by the crop rotation and fore-crop. Zeleny index depended on all researched factors. Crude protein content was influenced by soil tillage method ($p<0.0016$) and fore-crop ($p=0.0052$). Hagberg falling number was not influenced by any of the investigated factors.
**Key words**: wheat, yield, grain quality, crop rotation, soil tillage.

## Introduction

Wheat (*Triticum*) is an important crop globally due to its baking properties, which is dependent on such quality traits of grain as, for example, crude protein, Zeleny index and Hagberg falling number. Wheat grain yield and quality are strongly related to the growing conditions of crop that are possible to improve agronomically by carrying out an appropriate soil tillage and growing it in a well-planned crop rotation, which, in addition, helps to limit harmful organisms.

In the European Union (EU), a little more than a half of arable land is sown by cereals (wheat, barley (*Hordeum vulgare*), triticale *(×Triticosecale*), oats (*Avena sativa*), and rye (*Secale cereale*)). The highest proportion from all mentioned is taken by wheat – about 30% of the total harvested land. It may make one think that the crop diversificationin the EU is small. Crop diversification in rotations is constantly adapted to economic conditions and dependent on agricultural policy (Babulicová, 2016). Crop rotations with a high proportion of wheat are at risk of reducing yield level (Bonciarelli *et al.*, 2016). Wheat yield increases in cereal-based crop rotations if oilseeds (Sieling *et al*., 2005) or pulses (Jensen, Peoples, & Hauggaard-Nielsen, 2010; Babulicová, 2016) are included as fore-crops in the rotation. Pulses (soybean (*Glycine max*), pea (*Pisum*), bean (*Vicia faba*), lupine (*Lupinus*), vetch (*Vicia*), lentil (*Lens*)) occupy a small part of the harvested land in the EU – 3.7% in 2017 (FAOSTAT data, 2019 March, available at: http://www.fao.org/faostat/en/#data/QC). It is reported that one of the main reasons why farmers do not want to grow pulses is unstable and more variable yield in comparison to non-legume crops in Europe (Cernay *et al*., 2015).

Traditional soil tillage helps to limit harmful organisms like wheat leaf diseases (Bankina *et al.*, 2018) and weeds (Ausmane, Melngalvis, & Ruža, 2017), but is more time and energy consuming if compared to minimum soil tillage treatments (Strašil, Vach, & Smutný, 2015). In different studies, contradictory results are reported on advantages of soil tillage method (traditional or reduced) to ensure a higher yield and/or quality of wheat (e.g. Arvidsson, 2010; Cociu & Alionte, 2011; Amato *et al.*, 2013).

When crop diversification in rotation and different soil tillage is used, it is important to know whether they have an impact on grain quality. Important grain quality indicators for food are: crude protein (CP) content (%), Hagberg falling number (s) and Zeleny index. Cabinet of Ministers of the Republic of Latvia Regulations No. 461 (Cabinet of Ministers, 2014) prescribe grain quality requirements for food quality: the lowest value for CP content is 12.5%, for falling number – 220 s, and that for Zeleny index – 30. Significant indicators of yield are: 1000 grain weight (g) (TGW) and volume weight (g $L^{-1}$), which affect flour outcome in milling process (Liniņa & Ruža, 2015). Volume weight for food quality grain is set by grain purchasers and producers, e.g., stock company 'AS Dobeles Dzirnavnieks' purchases grains for food with the minimum volume weight of 750 g $L^{-1}$. Crop rotation and fore-crop impact on grain yield and quality indicators had also been studied in Slovakia, and the results showed the fore-crop (two fore-crops were compared - field pea and barley) effect on winter wheat grain and straw yield, TGW and volume weight (Babulicová, 2016).

The aim of this paper was to compare whether different soil tillage treatments and crop diversification in crop rotation have an impact on the winter wheat grain yield and grain quality.

**Materials and Methods**

Two-factor trial was conducted at the Research and Study farm 'Peterlauki' of Latvia University Life Sciences and Technologies (56° 30.658′ N and 23° 41.580′ E). This research was based on two-year data (2016/2017 and 2017/2018) from the trial started in 2009. The first factor was crop rotation, three variants in total: rotation (1) repeated winter wheat (*Triticum aestivum*) (hereinafter – wheat) sowings (W–W), rotation (2) oilseed rape (*Brassica napus* ssp. *oleifera)*–wheat–wheat (OR–W–W), rotation (3) faba bean–wheat–oilseed rape–spring barley (FB–W–OR–B) (hereinafter – barley). Rotation (2) (OR–W–W) had two plots each year (in 2017, wheat was grown in one plot with fore-crop OR, but in the 2nd plot OR was grown. In 2018, both plots were occupied by wheat: with fore-crop OR, and with fore-crop W, and the rotation (3) (FB–W–OR–B) had three variants (every year one of included crops was not grown). Winter wheat fore-crops in 2017 were: wheat (**W–**W, rotation (1)), oilseed rape (**OR**–W–W, rotation (2)) and faba bean (**FB–**W–OR–B, rotation (3)). In 2018, fore-crops were wheat (**W–**W, rotation (1), and OR–**W–**W rotation (2)), and oilseed rape (**OR**–W–W, rotation (2)). In rotation (3), wheat was not grown in 2018. The second factor was two soil tillage variants – conventional (CT) and reduced (RT). CT variant included mould-board ploughing at a depth of 22 – 24 cm, and RT – disc harrowing twice at a depth to 10 cm. Winter wheat variety 'Zentos' was used in 2017 and 'Skagen' in 2018. In 2017/2018, it was decided to change the used variety in described long-term experiment because 'Zentos' had lost its topicality among producers. Both varieties are characterised as suitable for bread baking. Soil type at the site was Cambic Calcisol (Bathyruptic, Episiltic, Protostagnic); soil texture was clay. Nitrogen rate was chosen according to the yield potential – 197 kg $ha^{-1}$ in 2017, and 180 kg $ha^{-1}$ in 2018. Yield was harvested at GS 89 (according BBCH) using direct combining, and recalculated to 100% purity and 14% moisture. Grain quality indicators were detected by express method using Infratec 1241 in 2017, and Infratec NOVA in 2018, the indicators measured were: CP content (%), Zeleny index, volume weight (g $L^{1}$). Standard methods were used for Hagberg falling number (s) (ISO 3093:2009) and TGW (g) (LVS EN ISO 520:2011) determination. Mathematical data processing was done by using rStudio Multi-way Anova analysis and correlation analysis.

Winter wheat vegetation started on April 14 in 2017 and on April 7 in 2018. Meteorological situation was favourable for high-yield formation in 2017, but unfavourable for plant growth and development in 2018. Autumn in 2016 started with a warm September and low precipitation, but continued with optimal conditions. A spring-summer season was good in 2017, the average temperatures in the vegetation period were close to those of long-term observations. The precipitation amount was lower if compared to long-term observations, except July, when the highest amount of precipitations was observed (Table 1). As air temperatures were mostly temperate, plants did not suffer from lack of moisture.

Next season (2017/2018) started with a high amount of precipitation in September, October and November; the sowing was delayed till the end of September, and the growing and development of plants was disturbed. In April 2018, air temperature

Table 1

**Meteorological conditions at the trial site in 2016/2017 and 2017/2018 in comparison to long-term observations**

| Month | Temperature | | | Precipitation | | |
|---|---|---|---|---|---|---|
| | 2016/2017 | 2017/2018 | Long-term observations | 2016/2017 | 2017/2018 | Long-term observations |
| Sowing year | | | | | | |
| September | 13.7 | 13.0 | 11.5 | 3.9 | 26.6 | 20.9 |
| October | 5.2 | 8.0 | 6.7 | 18.7 | 26.7 | 19.3 |
| November | 1.1 | 3.9 | 1.8 | 11.5 | 15.1 | 17.6 |
| Harvesting year | | | | | | |
| April | 4.8 | 9.0 | 5.3 | 38.5 | 69.5 | 40.0 |
| May | 11.5 | 16.1 | 11.7 | 23.5 | 12.0 | 51.4 |
| June | 15.1 | 16.8 | 15.4 | 49.5 | 15.6 | 75.3 |
| July | 16.6 | 20.9 | 16.6 | 83.0 | 33.6 | 81.7 |
| August | 16.8 | 19.5 | 16.2 | 31.0 | 28.4 | 73.7 |

was higher than optimum for effective tillering. Subsequent air temperatures in this season were higher than long-term observations. Precipitation starting from May till harvesting in July was low (Table 1). Lack of moisture at important growth stages for yield formation was observed (during tillering, spike formation and grain filling): the vegetation period was also shorter. The above mentioned factors led to the reduction of yield and grain quality. Wheat yield was harvested on August 8 in 2017, and on July 24 in 2018.

**Results and Discussion**

The average winter wheat yield in two trial years differed significantly (p=0.0001) (Table 2). Lower yields were gained in 2018, when the meteorological conditions were unfavourable for high yield formation.

In 2017, when the average wheat yield was higher, a significant difference between soil tillage treatments was also found, and higher yield on average was gained in reduced soil tillage variant. Assessing the average two-year yield depending on soil tillage treatment, a significant difference was not found (Table 2). Similar results were found in Romania, where significant differences between different soil tillage variants (including CT and RT) were not established (Cociu & Alionte, 2011). An impact of different soil tillage variants (conventional tillage (CT), reduced tillage (RT), no-till (NT)) on wheat yield was also studied in Italy (Mediterranean climate), and the research resulted in wheat yield increase in NT variant in comparison to CT, when water stress was high, but a yield decrease was observed when the water stress was low (Amato *et al.*, 2013). In this trial, the interaction effect between year conditions and soil tillage variant was found (p=0.002).

The highest winter wheat grain yield was harvested in rotation (3) (FB-W-OR-B) in 2017, when wheat fore-crop had been faba bean – 8.06 t ha$^{-1}$. Wheat was fore-crop in rotation (1) – repeated wheat sowings, and rotation (2) (R-**W**-W). Wheat as a fore-crop caused wheat grain yield reduction on average per two trial years (6.01 t ha$^{-1}$), and also in every specific year, in comparison to oilseed rape and faba bean as fore-crops (Table 2). The same results on significant differences of wheat yield depending on crop rotation variants established from this trial in 2015 (Ruža *et al.*, 2016). R.L. Anderson found that wheat yield significantly increased when fore-crops were pulses or pulse-cereal mixture in comparison to fore-crop wheat (Anderson, 2008). M. Babulicová concluded that higher wheat yield was gained when fore-crop was field pea in comparison to barley (Babulicová, 2016).

A positive significant impact of oilseed rape as fore-crop was found also on the 2nd wheat yield in rotation (2) (R-W-**W**) (Table 3). Similar results were found also in Lithuania, in trials with oilseed rape as wheat fore-crop (personal communication with Dr. Z. Kriaučiuniene, 13 December 2018).

Winter wheat yield level between crop rotation variants, where fore-crop was also wheat, showed a positive impact of oilseed rape introduction in rotation and yield increasing effect of crop diversification in rotation. Wheat yield in rotation (2) after wheat (6.41 t ha$^{-1}$) showed yield increase by 22.6% in comparison

Table 2

**Winter wheat grain yield depending on crop rotation scheme, fore-crop and soil tillage method**

| Factors | Year (p=0.0001) | | Average |
|---|---|---|---|
| | 2017 | 2018 | |
| Crop rotation (p<0.001) | | | |
| W-W | 6.38$^{a}$ | 5.23$^{a}$ | 5.81$^{A}$ |
| W-W-OR | 7.08$^{b}$ | 6.65$^{b}$ | 6.79$^{B}$ |
| FB-W-OR-B | 8.06$^{c}$ | - | 8.06$^{C}$ |
| Fore-crop (p=0.039) | | | |
| wheat | 6.38$^{a}$ | 5.82$^{a}$ | 6.01$^{A}$ |
| oilseed rape | 7.08$^{b}$ | 6.88$^{b}$ | 6.98$^{B}$ |
| faba bean | 8.06$^{c}$ | - | 8.06$^{C}$ |
| Soil tillage (p=0.069) | | | |
| conventional | 6.87$^{a}$ | 6.24$^{a}$ | 6.56$^{A}$ |
| reduced | 7.48$^{b}$ | 6.10$^{a}$ | 6.79$^{A}$ |
| Average depending on trial year | 7.17$^{B}$ | 6.18$^{A}$ | × |

W–W – wheat in repeated sowings; W–W–OR – wheat in rotation with oilseed rape; FB–W–OR–B – four different crop rotation, where wheat is sown after faba bean. Significantly different means are marked with different letters in superscript: $^{A, B, C}$ – significant difference for average yields of two trial years and means on factor graduations; $^{a, b, c}$ – significant difference in specific trial year.

Table 3

**Winter wheat grain yield depending on fore-crop in rotation and soil tillage method in 2018**

| Soil tillage method | Fore-crop (in bold) in crop rotation | | | Average depending on soil tillage variant, p=0.444 |
|---|---|---|---|---|
| | **W**-W | OR-**W**-W | **OR**-W-W | |
| Conventional | 5.72 | 6.40 | 6.60 | 6.24 |
| Reduced | 4.74 | 6.42 | 7.16 | 6.10 |
| Average depending on fore-crop, $LSD_{0.05}$=0.44 | 5.23 | 6.41 | 6.88 | × |

Table 4

**Winter wheat grain crude protein content (%) depending on investigated factors**

| Factors | Year (p=0.0176) | | Average |
|---|---|---|---|
| | 2017 | 2018 | |
| Crop rotation (p=0.1993) | | | |
| W-W | 11.0$^{a}$ | 9.9$^{a}$ | 10.4$^{A}$ |
| WW-OR | 10.8$^{a}$ | 10.4$^{a}$ | 10.6$^{A}$ |
| FB-W-OR-B | 11.0$^{a}$ | - | 11.0$^{A}$ |
| Fore-crop (p=0.0052) | | | |
| wheat | 11.0$^{a}$ | 9.9$^{a}$ | 10.3$^{A}$ |
| oilseed rape | 10.8$^{a}$ | 10.9$^{b}$ | 10.8$^{AB}$ |
| faba bean | 11.0$^{a}$ | - | 11.0$^{B}$ |
| Soil tillage (p=0.0037) | | | |
| conventional | 10.6$^{a}$ | 10.0$^{a}$ | 10.3$^{A}$ |
| reduced | 11.3$^{b}$ | 10.4$^{a}$ | 10.9$^{B}$ |
| Average depending on trial year | 10.9$^{B}$ | 10.2$^{A}$ | × |

W–W – wheat in repeated sowings; W–W–OR – wheat in rotation with oilseed rape; FB–W–OR–B – four different crop rotation, where wheat is sown after faba bean. Significantly different means are marked with different letters in superscript: $^{A, B}$ – significant difference for average crude protein (%) of two trial years and means on factor graduations; $^{a, b}$ – significant difference in a specific trial year.

to wheat yield in repeated sowings (5.23 t $ha^{-1}$). The highest grain yield in 2018 was harvested if fore-crop was oilseed rape and reduced soil tillage was used.

Investigated CP content in grain was low (9.9 – 11.3%) and did not reach criterion set by the Cabinet Regulations (Cabinet of Ministers, 2014) for food quality – 12.5% (Table 4).

Protein content differed mathematically significantly depending on the year (p=0.0176), fore-crop (p=0.0052) and soil tillage variant (p=0.0037) (Table 4). The highest value was gained in the variant where reduced tillage was used in 2017 (11.3%). Regardless of the established mathematically significant average CP content difference between two soil tillage variants (Table 4), this difference was only 0.7% (10.9% in traditional tillage and 10.2% in reduced tillage variant), and it is not agronomically important. An opposite effect was found in three-year trial in Romania, where higher protein content was gained in traditional tillage variant (Cociu & Alionte, 2011). The higher average CP content was gained in 2017 (10.9%), but lower in 2018 (10.2%) A fore-crop impact (p=0.0052) on winter wheat grain CP content was found – an average higher value was determined if fore-crop was faba bean, and it significantly differed between wheat as fore-crop. In 2017, significant differences between fore-crops were not found, but in 2018 – oilseed rape as fore-crop had an impact on higher CP content in comparison to fore-crop wheat. A fore-crop impact on winter wheat grain CP content was not found in research conducted in the USA, if spring wheat fore-crop was field pea, which was compared to repeated wheat rotation (Carr, Martin, & Horsley, 2008).

Average values of CP quality, which were described as Zeleny index, differed significantly depending on all investigated factors (Table 5). Values of Zeleny index corresponded to food grain demands in 2017, but in 2018, they were dramatically low (on average 22.8, criterion is 30). High temperature in May affected negatively CP quality in 2018. O. Veisz, S. Bencza, & G. Vida (2007) stated that heat stress after flowering may affect a CP spatial structure. C. Blumenthal *et al*. (1995) had claimed that despite high CP content heat stress can decrease the glutenin-

Table 5

**Zeleny index of winter wheat grain depending on researched factors**

| Factors | Year (p<0.001) | | Average |
|---|---|---|---|
| | 2017 | 2018 | |
| Crop rotation (p=0.0249) | | | |
| W-W | 33.5[a] | 20.4[a] | 26.9[A] |
| WW-OR | 30.3[a] | 24.0[b] | 26.1[A] |
| FB-W-OR-B | 31.9[a] | - | 31.9[B] |
| Fore-crop (p=0.001) | | | |
| wheat | 33.5[a] | 20.7[a] | 24.9[A] |
| oilseed rape | 30.3[a] | 27.0[b] | 28.7[AB] |
| faba bean | 31.9[a] | - | 31.9[B] |
| Soil tillage (p=0.006) | | | |
| conventional | 28.9[a] | 21.5[a] | 25.2[A] |
| reduced | 34.8[b] | 24.1[b] | 29.4[B] |
| Average depending on trial year | 31.9[B] | 22.8[A] | × |

W–W – wheat in repeated sowings; W–W–OR – wheat in rotation with oilseed rape; FB–W–OR–B – four different crop rotation, where wheat is sown after faba bean. Significantly different means are marked with different letters in superscript: [A, B] – significant difference for Zeleny index of two trial years and means on factor graduations; [a, b] – significant difference in a specific trial year.

Table 6

**Volume weight (g $L^{-1}$) of winter wheat grain depending on investigated factors**

| Factors | Year (p<0.001) | | Average |
|---|---|---|---|
| | 2017 | 2018 | |
| Crop rotation (p<0.001) | | | |
| W-W | 814[ab] | 791[a] | 802[A] |
| W-W-OR | 809[a] | 802[a] | 804[A] |
| FB-W-OR-B | 818[b] | - | 818[B] |
| Fore-crop (p=0.0002) | | | |
| wheat | 814[ab] | 794[a] | 800[A] |
| oilseed rape | 809[a] | 807[b] | 808[A] |
| faba bean | 818[b] | - | 818[B] |
| Soil tillage (p=0.8175) | | | |
| conventional | 813[a] | 798[a] | 806[A] |
| reduced | 814[a] | 798[a] | 806[A] |
| Average depending on trial year | 813[B] | 798[A] | × |

W–W – wheat in repeated sowings; W–W–OR – wheat in rotation with oilseed rape; FB–W–OR–B – four different crop rotation, where wheat is sown after faba bean. Significantly different means are marked with different letters in superscript: [A, B] – significant difference for average volume weight of two trial years and means on factor graduations; [a, b] – significant difference in a specific trial year.

gliadin ratio, and the percentage of very large glutenin polymers can decrease protein quality. In our research, Zeleny index and protein content had strong positive correlation ($r=0.957 > r_{0.01}=0.372$; n=48).

Volume weight was significantly influenced by the year, crop rotation and fore-crop (Table 6). Volume weight of the harvested grain corresponded to criterion stated for food wheat by stock company 'AS Dobeles Dzirnavnieks' (>750 g $L^{-1}$).

Highest wheat volume weight was determined in crop rotation (3), where fore-crop was faba bean in 2017. In the same year, volume weight in repeated wheat sowings (rotation (1)) did not differ significantly from that in other two crop rotation variants, and the lowest value was gained in rotation (2) – after oilseed rape (Table 6). The situation was different in 2018, when higher average value of volume weight was determined, when wheat was grown after oilseed

Table 7

**Winter wheat thousand grain weight (g) depending on investigated factors**

| Factors | Year (p<0.001) | | Average |
|---|---|---|---|
| | 2017 | 2018 | |
| Crop rotation (p<0.001) | | | |
| W-W | 44.6[a] | 41.2[a] | 42.9[A] |
| WW-OR | 46.2[b] | 42.2[a] | 43.5[A] |
| FB-W-OR-B | 47.6[b] | - | 47.6[B] |
| Fore-crop (p<0.001) | | | |
| wheat | 44.6[a] | 41.4[a] | 42.5[A] |
| oilseed rape | 46.2[b] | 42.7[b] | 44.5[B] |
| faba bean | 47.6[b] | - | 47.6[C] |
| Soil tillage (p=0.4787) | | | |
| conventional | 46.0[a] | 41.9[a] | 44.1[A] |
| reduced | 46.3[a] | 41.7[a] | 43.9[A] |
| Average depending on trial year | 46.2B | 41.8A | × |

W–W – wheat in repeated sowings; W–W–OR – wheat in rotation with oilseed rape; FB–W–OR–B – four different crop rotation, where wheat is sown after faba bean. Significantly different means are marked with different letters in superscript: [A, B, C] – significant difference for average TGW of two trial years and means on factor graduations; [a, b] – significant difference in a specific trial year.

rape. M. Babulicová (2016) found positive fore-crop effect on winter wheat volume weight if the fore-crop was field pea in comparison to variant where fore-crop was barley in Slovakia. P.M. Carr *et al.* reported that volume weight of spring wheat was influenced by interaction between crop rotation, tillage system and year (Carr, Martin, & Horsley, 2008). A tendency of such interaction was also found in our research (p=0.061).

Volume weight had a positive correlation with TGW ($r=0.807>r_{0.01}=0.372$; n=48); such a relationship has also been reported by Liniņa & Ruža (2015). TGW in the trial period was influenced by year, crop rotation and fore-crop (Table 7).

The lowest average TGW was found in repeated wheat sowings (W-W; rotation (1)), but higher average TGW when rotation was diversified (Table 7). Significant TGW differences were found depending on fore-crops – higher TGW gained after faba-bean and oilseed rape in 2017. M. Babulicová (2016) reported similarly that fore-crop field pea had a significant impact on TGW increase, if compared with variant where cereal (barley) fore-crop was used. Average TGW differed significantly between trial years, and it was higher by 4.4 g in 2017 in comparison to 2018 (on average 41.8 g). Other researchers in Latvia (Liniņa & Ruža, 2015; Skudra & Ruža, 2016) have concluded that meteorological situation in the vegetation period has the main influence on TGW. A.I. Cociu & E. Alionte (2011) also concluded that TGW of the same variant can differ significantly between years. Drought stress and heat stress may lead to lower TGW (Veisz, Bencza, & Vida, 2007). Soil tillage treatment did not show significant effect on average TGW (Table 7), and the same result was obtained in Romania (Cociu & Alionte, 2011). They found an interaction effect between year and used soil treatment on TGW.

The Hagberg falling number (on average in 2017 – 328 s, in 2018 – 338 s) was not significantly influenced by the investigated factors and was higher than grain food quality minimum requirements (220 s) according to the Cabinet Regulations No. 461.

## Conclusions

Higher winter wheat grain yields were gained in rotations with crop diversification in them. Higher yields and quality indicators were determined in the year 2017 due to more favourable meteorological conditions. Crop rotation with different field crops also showed an improvement effect on grain quality indicators – Zeleny index, volume weight, 1000 grain weight. Fore-crop impact was investigated on crude protein content, Zeleny index, volume weight and 1000 grain weight. Small soil tillage influence was found on crude protein content and Zeleny index. Hagberg falling number was stable and not influenced by investigated factors.

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# EVALUATION THE BAKING VALUE OF PASSAGE FLOURS

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**Abstract**
The main direction of using wheat grains is grinding them into low-extraction flours. The flours collected from individual passages differ in terms of chemical composition and physical properties, which in turn differentiates their baking value. The aim of the study was to evaluate the baking value of passage flours obtained from the milling of spring and winter wheat grain. Wheat grain was milled in a 6-pass laboratory mill MLU-202 by Bühler. The baking value of the obtained passage flours was evaluated by an indirect method (protein content, gluten content and quality, falling number, farinograph analysis) and by a direct method (by baking and performing quality evaluation of the obtained bread). The research showed that the efficiency of flours from individual milling passages varied. The passages flours differed significantly in terms of chemical composition and baking value. The highest flour yields were obtained from the first and second grinding stages, while the smallest from the third grinding stage. Ash and total protein content, flour water absorption, and amylolytic enzymes activity increased together with the subsequent milling stage in both reduction-passage and grinding-passage. The gluten content increased with the next reduction stage, while it decreased with the subsequent grinding passage. The bread from the laboratory baking test was diversified in terms of sensory characteristics, loaf volume, and crumb porosity. The best quality bread was obtained from flour from the first two reduction passages. The lowest quality bread was obtained from flour from the final grinding passage.
**Key words**: wheat, flour from different grinding stages, protein, rheological properties, bread quality.

## Introduction

Common wheat (*Triticum aestivum* L.), due to the chemical composition of the grain and its wide use, is the most popular cereal crop in the world. For the 2017/2018 season, the world wheat harvest has been estimated at 757 million tonnes (GUS, 2018). Approximately 60% of the wheat grain harvested each year is processed for consumption, mainly into various types of low-extraction (light) flour. The milling of wheat grain into low-extraction flours is a multi-stage process, as a result of which, the so-called passage flours are obtained, from which the final products – commercial flours are prepared. The baking value of commercial wheat flour, apart from the quality of the milled grain and the applied milling technology, is influenced by the selection of passage flour and its share in the final product. Among the components of wheat flour, the content and quality of protein substances play a particularly important role in shaping its baking value. In wheat grain endosperm, the higher protein concentration is in its external and internal parts, with gradual changes in protein content and no clear dividing zone between the endosperm richer and poorer in this component (Rothkaehl, 2006). The research conducted so far (Delcour *et al*., 1999; Prabhasankar *et al*., 2000; Rani *et al*., 2001; Rothkaehl, 2006; Banu *et al.*, 2010) shows that the flours collected from the individual mill passages differ in terms of protein content, including gluten proteins, as well as in terms of the content of starch, mineral substances, and enzymes. However, there are no reports indicating how differences in the chemical composition of passage flours affect the quality of bread obtained from them, so it was advisable to undertake such studies.

The aim of the study was to evaluate the baking value of passage flours obtained from laboratory milling of spring and winter wheat grains, on the basis of indirect indices and the direct method.

## Materials and Methods

Samples of spring and winter wheat grain were used as a test material. Wheat grain was obtained from a field experiment carried out in 2014, in the Experimental Station Osiny, belonging to IUNG-PIB (Institute of Soil Science and Plant Cultivation – State Research Institute) in Puławy, in Poland. In the first stage of the study, a physicochemical evaluation of wheat grain was carried out. The weight of 1000 grains, plumpness, uniformity, glassiness, and hardness were determined using the Brabender farinograph attachment, according to Cacak-Pietrzak & Gondek (2010). Total ash content was determined using AACC Method 08-01.01 (AACC, 2010), while the total protein content was determined by Kjeldahl method in Kjel-Foss Automatic apparatus (N×5.83) according to AACC Method 46-11.02 (AACC, 2010). The grain was milled in a six-passage laboratory mill MLU-202 by Bühler (Cacak-Pietrzak & Gondek, 2010). Before milling, impurities on Brabender granite were removed from the grains and then they were subjected to two-stage moistening – 24 hours before milling to 13.0% moisture content, and 30 minutes before milling to 13.5% moisture content. The weight of the grain sample for milling was 30 kg. After milling, the obtained products, namely, flours

from the reduction and grinding stages, as well as reduction and milling bran, were weighed. Next, their efficiency was calculated and the total ash content was determined according to AACC Method 08-01.01 (AACC, 2010).

The baking value of passage flours was evaluated by direct and indirect methods. Total protein content was determined using Kjeldahl method in apparatus Kjel-Foss Automatic (N×5.83) according to AACC Method 46-11.02 (AACC, 2010), gluten content and quality in Glutomatic 2200 apparatus according to Method 38-12.02 (AACC, 2010), while the falling number with Hagberg-Pertenin in apparatus Falling Number 1400 according to AACC Method 56-81.03 (AACC, 2010). A farinograph analysis was also performed using Brabender's farinograph with a 50 g flour mixer according to AACC Method 54-21.02 (AACC, 2010). Dough for baking was prepared using the direct method, from 400 g flour (14.0% moisture content), water in the amount needed to obtain dough of 350 FU consistency, 12 g of baker's yeast, and 6 g of kitchen salt. The dough was kneaded in the Stephan mixer for 2 min at a speed of 1400 revolution $min^{-1}$. The fermentation time was 90 min; after 60 min of fermentation, the dough was pierced. Next, the dough pieces with a mass of 250 g were weighed, which, after shaping, were placed in moulds and subjected to final fermentation. Baking was carried out in the Sveba Dahlen furnace at 230 °C for 30 min. The evaluation of bread was carried out 24 hours after baking. Bread output, loaf volume, and crumb porosity were determined by the Dallman method (Romankiewicz *et al.*, 2017). Sensory evaluation of bread was carried out by means of scaling, by a 10-person trained team of evaluators. The following were assessed: external appearance of the loaf, properties of the crust and crumbs, as well as taste and smell. Each quality distinction was awarded from 0 to 5 points. All of analysis were done in three replications. The results were developed statistically in the Statgraphics Centurion XVI program. A one-way analysis of variance was carried out, with the significance of differences between the averages being determined by Tukey's test at the level of α=0.05.

**Results and Discussion**

Grains of spring and winter wheat were significantly diversified in terms of physicochemical characteristics (Table 1). Winter wheat grain was more fertile and even in terms of size. It was characterized by a floury endosperm structure and lower ash content than spring wheat grain, which was finer, glassy, harder, and contained more total protein. The obtained results are confirmed by literature data (Cacak-Pietrzak, Ceglińska, & Torba, 2005; Cacak-Pietrzak & Gondek, 2010; Marzec, Cacak-Pietrzak, & Gondek, 2011; Dziki *et al.*, 2014; 2017), which indicate differences in physical properties and chemical composition of winter grain and spring wheat cultivars, which is reflected in its milling properties – energy consumption in the grain grinding process, total flour and bran yield, as well as flour yield from particular milling passages and their ash content.

The total efficiency of passage flours obtained from the milling of spring and winter wheat grain in the laboratory mill was high, comparable to the yield of low-extraction flours obtained in the industrial mill (Delcour, Van Win, & Grobet, 1999; Prabhasankar, Sudha, & Rao, 2000; Sutton & Simmons, 2006; Banu *et al.*, 2010). The total flour efficiency obtained from winter wheat grain milling was significantly higher than the efficiency of spring wheat flour, respectively: 78.8 and 74.4% (Table 2). This can be explained by the higher ripeness of winter wheat grain, and the resulting higher share of endosperm grain from which low-extraction flours are obtained, as well as a lower share of fruit and seed coats, which are sieved during grain milling and becomes a waste product – bran. The results of earlier studies (Cacak-Pietrzak, Ceglińska, & Torba, 2005; Dziki *et al.*, 2014) indicate higher flour efficiency obtained from winter wheat grain milling than spring wheat. The flour efficiency from reduction passages were about twice as low as from grinding passages, which resulted from high flour efficiency from the first (29.4 and 32.9%) and the second grinding passages (18.8 and 19.3%). This indicates good grindability of porridges and fines. This trait is of great practical importance, as it allows to reduce the number of porridge and grinding passages

Table 1

**Physicochemical characteristics of spring and winter wheat grains**

| Wheat grain | 1000 grain weight (g) | Selectness (%) | Uniformity (%) | Glassines (%) | Hardness (j.B) | Protein content (% s.s.) | Ash content (% s.s.) |
|---|---|---|---|---|---|---|---|
| Spring | $32.7^{b*}$ | $42^{b}$ | $62^{b}$ | $65^{a}$ | $650^{a}$ | $12.8^{a}$ | $1.96^{a}$ |
| Winter | $48.0^{a}$ | $85^{a}$ | $85^{a}$ | $6^{b}$ | $515^{b}$ | $10.4^{b}$ | $1.64^{b}$ |

* average values marked with the same letter indices within the column do not differ significantly statistically at the level of α=0.05

j.B – conventional units in Brabender scale, % of s.s. – the percentage calculated from the dry mass of grain.

Table 2

**Yields of flour and bran from the milling of spring and winter wheat grains**

| Wheat grain | Efficiency of reduction flours (%) | | | Efficiency of grinding stage flours (%) | | | Flour efficiency (%) | Bran efficiency (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | SI | SII | SIII | W1 | W2 | W3 | | ΣS | ΣW |
| Spring | 7.1[a*] | 10.8[b] | 2.3[a] | 32.9[a] | 19.3[a] | 2.0[a] | 74.4[a] | 14.9[a] | 10.7[a] |
| Winter | 11.7[b] | 14.2[a] | 2.8[a] | 29.4[b] | 18.8[a] | 1.9[a] | 78.8[b] | 11.5[b] | 9.7[a] |

* average values marked with the same letter indices within the column do not differ significantly statistically at the level of α=0.05
S, SI, SII, SIII – reduction passages W, W1, W2, W3 – grinding passages.

in the mill, and thus reduce the cost of the grain milling process. The grindability of porridge and pellets is influenced by the structure of wheat endosperm. The studies of Cacak-Pietrzak, Ceglińska & Torba (2005) and Cacak-Pietrzak & Gondek (2010) show that with the increase in glassiness and hardness of grains, the grinding efficiency of porridge increases, and more flour is obtained from the grinding passages, which has been confirmed by the results of the study. The lowest flour efficiency was obtained from the final reduction (2.3 and 2.8%) and dimensional grinding passages (1.9 and 2.0%).

Passage flours differed significantly among each other in terms of chemical composition (Table 3). In spring wheat flour, the ash content ranged from 0.52% (W1) to 1.97% (W3), while in winter wheat flour, it was lower and ranged from 0.44% (W1) to 1.80% (W3). Ash content increased with the subsequent passage, both for flours from the reduction and grinding passages. Similar relationships were also found in the total protein content in passage flours. The lowest content of this component was found in flours from the first reduction passages (8.9 and 10.1%), as well as in grinding passages (9.4 and 11.2%), while the highest content was found in flours from the final grinding passages (12.7 and 15.5%). The results of studies carried out by Rani *et al.* (2001), Rothkaehl (2006) and Gómez, Ruiz-Paris & Bonastre (2010) show similar differences in ash and total protein content in wheat passage flours taken from the industrial mill. The ash content of the industrial mill flours tested by Delcour, Van Wine & Grobet (1999) ranged from 0.35 to 3.18% and increased with the subsequent milling passages. In this study, gluten content increased with the subsequent reduction passages, while it decreased with the subsequent grinding passages. The

Table 3

**Chemical characteristics of passage flours**

| Passage flour | Ash content (% s.s.) | Protein content (% s.s.) | Gluten content (%) | Gluten index | Falling numer (s) |
|---|---|---|---|---|---|
| Spring wheat | | | | | |
| SI | 0.65[c*] | 10.1[e] | 26.7[b] | 95[b] | 301[b] |
| SII | 0.73[b] | 13.4[b] | 31.3[a] | 94[b] | 290[bc] |
| SIII | 0.74[b] | 15.2[a] | 31.7[a] | 95[b] | 253[d] |
| W1 | 0.52[d] | 11.2[d] | 25.9[b] | 98[a] | 315[a] |
| W2 | 0.72[b] | 12.6[c] | 25.2[b] | 100[a] | 289[c] |
| W3 | 1.97[a] | 15.5[a] | 21.6[c] | 99[a] | 251[d] |
| Winter wheat | | | | | |
| SI | 0.56[d] | 8.9[d] | 22.4[b] | 99[a] | 212[a] |
| SII | 0.58[d] | 10.6[b] | 28.6[a] | 99[a] | 198[b] |
| SIII | 0,67[c] | 10.8[b] | 29.5[a] | 99[a] | 168[c] |
| W1 | 0.44[e] | 9.4[c] | 23.4[b] | 100[a] | 207[ab] |
| W2 | 0.87[b] | 10.2[bc] | 22.6[b] | 100[a] | 204[ab] |
| W3 | 1.80[a] | 12.7[a] | 17.7[c] | 100[a] | 167[c] |

* average values marked with the same letter indices within the column (spring wheat, winter wheat separately) do not differ significantly statistically at the level of α=0.05
SI, SII, SIII – reduction-stage flours; W1, W2, W3 – grinding-stage flours
% s.s. – the percentage calculated from the dry matter of flour.

most gluten was washed from flours of the second (28.6 and 31.3%) and third reduction passages (29.5 and 31.7%), and the least from the final reduction passages (17.7 and 21.6%). Gluten isolated from all passage flours was of good quality (gluten index – IG >90). The activity of amylolytic enzymes in the flour increased with the subsequent milling passage, both in the reduction and grinding passages. The lowest amylolytic activity was observed for flours from the first reduction passages (falling numbers of 301 and 212 s), while the highest for flours from the final grinding passages (falling numbers of 251 and 167 s). The high activity of flour from the industrial mill's final grinding passages is also indicated by the results of Rani *et al.* (2001) and Rothkaehl (2006) studies, whereas in the studies of Prabhasankara, Sudha & Rao (2000) and Banu *et al.* (2010), the changes in the amylolytic activity of flour from subsequent industrial mill passages were irregular.

The farinographical evaluation makes it possible to examine the dough under conditions similar to those of bakery production, which makes it possible to determine the baking value of the flour and its suitability for mechanical processing more fully than using the evaluation of the quantity and quality of protein substances. It also provides information on the water absorption of flour – a parameter that affects the yield of dough and bakery products (Szafrańska, 2017). Passage flours differed significantly among each other in terms of water absorption (Table 4). Flours of spring wheat grain were characterized by higher water absorption (from 60.8 to 79.4%) than those of winter wheat (from 54.8 to 71.2%). The water absorption of flours increased with the subsequent stages, both in the reduction and grinding passages. Rothkaehl (2006) showed similar relationships in relation to the water absorption of passenger flours taken from the industrial mill, whereas in the study of Banu *et al*. (2010), the changes in the water absorption of flours from the subsequent milling passages were irregular.

In our research, the highest water absorption was observed in the flour from the final passages, which contained the largest number of particles of ground fruit and seed coats. Doughs obtained from spring wheat flour were characterized by longer development and stability times and lower softening than dough from winter wheat flour. Studies conducted by Abramczyk & Rothkaehl (2002) showed that dough made of flour with high gluten protein content and low amylolytic enzymes activity, is characterized by good rheological properties. This has been confirmed by the results of this study.

The output of bread obtained from the tested passage flours was statistically diversified (Table 5). Bread of a higher efficiency was obtained from flour from reduction passages than from grinding passages, which resulted from higher water absorption of flour from reduction stages. Significant differences were also found in loaf volume and crumb porosity. Bread made of flour from reduction passages (372 – 432 $cm^3$) was characterized by a larger volume than bread from grinding passages (206 – 409 $cm^3$). It was also characterized by crumbs of a more uniform porosity.

Table 4

**Water absorption of passage flours and rheological properties of the dough**

| Passage flour | Water absorption (%) | Development time (min) | Stability time (min) | Softness (FU) |
|---|---|---|---|---|
| Spring wheat | | | | |
| SI | 60.8$^{d}$ | 2.8$^{b}$ | 3.3$^{b}$ | 68$^{b}$ |
| SII | 62.5$^{c}$ | 3.8$^{a}$ | 4.4$^{a}$ | 55$^{c}$ |
| SIII | 65.5$^{c}$ | 3.7$^{a}$ | 3.1$^{b}$ | 52$^{c}$ |
| W1 | 64.3$^{c}$ | 2.8$^{b}$ | 2.7$^{c}$ | 74$^{b}$ |
| W2 | 71.6$^{b}$ | 2.2$^{c}$ | 2.1$^{d}$ | 82$^{a}$ |
| W3 | 79.4$^{a}$ | 2.5$^{bc}$ | 1.5$^{e}$ | 88$^{a}$ |
| Winter wheat | | | | |
| SI | 54.8$^{e}$ | 2.2$^{c}$ | 3.0$^{ab}$ | 74$^{c}$ |
| SII | 55.8$^{d}$ | 2.7$^{b}$ | 3.2$^{a}$ | 70$^{c}$ |
| SIII | 57.4$^{c}$ | 2.5$^{c}$ | 2.6$^{bc}$ | 62$^{d}$ |
| W1 | 56.4$^{cd}$ | 3.0$^{a}$ | 2.8$^{b}$ | 84$^{b}$ |
| W2 | 61.2$^{b}$ | 2.6$^{b}$ | 2.6$^{bc}$ | 92$^{a}$ |
| W3 | 71.2$^{a}$ | 2.3$^{c}$ | 1.4$^{d}$ | 95$^{a}$ |

* average values marked with the same letter indices within the column (spring wheat, winter wheat separately) do not differ significantly statistically at the level of α=0.05
SI, SII, SIII – reduction passages; W1, W2, W3 – grinding passages.

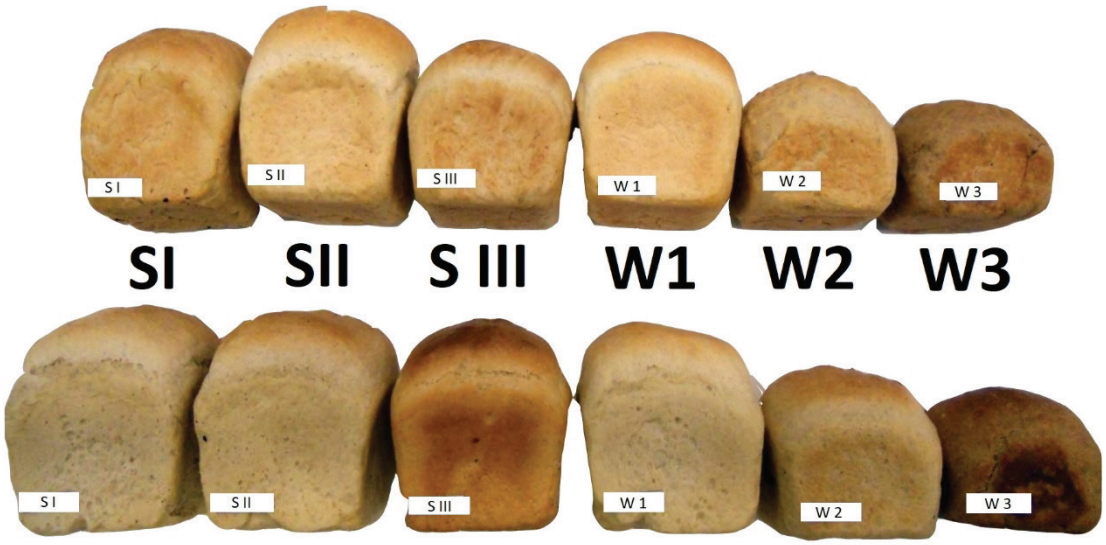


Figure 1. Appearance of bread from passage flours from the grains of winter wheat grain (upper row) and spring wheat grain (lower row).
SI, SII, SIII – reduction passages; W1, W2, W3 – grinding passages.

Table 5

**Yield and quality of bread made from passage flours**

| Passage flour | Bread output (%) | Bread volume ($cm^3$) | Porosity index of the crumb | Sensory assessment (Σ pkt.) |
|---|---|---|---|---|
| Spring wheat | | | | |
| SI | 138.4[a] | 423[a] | 90[a] | 24.0[a] |
| SII | 137.9[a] | 420[a] | 90[a] | 24.0[a] |
| SIII | 134.2[b] | 389[a] | 85[a] | 21.5[b] |
| W1 | 138.6[a] | 380[ab] | 85[a] | 20.0[b] |
| W2 | 140.4[a] | 316[b] | 50[b] | 16.0[c] |
| W3 | 140.7[a] | 217[c] | 30[c] | 7.0[d] |
| Winter wheat | | | | |
| SI | 135.8[c] | 418[ab] | 80[a] | 23.5[a] |
| SII | 137.6[c] | 432[a] | 85[a] | 24.5[a] |
| SIII | 137.7[c] | 372[c] | 90[a] | 22.0[b] |
| W1 | 137.7[c] | 409[b] | 85[a] | 24.0[a] |
| W2 | 144.1[b] | 288[bc] | 45[b] | 18.0[c] |
| W3 | 146.4[a] | 206[d] | 30[c] | 8.0[d] |

* average values marked with the same letter indices within the column (spring wheat, winter wheat separately) do not differ significantly statistically at the level of α=0.05
SI, SII, SIII – reduction passages; W1, W2, W3 – grinding passages.

Similarly, as in the research carried out by Every *et al.* (2006), bread from flours from the final grinding passages had the smallest volume.

The differences in loaf volume and porosity of bread crumbs from flours from individual milling passages were confirmed by sensory evaluation results. The sum of points awarded by the team conducting sensory evaluation of bread ranged from 7.0 to 24.5 (Table 5). Taking into account the external appearance of loaves, bread made of reduction-stage flour was rated higher than of grinding-stage flours (Figure 1). Reservations concerned in particular bread made from flour from the final grinding passage, which was very poorly grown, with crumbs too compact and not very porous. The majority of bread loaves were characterized by an appropriate skin colour, but the evaluators pointed to the colour of bread skin from flour from the final grinding passages as too dark. Additionally, the skin of this bread was cracked and wrinkled. The bread crumbs were dry, elastic, and

with the exception of bread made from flour from the final grinding passages, evenly coloured. The taste and smell were characteristic to wheat bread. No significant differences in the taste and smell of bread from particular passage flours were found.

**Conclusions**

Flours from the same batch of grain taken from individual passages of the laboratory mill were significantly diversified in terms of chemical composition and baking value, which allows the composition of final flour of defined quality parameters. However, flour from the final grinding passages should be absolutely rejected, as during milling they were contaminated with shredded particles of the fruit and seed coats, which significantly increased their ash content. Flours from these passages, despite the high total protein content, contained the least gluten proteins and were characterized by the highest activity of amylolytic enzymes. The bread obtained from these flours had a deformed shape, was poorly grown, with a compact crumb and too dark skin colour. The remaining passage flours have proper baking properties and can be used to make flour for baking purposes.

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# EFFECT OF NITROGEN RATE ON NITROGEN USE EFFICIENCY IN WINTER OILSEED RAPE (*BRASSICA NAPUS)*

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**Abstract**
Winter oilseed rape is the main oilseed crop in Latvia. High yield production depends on applied plant nutrients, especially nitrogen. Nitrogen is one of the most mobile plant nutrients in the soil and, therefore, nitrogen fertilizer management is an important part of agriculture. The objective of this paper is to evaluate the effect of nitrogen fertilizer rate on nitrogen use efficiency (NUE) in winter oilseed rape. The field experiment was conducted during four growing seasons (2014/2015, 2015/2016, 2016/2017 and 2017/2018) at the Research and Study farm 'Pēterlauki' of Latvia University of Life Sciences and Technologies (56° 30.658′ N and 23° 41.580′ E). In total, eight nitrogen rates were used in this experiment (kg $ha^{-1}$ of N pure matter): N0 or control, N60, N90, N120 (80+40), N150 (100+50), N180 (120+60), N210 (120+60+30) and N240 (140+60+40). All NUE parameters were calculated only for five nitrogen rates (N0; N60, N120, N180 and N 240). Results indicated that the nitrogen fertilizer rate had a significant ($p<0.001$) effect on winter oilseed rape seed yield. The yield increased until the rate N120 – N180. Nitrogen fertilizer rate also significantly ($p<0.001$) affected N, $P_2O_5$ and $K_2O$ removal with oilseed rape biomass. N and $K_2O$ removal with seed yield significantly increased until the nitrogen rate N120 – N180, but $P_2O_5$ until N60 – N180. Results showed that the nitrogen fertilizer significantly ($p<0.001$) affected NUE, nitrogen uptake efficiency (NUpE) and nitrogen utilization efficiency (NUtE), but it did not have a significant ($p=0.840$) effect on nitrogen harvesting index (NHI). By increasing the nitrogen fertilizer rate, NUE, NUpE and NUtE decreased.
**Key words**: seeds, stems, roots, content of nutritional elements, nutrient removal.

## Introduction

Winter oilseed rape (*Brassica napus* ssp. *oleifera*) is one of the most important and profitable crops in Latvia, which requires optimal nutrient supply. But nitrogen is one of the most mobile plant nutrients in the soil and nitrogen losses not only increase production costs, but also can lead to environment pollution. In the literature it is mentioned that the fertilizer application rate has a significant influence on the amount of nitrates leached out of the root zone (Podgornik & Pintar, 2007) and leaching losses can be large in agriculture, often 10 to 20% from applied nitrogen (Davis, 2007). Therefore, nitrogen fertilizer management is an important part of agriculture.

Nitrogen use efficiency (NUE) is an important indicator in agriculture that is defined as yield produced per unit of available nitrogen. Usually NUE is divided in nitrogen uptake efficiency (NUpE), which shows the ability of the plant to capture nitrogen from the soil, and nitrogen utilization efficiency (NUtE), which shows the ability to utilize the absorbed nitrogen to produce yield (Moll *et al*., 1982). NUE can be affected by several factors – meteorological conditions in the growing season, nitrogen fertilizer type, nitrogen fertilizer rate and time of application (Haile *et al*., 2012). In Latvia, previous studies showed that the winter oilseed rape seed yield significantly increased until nitrogen rate N120-N150 (Ruža *et al.*, 2012). But in general, little documented research is available about nitrogen fertilizer effect on winter oilseed rape yield and different NUE parameters, therefore research was continued. The objective of this paper is to evaluate the effect of nitrogen fertilizer rate on nitrogen use efficiency in winter oilseed rape.

## Materials and Methods

The field experiment was conducted during four growing seasons (2014/2015, 2015/2016, 2016/2017 and 2017/2018) at the Research and Study farm 'Pēterlauki' of the Latvia University of Life Sciences and Technologies (56° 30.658′ N and 23° 41.580′ E). In total, eight nitrogen rates (N rates) were used in this experiment: N0 or control, N60, N90, N120 (80+40), N150 (100+50), N180 (120+60) and N240 (140+60+40). All NUE parameters were calculated only for five nitrogen rates: N0, N60, N120, N180 and N 240, therefore also rape yield was analyzed depending on the above mentioned five rates.

The experiment was conducted in *Endocalcaric Abruptic Luvisol* (WRB, 2015), loam. In autumn, before sowing, the agrochemical analysis of the soil was done. Soil agrochemical indicators varied by growing year (Table 1). The forecrop was cereals. The soil tillage used was traditional with mould-board ploughing at the depth of 20 – 22 cm. In spring, when the vegetation renewed, nitrogen fertilizer was applied in all variants, except the control variant N0. During the first fertilization, ammonium nitrate ($NH_4NO_3$; N34%) was used. The second fertilization was done at GS 32 – 35 with ammonium sulphate ($(NH_4)_2SO_4$; N21%, S24%) at the rate of 200 kg $ha^{-1}$ and the remaining amount of needed nitrogen was added using ammonium nitrate. The third fertilization was done at GS 52 – 55 using ammonium nitrate. The whole rate of nitrogen fertilizer was applied once for variant

Table 1

**Soil agrochemical indicators depending on winter oilseed rape growing season**

| Indicators | Growing season | | | | Methods |
|---|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | |
| pH KCl | 6.9 | 6.7 | 6.7 | 6.8 | Potentiometric in 1 *M* KCl suspension |
| Organic matter content, g $kg^{-1}$ | 32 | 20 | 23 | 39 | Tyurin's method |
| $P_2O_5$ content, mg $kg^{-1}$ | 134 | 77 | 498 | 97 | Egner–Riehm (DL) method |
| $K_2O$ content, mg $kg^{-1}$ | 238 | 143 | 163 | 157 | Egner – Riehm (DL) method |

N60, fertilizer rate was divided into two applications for variants N120 and N180, and rate was divided into three applications for the variant N240.

Before harvesting, plant samples were taken from each plot from 0.5 $m^2$ square; these plant samples were used to calculate the mass (t $ha^{-1}$) of stems with pods and roots. Seed samples were taken after yield harvesting. Samples were used to determine the content of N, P, K in seeds, stems with pods and roots. The analysis of N, P, K was done in the Scientific Laboratory of Biotechnology Department of Agronomic Analysis of the Latvia University of Life Science and Technologies according to the standard methods. Nutrient removal was calculated from seed, stems with pods and main root mass, as well as the concentration of nutrient in them. Different NUE parameters were calculated according to formulas (1) – (4) (Rahimizadeh *et al*., 2010):

Nitrogen use efficiency (NUE, kg $kg^{-1}$) =
$$= S_y / N_{supply}, \quad (1)$$
where
$S_y$ – oilseed rape seed yield, kg $ha^{-1}$
$N_{supply}$ – sum of nitrogen used from soil in control variant (N-0) and from nitrogen fertilizer, kg

Nitrogen uptake efficiency (NUpE, kg $kg^{-1}$) =
$$= N_t / N_{supply} \quad (2)$$
where
$N_t$ – total plant nitrogen uptake, kg

Nitrogen utilization efficiency (NUtE, kg $kg^{-1}$) =
$$= S_y / N_t \quad (3)$$

Nitrogen harvesting index (NHI, %) =
$$= (N_s/N_t) \times 100 \quad (4)$$
where
$N_s$ – total seed nitrogen uptake, kg

Analysis of variance was used for data statistical processing (R-studio). Bonferroni test was used for comparison of means and the difference was considered statistically significant when $p<0.05$. Significantly different means were labelled with different letters in superscript ($^{a,b,c,d,e}$).

Meteorological situation, if compared with long term average data, differed during the trial period depending on a year. The first three years were more suitable for winter oilseed rape yield formation. Long and cool autumn and temperately warm spring with enough precipitation during the vegetation season were observed in 2014/2015. The autumn of 2015/2016 was warm and dry, and spring was also warm and with a small amount of rainfall. The autumn of 2016/2017 was quite warm, but dry in comparison to other trial years; spring and summer of 2017 were moderately warm (temperature was close to long-term average), the amount of precipitation was lower, if compared with long-term average data (except July), but lack of moisture was not observed. The last year of the investigation (2017/2018) was significantly different. During the autumn of 2017 warm temperatures and plenty of rain were observed; however, since May of the next spring (2018) untypically long drought period with high air temperatures started and lasted even until the harvest, negatively affecting the yield of oilseed rape and NUE.

## Results and Discussion

*Oilseed rape seed yield*

Winter oilseed rape has a high N requirement (Grant & Bailey, 1993). As a result, N rate has a significant impact on rape seed yield (Pellet, 2002). Excess use of nitrogen can reduce oilseed rape seed yield and quality, and it can delay maturity (Grant & Bailey, 1993). Previous studies in Latvia have showed that winter oilseed seed yield significantly increased until the rate of N120-N150. A higher N rate either did not give a significant yield increase or even reduced the yield (Ruža *et al.*, 2012). In our research, the increase of N rate significantly ($p<0.001$) increased the winter oilseed rape seed yield (Figure 1). An important yield increase was observed until the

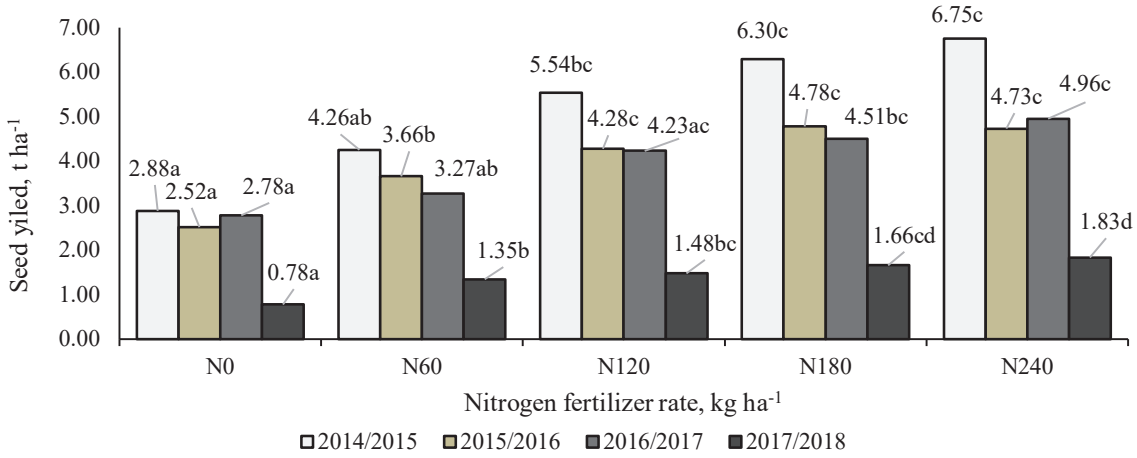


Figure 1. Winter oilseed rape seed yield depending on nitrogen fertilizer rate, t ha$^{-1}$ (a,b,c,d – yields labelled with different letters are significantly different in growing season depending on the nitrogen fertilizer rate).

rate of N120-N180. However, great yield differences depending on growing season did not allow to come to an objective conclusion – until which N rate the winter oilseed rape seed yield significantly increases. As a result, research should be continued.

The oilseed rape seed yield was determined not only by the used N rate, but also by meteorological conditions in the growing season. In our research, meteorological conditions significantly ($p<0.001$) affected the rape yield, which was extremely variable over the years. The most favorable year for rape growing was 2014/2015, when the highest oilseed rape yield was observed (2.88 – 6.75 t ha$^{-1}$ depending on the nitrogen fertilizer rate) (Figure 1). Years 2015/2016 and 2016/2017 also were characterized by suitable conditions for the rape growing (yields were 2.52 – 4.78 and 2.78 – 4.96 t ha$^{-1}$, respectively). An unfavorable year for rape yield formation was that of 2017/2018, when excessive moisture was observed in sowing autumn, but drought and heat in spring-summer season. As a result, extremely low seed yields were obtained (0.78 – 1.83 t ha$^{-1}$). This coincides with data from literature that soil moisture limits yield in dry conditions, and nitrogen fertilizer will increase the yield only to the limits secured by the moisture supply. At the same time, an increased moisture supply increases the yield potential of rape and the amount of N required for optimum yields (Grant & Bailey, 1993).

*Nutrient removal*

Nitrogen concentration in plant increases with the increase of N rate (Šidlauskas & Tarakanovas, 2004), and nutrient concentration in rape seeds significantly varies over the years (Szczepaniak *et al*., 2017). G.D. Jackson (2000) found that relatively large amounts of potassium are accumulated by rape, but only a small portion of that is removed by the seed. Our results showed that nitrogen fertilizer had a significant impact on nitrogen ($p<0.001$), phosphorus ($p<0.001$) and potassium ($p<0.05$) concentration in rape seeds. By increasing the nitrogen fertilizer rate, nitrogen concentration in rape seeds also increased, but phosphorus and potassium concentration – decreased.

N rate affected significantly ($p<0.001$) N, $P_2O_5$ and $K_2O$ removal with seed yield. By increasing the nitrogen fertilizer rate, removal of all three nutrients with seed yield also increased (Table 2). N and $K_2O$

Table 2

**Nutrient removal with winter oilseed rape seeds depending on nitrogen fertilizer rate and growing season, kg ha$^{-1}$**

| N rate | N removal | | | | $P_2O_5$ removal | | | | $K_2O$ removal | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 |
| N0 | 78.98$^{a}$ | 59.66$^{a}$ | 85.98$^{a}$ | 22.78$^{a}$ | 54.81$^{a}$ | 38.07$^{a}$ | 54.19$^{a}$ | 11.58$^{a}$ | 33.32$^{a}$ | 18.79$^{a}$ | 27.47$^{a}$ | 6.27$^{a}$ |
| N60 | 114.03$^{ab}$ | 89.27$^{b}$ | 93.85$^{a}$ | 38.35$^{b}$ | 74.09$^{ab}$ | 53.64$^{b}$ | 60.68$^{ab}$ | 18.19$^{b}$ | 46.62$^{ab}$ | 28.19$^{b}$ | 32.28$^{ab}$ | 10.53$^{b}$ |
| N120 | 148.47$^{bc}$ | 114.65$^{c}$ | 130.28$^{ab}$ | 42.69$^{bc}$ | 81.23$^{b}$ | 61.74$^{bc}$ | 74.62$^{ac}$ | 18.95$^{b}$ | 55.36$^{bc}$ | 33.99$^{c}$ | 39.22$^{ac}$ | 11.56$^{bc}$ |
| N180 | 194.52$^{cd}$ | 144.86$^{d}$ | 141.99$^{b}$ | 48.61$^{cd}$ | 86.53$^{b}$ | 69.00$^{c}$ | 78.48$^{ad}$ | 19.76$^{bc}$ | 63.67$^{c}$ | 40.29$^{d}$ | 42.87$^{bc}$ | 12.98$^{cd}$ |
| N240 | 218.70$^{d}$ | 150.95$^{d}$ | 157.57$^{b}$ | 55.41$^{d}$ | 89.69$^{b}$ | 67.21$^{c}$ | 84.00$^{bcd}$ | 22.70$^{c}$ | 66.64$^{c}$ | 39.88$^{d}$ | 48.32$^{c}$ | 14.36$^{d}$ |

$^{a,b,c,d}$ – indicators labelled with different letters are significantly different in columns depending on nitrogen rate.

removal with seed yield significantly increased until the nitrogen fertilizer rate N120-N180 (Table 2). $P_2O_5$ removal with seed yield highly varied depending on the growing season, and significant $P_2O_5$ removal increase was observed until the nitrogen rate of N60-N180. Growing season also significantly ($p<0.001$) affected N, $P_2O_5$ and $K_2O$ removal with oilseed rape seeds. Higher nutrient removal was observed in years when higher seed yields were obtained.

Results showed that N rate significantly affected N ($p<0.001$), P ($p<0.05$) and K ($p<0.001$) concentration in oilseed rape stems and pods. By increasing N rate, N and P concentration in winter oilseed rape stems and pods also increased, but that of P – decreased. In our trial, N rate significantly affected N, ($p<0.001$), $P_2O_5$ ($p<0.05$) and $K_2O$ ($p<0.001$) removal with rape stems and pods (Table 3). Growing season significantly ($p<0.001$) affected N, $P_2O_5$ and $K_2O$ removal with oilseed rape stems and pods. The highest nutrient removal with the mentioned aboveground plant parts was observed in 2016/2017, when the highest stem and pods mass (t $ha^{-1}$) was also observed.

N rate significantly ($p<0.001$) affected N, P and K concentration in winter rape main root mass. By increasing the nitrogen fertilizer rate, N and K concentration in main root mass also increased, but that of P – decreased. Nitrogen fertilizer had a significant ($p<0.001$) impact on N and $K_2O$ removal with rape main root mass, but the effect was not significant ($p=0.081$) on $P_2O_5$ removal. Growing season significantly ($p<0.001$) affected only N and $K_2O$ removal with main root mass. The highest removal with main root mass was observed in 2017/2018 and 2016/2017 growing seasons.

When evaluating the total N, $P_2O_5$ and $K_2O$ removal with winter rape biomass, we found similar results to those reported on separate plant parts: N rate had a significant ($p<0.001$) impact on total N, $P_2O_5$ and $K_2O$ removal. Increasing N rate, total N, $P_2O_5$ and $K_2O$ removal with crop biomass also increased in almost all growing seasons. Total N removal with biomass significantly increased until nitrogen fertilizer rate N180 (Table 5), that of $P_2O_5$ – until nitrogen fertilizer rate N60-N180, but that of $K_2O$ increased until N120-N240. Also, the growing season had a significant impact on N, $P_2O_5$ and $K_2O$ removal with oilseed rape biomass.

*Nitrogen use efficiency (NUE)*

Overly high NUE can indicate a fact that more nitrogen is removed than applied, and plants are

Table 3

**Nutrient removal with winter oilseed rape stem and pods depending on nitrogen fertilizer rate and growing season, kg $ha^{-1}$**

| N rate | N removal | | | | $P_2O_5$ removal | | | | $K_2O$ removal | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 |
| N0 | 9.79$^{a}$ | 15.81$^{a}$ | 49.06$^{a}$ | 16.78$^{a}$ | 6.06$^{a}$ | 7.07$^{a}$ | 31.41$^{a}$ | 8.18$^{a}$ | 30.25$^{a}$ | 52.91$^{a}$ | 121.62$^{a}$ | 64.90$^{a}$ |
| N60 | 19.35$^{b}$ | 29.28$^{b}$ | 59.08$^{ab}$ | 24.29$^{b}$ | 9.07$^{b}$ | 10.21$^{b}$ | 43.79$^{b}$ | 9.89$^{b}$ | 61.42$^{b}$ | 95.79$^{b}$ | 168.40$^{b}$ | 87.08$^{b}$ |
| N120 | 19.34$^{b}$ | 38.00$^{c}$ | 68.41$^{bc}$ | 38.02$^{c}$ | 5.97$^{a}$ | 10.33$^{c}$ | 50.70$^{b}$ | 15.84$^{c}$ | 64.05$^{b}$ | 125.61$^{c}$ | 277.37$^{c}$ | 134.83$^{c}$ |
| N180 | 19.07$^{b}$ | 46.53$^{d}$ | 83.47$^{cd}$ | 40.09$^{c}$ | 6.12$^{a}$ | 15.91$^{d}$ | 51.40$^{b}$ | 15.60$^{c}$ | 55.58$^{b}$ | 127.94$^{d}$ | 251.78$^{c}$ | 153.93$^{d}$ |
| N240 | 30.56$^{c}$ | 48.65$^{e}$ | 86.26$^{d}$ | 41.01$^{c}$ | 5.60$^{a}$ | 14.54$^{e}$ | 50.55$^{b}$ | 14.18$^{d}$ | 76.05$^{b}$ | 157.88$^{e}$ | 282.58$^{c}$ | 149.99$^{d}$ |

$^{a,b,c,d}$ – indicators labelled with different letters are significantly different in columns depending on nitrogen rate.

Table 4

**Nutrient removal with winter oilseed rape main root mass depending on nitrogen fertilizer rate and growing season, kg $ha^{-1}$**

| N rate | N removal | | | | $P_2O_5$ removal | | | | $K_2O$ removal | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 |
| N0 | 2.46$^{a}$ | 4.58$^{a}$ | 7.41$^{a}$ | 7.38$^{a}$ | 2.16$^{ab}$ | 1.52$^{a}$ | 4.70$^{a}$ | 3.55$^{a}$ | 4.74$^{a}$ | 8.70$^{a}$ | 15.47$^{a}$ | 10.53$^{a}$ |
| N60 | 4.16$^{b}$ | 5.64$^{b}$ | 7.39$^{a}$ | 7.64$^{a}$ | 2.97$^{b}$ | 1.82$^{b}$ | 4.84$^{a}$ | 3.54$^{a}$ | 8.46$^{b}$ | 12.96$^{b}$ | 18.96$^{a}$ | 11.42$^{a}$ |
| N120 | 3.36$^{ab}$ | 4.25$^{c}$ | 8.38$^{a}$ | 10.23$^{b}$ | 2.32$^{ab}$ | 1.06$^{c}$ | 5.15$^{a}$ | 3.74$^{a}$ | 6.59$^{ab}$ | 9.83$^{c}$ | 20.44$^{a}$ | 14.29$^{b}$ |
| N180 | 3.61$^{ab}$ | 6.34$^{d}$ | 8.16$^{a}$ | 11.38$^{c}$ | 2.62$^{ab}$ | 1.54$^{d}$ | 4.87$^{a}$ | 4.81$^{b}$ | 4.96$^{ac}$ | 11.95$^{d}$ | 16.47$^{a}$ | 14.75$^{bc}$ |
| N240 | 4.03$^{b}$ | 8.04$^{e}$ | 9.54$^{a}$ | 12.38$^{c}$ | 1.74$^{a}$ | 1.90$^{e}$ | 5.34$^{a}$ | 4.69$^{b}$ | 7.44$^{bc}$ | 15.87$^{e}$ | 22.45$^{a}$ | 15.97$^{c}$ |

$^{a,b,c,d}$ – indicators labelled with different letters are significantly different in columns depending on nitrogen rate.

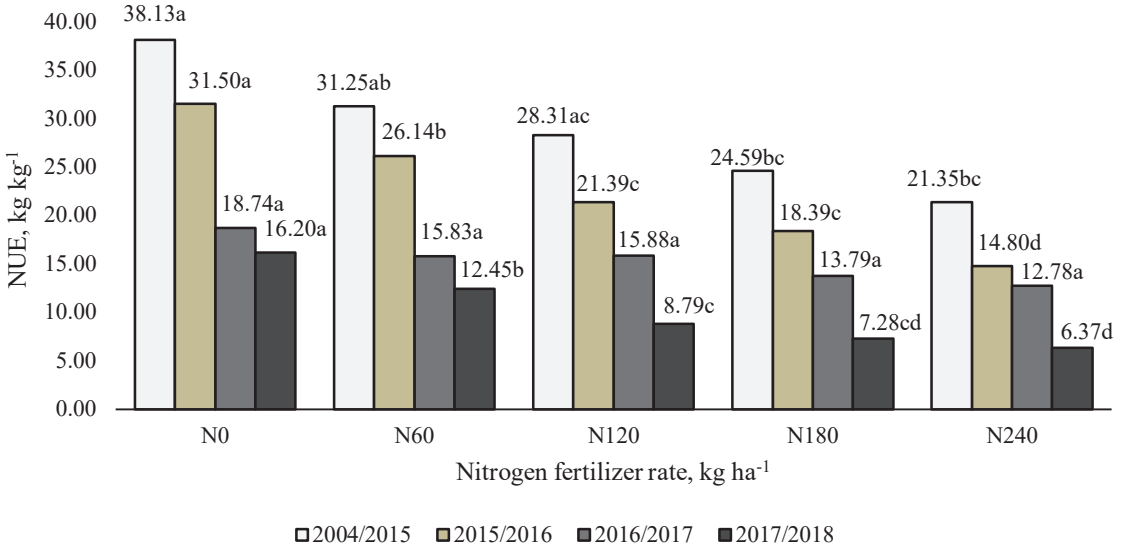


Figure 2. Nitrogen use efficiency of winter oilseed rape depending on nitrogen fertilizer rate, kg kg$^{-1}$ (a,b,c,d – NUE labelled with different letters are significantly different in growing season depending on nitrogen fertilizer rate).

using nitrogen from the soil organic matter or residual nitrogen from fertilizer application to a forecrop. Low NUE indicates an excessive use of nitrogen fertilizers, because less nitrogen is used than applied. As a result, unused nitrogen remains in the soil and may be lost from it, as reported by many researchers (e.g. Evans *et al.*, 2016). In our study, NUE was significantly ($p<0.001$) affected by N rate. Higher NUE was observed, when the lowest fertilizer rates were applied (Figure 2). It coincides with other studies, where it was also found that the nitrogen fertilizer rate had a significant effect on NUE, and the trend of decreasing NUE with increasing nitrogen fertilizer rate was observed (Gan *et al.*, 2008).

As the meteorological conditions during trial period were diverse, significant ($p<0.001$) impact of trial year on rape NUE was observed in our trial. The highest NUE was noted in the 2014/2015 growing season (21.35 – 38.13 kg kg$^{-1}$), when the highest seed yields were obtained. A slightly lower NUE was observed in 2015/2016 (14.80 – 31.50 kg kg$^{-1}$). Lower NUE was in 2016/2017 (12.78 – 18.74 kg kg$^{-1}$), but NUE was very low (6.37 – 16.20 kg kg$^{-1}$) in the 2017/2018 season due to drought.

*Nitrogen uptake efficiency (NUpE)*

Results showed that the N rate had a significant ($p<0.001$) impact on NUpE (Table 5). Like the NUE, the highest NUpE was also observed at the lowest N rates, and an increase of N rate significantly decreased the NUpE. Growing season affected the NUpE significantly ($p<0.001$). The highest NUpE was observed in the best season (2014/2015), when it was 0.80 – 1.20 kg kg$^{-1}$ depending on N rate. Similar NUpE depending on N rate was observed in 2015/2016 and 2016/2017 (0.65 – 1.00 and 0.65 – 0.96 kg kg$^{-1}$, respectively). Drought and heat in 2017/2018 reduced the NUpE (0.38 – 0.98 kg kg$^{-1}$).

*Nitrogen utilization efficiency (NUtE)*

NUtE was significantly ($p<0.001$) affected by N rate in our trial (Table 6). The tendency, when an

Table 5

**Winter oilseed rape nitrogen uptake efficiency (NUpE) depending on nitrogen fertilizer rate and growing season, kg kg$^{-1}$**

| N rate | Growing season | | | |
|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 |
| N0 | 1.20$^{a}$ | 1.00$^{a}$ | 0.96$^{a}$ | 0.98$^{a}$ |
| N60 | 1.01$^{b}$ | 0.89$^{b}$ | 0.77$^{b}$ | 0.65$^{b}$ |
| N120 | 0.87$^{c}$ | 0.78$^{c}$ | 0.78$^{c}$ | 0.54$^{c}$ |
| N180 | 0.85$^{c}$ | 0.76$^{c}$ | 0.71$^{d}$ | 0.44$^{d}$ |
| N240 | 0.80$^{c}$ | 0.65$^{d}$ | 0.65$^{d}$ | 0.38$^{d}$ |

$^{a,b,c,d}$ – indicators labelled with different letters are significantly different in columns depending on nitrogen rate.

Table 6

**Winter oilseed rape nitrogen utilization efficiency depending on nitrogen fertilizer rate and growing season, kg kg$^{-1}$**

| N rate | Growing season | | | |
|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 |
| N0 | 31.51$^{a}$ | 31.39$^{a}$ | 19.48$^{a}$ | 16.59$^{a}$ |
| N60 | 30.81$^{ab}$ | 29.44$^{b}$ | 20.31$^{ab}$ | 19.13$^{b}$ |
| N120 | 32.35$^{a}$ | 27.25$^{c}$ | 20.20$^{a}$ | 16.19$^{a}$ |
| N180 | 28.93$^{b}$ | 24.17$^{d}$ | 19.23$^{a}$ | 16.56$^{a}$ |
| N240 | 26.65$^{c}$ | 22.78$^{c}$ | 19.53$^{a}$ | 16.86$^{a}$ |

$^{a,b,c,d}$ – indicators labelled with different letters are significantly different in columns depending on nitrogen rate.

Table 7

**Winer oilseed rape nitrogen harvesting index (NHI) depending on nitrogen fertilizer rate and growing season, %**

| N rate | Growing season | | | |
|---|---|---|---|---|
| | 2014/2015 | 2015/2016 | 2016/2017 | 2017/2018 |
| N0 | 86.33$^{ab}$ | 74.40$^{a}$ | 60.20$^{a}$ | 48.61$^{a}$ |
| N60 | 82.57$^{b}$ | 71.84$^{a}$ | 58.29$^{a}$ | 54.53$^{b}$ |
| N120 | 86.71$^{ab}$ | 73.03$^{a}$ | 62.22$^{a}$ | 46.79$^{a}$ |
| N180 | 89.39$^{a}$ | 73.23$^{a}$ | 60.56$^{a}$ | 48.52$^{a}$ |
| N240 | 86.33$^{ab}$ | 72.66$^{a}$ | 62.10$^{a}$ | 50.90$^{ab}$ |

$^{a,b,c,d}$ – indicators labelled with different letters are significantly different in columns depending on nitrogen rate.

increase of N rate decreased NUtE, was observed in almost all growing seasons. The conditions of growing season also had a significant ($p<0.001$) impact on NUtE. The highest NUtE was observed in 2014/2015 and 2015/2016 (26.65 – 31.51 and 22.78 – 31.39 kg kg$^{-1}$, respectively), when the highest yield was obtained. Lowest NUtE was in 2016/2017 (19.23 – 20.31 kg kg$^{-1}$) and the 2017/2018 growing seasons (16.19 – 19.13 kg kg$^{-1}$, respectively). Despite the similar seed yield in 2015/2016 and 2016/2017 (Figure 1), NUtE was considerably lower in 2016/2017, due to the higher stem and pod, and root mass (t ha$^{-1}$).

*Nitrogen harvesting index (NHI)*

NHI represents the efficiency of absorbed nitrogen being transferred from harvested parts of crop to seeds (Hasanalideh & Hojati, 2012). Our results showed that the N rate had no significant ($p=0.840$) impact on winter oilseed rape NHI, but the growing season affected it significantly ($p<0.001$) (Table 7).

Similarly to other parameters characterizing nitrogen use efficiency, the lowest NHI was observed in overly dry 2017/2018 (46.79 – 54.53%), but the highest (82.57 – 89.39%) – in the favorable 2014/2015 (Table 7).

## Conclusions

Nitrogen fertilizer rate had a significant ($p<0.001$) effect on winter oilseed rape seed yield. Yield increase was observed until nitrogen fertilizer rate N120-N180, but great yield differences between seasons were observed and final conclusion cannot be drawn yet; research should be continued.

Nitrogen fertilizer rate affected N, $P_2O_5$ and $K_2O$ removal with oilseed rape biomass significantly ($p<0.001$). N and $K_2O$ removal with seed yield significantly increased until the rate N120-N180, but that of $P_2O_5$ – until the rate N60-N180.

Nitrogen fertilizer rate affected nitrogen use efficiency (NUE), nitrogen uptake efficiency (NUpE) and nitrogen utilization efficiency (NUtE) significantly ($p<0.001$), but it did not have a significant ($p=0.840$) effect on nitrogen harvesting index (NHI). By increasing nitrogen fertilizer rate, the NUE, NUpE and NUtE decreased. All the mentioned parameters varied significantly depending on meteorological conditions in the trial year.

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# INFLUENCE OF POLYMER FERTILIZER ON YIELD OF POTATOES IN THE NORTH-WEST RUSSIA

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**Abstract**
New types of polymer fertilizer series 'Vitanoll' are used in adaptive-varietal agro technology in the cultivation of seed potatoes. The experiments were conducted on sod-podzolic soils, typical of the North-West region of the Russian Federation. The aim of the research was to study the effect of new polymer fertilizers on potato yield. Research tasks included assessing the effect of various polymer fertilizers (Polymer-N, Polymer-P, Polymer-K.), as well as the effect of Polymer-N on different potato varieties. Based on the studies conducted, the most responsive potato varieties to polymeric fertilizers with nitrogen were identified. They turned out to be Salin (increase of 7.1 t $ha^{-1}$) and Mocart (increase of 4.1 t $ha^{-1}$). Evaluation of the influence of different types of polymer fertilizers revealed that the most effective are polymer fertilizers with potassium.
**Key words**: polymer fertilizers, foliar plant nutrition, organic-mineral complexes, resource-saving adaptive-landscape farming.

## Introduction

The positive effects of potato fertilizers are well-known (Holm & Nylund, 1978; Misgina, Kebede, & Alle, 2013). However, nutrients from mineral fertilizers are used by no more than 50%. To increase the efficiency of nutrient utilization from fertilizers, in recent years the Russian scientists have developed a fundamentally new class of fertilizers suitable for use as high-performance foliar plant nutrition. We are talking about liquid complex polymer fertilizers. These fertilizers are fundamentally different from the traditional means used for foliar plant nutrition. Importance of the difference lies in the fact that significant amounts of nitrogen (up to 25%), phosphorus (up to 25%) and potassium (up to 15%) contained in the new fertilizers are not aqueous solutions of mineral salts, but are in the form of organic-mineral complexes fixed on the polymer matrix. The organic polymer, which is the basis of fertilizers, possesses surface-active and adhesive properties in relation to the surface of the leaf plate, shoot, and stalk and is able to deposit, and then prolongedly supply the vegetative plant with nutrients.

A distinctive feature of the new fertilizers is a strictly constant chemical composition, which favorably distinguishes them from many compounds of irregular composition used for these purposes. In addition, due to the peculiarities of their structure, such fertilizers are fundamentally different in their properties from aqueous solutions of salts, which until now have been used for foliar dressings. In particular, they have the following important agrotechnical features: allow you to effectively feed, regardless of acidity and soil composition (do not acidify the soil, do not affect the microbiocenoses formed in the soil); provide a soft prolonged action; are not afraid of freezing; allow the use of water of any hardness. But most importantly, they are resistant to precipitation and wind erosion. That is, being applied to the plants they are not washed off with water and not blown away by the wind, and are resistant to insolation. Thus, one of the most significant properties of the new polymer fertilizers, distinguishing them from other previously used for foliar feeding, is their resistance to the effects of various meteorological factors. This resistance will be decisive for growing crops in adverse weather conditions.

It was previously shown that polymer fertilizers are 100% used by the plant (Nayda, Komarov, & Petropavlovsky, 2010; Osipov, Shkrabak, & Suvorov, 2013; Shkrabak, 2011). However, the effectiveness of these fertilizers in the cultivation of potatoes has not been studied yet. In order to study the effect of new polymer fertilizers on potato yields, relevant experiments have been carried out. While the experiments have been carried out only in the conditions of the North-West of Russia, it is possible to adapt the research data to other conditions.

*The purpose of the research was t*o study the effect of new polymer fertilizers on potato yield in the conditions of the North-West of the Russian Federation.

*Research tasks:*

1. Assess the effects of polymer fertilizer (polymer-N) on different varieties of potatoes, including: Nevskii-standard, Mocart, Red Lady, Courage, Sifra, Salin, Desire, Serafima;
2. Assess the effect of various polymeric fertilizers on potato yield, including: Polymer-N, Polymer-P, Polymer-K.

## Materials and Methods

One of the first polymer fertilizers was the polymer complex of trace elements – Akvadon-Micro

(Shkrabak, 2011). Then polymeric fertilizers enriched with macroelements were developed: fertilizers of the Zelenit (Osipov, Shkrabak, & Suvorov, 2013) and Kora (Nayda, Komarov, & Petropavlovsky, 2010). Finally, in addition to plant nutrition elements have been added to the polymer matrix: tools to control their use, means of penetration and fixation in plant tissues, hormonal and enzyme regulators, humates and other natural metabolites; thus, 'Vitanoll' series polymeric fertilizers were obtained (Komarov Andrey & Komarov Aleksey, 2018). In such a way, complex agro-adaptogens of the KAA series were developed. The basis of these fertilizers was an organic polymer matrix with the inclusion in the composition of the polymer not only the necessary nutrients, but also various means that ensured a complex effect of action at a synergistic level.

New types of polymer fertilizers can find their application in different directions, one of the most promising is the use in adaptive-varietal agro-technology, for example, in the cultivation of seed potatoes. To assess the effect of polymer fertilizers on potato yield, field experiments were conducted. The first experiment was conducted in the conditions of 'Agrotechnika' CJSC of the Tosnensky District of the Leningrad Region. The experiment was carried out at the seed-growing site, where different varieties were introduced from different regions by the leading potato producers. The experiments were carried out based on the method of ecological strain testing. The coordinates of the experimental field are 59 ° 30' – 59 ° 32 'north latitude and 31°18' – 31°20' east longitude. The soil is highly cultivated sod-podzolic with an organic matter content of 5.2%, pH $_{KCl}$ – 5.8, $K_2O$ – 290 mg $kg^{-1}$, $P_2O_5$ – 460 mg $kg^{-1}$.

Another experiment was carried out in the selection and seed production of OPH potatoes 'Kalozhitsy', Volosovsky District, Leningrad Region. Field experiments were performed on sod-carbonate medium loamy soil. The coordinates of the landfill are 59°25' – 59°26 'north latitude and 29°04' – 29°05' east longitude. The soils of the experimental plots were characterized by a low content of nutrients. Thus, the content of mobile phosphorus $P_2O_5$ was in the range of 300 – 375 mg $kg^{-1}$, and the content of exchangeable potassium $K_2O$ – 260 – 315 mg $kg^{-1}$. The humus content was low – up to 2.06%. The soils had a pH characteristic of 6.4 – 6.6, which is typical of this type and is close to neutral. Hydrolytic acidity was in the range of 0.81 – 1.08, the amount of exchange bases – 15 – 26 mmol per 100 g of soil. In general, the soil was characterized by a low level of cultivation.

**Results and Discussion**

Agro-technology was standard for cultivating seed crops of the super-super elite class, with the difference that part of the experimental field in all varieties for the width of one sprayer boom (6.5 m) was treated with the 'Polymer-N' preparation with a dose of 200 l $ha^{-1}$ at a solution concentration 2%. Processing of plants was carried out in the evening hours (after 21 hours) according to vegetative plants at the beginning of flowering plants.

Harvesting was done by hand on the plots. The yield of 5 – 10 typical bushes was estimated from each experimental plot. For each bush, the weight and amount of standard (more than 100 g) and non-standard (less than 50 g) products were taken into account. Accounting was carried out in 3 replicates.

The yield of the crop (Table 1) varied from 29.0 to 41.1 t $ha^{-1}$ by varieties in the control (background seed production) and from 32.1 to 47.2 t $ha^{-1}$ when processed by Polymer-N.

Based on the experiment, it was revealed that the introduced potato varieties, different in their precocity and physiological and biochemical characteristics, responded differently to the treatment with Polymer-N. Thus, varieties that have a more extended vegetation period and a less adaptive reaction, reacted to the treatment with a bookmark of additional stolons (Mozart, Red Lady, Courage). However, a limited growing season did not allow them to form all full-fledged tubers. A significant part of tubers, from 24 to 32.2% relative to the control, was formed in the form of small tubers (less than 50 g). The latter reflects that the processing of these varieties was not carried out in accordance with the optimum, when the outflow of nutrients needed to be sent to reproductive or spare organs (in this case, tubers). It is possible that for these varieties it was necessary to carry out additional processing with other polymeric fertilizers, for example, containing not only nitrogen, but also phosphorus with potassium, thereby giving them the opportunity to realize the potential introductory potential.

On the contrary, those varieties that adaptively reacted to the treatment formed mainly the main (large-fruited) products, where the average size of standard tubers was 100 – 150 g (Nevsky, Serafima, Desire, Salin, Sifra).

Thus, the drug 'Polymer-N' had an effective impact on the productivity of all the studied varieties, increasing the yield relative to the basic economic agro-technology by an average of 10 – 15%. Of particular interest is the specificity of the reaction of potato varieties to the use of the drug. The latter points to the need to develop adaptive-grade technology of precision farming, both when introducing new introduced varieties into the culture and to develop the foundations of resource-saving adaptive-landscape farming.

The study of the influence of various polymeric fertilizers on the yield and crop structure of different varieties of potatoes was carried out in the aspect of

Table 1

**Reaction of different potato varieties to the treatment of vegetative plants with the preparation 'Polymer-N'**

| Version | Productivity, t ha$^{-1}$ | | | Increment, % | | |
|---|---|---|---|---|---|---|
| | Total | Standard | Not standard | Total | Standard (large and medium tubers) | Not standart (small tubers) |
| Variety Mocart | | | | | | |
| Background | 29.0 | 25.9 | 3.1 | | | |
| Background + Polymer-N | 32.1 | 28.0 | 4.1 | +11 | +8 | +32 |
| Variety Red Lady | | | | | | |
| Background | 38.8 | 36.5 | 2.3 | | | |
| Background + Polymer-N | 42.2 | 39.2 | 3.0 | +9 | +7 | +30 |
| Variety Courage | | | | | | |
| Background | 37.8 | 32.8 | 5.0 | | | |
| Background + Polymer-N | 41.2 | 35.0 | 6.2 | +9 | +7 | +24 |
| Variety Sifra | | | | | | |
| Background | 32.8 | 26.0 | 6.8 | | | |
| Background + Polymer-N | 35.0 | 30.0 | 5.0 | +7 | +15 | - 26 |
| Variety Salin | | | | | | |
| Background | 41.1 | 36.0 | 5.1 | | | |
| Background + Polymer-N | 47.2 | 43.1 | 4.1 | +15 | +20 | -20 |
| Variety Desire | | | | | | |
| Background | 38.7 | 29.5 | 9.2 | | | |
| Background + Polymer-N | 40.3 | 31.8 | 8.5 | +4 | +8 | -8 |
| Variety Serafima | | | | | | |
| Background | 41.1 | 30.8 | 10.3 | | | |
| Background + Polymer-N | 39.5 | 31.5 | 8.0 | -4 | +2 | -22 |
| Variety Nevskii – standard | | | | | | |
| Background | 40.6 | 32.6 | 8.0 | | | |
| Background + Polymer-N | 45.5 | 38.6 | 6.9 | +12 | +18 | -14 |

ecological variety testing. Environmental testing, raised to a new technological and methodological level, reveals the prospect of further growth of plant productivity (at the level of varieties) and allows for more efficient use of fertilizers and other means of chemicalization under production conditions. Crop accounting was carried out by accounting sites for 10 – 20 bushes from each option in 3 times, yield data are presented in Table 2. Studies were conducted with potato varieties Nevsky.

The results of the experiment presented in the table demonstrate the different efficacy of polymeric fertilizers when they process vegetative plants. Thus, the processing of nitrogen-containing 'Polymer-N' contributed to a slight increase in yield (by 2.1 t ha$^{-1}$ or 7% to the corresponding background – control). Fertilizer 'Polymer-P' provided a large increase (up to 3.7 t ha$^{-1}$ or by 12% to the control). The high efficacy of the drug is probably due to the positive effect of phosphorus and potassium in its composition.

Indeed, the vegetative mass of potato plants was processed at the flowering stage, when the culture demand for nitrogen decreases and the demand for phosphorus and potassium increases. Taking into account the fact that the potato is a potassium dependent culture, then the processing of plants with potassium-containing 'Polymer-K' provided the highest yield increase (by 4.9 t ha$^{-1}$ or 15% to

Table 2

**The effect of polymeric fertilizers on potato yield**

| Version | Yield | Increase control | |
|---|---|---|---|
| | t ha$^{-1}$ | t ha$^{-1}$ | % |
| Control | 32.0 | 0.0 | 100 |
| Polymer-N | 34.1 | 2.1 | 7 |
| Polymer-P | 35.7 | 3.7 | 12 |
| Polymer-K | 36.9 | 4.9 | 15 |
| Statistics: the smallest significant difference ($SSD_{05}$) | 3.7 t ha$^{-1}$ | | |

the corresponding background). The high efficiency of potash supplementation can be attributed to the potash deficiency in the soil due to the abundance of precipitation of the season, which ensures the migration of water-soluble forms of potassium to the lower soil horizons (the latter was confirmed by the data of tissue diagnostics).

The results of the study were statistically interpreted using the criterion of significance, which takes into account such a basic statistical indicator as the smallest significant difference ($SSD_{05}$). Statistical calculations were done on the basis of analysis of variance adopted for assessing the accuracy of field experiments on Dospehov (Dospehov, 1985).

The data obtained in the experiments are consistent with the results presented by other researchers (Holm & Nylund, 1978; Misgina, Kebede, & Alle, 2013), where the highest effectiveness of potash fertilizers for potatoes was shown. In our experiments, the highest efficacy of polymer fertilizers with potassium was also shown. At the same time, the specificity of the varietal reaction of potatoes to polymer fertilizers was also revealed. These studies have been carried out so far only in the conditions of the North-West region of the Russian Federation. The authors hope to attract scientists and practitioners of agricultural production to study jointly the effectiveness of new polymer fertilizers in other countries, since science has no limits.

**Conclusions**

Polymer fertilizers effectively acted on the growth and development of potatoes, providing an increase in yield from 6 to 15% given the corresponding background. At the same time, various fertilizers, due to the nutrients contained in them, had different effects on the development of potatoes in the critical phase of ontogenesis.

To ensure the efficient use of polymer fertilizers, it is advisable to consider both their dose and targeted delivery to the necessary phase of crop development. To do this, it is necessary to develop a new technology of potato cultivation, based on optimizing the nutritional regime of plants using polymer fertilizers.

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# WINTER WHEAT LEAF DISEASES AND SEVERAL STEPS INCLUDED IN THEIR INTEGREATED CONTROL: A REVIEW

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**Abstract**
Winter wheat (*Triticum aestivum* L.) leaf diseases is an important risk factor that influences the productivity and quality of wheat production. The aim of the present study was to review published scientific literature about the possibilities for integrated control of winter wheat leaf diseases. The most common and economically important wheat leaf diseases are Septoria leaf blotch (caused by *Zymoseptoria tritici*), tan spot (caused by *Pyrenophora tritici-repentis*), yellow rust (caused by *Puccinia striiformis*), and powdery mildew (caused by *Blumeria graminis*). The severity of winter wheat diseases has varied significantly over the years and depended on meteorological conditions, variety resistance to pathogen, and tillage system. The crop rotation and an efficient residue management significantly decrease the development of tan spot. The development of Septoria leaf blotch mainly depends on meteorological conditions, but agronomic practice is less important. The use of disease-resistant varieties is the most economical, safe, and effective way to prevent and control wheat leaf diseases. Many European countries have a number of decision support systems for optimizing and minimizing the use of fungicides. Decision support systems are based on control thresholds and meteorological observations. Most used parameters are: air temperature, relative air humidity, and precipitation. These systems have been developed in the countries with a milder climate and a longer vegetation period than Latvia, and systems need to be adapted to Latvian conditions. The main groups of fungicides for disease control in winter wheat are azoles, strobilurin, and carboxamides. The results of many studies about the effectiveness of fungicide groups show that the obtained results differ and further research is needed.
**Key words**: *Pyrenophora tritici-repentis*, *Zymoseptoria tritici*, fungicides, decision-support systems.

## Introduction

Wheat (*Triticum aestivum* L.) is one of the most profitable crops in Latvia, especially in the central part of Latvia. According to the data of Central Statistical Bureau of Latvia, in 2017 wheat areas reached 448.2 thous. ha and covered 38.8% of the total field crop area (CSB, 2019). Wheat leaf diseases are widespread throughout the world and are an important risk factor for obtaining high and stable grain yields. The most economically important wheat leaf diseases are Septoria leaf blotch (caused by *Zymoseptoria tritici*), tan spot (caused by *Pyrenophora tritici-repentis*) (Ronis & Semaškiene, 2011; Fernandez *et al.*, 2016; Bankina *et al.*, 2018), yellow rust (caused by *Puccinia striiformis*), and powdery mildew (caused by *Blumeria graminis*) (Jørgensen *et al*., 2014; Fernandez *et al*., 2016).

Integrated disease management is built on agronomic (for example, crop rotation, crop management), mechanical, physical and biological principles, resorting to selective pesticide use in situations that cannot be successfully managed with other tools (Barzmann *et al.*, 2014). Reliable and timely information on plant fungal disease epidemics is crucial for optimizing the use of fungicides, therefore integrated disease management is based on monitoring and decision-support systems (Fones & Gurr, 2015). A lot of investigations and surveys related to the development and control of wheat leaf diseases have been carried out and various decision support models have been developed in different countries, but results are not conclusive.

The aim of the present study was to summarize the latest results of researches and identify the possibilities for integrated control of winter wheat leaf diseases.

## Materials and Methods

Monographic method was used in this study. Scientific literature from different journals and monographs was used in this review. The literature includes information about winter wheat leaf diseases: their biology, possibilities for integrated control, and decision support systems. The review includes information from investigations performed in different countries with different agroclimatic conditions.

## Results and Discussion

*Winter wheat leaf diseases*

The results of a six-year (2012-2017) field experiment in Latvia showed that tan spot was the dominant disease. The level of Septoria leaf blotch was significantly lower and exceeded the severity of tan spot only in 2015. Powdery mildew was observed every year; however, the disease severity never reached 2% during the evaluation (Bankina *et al*., 2018).

In Latvia, tan spot was first identified only in the first half of the 1990s, and studies show that the spread of the disease has rapidly increased with the increase in wheat percentage in a crop rotation and with the enlargement of the area under minimum tillage (Bankina *et al*., 2011). In Denmark, tan spot occurs periodically (Matzen *et al.*, 2019). The time of the appearance of the first tan spot symptoms

depends on meteorological conditions and varieties. On susceptible wheat leaves, the pathogen *P. tritici-repentis* produces characteristic oval to diamond-shaped lesions. On resistant and partially resistant wheat, lesion size is reduced and chlorosis and necrosis may be absent (De Wolf *et al.*, 1998). In Lithuania, the first visible symptoms of tan spot were detected at the beginning of stem elongation growth stage (Ronis & Semaškiene, 2011) but in Latvia, only after flowering (Bankina & Priekule, 2011).

The fungus propagates asexually by conidia and sexually by ascospores (Cotuna *et al*., 2015), which are wind-born. Wheat straw debris, where pseudothecia with ascospores develop, is the main source of infection (De Wolf *et al.*, 1998; Bankina & Priekule, 2011; Ronis & Semaškiene, 2011; Cotuna *et al*., 2015). In Latvia, pseudothecia develop on the stems about two months after harvesting, but differentiation of spores starts only in spring (March–April). Ripe ascospores are observed during May (Bankina & Priekule, 2011). The optimal temperature for maturation of pseudothecia and ascospores ranges between +15 and +18 °C (Wright & Sutton, 1990). Researchers confirm that ripening of ascospores occurs gradually and the dispersal of ascospores continues throughout the growing season period. Conidia develop only on senescent spots (De Wolf *et al.,* 1998). During the period of rainfall and high air humidity, multiple cycles of conidial production and release occur, which leads to rapid development of tan spot in the following month (Ronis & Semaškiene, 2011).

Septoria leaf blotch is the most important wheat disease in the majority of European countries, and grain yield losses can reach 65 – 75% when conditions are favourable for the disease development (Jørgensen *et al.*, 2014). The symptoms are yellowish or chlorotic flecks and necrotic blotches containing a varying density of small black pycnidia (Kema *et al.*, 1996).

*Z. tritici* is a polycyclic pathogen reproducing both sexually and asexually, resulting in infections initiated by two types of spores (ascospores and conidia). The research results show that the incidence and severity of Septoria leaf blotch depends on meteorological conditions (Kuzdralinski *et al.*, 2015; Bankina *et al.*, 2018.)

Under field conditions, the latent stage of *Z. tritici* persists for approximately 14 days; in colder weather, this time protracts up to 28 days (Fones & Gurr, 2015; Suffert & Thompson, 2018), but in other literature sources – up to 36 days (Steinberg, 2015). Early epidemics were preceded by almost constant average daily temperatures of 13.2 ± 0.8 °C between 181 and 210 days after sowing. Late epidemics were preceded by an approximately linear increase in temperature from 8.7 ± 0.9 to 12.1 ± 0.9 °C (Beyer *et al.*, 2012). The mean latent period for seedlings was significantly shorter than that for adult plants (Suffert, & Thompson, 2018).

The causal agent of yellow rust *Puccini striiformis* is an obligate parasite. The pathogen overwinters on green plants. Symptoms appear about one week after infection, and sporulation starts about two weeks later (Khanfri, Boulif, & Lahlali, 2018). Initial symptoms are tiny, yellow to orange-coloured rust pustules which contain urediniospores. Spots develop into long and narrow stripes on leaf sheaths, glumes, and awns (Chen, 2005). Stripes of uredia or necrosis are formed generally after stem elongation. Spore germination, infection and survival are directly affected by moisture. Favourable conditionis light rain, but abundant moisture can also negatively affect spore viability (Chen, 2005; Khanfri, Boulif, & Lahlali, 2018). The surveys confirm that yellow rust occurred periodically (Bankina, Jakobija, & Bimšteine, 2011; Matzen *et al.,* 2019). Warmer winters can promote earlier yellow rust infection and spread. Researchers prognosticate that the severity of the epidemics will increase throughout all wheat growing regions. Growing resistant varieties is the major component of integrated control of yellow rust (El Jarroudi *et al.*, 2014; Ali *et al.,* 2017; Khanfri, Boulif, & Lahlali, 2018).

Powdery mildew (caused by *Blumeria graminis*) is common but its incidence and severity are low (Olesen *et al.*, 2003; Bankina, Jakobija, & Bimšteine, 2011; Bankina *et al.*, 2018). Powdery mildew infects mainly leaves, but it can also infect leaf sheath, stem, and ear. The infection of powdery mildew was serious in a sowing where plant density was high and ventilation was poor (Olesen *et al.*, 2003; Gao, Niu, & Li, 2018). The results of the studies show that the yield reduction depends on the time and severity of the onset of the disease. When the infection occurs at the seedling stage, the growth and development of wheat is impaired and the plants are likely to die. When the infection occurs at the tillering stage, powdery mildew can delay the formation of wheat roots and decrease the formation of tillers. The occurrence of powdery mildew at heading and blooming stages may result in a reduction of the number of grains per ear, grain fullness and grain weight (Gao, Niu, & Li, 2018).

*The impact of cultural methods on diseases*

Many investigations have been carried out to clarify the importance of cultural methods on disease severity.

Most studied cultural methods are crop rotation and tillage; however, the results are contradictory. They show that crop rotation and an efficient residue management are effective tools for reducing tan spot in winter wheat (Cotuna *et al.*, 2015); however, in a study conducted in Latvia, the previous crop did not significantly affect the level of Septoria leaf blotch (Bankina *et al.*, 2018). In a repeated wheat sowing, tan spot infection started earlier (Bankina *et al.*, 2018)

and achieved a higher severity level (Kuzdralinski *et al.*, 2015; Fernandez *et al.*, 2016; Bankina *et al.*, 2018). Short crop rotations, where oilseed rape and wheat were included, provided a sufficient decrease in tan spot severity only in the fields under traditional soil tillage with ploughing at the depth of 22 – 24 cm (Bankina *et al.*, 2018). A field experiment in Canada showed that a minimum of two years between wheat crops is necessary to prevent Septoria leaf blotch, but one year between wheat crops may be sufficient to control tan spot (Duczek *et al*., 1999).

The results of many experiments demonstrate that the severity of tan spot under reduced tillage was greater than that under traditional tillage (Bankina *et al.*, 2014, 2018; Fernandez *et al.*, 2016). The results from Denmark verified that non-inversion tillage increased the severity of tan spot and Fusarium head blight. The assessments of the severity of tan spot carried out at BBCH GS 31 (first node detectable) showed that the level of tan spot in plots with reduced tillage was 4 – 10 times higher than in ploughed plots. Non-inversion tillage reduced the severity of powdery mildew and Septoria leaf blotch (Jørgensen & Olesen, 2007), but a long-term experiment in Latvia demonstrated that the development of Septoria leaf blotch mainly depends on meteorological conditions but agronomic practices are less important (Bankina *et al.*, 2018).The results of field trials in Romania showed that under both minimum and no-tillage systems with residues, the tan spot epidemic occurs earlier than under conventional tillage, and higher levels of disease severity are recorded during grain filling stage (Cotuna *et al.*, 2015).

The results of the studies confirm that the use of disease resistant varieties is the most economical, safe and effective way to prevent and control wheat leaf diseases (Gao, Niu, & Li, 2018). In Denmark, the differences in yields between the susceptible varieties and the moderately resistant varieties to tan spot in untreated plots were 0.5–1.0 t $ha^{-1}$ depending on season (Jørgensen & Olesen, 2007). The selection of varieties resistant to Septoria leaf blotch and tan spot in repeated wheat sowings increased the yields on average by 700 kg $ha^{-1}$ (Mazzili *et al.*, 2016). An experiment in the Czech Republic showed that the impact of variety resistance to Septoria leaf blotch on the reduction of grain yield losses was significant. Compared to the 34.7% reduction in grain weight per spike in the susceptible variety 'Bakfis', the resistant variety 'Arina' showed only a 17.3% reduction (Šip, Chrpova, & Palicova, 2015).

*Decision-support systems*

The results of researches show that the development of wheat diseases depends on many factors and decision-support systems are essential for optimizing and minimizing the use of fungicides.

The development of decision-support systems for the control of diseases in cereals started in the late 1980s. Now, many European countries have a number of forecasting and warning systems for optimizing and minimizing the use of fungicides. For example, the Danish decision-support system 'PC-Plant Protection' was introduced in 1993, but in 2002, it was reintroduced as a web-based decision-support system and is now called 'Crop Protection Online' (Hagelskjæ & Jørgensen, 2003).

An accurate identification of pathogens and the determination of pathogen-specific control thresholds are key elements of the integrated pest management programs and decision-support systems. The threshold defines the optimal time for applying fungicide, when infection material transfers from the primary source of infection to the upper, yield-essential leaves (Verreet, Klink, & Hoffmann, 2000). Thresholds for the major diseases of wheat in different decision support systems vary significantly. For example, the threshold for tan spot in France and the Netherlands are the first symptoms on upper leaves. In Germany, the use of pesticides is recommended only in cases with minimal tillage and the previous plant being wheat, if 10% of plants are attacked on the upper three leaves between BBCH GS 35 and BBCH GS 65. In Denmark and Sweden, tan spot is considered devastating only in fields with minimal tillage and the pre-crop of wheat. The threshold for susceptible cultivars is 75% of plants attacked at BBCH GS 31 – 32 and 25% of plants attacked at BBCH GS 33 – 60. In the United Kingdom and Hungary, there is no threshold for tan spot (Jørgensen *et al.*, 2014). The researches in Latvia reveal that recommendations should be based on the disease incidence on the third or second leaf of wheat (Bankina *et al.*, 2014).

Meteorological conditions are important factors in the development of fungal diseases in winter wheat (Bankina *et al.*, 2018; Fernandez *et al.*, 2016; Castro *et al.,* 2018) and are the main inputs of decision-support systems (El Jaroudi *et al*., 2017). The mostly used parameters are air temperature, relative air humidity, and precipitation (Greiner *et al.*, 2019). For example, in the decision-support system 'PROCULTURE', certain meteorological conditions must be observed for the infection to occur: during 2-hour rainfall, in the first hour, rainfall must be at least 0,1 mm to allow for the swelling of pycnidia and be followed by at least 0,5 mm during the second hour to aid in spore release and splashing. In addition to the rainfall, the relative humidity must be above 60% within 16 hours after the rain event and the temperature must remain 4 °C for 24 hours (El Jarroudi, 2009, 2017).

In the Danish decision support system 'PC-Plant Protection', the forecasting of disease depends on pathogen type. The system includes models for

powdery mildew, rusts, Septoria leaf blotch, net blotch, and eyespot. The models are based on control thresholds, but for splash-borne pathogens such as *M. graminicola*, the degree of infection is replaced by the number of days with precipitations more than 1 mm during the past days or weeks. The models assume a 10-day period of protection of splash-borne pathogens and 14 days for *B. graminis* and *Puccinia* spp. (Hagelskjæ & Jørgensen, 2003).

There were many investigations on the effectivity of decision-support systems, and the results obtained are contradictory. For example, the evaluation of the cost effectiveness of the decision-support system 'PROCULTURE' shows that the decision support system-based recommendation resulted in significant grain yield increases compared to the control in years with a high disease pressure. The yield increase was 4 – 42%, depending on the site and year. The financial gain in treated plots compared to the control ranged between 3 and 16% at the study sites. In seasons when dry weather conditions precluded the development of epidemic, the decision-support system recommended no fungicide spray, reducing the use of fungicides and thus saving the cost of the product (El Jaroudi *et al*., 2015). Studies have shown that there is no significant distinction among grain quality indicators (thousand grain weight, specific weight and grain starch content) for the three different methods using either one or two applications of treatment, or treatments according to the decision-support system (Matzen *et al.*, 2019). The results of research in Latvia in 2008 – 2012 confirm that considerably higher yields were obtained in treatments with fungicide application, but differences between control strategies were not significant (Bankina *et al.*, 2018).

Decision-support systems have been developed in countries with a milder climate and a longer vegetation period than Latvia, and systems need to be adapted to Latvian conditions.

*Fungicides*

Fungicides are intensively used as a part of disease management. Azoles, strobilurin, and carboxamides are the main groups of fungicides for disease control in winter wheat. There are many studies about the effectiveness of fungicide groups, however obtained results differ.

The main aim of using fungicides is to maintain the green leaf area (Gaurilčikienė, Butkutė, & Mankevičienė, 2010; Bankina *et al.*, 2014; Matzen *et al.*, 2019). For example, the results of researches in Argentina confirm that fungicide treatments increased green leaf area duration (GLAD) on average by 16% compared to the control treatment. In the wettest years, GLAD means were even 51.7% higher than in the driest years when Septoria leaf blotch was the prevalent disease (Castro *et al.*, 2018). As a result, fungicide application significantly decreased the AUDPC values of Septoria leaf blotch and tan spot (Castro *et al.*, 2018; Fleitas *et al.*, 2018). Unfortunately, researchers found no significant differences between fungicide variants (tested variants for Septoria leaf blotch: TS (triazole + strobilurin), T (triazole), and UT (untreated); for tan spot: TSC (triazole+strobilurin+carboxamide), TS (triazole + strobilurin), and UT (untreated)) (Castro *et al.*, 2018). In another field trial in Argentina, the fungicide group significantly influenced the duration of the leaf green area; however, significant differences were found among fungicide groups. Leaf green area duration of wheat (on average 130 days) was significantly more extended if the mixture of triazole+strobilurin+carboxamide was used. The use of the mixture of triazole and strobilurin provided leaf green area duration on average for 114 days, but in the untreated variant – for only 78.8 days (Fleitas *et al.*, 2018).The researches in Latvia proved that the largest leaf green area was observed in variants where fungicides with active ingredients containing strobilurin were used. The efficacy of two fungicide treatments was not increased if compared to a single application (Bankina *et al.*, 2014).

The research data show that fungicides increased grain yields significantly (Bankina *et al.*, 2014; Castro *et al.*, 2018; Matzen *et al.*, 2019). In Sweden, data from 350 field experiments performed in 1996-2011 showed that the mean yield increase in fungicide-treated plots was 10% if compared to untreated plots, and ranged between 0.39 and 3.39 t $ha^{-1}$ depending on year (Djurle, Twengström, & Andersson, 2018). In Argentina, the grain yield increase was 30.5% after fungicide application (Castro *et al.*, 2018). Wegulo, Breatnach and Baenziger (2009) obtained a yield increase that varied from 27% to even 42% after fungicide application. Long-term investigations have demonstrated that the change of fungicide group (from azole to strobilurin) provided a higher yield increase (970 kg $ha^{-1}$) compared to earlier years (only 660 kg $ha^{-1}$). The increasing of thousand grain weight by 1 g due to fungicide treatment just before/during heading increased the yield by approximately 2000 kg $ha^{-1}$ (Wiik, 2009). In other study, Ronis *et al.* (2014) obtained an increase in thousand grain weight from 0.70 to 5.88 g compared to the grain weight in untreated plots. The results of experiments show that the increase in grain yield depended on fungicide group and even on active ingredients of a fungicide. For example, in Argentina, the grain yield increase per day under fungicide treatment containing triazole+strobilurin+carboxamide (fluxapyroxad) was 34.2 kg $ha^{-1}$ $day^{-1}$, under fungicide treatment containing triazole+strobilurin– from 18.1 to 34.2 kg $ha^{-1}$ $day^{-1}$, and without fungicide treatment – only 10.1 kg $ha^{-1}$ $day^{-1}$. In Lithuania, a single epoxyconazole application

increased the grain yield from 0.31 to 1.77 t $ha^{-1}$, but prothioconazole application increased the grain yield from 0.22 to 0.94 t $ha^{-1}$ (Ronis *et al.*, 2014).

Fungicide significantly influences the grain chemical content. It has been reported that fungicide considerably increased grain starch content compared to untreated variant (Matzen *et al.*, 2019). The results about the influence of fungicide treatments on grain protein content are contradictory. An experiment in Lithuania confirmed that the application of fungicides (both strobilurins and triazoles) at the end of booting-heading stages (GS 47 – 55) essentially increased the yields of grain protein and gluten. The highest average protein yield was obtained when the fungicide used contained both strobilurin and epoxyconazole (Gaurilčikienė, Butkutė, & Mankevičienė, 2010).The researchers in Argentina found that application of 0 – 70 kg N $ha^{-1}$decreased the grain protein content when fungicides were used, particularly under the mixture of triazole, strobilurin and carboxamide (Castro *et al.*, 2018). Similar results were obtained in Denmark. The control of Septoria leaf blotch, yellow rust, and powdery mildew reduced the grain protein content significantly (Matzen *et al.*, 2019).

While fungicides are regularly used to protect the flag leaf, the decision to use the fungicide generally depends on local environmental conditions and the timing of disease detection. In general, one to three applications are used each season, depending on the pressure of the disease, susceptibility of variety and yield potential. For example, the protection of wheat in Grand-Duchy of Luxembourg largely depends on early fungicide use before severe symptoms appear that can reduce grain yields. Beyer et al. (2012) confirm that an early *Z. tritici* epidemic (about 245 days after sowing) is more devastating than late epidemics (epidemics around 270 days after sowing) and requires an accurate prognosis for early epidemics. The first spray is used during the period of stem elongation and is aimed to control early-season diseases, including powdery mildew and eyespot. The second fungicide application is usually intended to protect the flag leaf from the Septoria leaf blotch. The third application is used at early flowering stage to protect wheat against Fusarium head blight infection (caused by *Fusariumgraminearum* Schwabe) (El Jarroudi *et al*., 2017). Jørgensen and Olsen (2007) recommended a three-spray fungicide method in conditions favourable to the development of tan spot, but in most cases, the strategy of one or two applications provided sufficient control. The best controls were observed by the usage of products containing strobilurin (pyraclostrobin, picoxystrobin, and azoxystrobin) together with products containing propiconazole. The profitability of fungicide use depends on the level of yield, the increase in actual yields from the treatment, treatment expenses and the sales prices of wheat. Wegulo, Breathnach and Baenziger (2009) found that the use of the fungicide INBBCH GS 31 and later BBCH GS 39 may reduce the intensity of the disease and increase the yield by more than one fungicide, either BBCH GS 31 or BBCH GS 39. However, applications at BBCH GS 31and BBCH GS 39 might not be cost–efficient, depending on the disease level, the costs of fungicide and its application, and the price of wheat. Researchers emphasise that the use of foliar fungicides earlier than BBCH GS 39 can be justified and can only be useful if environmental conditions contribute to the development of a severe disease at the beginning of the growing season. A growing amount of precipitation (rain) and days with rainfall coincided with profitable fungicide treatments more frequently than in drier conditions (Djurle, Twengström, & Andersson, 2018). Studies carried out in Sweden have shown that fungicide use was profitable in 188 cases and was not profitable in 162 cases when a wheat price of 1 SEK per kg was used. The rise in the price of wheat to 1.50 SEK per kg resulted in 260 treatments that made a profit and 90 treatments that caused economic losses (Djurle, Twengström, & Andersson, 2018).

The results of many studies show that the effectiveness of fungicides depended on different factors, such as pressure of diseases, meteorological conditions, region and economic situation, therefore the universal systems are not effective, they must be adapted to the local conditions.

**Conclusions**

1. The important part of integrated control of diseases is cultural methods such as crop rotation, tillage and the use of disease resistant varieties.
2. The development of wheat diseases depends on many factors and warning and forecasting systems are essential for optimizing and minimizing the use of fungicides. Many European countries have a number of decision-support systems, based on control thresholds and meteorological observations. These systems have been developed in countries with a milder climate and a longer vegetation period than Latvia, so they need to be adapted to the Latvian conditions.
3. The main fungicides for disease control in winter wheat are azoles, strobilurin, and carboxamides. In general, one to three applications are used each season, depending on the pressure of the disease, susceptibility of variety and yield potential. The results of many studies show that the effectiveness of fungicides depend on different factors, such as pressure of diseases, meteorological conditions, region and economic situation, therefore the universal systems are not effective, they must be adapted to local condition.

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# *BOTRYTIS* GENUS FUNGI AS CAUSAL AGENTS OF LEGUME DISEASES: A REVIEW

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**Abstract**
Grain legumes are important crops for the diversification of European farming system. In Latvia, the areas of faba beans (*Vicia faba*) and field peas (*Pisum sativum*) are increasing and legumes that have not been previously cultivated are sown. Globally, the important causal agent of legume diseases belongs to the genus *Botrytis*. *Botrytis* spp. cause significant losses in faba beans and infect a wide range of legume crops. Currently, the composition, pathogenicity and biological characteristics of *Botrytis* species in legumes in Latvia are not known. The aim of this study was to summarize the information about *Botrytis* spp. on legumes, using monographic method. The researches carried out all over the world show a high genetical diversity of *Botrytis cinerea*. Non-host specific *B. cinerea* has been found on 586 plant genera, including many legume crops. *B. cinerea* causes gray mold on leaves and pods of field peas, gray mold on pods of faba beans, and chocolate spot of faba bean leaves. *B. fabae* can infect plants from *Fabaceae* family. *B. fabiopsis* is known as a pathogen of faba beans. *B. fabiopsis* has been observed in Latvia, but no information is available on its presence in Europe. *B. pseudocinerea* has been found on beans, peas, and clover (*Trifolium*). Some other *Botrytis* spp. have been detected on legumes; however, their occurrence and importance are not clear. Summary of existing knowledge about *Botrytis* spp. on legumes is necessary to continue investigations about the diversity and economic importance of *Botrytis* spp. in legumes.
**Key words**: cool season legumes, faba beans, chocolate spot, gray mold.

## Introduction

Legumes is an important crop all over Europe, and sowing areas have been increasing during the last years. Leaf and pod diseases is one of the most important yield-limiting factors. Diseases caused by *Didymella* spp., *Fusarium* spp., *Sclerotinia sclerotiorum*, *Alternaria* spp., and *Stemphylium* spp. are widespread and harmful all over the world. The occurrence of pathogens depends on hosts and meteorological conditions, but fungi from the genus *Botrytis* infect all species of *Fabaecea*. *Botrytis* is one of the most studied necrotrophic fungi; nevertheless, it can cause considerable economic losses – pathogenicity and biological properties of different *Botrytis* species are still unclear. A high genetical and morphological diversity has been observed within this genus; therefore, knowledge of *Botrytis* species and their life cycles is important. The aim of this study was to summarize the information about *Botrytis* species, their harmfulness and legume hosts, to determine the necessity for future research in Latvia.

## Materials and Methods

In the present study, the monographic method was used. The literature on the biology and taxonomy of *Botrytis* spp. and the diseases they cause was analysed. The results of research on *Botrytis* species in legumes carried out in different parts of the world were summarized.

## Results and Discussion

*Importance of legumes in Europe and Latvia*

Cropping systems in Europe are heavily dominated by cereals and oilseed rape (*Brassica napus*). These two crop groups have the highest profit margins and therefore are favoured by European farmers. Unfortunately, this is one of the main reasons why European cropping systems lack crop diversity. Legume grain crops provide various benefits for cropping systems from which the most notable is the reduced need for synthetic fertilisers (Watson *et al*., 2017).

Grain legumes are slowly regaining their position in the European agriculture. Most of the legumes that are bred in Europe are field peas (*Pisum sativum*), faba beans (*Vicia faba*), sweet lupines (*Lupinus albus*), chickpeas (*Cicer arietinum*), lentils (*Lens culinaris*), and vetches (*Vicia sativa*) (Eurostat, 2018). With political support of the European Union, the total sown area of grain legumes in Europe is increasing. In the last 10 years, the area of peas has almost doubled – from 1.5 million ha in 2007 to 2.7 million ha in 2017. A more rapid expansion is seen in the niche of grain legumes such as lentil and chickpea. The area of chickpea fields has seen rapid expansion: in 2007, chickpea area was only 67.6 thousand ha, whereas in 2017, it covered 562.6 thousand ha. The development of the area of lentil is not quite as rapid as that of chickpea; however, the growth is still considerable – from 37.3 thousand ha in 2007 to 241.9 thousand ha in 2017. Soybean (*Glycine max*) is one of the most important and widespread grain legumes worldwide, e.g., in Europe, from 2007 to 2017, soybean area tripled – from 1.9 million ha to 5.7 million ha. Lupine is the only grain legume in Europe whose sown areas start to decrease – after reaching its peak in 2015, when the lupine area was 370 thousand ha, it fell down to 274.4 thousand ha in

2017. In countries where soybean or pea growing is not suitable or causes inconveniences in the planning of harvesting, faba bean takes an important place in grain legume proportion (FAO, 2017). Faba bean is a valuable legume crop, which can be grown as a grain crop or a green-manure legume in numerous cropping systems across the globe. The seeds are used for human consumption or animal feed and are highly nutritious because of the high protein content (up to 35%) and the great diversity of nutrient and bioactive compound content (Karkanis *et al*., 2018). Faba bean is a typical cereal pre-crop in the European cropping systems and is usually followed by one or two cereals (Karkanis *et al*., 2018). Despite the positive characteristics of faba bean, its global sown area declined from 3.7 million ha in 1980 to 2.4 million ha in 2006, and from then, there have been no considerable changes in the global sown area of faba bean (FAO, 2019). In contrast, the total area of faba beans in Latvia, due to changes in the agricultural policy of the European Union, has started to grow rapidly – from 4.4 thousand ha in 2013 to 42.5 thousand ha in 2017 (Central Statistical Bureau of Latvia, 2018).

In Latvia, sowings of faba beans and field peas are increasing, and lupines and vetches are grown in small areas (Central Statistical Bureau of Latvia, 2018). Lucerne (*Medicago sativa*), lupine, red clover (*Trifolium pratense*), white clover (*Trifolium repens*), alsike clover (*Trifolium hybridum*), fodder galega (*Galega orientalis*) (also common as eastern galega), and honey clover (*Melilotus albus*) are grown as fodder legumes and herbaceous forage under the agronomical and ecological conditions of Latvia (Karklins & Lipenite, 2015).

Diseases is one of the most important factors that limit legume production. There are several leaf and pod diseases caused by different pathogens (*Didymella* spp., *Fusarium* spp., *Sclerotinia sclerotiorum*, *Alternaria* spp., and *Stemphylium* spp.), but the most important diseases are caused by fungi from the genus *Botrytis*, which infects all species of legumes. Diseases, which are caused by these pathogens are the most widespread also in Latvia (Pluduma-Paunina *et al*., 2018).

*Taxonomy and phylogeny of Botrytis genus*

*Botrytis* spp. are worldwide-distributed plant pathogens with a high genetic diversity. *Botrytis* genus is classified in the kingdom *Fungi*, phylum *Ascomycota*, subphylum *Pezizomycotina*, class *Leotiomycetes*, order *Helotiales*, family *Sclerotiniaceae*. There is also sexual stage – *Botryotinia* spp., asexual name *Botrytis* should be used according to the rules of the International Code of Nomenclature (Rossman, 2014). The genus *Botrytis* includes about 30 species, one hybrid species *B. allii* (*B. byssoidea* × *B. aclada*), and species complexes (Yohalem, Nielsen, & Nicolaisen, 2003; Walker, 2016); investigations in taxonomy are still continuing.

The majority of *Botrytis* species were described at the end of the 19th and in the 20th centuries on the basis of fungal morphology. *Botrytis* spp. have high morphological diversity – colonies in pure culture vary in colour and morphology. Species are difficult to distinguish morphologically; therefore, molecular identification methods succeed in discovering new species and compiling phylogenetic trees. New species are discovered and described occasionally worldwide in different crops and wild plants (Zhang *et al*., 2010a; Li *et al*., 2012). At least seven species have been found or differentiated in the last decade (Walker, 2016).

*Botrytis* spp. were grouped into two distinct phylogenetic groups (clades) by M. Staats *et al*. (2005) using combined phylogenetic analysis of three protein-coding genes. Clade 1 includes species that infect dicots, but species from Clade 2 infect either dicots or monocots. Since the establishment of the clades, several new species have been described. At this moment, Clade 1 includes non-host-specific *B. cinerea* and *B. pseudocinerea* and host-specific species *B. fabae*, *B. calthae*, *B. sinoviticola* and *B. californica*. *Botrytis* species from different subclades, for example *B. fabae* and *B. fabiopsis,* can infect one hostplant (Zhang *et al*., 2016). Researches are still in progress to find genes for the identification of species from both clades (Hyde *et al*., 2014).

*Botrytis* species are usually named depending on the host plant name. However, it has been found that host and pathogen phylogenies are not congruent (Staats, van Baarlen, & van Kan, 2005). It proves that both organisms do not co-evaluate to match resistance genes in host with virulence genes in the pathogen. Host shifts explain the low congruence between *Botrytis* species and their hosts (Staats, van Baarlen, & van Kan, 2005).

*Characterization of Botrytis genus as a plant pathogen*

Fungi of the genus *Botrytis* might have asexual (anamorph) and sexual (teleomorph) development stages of the life cycle. In asexual stage, fungi produce macroconidia and microconidia. The majority of *Botrytis* species produce sclerotia, which are able to overwinter and survive in extreme conditions. Usually, sclerotia germinate, produce mycelium and conidia, and continue asexual stage. To induce the sexual reproductive cycle and produce apothecia, microconidia should fertilize sclerotia (Faretra & Antonacci, 1987; Fukumori, Nakajima, & Akutsu, 2004). Not all *Botrytis* species produce ascospores. It has been observed that the sexual stage disappears because of negative selection (Willetts, 1997). The ascospores need moisture and have low UV-tolerance (Willetts, 1997). This confirms the necessity for additional research of *Botrytis* spp. in different regions

of the globe with various meteorological conditions.

All *Botrytis* species are necrotrophs and kill plant cells to metabolize them. Most studied is the pathogenesis of *B. cinerea*, but the infection process is similar to other *Botrytis* spp. The pathogen is able to penetrate through the plant cuticle or stromata openings. Fungi are opportunists and often infect damaged tissues or sites infected by other pathogens (Kars & van Kan, 2007). *Botrytis* spp. produce enzymes (oxidases, cutinases, and lipases) to penetrate into plant (Tenberge, 2007). Epidermal cells are destroyed by metabolites such as laccases, proteases, and pectinases. The pathogen causes programmed host–plant cell death to attack and take the nutrients.

There are known several *Botrytis* spp. that have two forms of the disease – aggressive and non-aggressive (Price, 1970; Hargreaves, Mansfield, & Rossall, 1977; Harrison, 1981). Optimal weather conditions can cause phase transformation, resulting in large-scale damage to plants in the form of small restricted spots. During prolonged periods of high humidity and moisture, on the leaves of faba beans, aggressive forms of chocolate spot disease have been observed (Park & Lopetinsk, 1999; Kaur *et al*., 2018).

*Botrytis* species are necrotrophic facultative pathogens; however, recent studies have shown the ability of some species to live in plant tissue as endophytes. Six undescribed haplotypes of *Botrytis* have been found during the studies (Shipunov *et al*., 2008). Many other undescribed species could be concealed in plant tissues as endophytes without causing any symptoms of infection.

*Botrytis spp. in legumes*

*Botrytis* fungi have been observed worldwide everywhere the host plants grow (Jarvis, 1977). As Y. Elad *et al*. (2016) summarized, *Botrytis* spp. have been recorded on 596 genera of vascular plants. In the same study, the authors suggest that *Botrytis* occurrence is related to the softness and tenderness of plant tissues. Leaves of legumes mainly are thick and brittle, and any injuries as mechanical or by insects can induce *Botrytis* infection (Williamson *et al*., 2007). Drought stress makes legumes weak and easily attacked by pathogens, which does not cause damages in normal growing conditions (Ahmed *et al*., 2011).

At present, only two species are known that are not strictly specialized plant pathogens – *B. cinerea* (can infect more than 235 plant species of eudicotyledons) and *B. pseudocinerea*, that have multiple plant hosts (Williamson *et al*., 2007; Walker *et al*., 2011; Elad *et al*., 2016). *B. cinerea* has been found on 586 plant genera (Elad *et al*., 2016). *B. fabae* is able to infect plants from several plant genera, but all of them are related to *Fabaceae* family. Other *Botrytis* species are specialized pathogens that are able to infect one plant species or a few species from one genus.

*B. cinerea*

The information on the occurrence of *B. cinerea* Pers. in *Fabaceae* plant family was collected by Y. Elad *et al*. (2016). *B. cinerea* causes gray mold on lentils (Davidson *et al*., 2004; Tivoli *et al*., 2006), chickpeas (Pande *et al*., 2001; Davidson *et al*., 2007), vetches, beans, peas, clover (Grigaliūnaitė, 2001), galega, soybean, and severe species of *Lupinus* genus: *L. albus*, *L. angustifolius*, *L. hirsutus*, *L. luteus*, *L. mutabilis*, *L. polyphyllus*, *L.* × *regalis*. *B. cinerea* leaf blight and gray mold have been found on eastern clover (*Trifolium dasyurum*) (Loi *et al*., 2007), white clover and subterranean clover (*Trifolium subterraneum*) (Elad *et al*., 2016), honey clover, and has been isolated from lesions on roots (Cormack, 1946). *B. cinerea* causes blossom blight in lucerne (Huang, Kokko, & Erickson, 1999; Li *et al*., 2004).

*B. cinerea* causes grey mold on field pea pods (Dobson & Heath, 1991) and has been isolated from pea flowers (Ma & Michailides, 2005). Gray mold of peas, mostly on leaves, has been commonly noted during wet seasons in Canada (Basu *et al*., 1973). *B. cinerea* infects flowers and pods of bean (Deverall & Wood, 1961; Davidson *et al*., 2007) and leaves (Zhang *et al*., 2010). Different isolates of *B. cinerea* may significantly differ in pathogenicity on various host plants (Mirzaei *et al*., 2009). Diseases caused by *B. cinerea* are difficult to control, because they have many host plants that act as a source of infection.

Symptoms of gray mold caused by *B. cinerea* are similar on different hosts. The infection develops on leaves, plant stem, crown, flowers and pods, and, as a result, the amount and quality of yield reduce or the whole plant can dry out (Bayaa & Erskine, 1998; Taylor *et al*., 2007). *Botrytis* spp. has been isolated from discolored and shrivelled seeds (Kaiser, 1992). Disease symptoms are brown or blanched water-soaking lesions on leaves and fruits. Grey masses of conidia cover lesions on plants and pods (Bayaa & Erskine, 1998). Conidia land on flowers, germinate, and the infection penetrates into the closely related plant tissues (Biddle & Cattlin, 2007); therefore, pods are often infected. Cool and moist weather conditions are favorable for the spreading of infection through the plant. More harmful are early infections – as a result of infection and enzymatic degradation, considerable number of lesions may occur on plants (Emden, Ball, & Rao, 1988).

*B. fabae*

*B. fabae* is one of the most studied pathogen of faba beans; however, it is able to infect plants from *Fabaceae* plant family and has been also found on the genera of *Vicia*, *Pisum*, *Lens*, *Phaseolus,* and *Trifolium* (Jarvis, 1977; You *et al*., 2009; Elad *et al*., 2016). *B. fabae* has been recorded on common vetch. Chocolate spot caused by *B. fabae* has been observed on field peas and eastern clover (Elad *et al*., 2016).

Chocolate spot caused by *Botrytis* spp. is the most common and important disease of faba beans. *B. fabae* is able to infect all overground plant parts, and, likewise, *B. cinerea* is worldwide distributed. *B. fabae* is more aggressive for faba beans because of its ability to attack, penetrate and metabolize plant tissues as a specialized pathogen (Jellis & Bond, 1980; Davidson *et al*., 2007). Symptoms are numerous red-to-dark brown spots, generally on leaves and pods. The infection causes leaf damage, seed and pod reduction, or total crop failure at severe epidemics. In cool and humid conditions, small spots merge into larger lesions (Harrison, 1981). Prolonged wet conditions, when relative humidity is 92 – 100%, are more favorable for chocolate spot development (Harrison *et al*., 1984; Davidson *et al*., 2007). Faba bean infection at the growth stages of flowering and early pod development causes a significant reduction in seed yield from the plant and pod number decrement (Griffiths & Amin, 1977). Recorded yield losses in different parts of the world have reached 50 – 90%. The yield losses may even reach 100% if the yield formation is disturbed (Davidson *et al*., 2007).

Optimal temperature of *B. fabae* growth, sporulation, and development is 22 °C (Terefe *et al*., 2015).

*B. fabiopsis*

For the first time, *B. fabiopsis* was described in China by J. Zhang *et al*. (2010). Symptoms caused by unknown species on faba bean leaves were similar to *B. fabae* lesions but smaller than *B. cinerea* lesions. Morphological characteristics differed between the species. Mycelial growth temperature ranged between 5 °C and 10 °C, and the optimal temperature was 20 °C. The authors report that *B. fabiopsis* infected faba beans and was not found on other crops near the bean field, unlike *B. cinerea* that could infect some winter crops like peas, wheat (*Triticum*), and oilseed rape. *B. fabiopsis* is incompletely studied, and there is no information available on the presence of *B. fabiopsis* in Europe. The occurrence of *B. fabiopsis* in other legumes is unknown, and no researches have been made after detecting the new species in China. The identification of the causal agent of chocolate spot under field conditions is impossible; therefore, DNA-based analyses are necessary for species identification. Recent studies of chocolate spot of faba beans show that *B. fabiopsis* has been found in Latvia (Bankina *et al*., 2017).

*B. pseudocinerea*

Earlier *B. pseudocinerea* has been classified as part of *B. cinerea* species complex or Group I of *B. cinerea sensu lato* (Leroux *et al*., 2002; Beever & Weeds, 2007). Fournier *et al*. (2003) found genetic differentiation between both groups. The first time the species was described by Walker *et al*. (2011), who found the fungus in French vineyards in complex with *B. cinerea*. This complex can be observed in faba beans and also on peas and in clover. Five strains of *B. pseudocinerea* were found in a faba bean field in Germany (Plesken *et al*., 2015). *B. pseudocinerea* and *B. cinerea* differ in resistance pattern to fungicides (Fournier *et al*., 2003).

*B. pseudocinerea* is different from *B. cinerea* genetically, but similar in morphology. No significant morphological differences were found between *B. cinerea* and *B. pseudocinerea* (Fekete *et al*., 2012).

*B. pseudocinerea* showed unique overlapping between isolates in vegetative compatibility tests, possibly due to the low genetic diversity (Fekete *et al*., 2012). Also, gene transfers between *B. cinerea* and *B. pseudocinerea* strains can be possible, as E. Fekete *et al*. (2012) suggested.

*Other species*

*B. caroliniana* was detected on blackberries in 2010 (Li *et al*., 2012). Pathogenicity tests showed the ability of *B. caroliniana* to infect faba bean leaves. Also A. S. Walker (2016) suggested, based on unpublished data, that probably *B. caroliniana* can be pathogenic to faba beans. *B. caroliniana* is genetically closely related to *B. fabiopsis* and they can infect faba beans (Li *et al*., 2012).

*B. anthophila* was discovered in red clover in 1913. The fungus develops on plant flowers and petals and infects seeds. *B. anthophila* was found on red clover flowers and seeds in Lithuania (Grigaliūnaitė, 2001).

*B. pyriformis* could infect faba bean leaves *in vitro* during pathogenicity tests using agar plugs with mycelium and conidia suspension (Zhang *et al*., 2016). There is no information about the occurrence of the fungus on broad beans in nature.

Pathogenicity tests showed the ability of *B. aclada*, *B. euroamericana,* and *B. paeoniae* to form lesions on faba bean leaves (Garfinkel *et al*., 2017). *B. aclada* is a specialized pathogen of onion (*Allium cepa*) but also could cause primary lesions on the non-host plant that were significantly smaller than *B. cinerea*, *B. euroamericana,* and *B. paeoniae* caused lesions. The role of *B. euroamericana* in broad beans is unclear, and no further researches have been made to determine its pathogenicity in field conditions.

**Conclusions**

1. Pathogens from genus *Botrytis* are common causal agents of diseases of different legumes cultivated in Latvia, Europe, and worldwide. Studies show that one legume crop can be infected with several *Botrytis* species, which differ in their pathogenicity and aggressiveness.
2. *B. cinerea*, *B. fabae,* and *B. fabiopsis* are faba bean pathogens, but their significance should be clarified. *B. pseudocinerea* has been found on faba beans in field conditions, and it might

be a potential pathogen of different legumes. *B. caroliniana* and *B. euroamericana* infected faba beans during pathogenicity tests *in vitro*. *B. aclada* and *B. paeoniae* formed primary lesions on faba bean leaves, but their role in infection of legumes is uncertain.

3. Basic knowledge about diversity of *Botrytis* spp., their distribution and biological properties is required to understand the life cycles of the species and to establish an economically and biologically based control of the causes of this species diseases.
4. Further investigations are required to determine *Botrytis* species on legumes in Latvia, investigate the occurrence and pathogenicity of the fungi and select plant protection methods to control *Botrytis* infection in legumes.

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# CHARACTERIZATION OF *PUCCINIA RECONDITA*, THE CAUSAL AGENT OF BROWN RUST: A REVIEW

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**Abstract**
Brown rust caused by *Puccinia recondita* is a significant disease in cereal growing areas worldwide. On average, brown rust can cause yield losses from 10% to 40% resulting in economic losses. The disease damages the leaves, stems and glumes of cereals. Classification of the pathogen causing brown rust has undergone several revisions. There are two different opinions about the causal agent causing brown rust on rye and wheat. Some scientists consider that the causal agent of brown rust in wheat (*Triticum aestivum* L.) and rye (*Secale cereale*) is included in the broad species of *P. recondita* defined by Cummins, but other scientists consider that there are two species causing brown rust – *P. recondita* in rye and *P. triticina* in wheat. There are many studies about the races of *P. recondita* in wheat: in North America, 70 races are collected every year; in Canada, 35 races have been found; in Europe, 105 races have been found. Unfortunately, there are no studies about the races of the pathogen of rye. *P. recondita* is a heteroecious fungus with a complicated life cycle. For successful development, the fungus requires cereals as primary hosts and different alternative hosts, depending on the specialization of the pathogen. Specific studies about the biology, distribution and harmfulness of *Puccinia recondita* in Latvia are necessary. Monographic method was used for this study. The aim of this article is to summarize the information from the literature about *Puccinia recondita,* the causal agent of brown rust, with emphasis on the occurrence, harmfulness, taxonomy, and life cycle of *P. recondita* f. sp. *secalis*.
**Key words**: taxonomy, cereal, fungal diseases, rye, *Uredinales*.

## Introduction

Brown rust (also called brown leaf rust) caused by *Puccinia recondita* (syn. *Puccinia triticina*) can infect wheat (*Triticum aestivum* L.), rye (*Secale cereale*), triticale (×*Triticosecale*), and barley (*Hordeum vulgare*). Brown rust is widespread in major wheat production regions such as America, Africa and Europe (Ordonez, German, & Kolmer, 2010; Huerta-Espino *et al*., 2011). Brown rust is the most widespread and prevalent disease of wheat in South America (German *et al*., 2007). In the USA, epidemics of brown rust on winter wheat have occurred in the southern part of the country more frequently than in the areas in north of the country. Brown rust is the most important wheat disease in Mexico (Roelfs, 1989). Level of yield losses caused by leaf rust are different, depending on various weather conditions, availability of inoculum and cultivar susceptibility (Teferi, 2015). The disease can cause yield losses in wheat from 5% to 10% in Canada, from 10% to 22% in the USA, and up to 40% in Mexico (Moschini & Perez, 1999).

Brown rust caused by *Puccinia recondita* f. sp. *secalis* occurs regularly in all areas where rye is growing. This disease is one of the most significant diseases of rye in Europe (Miedaner *et al*., 2012), and it is common also in Latvia (Bankina *et al.*, 2013). Early infection of brown rust in continental climates can cause yield losses of up to 40%, and if the epidemic is early and strong – even up to 60 – 80% in rye (Kobylanski & Solodukhina, 1996).

*Puccinia recondita* is a heteroecious fungus, macrocyclic, and has five distinct stages of development: teliospores, basidiospores, and urediniospores on cereal hosts, and pycniospores and aeciospores on the alternative hosts.

Genetic resistance is most commonly used to prevent yield losses caused by brown rust. The identification of pathogens' races is very important for the breeding of resistant varieties (Bolton, Kolmer, & Garvin, 2008).

There are many studies about the races of brown rust in wheat, but no research has been carried out on the races of *P. recondita* in rye.

The aim of this article is to summarize the information from the literature about *Puccinia recondita,* the causal agent of brown rust, with emphasis on the occurrence, harmfulness, taxonomy, and life cycle of *P. recondita* f. sp. *secalis*.

## Materials and Methods

Monographic method was used for this study. Scientific literature from different countries related to *Puccinia recondita* (the causal agent of cereal brown rust), its biology, evolution and distribution was summarized.

## Results and Discussion

*Distribution and harmfulness of brown rust*

Brown rust occurs on wheat (*Triticum aestivum* L.), rye (*Secale cereale*), triticale (×*Triticosecale*), and barley (*Hordeum vulgare*). The occurrence of brown rust is high in all regions where rye, wheat and triticale are produced. Under Latvia's climatic conditions, brown rust in rye sowings appears every year, but wheat and triticale sowings are seldom infected (Treikale, 2010, 2016).

Wheat brown rust can cause a reduced number of kernels per head and kernel weight (Kolmer, 2013). Grain losses can reach up to 30 – 70% even in susceptible varieties in South America (Ordonez, German, & Kolmer, 2010). Different results have been obtained in Europe, where yield losses in susceptible cultivars reached 14 – 29%, mainly due to reductions in kernel weight (Huerta-Espino *et al*., 2011). Findings of American researchers confirm that yield losses caused by rust can make 5 – 15% in Canada, 10 – 22% in the USA, 9 – 51% in Argentina, and even up to 40% in Mexico (Moschini & Pérez, 1999).

Brown rust in rye can cause significant yield losses, especially when infection is early. In continental climates, yield losses can reach up to 40%, and if the epidemic is early and strong – even up to 60 – 80% (Kobylanski & Soludhkina*,* 1996). Disease severity in Latvia in some years increased up to 15% (Treikale, 2010, 2016).

Brown rust is a significant disease for winter triticale in Poland, and the infections caused by *P. recondita* can result in substantial yield losses (Wooe, Maekowiak, & Cichy, 1994).

Harmfulness of brown rust depends on the time of infection – earlier appearance of disease leads to more substantial yield losses.

There are findings which confirm that brown rust infection depends on the cultivar. In Finland, rye cultivars differed in brown rust infection level; however, the effect of cultivar was also directly related to the time and location of sowing (Serenius *et al*., 2005). In Latvia, observations showed that disease severity differed depending on the cultivar, but clear regularities were not found (Bankina *et al*., 2013).

*Characterisation of the pathogen*

Causal agents of brown rust belong to the genus *Puccinia*, family *Pucciniaceae*, order *Pucciniales*, phylum *Basidiomycota* in the kingdom *Fungi*.

The classification of these pathogens has undergone several revisions. The fungi develop on two different hosts: uredospores, teliospores and basidiospores develop on the principal host, and pycniospores and aeciaspores develop on the alternative host. At the beginning, the causal agent of brown rust was designated as *Uredo rubigo-vera* in 1815 by Augustin de Candolle. Winter in 1884 placed the causal agent of this disease in the species complex of *P. rubigo-vera*. Eriksson in 1899 was the first one to report *Puccinia triticina* as a single species. At the beginning of the 20th century, it was adopted by many scientists in North America and Europe that some species infect rye, wheat, barley, and few grasses; at that time, the species' name was *P. rubigo-vera*. The alternative hosts of *P. rubigo-vera* were supposed to be the plants from the family *Boraginaceae.* When Plowright described the new species as *Puccinia perplexans* in 1885, it was considered that more than one species can cause brown rust on various plants. Later, many species were described and named according to host specialization. The classification of causal agents of brown rust proceeded to be modified from time to time (Liu *et al*., 2013).

In 1894 and 1899, Eriksson and Henning described many species (*P. agropyrina*, *P. bromina*, *P. dispersa*, *P. glumarum*, *P. holcina*, *H. mollis*, *P. simplex*, *P. triseti*, *P. triticina*), which before were grouped as one species – *Puccnia rubigo-vera*. Arthur and Fromme, in contrast, united all forms of *P. rubigo-vera* with alternative host plants from *Ranunculaceae* family into one species with one name – *Dicaeoma clematidis.* Mains in 1933 suggested to place all featured species causing brown rust back into one species under name *Puccinia rubigo-vera.* In 1934, Arthur accepted the causal agents of brown rust as one species *P. rubigo-vera*. Cummins and Caldwell in 1956 suggested *Puccinia recondita* as the valid binomial for the causal agents of brown rust of grasses and cereals. This broad species concept was widespread in North America (Huerta-Espino *et al*., 2011).

*P. recondita* has alternative hosts in four families of plants (*Balsaminaceae*, *Boraginaceae*, *Hydrophyllaceae*, and *Ranunculaceae*). Cummins in 1956 and Caldwell in 1971 placed all causal agents of brown rust into one species, because of spore morphology and host range was similar. Other scientists arranged these pathogens into more than one species, because of small but permanent differences in the morphology of teliospores, aeciospores and uredospores (Savile, 1984). There are two diverse opinions about the *P. recondita* complex: some of researchers hold the opinion that the causal agent of brown rust in wheat and rye is included in the broad species of *P. recondita*, but some consider that there are two species that cause brown rust – *P. recondita* in rye and *P. triticina* in wheat.

The causal agents of cereal brown rust have been divided into various species including *Puccinia aegilopis* (Maire, 1914), *Puccinia dispersa* (Gaumann, 1959), *Puccinia persistens* (Urban, 1992), *P. rubigo-vera* (Arthur, 1934), *Puccinia tritici-duri* (Viennot-Bourgin, 1941), and *Puccina triticina* (Savile, 1984), and *P. recondita* as well (Cummins, 1971). The causal agent of brown rust in wheat and rye is included in the broad species of *P. recondita*; however, some scientists separated this pathogen into two species – *P. recondita* (rye group) and *P. triticina* (wheat group) (Savile, 1984; Swertz, 1994) or *P. persistens* spp. *triticina* (Urban & Markovi, 1992). Generally, the conception of the *P. recondita* complex as a single broad species is more accepted in the USA than in Europe where the conception of more narrowly described brown rust species dominates. The name *Puccinia recondita* f. sp.

*secalis* is the most accepted name for the causal agent of rye brown rust (Anikster *et al*., 1997).

*P. recondita* has different alternative hosts depending on their specialization: principal host – cultivated wheat; alternative hosts – meadow rue (*Thalictrum speciosissimum*), *Triticum turgidum* ssp. *durum* and blue bugloss (*Anchusa italic*), rye and bugloss (*Lycopsis arvernsis*) (Urban & Markovi, 1992). The alternative hosts of *P. recondita* from wild wheat species are poorly investigated; however, several species in the *Boraginaceae* family have been found.

Depending on genome size and host range, Anikster *et al*. (1997) separated *P. recondita* on rye, wheat and grasses (*Aegilops* spp.) into two groups. Group one infects wheat, and group two infects rye and grasses. Isolates of each group are interfertile, and selections of groups are not sexually consistent. In group one, there are isolates of *P. recondita* and *Thalictrum speciosissimum* is the alternative host. Group two comprises isolates that have few species from the *Boraginaceae* family as the alternative hosts (Anikster *et al*., 1997). The most accepted names of brown rust causal agents are: *P*. *recondita* f. sp. *tritici* and *P*. *recondita* f. sp. *secalis*.

In the taxonomic hierarchy, race is an informal rank, under the level of subspecies. Race nomenclature was uncomplicated as long as the early standard differentials were applied and a key was contended for the identification of races. The introduction of new hosts required additional names. This pursued in many systems of nomenclature; however, none of them was fully satisfactory. In North America in 1980, leaf rust researchers used a formula system similar to that made by Green for wheat stem rust (Green, 1981).

Mains and Jackson in 1921 and 1926 were the first to research the physiologic specialization of *Puccinia recondita* f. sp. *tritici*. They found twelve races by infection types on 11 plants. The researchers developed their own systems of race designation and analysis (Long & Kolmer, 1989).

Populations of brown rust causal agents are extremely different in the world. Each year in North America, more than 70 races are collected. The fungus has an inherent mutation mechanism to produce races that are still unknown, even without sexual stage of development (Huerta-Espino *et al*., 2011). From 1997 to 2007 in Canada, 35 races were found. In Europe, from 2608 isolates 105 races were identified (Mesterhazy *et al*., 2000). Goyeau *et al*. in 2006 France identified 104 races. The identification of rust races has changed recently because genetic markers were introduced (Ordonez, German, & Kolmer, 2010). Virulence studies of *P. recondita* f. sp. *tritici* have been conducted in the former Czechoslovakia, where 14 races of this pathogen were found (Hanzalova *et al*., 2008). In France, pathogens were reported to be diverse for virulence despite that there are only a few specific resistance genes (Goyeau *et al*., 2006). In Hungary, it was found that the main races in the population are the races 77 and 61 (Manninger, 2006). As uredospores of *P. recondita* are dispersed by wind, it can be assumed that the main virulence phenotypes might be discovered in many countries in Europe, which was the case from 1960 to 1980 for race 77 (Zadoks & Bouwmann, 1985). A large study of *P. recondita* virulence in the west of Europe was conducted in 1995 (Park & Felsenstein, 1998), which was significant in that a big number of collections were achieved from a few of different countries and were featured for virulence using the differential set and description nomenclature. A total 850 isolates were collected and 53 races were identified in France, Germany, Austria, Belgium, Italy, Switzerland, and the UK. Four races were found on 64% of isolates, and they were reported to be widespread all over Western Europe. Three of the four dominant races were also found in collections from Estonia, Finland Poland and Hungary. Unfortunately, there are no studies about the races of *Puccinia recondita* f. sp. *secalis*.

*Resistance*

There is only fragmentary information about the rye varieties resistant to *P*. *recondita* f. sp. *secalis*. Kornicke and Werner (1885) were the first to report the discovery of resistant rye cultivars. Later, many scientists observed a higher degree of resistance in some of the cultivars (Novikov, 1907; Yachevsky, 1909; Mains & Leighty, 1923; Dmitriev, Talchuk, & Serova, 1982). Meantime, genotypes resistant to leaf rust have been detected in many populations of wild perennial rye and in cultivars bred in Russia, Ukraine, Belarus, Poland, Germany, Austria, Hungary, and Canada (Kobylyanskii, 1982; Kobylyanskii & Soludhkina, 1996).

There is information that 71 brown rust resistance genes have been found in wheat to chromosome position and specified gene names. The study of genetic analysis of the causal agent of rye brown rust helped to identify two dominant resistance genes Pr1 and Pr2. These two genes demonstrated to be against a local brown rust population and single-pustule isolates as well (Wehling *et al*., 2003). Earlier, resistance genes Pr1 and Pr2 had names Lr-a and Lr-b (Linz & Wehling, 1998). Studies in Germany showed that there were three dominant genes of resistance to brown rust (*Puccinia recondita* f. sp. *secalis*). Resistance genes Pr3, Pr4, and Pr5 were recognized using genetic analysis of resistance to brown rust in rye. These genes – Pr3, Pr4, Pr5 confer resistance to many isolates of single-pustules (Roux *et al*., 2004).

Many resistance genes are beneficial in seedlings; they stay effective till the adult stage of the plant. Genes like Lr1, Lr10, and Lr21 are excelent examples

of race-specific resistance genes that are beneficial in seedlings and adult plants (Dyck & Kerber, 1985). At first, leaf rust resistance genes – Lr1, Lr2a, Lr3, Lr10, Lr11 were characterized in wheat *T. aestivum*, and then, in species connected to wheat, such as *Aegilops elongatum*, *A. umbellulata*, *T. tauschii*, *Aegilops elongatum* and *S. cereale*. It has been proven that race-specific seedling resistance genes are very weak to selection and could increase virulent races in leaf rust populations. Primarily, multiple wheat cultivars were resistant when they were first created, but as new brown rust races appeared, the seedling resistance decreased and, as a result, the resistance of cultivars decreased. In regions where winter wheat and rye are grown, the selection of virulent races can happen comparatively fast. Race-specific resistance genes that are normally expressed in the adult stage of plant but weakly expressed in seedlings have been characterized as well. Such resistance genes as Lr12 and Lr13 were obtained from wheat, while other genes like as Lr22a and Lr37 were obtained from *A. ventricosa* and *T. auschii* (Kolmer *et al*., 2008). When plants have seedling resistance genes to disease, then, at the adult stage of the plant, resistance genes have eroded the effectiveness of resistance (Dyck & Johnson, 1983). A partial type of resistance is normally expressed in adult plants; however seedlings can also be sensitive. A clue to the characteristics of these genes is that they present resistance to many known races of *P. recondita* that do not express race specificity. These genes individually do not provide full resistance, but resistance of these genes appears by sensitive infection types that do not produce uredinia. The most familiar and mostly described of these genes is the gene Lr34 (Kolmer *et al*., 2008). Wheat cultivars with the gene Lr34 also have a diverse phenotype of leaf necrosis that appears separately from rust infection. Leaf rust resistance genes Lr46, Lr67, and Lr68 are also liable for adult-plant resistance (Herrera-Foessel *et al*., 2012).

*Life cycle*

*Puccinia recondita* is a heteroecious fungus, macrocyclic, and has five distinct stages of teliospores, basidiospores, and uredospores on cereal hosts, and pycniospores and aeciospores on the alternative hosts (Kolmer, 2013).

The uredospores of uredinia are typical symptoms of brown rust. The diameter of uredinia can reach even 1.5 mm, their colour is orange to brown, their shape is round to ovoid. Uredinia are scattered on both sides of leaf surfaces. Uredospores release from uredinia, their average size is 20 mm in diameter, and colour – orange-brown. Uredospores have up to eight germ pores scattered in dense walls (Bolton, Kolmer, & Garvin, 2008). There can be thousands of spores in each pustule. Under severe epidemics of leaf rust, pustules are able to develop on the beards and glumes of heads or sometimes on the stem underneath the head. Late in the growing season, leaf rust may get very severe, which can result in leaf death. This is characteristic of America. Telia with black teliospores were produced on the leaves later in the season. Telia develop beneath epidermis, primarily on leaf sheets and blades. Telia are not always formed, especially if brown rust infection occurs late in the growing season (Dyck & Kerber, 1985).

Symptoms depend on the level of cultivar resistance; there are cultivars that are completely susceptible and have big uredinia without causing necrosis or chlorosis in the plant tissues. Varieties that are resistant are described by different responses – from small spots to small- to medium-size uredinia that could be surrounded by necrotic and chlorotic areas (Kobylanski & Soludhkina, 1996).

*P. recondita* spores are spread by splashing water and wind. Optimal environmental conditions for disease development are temperatures ranging from 15 °C to 20 °C, but the fungus can develop at the temperature of 2 – 35 °C. The fungus needs aproximately six hours of moisture on leaves to start developing. With much moisture and suitable temperatures, lesions are formed within 7 – 10 days, and spore production reduplicates another uredospore generation (Kolmer, 2013).

Normally, *P. recondita* develops from autumn infections. Usually, the disease appears first on lower leaves and then moves forward up the plant to the upper leaves of the infected plant until summer. However, infections ordinarily occur first on the upper leaves of the plant, which happens because of the wind-blown spores that are laid out of the air in the course of spore showers (Roelfs, Singh, & Saari, 1992).

The teliospores of *P. recondita* are made under the epidermis of blades under senescence or unfavourable conditions and remain with the leaves. Leaves can be moved or dispersed by wind, animals or humans at remarkable distances. Basidiospores need humid conditions to form and release, and moisture limits their spread. Basidiospores are also translucent and sensitive to light, that limits traveling further to perhaps tens of metres. The pycniospores are usually carried by insects to other sites of infection where the fusion of two genetically divergent cells happens, which reestablishes the dikaryotic nuclear condition (Cummins & Caldwell, 1956). The dikaryotic aecium grows on the underneath of the leaf surface, and within these, chains of aeciospores are produced. When the aecium has developed, the aeciospores are released and dispersed by wind to infect their cereal host. Several generations of uredo spores develop on the cereal host as long as favourable conditions are available. Teliospores develop in the late of the season or under unfavourable conditions. The

sexual cycle of brown rust is related to the presence of an appropriate alternative host. Meadow rue, the alternative host for *P. recondita* in wheat, *Thalictrum speciosissimum* L., is characteristic to southwest Asia and southern Europe and does not occur naturally in North America (Samborski, 1985). There are no studies of aeciospores or pycnia produced on either or *T. glaucum* or *T. speciosissimum* in North America. Species of *Thalictrum* are resistant to basidiospore infection caused by *Puccinia triticina* (Saari, Young, & Kernkamp, 1968). As a result, *P. recondita* is found only as uredinial infection on wheat in the majority of rye and wheat growing areas all over the world. Aeciospores produced on *Thalictrum* spp. follow from basidiospore infection from different *Puccinia* spp., often have ITS DNA sequences and do not infect wheat, which are very much related to uredinial collections from *Elymus glaucus*.

The urediniospores are scattered by winds and they infect cereal crops developing furthermore (Roelfs, 1989). Ultimately, brown rust uredinial infections could be found by mid-June on spring wheat. Many winter cereal cultivars are sensitive to brown rust, which lets a huge population of *P. recondita* to overwinter across a big geographic region on an annual basis (Saari, Young, & Kernkamp, 1968).

**Conclusions**

Brown rust is a significant disease wherever rye and wheat are grown, and it can cause substantial yield losses. After many revisions in taxonomy of the causal agent of brown rust in rye and wheat, there are still different opinions, but the most accepted point of view is that there is one species causing brown rust – *P. recondita* with different specialized forms (f. sp.).

The life cycle of brown rust is complicated, and it depends both on the primary and alternative hosts and on environmental conditions.

Further research about the biology, distribution and harmfulness of *Puccinia recondita* in Latvia is needed.

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# EVALUATION OF COCKSFOOT (*DACTYLIS GLOMERATA* L.) COLLECTION OF DIFFERENT GEOGRAPHICAL ORIGIN IN THE LENINGRAD REGION

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**Abstract**
The aim of the work was to study accessions of *Dactylis glomerata* L. of different origin for breeding in the Leningrad region. The work was carried out at the Leningrad Agricultural Research Institute. The study involved 15 accessions. The nursery was founded in 2016 and included two replications for green yield and two – for seed production. Cutting and sampling for biochemical studies were conducted in May-June 2018, seeds were collected in July. The amount of ascorbic acid, carotenoids and chlorophylls and crude protein were determined. Statistical analysis included the calculation of the parameters of variation, ANOVA and correlation analysis. Three groups were identified by the degree of ripeness: a small group of early maturing – 31 days, a group of late maturing (single accession from Karelia) – 51 days, a large group of middle maturing – 34-37 days. For the late maturing accession the mechanism of regulation of the beginning of heading is due to the sensitivity to photoperiod. The adaptive potential of widely zoned varieties is wider than for localized. Their productivity is higher. The content of pigments in the green mass is closely correlated. The system of pigments in the complex of characters is separate, but is positively associated with the seed productivity and negatively – with the content of ascorbic acid. The seed productivity of the accessions is related to the total pigment content and power of the generative shoots (length and mass).
**Key words**: cocksfoot, agronomic evaluation, pigment system.

## Introduction

Cocksfoot (*Dactylis glomerata* L.) is a valuable forage crop, one of the earliest, highly nutritious, widely used cereal grasses. Creating new high yielding varieties with a wide adaptive potential in changing environmental conditions is a priority for breeding programs. Due to global climate change in recent years, weather conditions have shown sharp jumps from year to year. Varieties zoned in several regions have a wider range of adaptations and higher plasticity to various environmental conditions in comparison with strictly agro-ecologically specialized varieties (Жученко, 2010). The adaptive potential of plants depends on the variability of all its structures at different levels. Cocksfoot, as a polyploid, can demonstrate a wide range of variability.

Although the role of biologically active substances for the normal functioning of organisms and improvement of the forage quality is well known, scientific studies of the content of cocksfoot plants for ascorbic acid, chlorophylls A and B, carotenes, *β*-carotene and carotenoids are currently scarce. There are some works on the content of carotenes, carotenoids and vitamins A and C (Woods *et al.*, 1935; Скоблин, 1983; Farshadfar, 2017). Data on the content of chlorophylls in the green mass of cocksfoot were not found in the literature. Ascorbic acid is a multi functional compound that has the ability to reversibly oxidize and regenerate, which makes it possible for it to participate in the most important energy processes of a plant cell – photosynthesis and respiration. Ascorbic acid is a powerful antioxidant. It participates in the processes of growth, flowering, vegetative and reproductive differentiation, in water metabolism, regulation of enzymatic activity, stimulation of metabolic reactions associated with nucleic acid metabolism and protein synthesis, in plant defense reactions (Чупахина, 1997). The plants contain various pigments. Green pigments are represented by chlorophylls A and B, which take part in photosynthesis processes and are contained in all assimilating organs. They are often associated with protein and are easily extracted by solutions like acetone or ether. Carotenoids are yellow fat-soluble pigments, that are tetraterpenoids and are widely distributed, as well as chlorophylls. One of the most important functions of carotenoids is additional pigments in photosynthesis. Carotenoids are widely distributed in plants and are a mixture of xanthophylls (70%) and carotenes (30%). In plants, carotenes are represented by a mixture of isomers, where the total content of the *α*- and *β*-forms reaches 98%. They have a biological activity – the ability in the organism to turn into vitamin A. The most active is *β*-carotene (Furr & McGrane, 2003).

Objective of the paper: to study the varieties and wild accessions of cocksfoot of different geographical origin with the identification of the most promising for breeding work in the Leningrad region, as well as for a comprehensive assessment of forage and nutritional values.

## Materials and Methods

The work was carried out on the basis of the Leningrad Agricultural Scientific Research Institute 'Belogorka'. The study involved varieties and wild

accessions from the collection of the N.I. Vavilov All-Russian Institute of Plant Genetic Resources (VIR).

The nursery was founded in 2016. Scheme of experiment included two randomized replications for green yield and two replications for seed production. Square of plot was 3.5 $m^2$ (5 × 0.7 m), sowing continuous. Fertilizer $N_{16}P_{16}K_{16}$ was applied at the rate of 100 kg $ha^{-1}$.

Fifteen accessions of cocksfoot were studied: varieties, zoned in the North-West (variety 'Neva', 'Leningradskaya 853', 'Triada'), in the Northern region (variety 'Dvina'), widely zoned in Russia variety 'VIK61', and in the Volgo-Vyatka and North Caucasus regions variety 'Khlynovskaya', variety 'Tammisto' from Finland, variety 'Petrozavodskaya' from the Republic of Karelia and wild accessions from Scandinavia, North-West and Central regions of Russia. 'Neva', variety zoned in Leningrad province, was chosen as a standard for comparison. The accessions of cocksfoot under study belong to subspecies *glomerata subsp. glomerata* (2n=28).

Cutting and sampling for biochemical studies were conducted on May 28 2018 except for accession k-00001 from the Republic of Karelia (June 9 2018). Seeds were collected on July 11 2018 (from k-00001 – July 18 2018).

Material for biochemical study was processed and analyzed by methods of VIR (Ермаков *et al.*, 1987). The amount of ascorbic acid was determined by direct extraction from plants with 1% hydrochloric acid, followed by titration with 2.6-dichloroindophenol (ГОСТ 7047-55). Carotenoids and chlorophylls were extracted with acetone (ГОСТ 8756.22-80); their absorption was measured on a spectrophotometer 'Ultrospec II, LKB Biochrom' at various wave lengths, the total content of carotenes was determined by paper chromatography. Determination of crude protein was performed in a dry material using a 'Kjeltek2200' instrument.

Statistical data processing was performed using the STATISTCA 7.0 package and included the calculation of the main parameters of variation, analysis of variance and correlation analysis.

Meteorological conditions during the period of the study (2018) were distinguished by excess of heat and lack of moisture. The air temperature in May and June exceeded the average multi year by 1.6 and 1.3 °C.

The amount of precipitation in April was about twice the norm (58 mm); in May and June precipitation fell by half the norm (16 and 28 mm), in July– about two monthly norms (148 mm).

**Results and Discussion**

*Economically valuable characters*

The spring renewal of vegetation began on the 15 of April, 2018 for all accessions of cocksfoot.

Wild accessions from the Pskov region (k-38088) and Norway (k-44020) were the earliest to enter the heading phase – 15$^{th}$ of May. The period from the renewal of vegetation to heading was 31 days, the sum of active temperatures (more than +10 °C) over this period was 540 – 550 °C. The heading of a wild accession from the Republic of Karelia (k-00001) began on June 4 the duration of the period from the renewal of vegetation to heading – 51 days. The rest of the accessions began heading on May 18-21, 34 to 36 days passed from the renewal to heading; the amount of active temperatures was 580 – 620 °C.

The collection site of accession k-00001 (the northern coast of Onega Lake) is characterized by cold, lingering spring with recurrent frosts in May and early June (Филатов, 2004). Probably, the reaction to the length of the day, as one of the adaptations to the unfavorable conditions of the North, postpones the beginning of the generative phase to a later date, when the threat of frost has passed. Thus, the late ripeness of this cocksfoot specimen is the result of strong sensitivity to the photoperiod.

Other northern accessions from Russia, Norway and Finland in the studied set had a relatively short period from the renewal of vegetation to the beginning of the generative phase, and do not differ from the more southern accessions. This indicates the rarity of the late ripening forms in the northern cocksfoot populations. In late ripening varieties of annual cultivated cereals, such as *Avena* L. and *Triticum* L., strong sensitivity to the photoperiod was found; early ripening varieties are weakly sensitive to photoperiod (Кошкин *et al.*, 1994, 2013). Strong photoperiodic sensitivity of wheat is due to recessive genes (Keim, Welsh & McConnel, 1973). Perennial cereal grasses related to annuals, including cocksfoot, most likely have the same feature. If we consider that cocksfoot is a tetraploid (Linder, Garcia, & Velasco, 1999), the frequency of occurrence of late ripening forms will be low due to the recessivity of this trait.

The variety 'Leningradskaya 853' differed from all the others by the high intensity of spring regrowth (height on the 20$^{th}$ day from the renewal of vegetation). The varieties 'Khlynovskaya', 'Dvina', 'Neva' and 'Triada' had an average intensity of spring regrowth (the differences were significant). All wild accessions and varieties Tammisto and 'Petrozavodskaya' were characterized by low intensity of spring growth (Table 1).

Three groups of accessions of cocksfoot were emphasized by the height before cutting: tall – from 99 to 106.2 cm, which included most varieties and a wild accession from the Republic of Karelia (k-00001); middle – with the only accession k-44020 from Norway; low – the group of accessions (height from 76.2 to 82.8 cm), where 'Tammisto' variety

Table 1

**Economic evaluation of cocksfoot, 'Belogorka', 2018**

| Catalogue VIR | Name | Origin | Height, cm | | Hay yield, kg $m^{-2}$ | Seed yield, g $m^{-2}$ |
|---|---|---|---|---|---|---|
| | | | On 20th day after renewal | Before the 1st cutting | | |
| 00001 | Wild | rep. Karelia | 20.8 ± 1.07 | 100.4 ± 4.20 | 0.603 ± 0.107 | 29.5 |
| 36566 | Tammisto | Finland | 32.2 ± 1.93 | 76.2 ± 3.73 | 0.588 ± 0.064 | 32.3 |
| 36682 | VIK 61 | Moscow reg. | 31.0 ± 1.41 | 99.0 ± 3.22 | 0.846 ± 0.266 | 31.4 |
| 36684 | Dvina | Arkhangelsk reg. | 35.6 ± 2.14 | 99.6 ± 3.57 | 0.837 ± 0.041 | 31.9 |
| 38088 | Wild | Pskov reg. | 27.0 ± 2.17 | 82.8 ± 2.85 | 0.472 ± 0.054 | 12.3 |
| 43142 | Wild | Yaroslavl reg. | 26.6 ± 1.72 | 81.4 ± 5.56 ± | 0.735 ± 0.003 | 23.6 |
| 44020 | Wild | Norway | 32.2 ± 1.28 | 90.0 ± 2.61 | 1.032 ± 0.082 | 28.2 |
| 44021 | Wild | Norway | 30.6 ± 2.40 | 81.6 ± 3.97 | 0.659 ± 0.079 | 37.2 |
| 44349 | Wild | Leningrad reg. | 31.6 ± 1.44 | 81.6 ± 1.89 | 0.757 ± 0.073 | 40.7 |
| 44354 | Wild | rep. Komi | 30.0 ± 1.82 | 81.6 ± 1.63 | | 26.7 |
| 27863 | Leningradskaya 853 | Leningrad reg. | 40.4 ± 2.42 | 103.2 ± 5.09 | 1.165 ± 0.155 | 39.0 |
| 35060 | Neva | Leningrad reg. | 37.2 ± 2.03 | 99.2 ± 5.08 | 0.991 ± 0.009 | 39.7 |
| 38648 | Petrozavodskaya | rep. Karelia | 32.8 ± 2.33 | 103.4 ± 1.96 | 0.790 ± 0.013 | 36.6 |
| 45034 | Khlynovskaya | Kirov reg. | 34.8 ± 1.25 | 106.2 ± 2.96 | 0.875 ± 0.114 | 41.7 |
| 48628 | Triada | Leningrad reg. | 36.4 ± 2.16 | 102.2 ± 3.68 | 0.921 ± 0.212 | 55.6 |
| $LSD_{0.05}$ | | | 2.67 | 6.97 | 0.109 | 5.42 |

and other wild accessions were found (Table 1) (the differences between groups were significant).

The following varieties were distinguished by hay yield: 'Leningradskaya 853', 'Neva' and 'Triada' (from the Leningrad Agricultural Scientific Research Institute 'Belogorka') and the wild accession from Norway (k-44020) (Table 1).

Varieties 'Khlynovskaya', 'Leningradskaya 853', 'Neva', 'Triada' and the wild accession k-44349 from the Leningrad region were characterized by high seed productivity.

*Biochemical characters*

During the work we noted significant differences in the content of nutrient and biologically active substances of cocksfoot: ascorbic acid, chlorophylls, carotenoids, carotenes, *β*-carotene and protein (Table 2).

On the basis of the research it was established that the accessions were characterized by high value and low variation of dry matter content (average value – 26.5%). The range of variability fluctuated from 24.0 to 28.8%. The highest dry matter content (more than 28%) was found in the wild accessions from the Pskov region (k-38088) and Norway (k-44020); these accessions entered the heading phase earlier than other accessions and reached the full heading phase before cutting. The accession of cocksfoot from the Republic of Karelia (k-00001) has the lowest dry matter content; the accession before the cut was still in the phase of the stem elongation.

The accumulation of protein in the studied accessions was noted at a low level: from 9.3 to 16.5% for absolute dry matter, with an average content of 11.3%. High percentage of protein (over 12.4%) in the studied accessions defined wild accessions from Norway (k-44021), the Leningrad region (k-44349) and the Republic of Karelia (k-00001) and Komi (k-44354) (Table 2).

The assimilating leaves of cocksfoot accumulated a significant amount of ascorbic acid; the average value of ascorbic acid was 40 mg 100 $g^{-1}$. We noted the variability in the accumulation of ascorbic acid in the green mass of various accessions ranging from 30 to 50 mg 100 $g^{-1}$. Three accessions were found with ascorbic acid content above 48 mg 100 $g^{-1}$: wild forms k-00001 (the Republic of Karelia) and k-43142 (the Yaroslavl region) and 'Neva' variety. The wild accession from the Yaroslavl region (k-43142) was characterized by both the highest content of ascorbic acid and the lowest content of pigments (Table 2).

In our experiments, the accumulation of chlorophylls A and B in plants varied greatly depending on the accession (Table 2). The total content of chlorophylls varied from 73 to 215 mg 100 $g^{-1}$ (average content – 148 mg 100$g^{-1}$). We identified three accessions of cocksfoot with a high content of chlorophylls: k-44349

Table 2

**Biochemical composition of cocksfoot, 'Belogorka', 2018**

| Catalogue VIR | Name | Dry matter, % | Ascorbic acid, mg 100 $g^{-1}$ | Chlorophyll A, mg 100 $g^{-1}$ | Chlorophyll B, mg 100 $g^{-1}$ | Carotenoids, mg 100 $g^{-1}$ | Carotenes, mg 100 $g^{-1}$ | $\beta$-carotene, mg 100 $g^{-1}$ | Protein, % |
|---|---|---|---|---|---|---|---|---|---|
| 00001 | Wild | 24.0 | 48.96 | 213.77 | 91.33 | 37.72 | 9.87 | 6.212 | 12.44 |
| 36566 | Tammisto | 26.6 | 44.88 | 177.56 | 71.27 | 29.31 | 7.53 | 5.478 | 11.50 |
| 36682 | VIK 61 | 25.6 | 40.80 | 222.44 | 96.28 | 32.86 | 10.33 | 7.070 | 9.95 |
| 36684 | Dvina | 26.7 | 39.44 | 209.84 | 91.32 | 36.66 | 10.02 | 6.556 | 9.95 |
| 38088 | Wild | 28.8 | 36.72 | 119.95 | 50.04 | 25.24 | 5.99 | 4.201 | 10.26 |
| 43142 | Wild | 26.4 | 50.32 | 101.88 | 44.25 | 18.44 | 4.91 | 3.437 | 10.26 |
| 44020 | Wild | 28.0 | 42.16 | 179.75 | 76.06 | 34.04 | 8.90 | 6.236 | 9.33 |
| 44021 | Wild | 26.3 | 32.64 | 215.66 | 99.11 | 33.28 | 11.04 | 7.370 | 16.48 |
| 44349 | Wild | 26.8 | 32.64 | 271.46 | 129.52 | 37.30 | 12.49 | 8.660 | 12.44 |
| 44354 | Wild | 26.0 | 34.00 | 230.52 | 104.73 | 31.53 | 11.36 | 7.437 | 12.44 |
| 27863 | Leningradskaya 853 | 26.6 | 43.52 | 190.32 | 80.33 | 31.58 | 8.02 | 6.057 | 9.95 |
| 35060 | Neva | 26.0 | 48.96 | 148.82 | 65.18 | 23.18 | 5.59 | 4.668 | 11.81 |
| 38648 | Petrozavodskaya | 26.0 | 38.08 | 239.81 | 105.60 | 37.73 | 11.77 | 7.839 | 11.81 |
| 45034 | Khlynovskaya | 26.1 | 40.80 | 295.75 | 134.33 | 41.28 | 14.65 | 9.310 | 10.26 |
| 48628 | Triada | 27.0 | 29.92 | 263.89 | 113.12 | 48.76 | 13.25 | 7.938 | 10.88 |
| $LSD_{0.05}$ | | 0.58 | 3.53 | 30.02 | 14.50 | 4.13 | 1.59 | 0.911 | 0.98 |

(wild, Leningrad region), 'Khlynovskaya', 'Triada' (over 188 mg 100 $g^{-1}$).

The content of carotenoids in the green mass of cocksfoot (Table 2) varied from 18 to 49 mg 100 $g^{-1}$ (average – 33 mg 100 $g^{-1}$). Two accessions of cocksfoot were distinguished (more than 41 mg 100 $g^{-1}$): 'Khlynovskaya' and 'Triada'.

There was also a strong variability in the content of carotenes in the green mass of cocksfoot. This character ranged from 4.9 to 14.6 mg 100 $g^{-1}$ (average – 9.7 mg 100 $g^{-1}$). Two accessions of cocksfoot showed high rates of total carotene content (more than 13.2 mg 100 $g^{-1}$): 'Khlynovskaya' and 'Triada'.

The studied cocksfoot accessions contained approximately 6.6 mg 100$g^{-1}$ of $\beta$-carotene (range of variation 3.4-9.3 mg 100 $g^{-1}$). It should be noted that in green mass the proportion of $\beta$-carotene composed 80 – 100% of the total amount of carotenes; in the studied accessions of cocksfoot the content of $\beta$-carotene varied from 60 to 84% (average – 69%). Four accessions with a high content of $\beta$-carotene (more than 7.8 mg 100 $g^{-1}$) were identified: wild k-44349 from the Leningrad region, 'Petrozavodskaya', 'Khlynovskaya' and 'Triada'.

Wild cocksfoot from the Leningrad region (k-44349) stood out according to the complex of features (high content of nutrients and biologically active substances).

*Correlation structure of variation*

When analyzing the system of correlations, the following results were obtained:

1. The dry matter content, protein content and foliage do not have significant correlations with other studied characteristics;
2. The yield of hay mass correlates with the height of the plants and the yield of seeds;
3. Seed productivity of accessions is also correlated with the content of pigments and plant height on the 20$^{th}$ day after spring regrowth and before cutting;
4. Plant height on the 20$^{th}$ day after regrowth and before cutting is closely correlated;
5. The content of ascorbic acid has a negative correlation with the content of all pigments;
6. The content of pigments is closely related;
7. The ratio of chlorophylls A and B negatively correlates with the content of carotenoids.

Thus, in the system of variation, two large correlation pleiads are distinguished: a) a pleiad of 'pigments', which includes the content of all pigments, and b) a pleiad of the 'plant's power', with which the height and hay mass of plants are related.

The variability of seed productivity of accessions is also associated with the first and second Pleiads.

The dependence of green yield from the content of chlorophylls, discovered previously by some authors

(Шимко *et al.*, 2009; Тютерева, Дмитриева, & Войцеховская, 2017), was not found.

**Conclusions**

1. Three groups of cocksfoot accessions were identified according to the degree of ripeness for economic use on green mass: a small group of early ripening (from the Pskov region and Norway k-44020) – 31 days, the group of late ripening with the single accession k-00001 from the Republic of Karelia – 51 days, large group of middle ripening with the rest of the accessions – 34-37 days. For the late ripening accession, the mechanism of regulation of the beginning of the generative phase is due to the sensitivity to the photoperiod factor.
2. The adaptive potential of cocksfoot varieties zoned in several regions is wider than that for narrowly localized. Variety 'Khlynovskaya' demonstrated a high value of main economic traits, high intensity of growth in spring, a high content of pigments under the conditions of 2018. This variety was proposed for the southern regions of Russia, and, perhaps, the productivity of the variety under the conditions of 'Belogorka' in the Leningrad region is associated with a very warm vegetative season. The variety 'Dvina' is well adapted to the conditions of the North in the Arkhangelsk region and has not shown its advantage. Variety 'Triada' surpassed in productivity and biochemical indices the other two varieties from 'Belogorka': 'Neva' and 'Leningradskaya 853'.
3. The content of pigments in the green mass of cocksfoot is closely related to each other. The system of pigments in the considered complex of features is located separately, but is positively associated with the seed productivity and negatively with the content of ascorbic acid.
4. Seed production of the studied accessions of cocksfoot is associated with both, the total content of pigments and the power of the generative shoot (length and weight). Thus, when screening cocksfoot for breeding programs, certain relationships of the listed features should be taken into account.

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# ROCK USE TECHNOLOGY FOR IMPROVEMENT MICROBIOLOGICAL INDICATORS OF LEACHED CHERNOZEM

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**Abstract**
Studies were conducted at the experimental station of the Stavropol State Agrarian University on leached chernozem, powerful, low-humus heavy loam on loess-like loam in 2017. The goal was to study the effect of the introduction of rocks rich in chemical composition (limestone-shell rock, apatite and phosphogypsum), both separately and jointly, on the microbial phase of the soil. The determination of the number of microorganisms was produced on dense nutrient medium by direct counting of colonies. It was found that the amount of ammonifiers under the control was 37 ml CFU $g^{-1}$ (colony-forming units), increasing 1.3 – 1.5 times with separate use and 2.5 – 3 times with the joint use of rocks. Similar changes were observed with respect to the number of nitrifiers and aerobic nitrogen fixers of the type *Azotobacter*. The number of cellulose-depleting microorganisms in the remineralization variants reached 220,00 – 230,00 CFU $g^{-1}$ compared to 115,00 CFU $g^{-1}$ under the control. With the introduction of separate rocks, there was a decrease in the occurrence of pathogens, while with a joint introduction they were not detected. The frequency of occurrence of toxin formers, such as *Aspergillus* and *Penicillium,* reached 100% at the control and decreased by 20 – 40% at the experimental variants. It was revealed that the introduction of shell limestone, apatite and phosphogypsum had an effect on the increase in the number of soil microbiota of various physiological groups. Among the fungal microflora, the number of pathogens and toxin formers decreases and the number of pathogen antagonists increases.
**Key words**: rocks, microorganisms, leached chernozem, pathogens, toxin formers, pathogen antagonists.

## Introduction

Remineralization is a way to improve soil fertility by adding rocks that are rich in chemical composition. This method is widely used in the countries of northern Europe on poor soils of the podzolic type.

The object of research is leached chernozem, powerful low-humus heavy loam on loess loam. Chernozems are among the most fertile soils. They, however, do not have a single soil difference that does not require an increase in productive capacity (Tshovrebov *et al.*, 2018; Esaulko *et al.*, 2017).

We believe that leached chernozem needs remineralization. They are at the first stage of degradation (Korobskoi *et al.*, 2012; Podkolzin *et al.*, 2017; Vlasova *et al.*, 2018). The analysis of the mineralogical composition indicates the outlined significant differences between the soil-forming rock and the soil. The alkaline medium of the parent rocks becomes slightly acidic and acidic in the soil. This is especially noticeable in agrocenoses (Russel, 1950; Tshovrebov *et al.*, 2017). As a result of agricultural use, the rate of weathering of the mineral base increases, and the nutritional elements are alienated along with the harvest. This leads to inevitable poor nutrition and steadily declining soil fertility (Titova, Dabakhov, & Dabakhova, 2002; Faizova, Tskhovrebov, & Nikiforova, 2015). Fertilizers alone cannot solve this problem. It is necessary to constantly rejuvenate the mineral basis of soils with mountainous rocks rich in chemical composition.

Soil microflora causes soil formation processes. The number and activity of microorganisms in the soil undergo strong changes in the process of agricultural use of black soil. The microbial association must be considered as a mobile component of the soil that delivers trace elements to plants in a form that is accessible to plants.

## Materials and Methods

The research was conducted at the experimental station of the Stavropol State Agrarian University in 2017. It is located in the Central part of the Stavropol upland. The climate is characterized by moderate moisture, the amount of precipitation 650 – 700 mm and the sum of active temperatures of 2800 – 3000 °C. The relief is flat, parent rocks are loess-like loam. Leached chernozem differs from other topsoil in that the carbonates are washed outside of the soil profile. Many of the nutrition elements released from minerals are removed with them. The main disadvantage of the investigated soils is low or close to low content of mobile phosphorus (15 – 17 mg $kg^{-1}$), potassium (180 – 210 mg $kg^{-1}$), sulfur (3.0 to 4.0 mg $kg^{-1}$), and micronutrient deficiencies such as manganese, molybdenum, cobalt, zinc and copper. In addition, in the absence of free calcium, the soils possess a high degree of fusion, structurelessness, and in the dry period are covered by deep and wide vertical cracks. We can assume that this soil type is in the first stage of degradation. Therefore, the aim of the research is to study the impact of making the rich chemical composition of rocks (limestone, apatite and phosphogypsum) separately and jointly on the microflora of the soil.

Such rocks as apatite, shell limestone and phosphogypsum were introduced as waste in the production of mineral phosphate fertilizers. We made both separate and joint introduction of them according to the

Table 1

**Gross content of nutrients in rocks%**

| Rock | $P_2O_5$ | S | B | Mn | Cu | Zn | Co | Mo |
|---|---|---|---|---|---|---|---|---|
| Phosphogypsum | 3.4 | 20.2 | 0.1 | 1.0 | 0.01 | 0.05 | 0.03 | 0.05 |
| Shell limestone rock | 0.24 | - | 0.2 | 1.5 | 0.5 | 1.5 | 0.2 | 0.13 |
| Apatite | 41.0 | - | 0.15 | 2.3 | 0.4 | 1.3 | 0.09 | 0.1 |

following scheme: 1) Control; 2) Shell limestone rock – 6 t $ha^{-1}$; 3) Shell limestone rock – 12 t $ha^{-1}$; 4) Apatite – 1.5 t $ha^{-1}$; 5) Apatite – 3.0 t $ha^{-1}$; 6) Phosphogypsum – 12 t $ha^{-1}$; 7) Shell limestone rock –6 t $ha^{-1}$ + apatite – 1.5 t $ha^{-1}$; 8) Shell limestone rock – 12 t $ha^{-1}$ + apatite – 3.0 t $ha^{-1}$; 9) Shell limestone – 6 t $ha^{-1}$ + apatite – 1.5 t $ha^{-1}$ + gypsum – 12 t $ha^{-1}$; 0) Shell limestone rock – 12 t $ha^{-1}$ + apatite – 3.0 t $ha^{-1}$ + gypsum – 12 t $ha^{-1}$.

The choice of rocks is due to the content of a large number of micro-and macro–elements (Table 1).

Shell limestone is a rich sedimentary rock of biogenic origin which contains Ca – 36 – 37%; Mg – 0.48%, as well as macro and micronutrients (Table 1). This type was delivered from the quarry of Mount Nedremanny, located at a distance of 30 km from the experimental site.

Apatite is mined on the Kola Peninsula and transported to the city of Lermontov for the production of phosphate fertilizers. It also contains fairly large gross reserves of macro and micronutrients.

Phosphogypsum is obtained from the production of phosphate fertilizers by irrigation with sulfuric acid. The resulting phosphoric acid is used for the production of fertilizers and gypsum is a by-product. Its reserves in the Stavropol region are estimated at millions of tons. It is also a relatively rich improver in chemical composition.

Shell limestone is needed to increase the content of free calcium and trace elements; apatite is necessary to increase the content of phosphorus, calcium and trace elements. Phosphogypsum is used to eliminate the deficiency of sulfur and calcium in the soil.

The introduction of improvers was made fractional. Half of the dose was scattered directly on the stubble, BDT – 7 was dispelled to the depth of 10 – 12 cm, followed by plowing to the depth of 20 –25 cm. Then the second half was added to the ameliorant and BDT – 7 was harrowed, thus achieving complete mixing of the soil with ameliorants. The sown crop was maize for grain (*Veralia hybrid*).

The determination of microorganism number was made on dense selective nutrient medium: on meat-peptone agar – the number of ammonifiers; on ammonium starch agar – the number of microorganisms that assimilate the mineral forms of nitrogen; on the medium Getchenson – the number of cellulose-depleting microorganisms; on the medium of Chapek–doksa – the number of micromycetes. Incubation was carried out in thermostats at a temperature of + 28 °C. Mathematical processing of the data was carried out according to the Dospehov method.

**Results and Discussion**

We have conducted the studies of soil microflora state in the flowering phase of maize. It was found that the number of ammonificators in the flowering phase of maize under control was 36.8 million CFU $g^{-1}$ (Table 2). The use of shell limestone in doses of 6 and 12 t $ha^{-1}$ increased the number of these microorganisms by 1.5 and 2.2 times, respectively. The introduction of apatite in doses of 1.5 and 3 t $ha^{-1}$ and phosphogypsum did not significantly affect the amount of ammonifiers. The joint introduction of rocks had a more significant effect on the number of this group of microorganisms with an increase of 1.6 to 2.6 times. The greatest difference was noted in the joint introduction of rocks in maximum doses.

Studying microorganism number that convert the mineral forms of nitrogen, the dependence inherent to ammonificators is revealed. There is a close metabiotic relationship between soil microorganisms involved in ammonification and nitrification processes. As a result of this relationship, in vivo excretions of ammonifiers serve as food for microorganisms that convert mineral forms of nitrogen. For this reason, changes in the number of nitrifiers are similar to changes in the number of microorganisms that convert organic forms of nitrogen.

The number of aerobic nitrogen fixers at the control was 26,1 CFU $g^{-1}$ with the addition of shell lime in doses of 6 and 12 t $ha^{-1}$ increased 2.6 and 2.8 times, respectively. The introduction of apatite in doses of 1.5 and 3 t $ha^{-1}$ and phosphogypsum provided not so significant increase in the number of this group of microorganisms, only 1.3 – 1.4 times. With the joint introduction of rocks, the number of microorganisms of the type Azotobacter increased 2.1 – 2.4 times. Such dependence, in our opinion, is explained by more favorable conditions for the nutrition of the plants themselves and an increase in the content of trace elements, among which molybdenum plays the most decisive role. It is part of the enzyme nitrogenase and contributes to the activation of nitrogen fixation processes.

In all variants of the experiment, the number of cellulose-depleting microorganisms was higher than under the control. The smallest difference was found

Table 2

**The number of different physiological groups of microorganisms in the soil in the flowering phase of maize depending on the introduction of rocks**

| Test form | Ammonifiers (mln. CFU $g^{-1}$) | Nitrifiers (mln. CFU $g^{-1}$) | Aerobic nitrogen fixers (CFU $g^{-1}$) | Cellulose-depleting (CFU $g^{-1}$) | Fungi (CFU $g^{-1}$) |
|---|---|---|---|---|---|
| 1. Control | 36.8 | 31.2 | 26,1 | 112,7 | 156,5 |
| 2. Shell limestone 6 t $ha^{-1}$ | 55.2 | 49.6 | 67,0 | 129,1 | 197,6 |
| 3. Shell limestone 12 t $ha^{-1}$ | 82.5 | 71.3 | 72,3 | 145,8 | 275,1 |
| 4. Apatite 1.5 t $ha^{-1}$ | 31.2 | 28.4 | 33,7 | 154,8 | 197,4 |
| 5. Apatite 3 t $ha^{-1}$ | 37.5 | 32.1 | 32,9 | 132,0 | 242,0 |
| 6. Phosphogypsum 12 t $ha^{-1}$ | 40.2 | 35.7 | 35,7 | 163,5 | 273,5 |
| 7. Shell lime 6 t $ha^{-1}$ + apatite 1.5 t $ha^{-1}$ | 59.9 | 51.0 | 46,2 | 157,8 | 297,5 |
| 8. Shell lime 12 t $ha^{-1}$ + apatite 3 t $ha^{-1}$ | 84.2 | 72.4 | 69,0 | 230,6 | 264,2 |
| 9. Shell limestone 6 t $ha^{-1}$ + apatite 1.5 t $ha^{-1}$ + phosphogypsum 12 t $ha^{-1}$ | 61.2 | 54.3 | 57,2 | 218,7 | 222,0 |
| 10. Shell limestone 12 t $ha^{-1}$ + apatite 3 t $ha^{-1}$ + phosphogypsum 12 t $ha^{-1}$ | 94.3 | 85.1 | 69,7 | 261,6 | 371,6 |
| $HCP_{05}$ CFU / g | 8.3 | 9.4 | 7,1 | 15,4 | 21,1 |

Table 3

**Frequency of micromycete occurrence in the soil under maize depending on the after effect of rocks, %**

| Experimental variant | Pathogens Toxiners | | | | | | Other saprophytes | | Other saprophytes | | | Pathogen antagonists | | | Shannon diversity index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rhizopus | Fusarium | Botrytis | Verticillium | Alternaria | Bipolaris | Aspergillus | Penicillium | Cladosporium | Absidia | Mucor | Mortierella | Stachybotrys | Trichoderma | |
| 1. Control | 60 | 100 | 20 | 40 | 40 | 40 | 100 | 100 | 40 | 60 | 20 | 60 | 60 | – | 0.94 |
| 2. Shell limestone 6 t $ha^{-1}$ | 40 | 60 | – | 20 | 40 | 20 | 60 | 80 | 20 | 60 | 20 | 80 | 20 | – | 0.99 |
| 3. Shell limestone 12 t $ha^{-1}$ | 20 | 60 | – | 20 | 40 | 20 | 60 | 60 | 20 | 80 | – | 80 | 20 | – | 1.09 |
| 4. Apatite 1.5 t $ha^{-1}$ | – | 80 | 20 | – | 60 | 40 | 80 | 80 | – | 60 | – | 60 | 40 | – | 1.42 |
| 5. Apatite 3 t $ha^{-1}$ | – | 80 | – | – | 60 | 20 | 60 | 80 | 20 | 60 | 40 | 60 | 40 | – | 1.48 |
| 6. Phosphogypsum 12 t $ha^{-1}$ | 20 | 80 | 20 | – | 60 | 20 | 80 | 80 | – | 60 | 40 | 60 | 20 | – | 1.50 |
| 7. Shell limestone 6 t $ha^{-1}$ + Apatite 1.5 t $ha^{-1}$ | – | 60 | – | – | 60 | 20 | 60 | 60 | – | 80 | – | 80 | 20 | 20 | 1.77 |
| 8. Shell limestone 12 t $ha^{-1}$ + apatite 3 t $ha^{-1}$ | – | 40 | – | – | 40 | – | 40 | 60 | – | 80 | – | 80 | 20 | 20 | 1.83 |
| 9. Shell limestone 6 t $ha^{-1}$ + Phosphogypsum 12 t $ha^{-1}$ | – | 40 | – | – | 20 | – | 40 | 60 | – | 100 | – | 80 | 20 | 20 | 2.06 |
| 10. Shell limestone 12 t $ha^{-1}$ + Apatite 3 t $ha^{-1}$ + Phosphogypsum 12 t $ha^{-1}$ | – | 40 | – | – | 20 | – | 40 | 60 | – | 100 | – | 80 | 20 | 20 | 2.11 |

when making shell limestone at doses of 6 and 12 t $ha^{-1}$ (1.1 and 1.3 times, respectively) and apatite at doses of 1.5 and 3 t $ha^{-1}$ (1.4 and 1.2 times, respectively). The introduction of phosphogypsum caused an increase in the number of microorganisms studied by 1.5 times and amounted to 163,5 CFU $g^{-1}$. The largest number of cellulolytics (261,6 CFU $g^{-1}$) was noted with the joint introduction of rocks in maximum doses.

The number of micromycetes under the control was 156,5 CFU $g^{-1}$ of soil. With the addition of shell

limestone in doses of 6 and 12 tons per hectare, the studied value increased by 1.4 and 1.8 times, respectively. On variants of joint introduction of rocks, the studied indicator tended to increase. At the maximum doses of rocks, the number of micromycetes increased 2.4 times and amounted to 371,6 CFU $g^{-1}$.

To determine the phytosanitary condition of the soil, we studied the generic composition of fungi, their frequency of occurrence and divided them into 4 groups: pathogens, toxin-formers, antagonists of pathogens, and other saprophytes.

The highest occurrence of such pathogens as *Rhizopus* (60%), *Fusarium* (100%), *Verticillium* (40%), *Alternaria* (40%), *Bipolaris* (40%) was found under the control. Microorganisms of the type *Botrytis* had the lowest occurrence (Table 3). With the introduction of rocks a decrease in the occurrence of pathogens was found and with the joint introduction of ameliorants, fungi of the type *Rhizopus*, *Verticillium* and *Bipolaris* were not detected. The frequency of occurrence of toxin formers, such as *Aspergillus* and *Penicillium*, reached 100% under control and decreased by 20 – 40%, especially with the joint introduction of rocks. The frequency of occurrence of pathogen antagonists increased with the options for the application of mountain weather, while the number of other saprophytes decreased. It should be noted that antagonist fungi of various pathogens of the type *Trichoderma* were not found under the control and variants with separate use of rocks, and were found on variants with their joint introduction.

The frequency of occurrence of micromycetes on the Shannon index is considered to be poor under control (0.94) and rich in the joint introduction of rocks (2.11). A richer community indicates a better medium sustainability of the soil system when introducing most of the rocks.

**Conclusions**

Thus, as a result of the research, it was found that the number of microorganisms has changed in all variants of the experiment compared to the control. The introduction of shell limestone, apatite and phosphogypsum has a certain effect on the increase in the number of soil microbiota of various physiological groups. Among the fungal microflora, as a result of remineralization of leached chernozem, the number of pathogens and toxin-formers decreases and the number of antagonists of pathogens increases. The abundance of micromycetes according to the Shannon index is considered poor under control (0.94) and rich when rocks are introduced together (2.03 – 2.11).

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# THE ROLE OF COOPERATION FOR THE NEEDS OF BIOECONOMY DEVELOPMENT

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**Abstract**
The concepts of bioeconomy development require the integration of different sectors and economic activities. Bioeconomy helps to achieve the goals of sustainable development. This paper provides an overview of the cooperation for the need of bioeconomy development, examining it from agricultural cooperatives development, theoretical concept and European countries policy and Kazakhstan perspective. The research methods are induction and deduction, monographic, the group interview, statistical data analysis and synthesis, descriptive, matching and comparison and other methods. The cooperation passes through several levels of development – information, consultation, joint action, collective decision-making. The cooperation within farmers (horizontal cooperation) is so far narrow and limited to traditional cooperatives that bring together producers of the same product. New forms of cooperation and more diverse directions in national, regional and local levels are needed to develop the bioeconomy. Partnerships, the interdepartmental and interdisciplinary cooperation based on knowledge and innovation should be established between farmers, agri-food companies and scientific institutions, Kazakhstan and other countries universities. The agricultural and rural development advisory system should be improved, and new measures to promote communication, counseling and cooperation should be introduced.
**Key words**: cooperation, bioeconomy development, Kazakhstan.

## Introduction

In order to achieve the goals of sustainable development, it is necessary to move towards a new way of economic growth, compatible with environmental protection and sustainable use of limited natural resources, while ensuring a significantly higher standard of living and reducing poverty (Bosman & Rotmans, 2016; Lithuanian Bioeconomy..., 2017). One of the factors (key action) which has an influence to the development of bioeconomy, especially when bioeconomy is based on distributed economy model, discussed by P. Luoma, J. Vanhanen, P. Tommila (2011) is the cooperation. In this alternative strategy for the bioeconomy is an important argument that there is a need for the development of a global bio-based economy and distributed production models at the local level. The distributed bio-based economy model is therefore – 'glocal' – both global and local. This distributed model is based on the fact that biomass cannot be easily or cheaply transported long distances. Instead, a distributed bioeconomy stresses the proximity both of the sites where raw material is acquired, and where goods and energy are produced and consumed. K. McCormick, N. Kautto (2013) identified that European Commission (2012) outlined key actions for a coherent bioeconomy enabled. One of them is strengthening cooperation at the international, national and regional levels.

The concept of cooperation has become broader and involves more forms of partnership and cooperation than the ordinary activities of traditional agricultural cooperatives. An essential problem of cooperation in Kazakhstan is that cooperation is not a value for the farmers and other stakeholders. Therefore, the latter research aimed to understand the value of the cooperation, its benefits and aspects of its development, to analyse the state of cooperation in Kazakhstan.

*The research object* is role of cooperation between farmers and other rural stakeholders.

*The research aim* is to define the role of cooperation for the needs of bioeconomy development.

*To achieve the aim, the following tasks were set*: to analyse the theoretical preconditions for the development of bioeconomy and cooperation; to examine the trends of cooperation and agricultural cooperatives in Kazakhstan; to identified the networks and platforms for the needs of bioeconomy development in Kazakhstan.

*The research methods are* induction and deduction, monographic, the group interview, statistical data analysis and synthesis, descriptive, matching and comparison and other methods. Four group interviews (26 farm opinions) were organised after the training on agricultural issues in S. Seifullin Kazakh Agro Technical University. The interviews were carried out with the executives of profitably working private farms and agricultural companies as well as agricultural and rural development professionals, community organizations and non-government organization's leaders. The specific questions addressed: How can the cooperation between public authorities, farmers, researchers, extension services and market actors support a more sustainable (balanced) development? What are the characteristics of farmer's cooperation in the region? Are you aware of companies or farmers who are organizing activities under the principles of bioeconomy development?

**Materials and Methods**

The paper is built on the analysis and synthesis of scientific literature which allow to describe the main terms of bioeconomy and cooperation. Several research methods were applied: monographic, descriptive, analysis and synthesis, induction and deduction.

'The Bioeconomy encompasses those parts of the economy that use renewable biological resources from land and sea to produce food, bio – materials, bio – energy and bio – products' (EU bioeconomy strategy, 2012). Bio-economy is a broad field ranging from agriculture, forestry, food and marine life to production of non-food materials, comprises several economic sectors, academic disciplines, and areas of policy. It is at the centre of several global and EU challenges in the near future such as the creation of growth and jobs, climate change, food security and resource depletion (Philippidis, M'barek, & Ferrari, 2016). It is a cross-cutting issue having an effect on the whole society (Luoma, Vanhanen, & Tommila, 2011). Bioeconomy helps society to meet the challenges that the EU and other countries face. One of the most important challenges is ensuring food security. The Rome Declaration on World Food Security in 1996 defined its three basic dimensions as: availability, accessibility and utilization, with a focus on nutritional well-being (Food and Agriculture Organization of the United Nations, 1996).

Managing natural resources sustainability and reducing dependence on non-renewable resources can only be overcome by developing the bioeconomy. For example, forest-based bioeconomy can contribute to climate change adaptation and mitigation. According the M. Lindner, M. Hanewinkel, G. Nabuurs (2017) findings measures that support active management and sustainable use for forests can contribute to the climate change adaptation and mitigation and bioeconomy development. The cooperation between the stakeholders and win-win solutions can ensure that forests remain stable and productive.

Most often, agricultural processing companies are located in cities. Concentration of jobs in cities and geographical mobility of labor force in rural areas poses a number of problems. Some rural areas are no longer able to carry out economic functions and become completely unattractive to young people. There is a threat to the development of public good and the complete depopulation of the regions. One of the most important strategic goals of the bioeconomy should be the creation of new jobs, the convergence of work and living places, the management of geographical mobility of the workforce, the strengthening of the competitiveness of rural regions.

Sustainability should be considered as part of the long-term time dimension in the assessment of food security (Berry *et al*., 2015), managing natural resources and others factors. Sustainability, which generally defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs, can be achieved through the development of the bio-economy. So, bioeconomy is here to stay. It is much more than just biomass-based production or biotechnology. Bioeconomy is a societal strategy to combat climate change and the increasing scarcity of natural resources (Luoma, Vanhanen, & Tommila, 2011).

Without integrating sustainability as an explicit dimension of food security (Berry *et al*., 2015), managing natural resources, today's policies and programmes could become the very cause of increased food insecurity in the future. To modify program design and practice in ways that help to realize the great potential of bioeconomy, the stakeholders can overcome four levels of cooperation: information, consultation, joint action, collective decision-making.

Two key messages came from A. Wijering (2017), the member of Standing Committee of agriculture research (SCAR), during the presentation about contribution to stimulate the bioeconomy: balanced attention is required for all the (knowledge) demands in the bioeconomy. As areas influence each other, this demands an integrated systems approach; the added value of the bioeconomy lies in the interaction of the bioeconomy areas providing opportunities for new innovation (Langeveld, 2015).

Collaboration can help achieve outcomes that might otherwise be impossible. To do so, collaboration requires effort to nurture human relationships. People represent organizations, agencies, or occupations, but they are fundamentally human beings. 'The situation of two or more people working together to create or achieve the same thing' (Cambridge Dictionary) can be defined as collaboration. According to B. Gazley, J. Brudney (2007), collaboration is a 'process by which organizations with a stake in a problem seek a mutually determined solution pursuing objectives they could not achieve working alone'.

Cooperatives are people-centred enterprises owned, controlled and run by and for their members to realise their common economic, social, and cultural needs and aspirations. The concepts of bioeconomy development require the integration of different sectors and economic activities that can be achieved through regional/cross-border cooperation. However, cooperative stakeholders need to have confidence and responsibility and accountability. Cooperation is a form of business where two or more people share ownership, the responsibility for managing the company and the income or losses the business generates. That income is paid to partners, who then claim it on their personal tax returns – the business is

not taxed separately, as corporations are, on its profits or losses.

According to scientists (Boardman, 2009; Brostrom, 2008; Chen, Yen – Chun Jim, & Wen-Hsuing, 2013), the main motives for co-operation are the following: benefits, belief in the value of collaboration and the importance of teamwork, continuous improvement, at the same time creating and sharing knowledge, pursuing prosperity using the available potential, etc. N. Miginis and M. Ulozas (2014) describe it as complementary cooperation between government, state institutions (health, education, environment, culture, sport, etc.), society, non-governmental organizations, business and media. The scientists distinguish the following essential features of cooperation:

- It is a well-defined and complementary cooperation between two or more sectors, but brings together as many stakeholders as possible for joint actions cooperation, added value creation;
- The sectors combine activities, ensure effective communication, resource use and leadership;
- Inter-organizational cooperation based on the set goals that aim to form a systematic, consistent and effective interaction.

It can be assumed that co-operation is a process in which cooperating actors seek a common mission, goals and efforts to achieve them. The end result, the value created by the actors is most satisfying. In the context of the development of bioeconomy, organizations are pooled to form joint activities, share activities, share resources, build capacity, and create new added value for all stakeholders and at the same time for society.

R. Bosman, J. Rotmans (2016) made the comparison analyses of Finland and the Netherlands on transition governance towards a bioeconomy. They found out, that in Finland and Netherlands it is very important to stimulate 'hybrid collaboration between agile and risk-taking niches (start-ups, small and medium enterprises), and risk-aversive elephants (traditional big companies), could be fruitful in accelerating the transition'.

S. Holtinger, M. Weigl (2017) made research in Central, East and South-East Europe, in particularly the Danube regions, and conclude, that the region could have a competitive advantage by shifting to bioeconomy as a comprehensive, innovative and sustainable economic paradigm. This would give an impulse to wide-ranging modernization, with positive impacts on economic growth, job creation, rural development, environment, etc. But the main barrier and weakness was identified 'lack of coordination among stakeholders, a limited access to finance, infrastructural weaknesses and depletion, instable regional/cross-border cooperation among stakeholders' (Holtinger & Weigl, 2017). W.C Clarka, P. Thomas, T.P. Tomichb, M. Van Noordwijkc, D. Gustond, D. Catacutane, & E. McNief (2016) made research of boundary work for sustainable development and conclude that especially important are arrangements regarding participation of stakeholders, accountability in governance, and the use of 'boundary objects'. The improving the ability of research programs to produce useful knowledge for sustainable development will require both greater and differentiated support for multiple forms of boundary work.

There are issues in Russian bioeconomy, which needed to be considered. Law does not fix the content of biofuel in gasoline. Only biofuels based on agricultural crops counted). It is recommended to correct these flaws. Biogas production is not industrial, not supported by law (stimulated by the need for waste disposal). Producing pellets with the adjusted production and the abundance of raw materials, Russian large manufacturers under load their production capacity and manufactured products are exported. It is recommended to establish infrastructure for internal use of pellets. Solid fuel (wood and peat pellets) is a full-fledged, marketable product that has not high demand in Russia, but is in demand among foreign consumers (Kudryavceva *et al*., 2016).

In the study assumed that the bioeconomy has the potential to improve the living conditions of farmers, foresters and other stakeholders – by cooperation and creating additional outlets for higher value-added products as well as promoting innovation in the primary sector. There are four levels of cooperation between farmers: information, consultation, joint action, collective decision-making. A bio-based economy is a new way of thinking of how to live in a sustainable way.

**Results and Discussion**

*The challenges and relevant strategies for the cooperation in Kazakhstan.* Cooperation within farmer's time to time attracts attention from state authorities and then become in the priorities list of agricultural reforms. In connection with the need to regulate production relations in agriculture, the first law on agricultural cooperation called 'About Production Cooperative' was issued in 1995. The number of agricultural cooperatives increased up to 2540 in 1995 from 487 in 1994.

New Law on Agricultural Cooperatives entered into force in 2016. According to it, the cooperatives in the agriculture of Kazakhstan operate in the form of a production cooperative and become commercial. The main players were supposed to be house holdings and small business (farmers). Until January 2016 all cooperatives in agriculture were non-commercial.

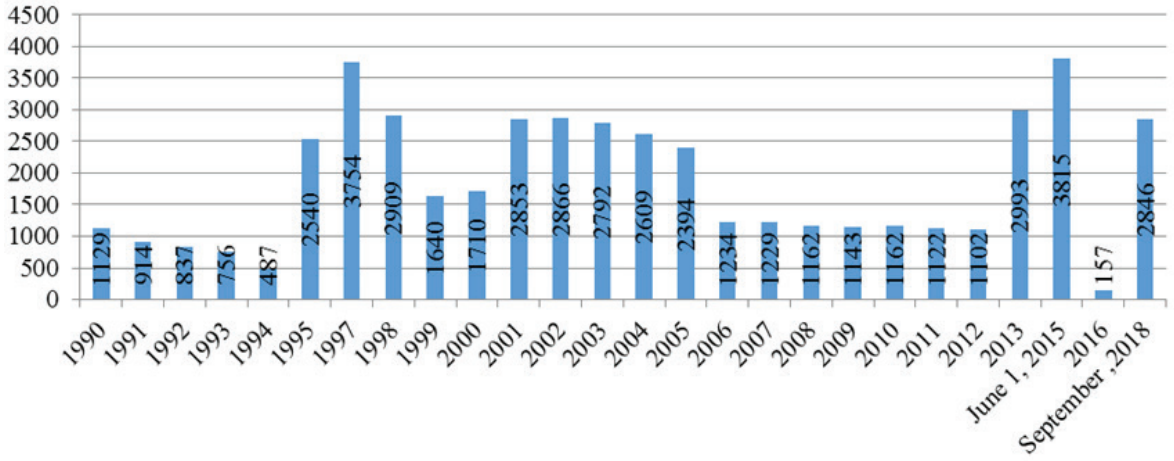


Figure 1. Number of operating agricultural cooperatives in Kazakhstan, September 1, 2018.
Number of Agricultural Cooperatives in Kazakhstan

Source: Official website of Statistics Committee of the Ministry of national Economy of the Republic of Kazakhstan.
Note: in 2016 only a number of new cooperatives launched under New law.

According to incomplete data, in 2015 there were 3,815 cooperatives of different types in rural areas, which after the adoption of the new law had to be reorganized into one type of agricultural cooperative – agricultural producer co-operative, where agricultural cooperative can engage in various types of economic activities. Thus, in Kazakhstan there are agricultural cooperative, formed earlier, having some work experience and new agricultural cooperative, mainly dairy and meat directions, formed after enacting the new law.

Since 2017, the national statistics authorities have started to keep separate records on agricultural cooperatives with the following data: the number of agricultural co-operative and their members; unit trust; number of employees; production, purchase, sale, procurement of products; provision of services; availability of agricultural machinery; the presence of livestock and poultry.

In the first half of 2018 in Kazakhstan, 2872 agricultural cooperatives are registered. 43% of them operate in livestock. The number of entities increased 1.3 times in comparison to previous year.

The number of agricultural cooperatives increased during 2018 to 5%. The main regions united in agricultural cooperatives are Turkestan, Eastern Kazakhstan, Akmola, Western Kazakhstan, Kyzylorda and Almaty representing total 67%. Due to unfavourable climatic conditions in Mangystau and Atyrau oblasts, the agricultural sector is poorly developed, and therefore the number of employees in agricultural cooperatives is insignificant compared to other regions.

The main specialization of cooperatives is milk and meat direction of livestock (42%), seasonal cultivation (7%).

However, as announced by First Vice-Minister of Agriculture of Kazakhstan, 42% of those registered cooperatives created formally, 18% are virtually inactive. According to new agricultural reforms, since 2016 state authorities propose to maintain three measurable key indicators with an annual growth of at least 10%. This is:

- the growth of labour productivity of all the participants of cooperatives,
- the growth of revenue from sales of products, including from exports, as well as

the growth of investments in fixed assets, for example, for the purchase of agricultural equipment. (Report of the First Vice-Minister of Agriculture Evniev A.K., 2018).

The welfare of their cooperative can be tracked online. The Ministry of Agriculture is launching a special portal for monitoring the key indicators for agricultural cooperatives.

Although the number of agricultural cooperatives has increased since state initiatives the share of planned key participants such as individual house holdings is still low presenting as their members only 29 073 (1.6%) house holdings and 27399 farmers (14.9%) at the beginning of 2018. Share of entities cooperated is 3.7%. State budget spent 4.7 M USD or 2% on subsidies to agricultural cooperatives. From 2020 subsidies will be given only entities not individual farmers. It is believed that it triggers farmers to enter cooperatives. Agricultural cooperatives are considered to be of horizontal and vertical (cluster) types. In Kazakhstan so far horizontal cooperatives are registered, but vertical cooperation still needs to be established.

In general, it can be said that small-scale agricultural commodity producers understand the

need for cooperation, but due to psychological factors, they do not dare to unite into cooperatives. Despite the fact that a number of government measures have been developed to support agricultural cooperation, the indecisiveness of all respondents does not diminish (Balkibayeva & Orazbayeva, 2012).

Over time, the opinion of the farmers is changing. When we re-surveyed a group of farmers, it is necessary to emphasize that the level of awareness turned out to be higher: farmers are interested in receiving comprehensive information about cooperation from various sources. At the same time, they are interested not only in theoretical aspects of the activities of cooperatives, but also in domestic and foreign experience in agricultural cooperation. One of the positive aspects is that some farmers are already in agricultural cooperation.

According to the results of the audit by the Presidential Administration in 2018, a number of systemic problems were identified that hinder the effective development of agricultural cooperation. This is a large proportion of inactive (18%), and formally created cooperatives (42%). Within problems facing by agricultural cooperatives were founded such as problems with processing and marketing of products manufactured by members of cooperatives, insufficient measures to stimulate the development of cooperatives, lack of agricultural land as well as the discrepancy of local authority (akimat's) data with official statistic data. According to analytical data of Ministry of agriculture the main limiting factors were: low level of explanatory work and lack of state support measures. Due to the low level of information work and the practical lack of propaganda of positive experience, there is a lack of understanding of the goals, principles and processes of cooperation on the ground. Often there is a formal creation of cooperatives as means to gain access to concessional loans (Ministry of Agriculture of Kazakhstan, 2015).

Ministry of Agriculture in 2015 updated the current state program, where 6 key problems of the agro industrial complex have been identified, the solution of which is facilitated by agricultural cooperation. There are: low labour productivity; low competitiveness of products, as a result - the lack of loading of processing enterprises; low technical equipment; lack of knowledge; low yield from sales of products; high overhead costs.

Insufficient amount of preferential credit resources from the republican budget to support established rural consumer cooperatives, also lead to negative reactions to co-operate between small commodity producers.

*The networks and platforms for the needs of bioeconomy development in Kazakhstan.* In Kazakhstan agricultural units like community type are organized mostly by sectors of agricultural economy, for instance Poultryman union, Meat Union, Potato producers Union, Farmers Union, Dairy Union etc. National Chamber of entrepreneurs registered in 2015 is considered as very active non government organization which united all entrepreneurs despite of industry.

National Union of Agricultural Cooperatives was established in 2017, but currently it has stopped its operation. The reason is agricultural cooperatives support was stopped by new Ministry of agriculture.

Farmers Union as non government unit to cooperate farmers was established in 2003. Over 10, 000 farmers are members (5%) of Farmers Union. The main aim of the organization is to support farmers, represent their interests and rights.

More than a half of rural NGOs in Kazakhstan (53.8%) represent small organizations, the number of staff of which is not more than 3 persons. The biggest proportion of such large-scale rural NGOs we can see in southern region (39.1%) what is determined by the largest part of rural population in Kazakhstan living there (60% by the beginning of 2004), as well as by the lowest living standards in that region of the country (Saktaganova, & Ospanova, 2013).

There are State Enterprise, business and governmental organizations, which act in the interdisciplinary cooperation. State Enterprise 'National Center for Biotechnology' (NCB) – the country's leading biological center supports bioeconomy aims and plays an important role, implementing the State policy on support and development of biotechnology industry – was founded in 1993. The center implements and coordinates the government-funded scientific – technical programmes in the field of biotechnology, biosafety and ecology.

As part of cooperative projects NCB cooperates with other structures in the form of 4 consortiums:

- *The Corporate Research Center for Biopreparations and Vaccines Production*. Based on 'BIOTRON GROUP' LLP there are established scientific laboratories of NCB for development and production of new biotechnology products.
- *The Eurasian Biomedical Technology Platform* **(**2014). The Consortium members: on part of the Russian Federation – Non-commercial Partnership 'Technology Platform 'Medicine of the Future'', on part of the – SI 'Belarusian Institute of System Analysis and Information Support of Scientific and Technical Sphere', on part of the Republic of Kazakhstan – BCB. The Consortium is a permanent coordinating and advisory body formed to organize effective interaction of research, educational, industrial and other organizations on the issues of preparation

and implementation of projects in the field of biomedicine.

- *The Eurasian Biotechnology Platform***.** Members are Russia, Belorussia and Kazakhstan. The Consortium is a permanent coordinating and advisory body formed to multiply the creative and technical capabilities of its members. All of the biotech community of the Eurasian Economic Commission member states, by means of concentration of intellectual and administrative resources of the states, businesses, educational institutions and non-governmental organizations aimed at development and effective use of biotechnology for benefit of science, education, industries, social and public needs.
- *The Innovative-Educational Consortium 'Biotechnology'*. The Consortium members are NCB and Kazakhstani universities (National Center for Biotechnology, 2019).

The interviewed farmers knew little about innovative centers and platforms. Key factors have been identified that limit cooperation: the insufficient information on the procedure of creating cross sectorial cooperatives, platforms; lack of motivation and knowledge how to participate in the State Enterprise 'National Center for Biotechnology' activities; lack of qualified middle-level specialists as consultants; the difference in the life values of individual farmers.

**Conclusions**

1. Agricultural cooperatives of Kazakhstan have a very small share in the market and their activities are usually focused on sales of the raw material rather than on processing and marketing. After new Ministry team, coming no further support was given to promote agricultural cooperatives movements. A result, the number of formed cooperatives is decreasing. National Union of Agricultural Cooperatives was established in 2017, but currently stopped its operation due to the above-mentioned reason.
2. Representing Kazakhstan farmers' organizations, the role of the farmers' organizations in self-government does not work on the principles of self-organization. The further steps of municipal organizations, uniting farmers, are strengthening the representation of the farmers, positive self-image and larger increase in the number of the members.
3. The cooperation within farmers (horizontal cooperation) is so far narrow and limited to traditional cooperatives that bring together producers of the same product. New forms of cooperation and more diverse directions in national, regional and local levels are needed to develop the bioeconomy. It is time and place to be integrative and complex for either individual farmers or enterprisers and other members of agro industrial complex.
4. The analysis of scientific literature, the strategic provisions of the European Union countries and the small experience of Kazakhstan have shown that cooperation plays a major role in the development of the bioeconomy.
5. There are business organizations in Kazakhstan that plan to develop their activities according to the principles of bioeconomy. In order to achieve the bioeconomy potential, primary producers need to play a more active role in the value creation of the bioeconomy supply chains. The agricultural and rural development advisory system should be improved, and new measures to promote communication, counseling and cooperation should be introduced.
6. Partnerships, the interdepartmental and interdisciplinary cooperation based on knowledge and innovation should be established between farmers, agri-food companies and scientific institutions, Kazakhstan and other countries universities.
7. As financial assistance, we consider it possible to provide grant funding for projects that are breakthrough in their significance and scope for the development of the bioeconomy, in which agricultural producers, cooperatives, and other organizations participating in the "research-production-sales" chain will be involved.

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# COMPARISON OF THE SUPPORT FOR CATCH CROPS IN THE BALTIC SEA REGION COUNTRIES

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**Abstract**
Catch crops contribute to soil and environmental quality, which has determined a growing interest in their use as a nature-based solution. Though, the introduction of catch crops increases the complexity of farm management and is related with additional costs. In Latvia, the area under catch crops accounts for less than 5% of the arable land, while 30% is bare over the winter. In order to identify the possibilities for promoting of catch crops in Latvia, the objective of the study is to explore the support practices for growing of catch crops in the Baltic Sea region countries. The paper seeks to explore the main benefits associated with the growing of catch crops, followed by the study and synthesis of the main support measures. For the study, numerous information sources have been explored and appropriate research methods applied. Catch crops reduce nutrient leaching from the soil, transfer nutrients to the next crop, improve soil quality, reduce soil erosion, and mitigate climate change; these benefits can translate also at farm level, mainly as reduced N inputs. Growing of catch crops is being increasingly supported in the Baltic Sea countries – as a greening measure and by different agri-environment and climate measures of the RDPs 2014-2020. Growing of economic focus area catch crops (supported in quite a similar approach in these countries) and introduction of agri-environment scheme for catch crops (supported in directly and/or indirectly targeted way) can contribute to the solving of environmental problems and decrease the share of bare land left over the winter in Latvia.
**Key words**: catch crops, support, ecologic focus area, the Baltic Sea region countries.

## Introduction

Catch crops are grown as supplementary crops after harvesting of the main crop with the primary purpose of capturing excess N released from the remains of the harvested crop or the soil and thus preventing leaching losses (Cicek *et al*., 2015; Guo *et al*., 2018; Molinuevo-Salces *et al*., 2013). They also ensure soil protection by providing plant cover after the harvest of the main crop. The term 'catch crops' is very often used interchangeably with the term 'cover crops'. In the context of the EU statistics and land use modelling, cover crops are defined as the crops that are not normal winter crops or grassland but are sown specifically to protect bare soil in winter or other periods when it would otherwise be bare and susceptible to losses. The economic interest of these crops is low, and the main goal is soil and nutrient protection (Eurostat, 2013b; Panagos *et al*., 2015). Catch crops may be undersown at the same time when the main crop (i.e., under-sowings), or catch crops may be grown between the two main crops and sown after the harvest of the main crop (i.e., intercrops).

Due to the significant contribution to the soil conservation and environmental quality, there has been a growing interest in considering catch crops as a nature-based solutions (NBS) practice globally, indicated, e.g., by doubling catch crop area in the United States of America (Daryantoa *et al.*, 2018). Also, in Europe, the interest in catch crops has been expanding by the introduction of the greening component to the direct payment system in 2015. Overall, the growing of catch crops has been widely applied land management practice in temperate climates of Europe (De Baets *et al*., 2011), though, the introduction of these crops can add to the complexity of farming (Daryantoa *et al*., 2018). Therefore, the number of catch crop growers is still limited due to the challenges associated with adoption of the practice, particularly for smallholders, which include the lack of knowledge and skills, access to cover crop seeds, training and technical assistance (Daryantoa *et al*., 2018).

In Latvia, the area under catch crops accounts for less than 5% of the arable land, while 30% of the land is left bare over the winter (CSB, 2018), which along other Baltic States is the largest indicator in the Baltic Sea region countries (Eurostat, 2013a). However, according to the environmental objectives of the future CAP, soil protection and quality conditions will require that there is no bare soil in most sensitive periods (EC, 2019). Growing of catch crops is related with additional costs for farmers, but up to now there has been a limited experience regarding the introduction of relevant and efficient catch crop solutions into farmland management practices, including related support measures in Latvia.

In order to identify the possibilities for promoting of catch crops in Latvia, the objective of the study is to explore the support practices for growing of catch crops in the Baltic Sea region countries. The paper first seeks to explore the main benefits associated with the growing of catch crops, followed by the study and synthesis of the main support measures for catch crops provided by the greening requirements of direct payment system and agri-environment and climate actions of national rural development programmes (RDPs) for 2014-2020 in the Baltic Sea region countries.

In the study, the Baltic Sea region countries refer to the European Union (EU) countries having a shoreline along the Baltic Sea – Latvia, Lithuania, Estonia, Poland, Finland, Denmark and Germany.

**Materials and Methods**

The main data sources for the study are the national RDPs 2014-2020 of the analysed Baltic Sea region countries (Bavaria is chosen for Germany) prepared by the relevant ministries, complemented by the detailed information on the support requirements available from the national agricultural support paying agencies (websites) in each of the countries. Different publications and papers, e.g., research papers and the reports of institutions have also been applied in the study.

For various solutions in the process of the study appropriate qualitative and quantitative research methods have been used: monographic, analysis and synthesis, data grouping, logical and abstractive constructional, etc.

**Results and Discussion**

*The main benefits of the growing of catch crops*

The main benefits associated with the growing of catch crops is the reduction of nutrient leaching from the soil, transfer of nutrients to the next crop, improving of soil quality, reduction of soil erosion by water, as well as mitigation of climate change, which can translate also as a farm level benefits, mainly as reduced N inputs and the possibility to reduce the costs of mineral fertilisers.

Intensive agriculture and bare soils increase the risk of N leaching to groundwaters, causing water pollution and eutrophication of water bodies, with negative impacts to human health and the environment. Generally, the leaching occurs due to the oversupply of N from the soil and fertilisers exceeding the needs of agricultural crops. The period of a particular risk of leaching is late-autumn and winter, when residual N from the harvest of spring crops is exposed to leaching due to more frequent drainage events. Catch crops grown during the autumn-winter period between two main crops in annual rotation are considered an effective solution to decrease N leaching due to their ability to capture soil mineral N (Couëdel *et al*., 2018, Teixeira *et al*., 2016). Furthermore, catch crops have been shown to be more effective in capturing excess N than such management practices as reduced tillage and reduced fertiliser inputs (Cicek *et al*., 2015; Valkama *et al*., 2015). To maximize N uptake, early establishment of catch crops is generally recommended (Teixeira *et al*., 2016). Under-sowings enable an immediate uptake of residual N after the harvest of the main crop, and they are considered particularly potential in the countries with a short growing season, where the time after the main crops is too short for post-harvest catch crops (Peltonen-Sainio *et al*., 2015; Valkama *et al*., 2015).

After the end of the vegetation, nutrients that have been up-taken and retained in catch crops can be transferred to the following crop, upon catch crop biomass incorporation into the soil (Couëdela *et al*., 2018; Piotrowska-Dlugosz & Wilczewski, 2015; Tosti *et al*., 2014). Late catch crop termination is usually recommended as this allows higher N accumulation in the biomass and also provides better synchronization of the released N from the decomposing catch crop residues with N uptake by the next crop (Daryantoa *et al.*, 2018). Catch crop residue decomposition and subsequent N mineralization depends primarily on soil temperature, water content, biochemical constituents, residue quantity and inversely proportional to the C:N ratio. (Couëdela *et al*., 2018; Piotrowska-Dlugosz & Wilczewski, 2015; Tosti *et al*., 2014). Catch crop use as a green manure is considered to be an important management practice with the potential to reduce the dependence on mineral fertilisers (Piotrowska-Dlugosz & Wilczewski, 2015).

Along with nutrients retention, catch crops have been recognized as a favourable practice for the accretion of soil organic matter (SOM) (Piotrowska-Dlugosz & Wilczewski, 2015). SOM is a major nutrient source for plant growth, it also affects the activities of soil microorganisms and improves soil structure (better aeration, moisture retention, buffering and exchange capacity) (Function of organic…). The growing of catch crops increases C inputs into the soil, thus increasing soil organic carbon (SOC) (Piotrowska-Dlugosz & Wilczewski, 2015; Poeplau & Don, 2015). Catch crops have a positive impact on maintaining or improving soil structure (Peltonen-Sainio *et al*., 2015), they improve soil physical, biological and chemical properties (Cerdà *et al*., 2018). Catch crops can also provide agronomic services including certain soil microorganism induction, rarer incidence of certain soil pathogens and early-season weeds (Daryantoa *et al.*, 2018).

Catch crops improve soil quality also by reducing soil erosion (Molinuevo-Salces *et al*., 2013). As most of SOM is in the topsoil, with soil erosion, SOM is lost with it (Funderburg, 2016). Thus, soil erosion not only affects soil fertility and the resulting crop productivity, but it also contributes to the pollution of water bodies (Ritter, 2018). The use of catch crops for erosion control is related to their capacity to act as a buffer in reducing water-induced soil erosion by rainfall, to increase water infiltration rate resulting in less runoff volume, to reduce the flow rate of runoff across the soil surface, and binding of soil particles with plant roots (De Baets *et al*., 2011; Kaspar, 2009). To be effective, catch crops must be quick to establish, provide an early plant cover, be aggressive enough to

suppress weeds and have a deep root system (Morgan, 2005). Catch crops can be a very effective erosion control and environmental conservation technique (De Baets *et al*., 2011).

Growing of catch crops is an important management option to increase SOC stocks in agricultural soils thus mitigating climate change. It has been found that catch crop potential is the same as for other organic-input-related C sequestration management options in agricultural soils and almost as effective as land-use changes like afforestation of croplands (Poeplau & Don, 2015). Considering that catch crops reduce N leaching, they have a potential to contribute to the reduction of indirect $N_2O$ emissions. Though there is not a consensus regarding the effect of catch crops on direct $N_2O$ emissions as they do not always reduce direct $N_2O$ emissions from the soil surface in the short term. In general, catch crops have seemingly a greater potential to reduce $N_2O$ emissions when nonlegume species are grown and their residue is not incorporated into the soil. Even a small reduction in $N_2O$ emissions from agricultural soils can have a large impact on global warming because $N_2O$ is about 300 times more potent than $CO_2$ (Basche *et al*., 2014).

Along the potential benefits of catch crops to farmers, the introduction of catch crops, as it has been mentioned before, can also make farm management more complex. Some other disadvantaged mentioned for catch crops include reducing water availability, especially in dry periods, as well as competition with the main crops for nutrients in the case of under-sowings (Valkama *et al*., 2015; Daryantoa *et al.*, 2018).

The support for catch crops in the Baltic Sea region countries

Due to the associated environmental benefits, the growing of catch crops is being increasingly supported in farmer support schemes in the EU countries – mainly as a greening measure and by different agri-environment and climate measures of the RDPs 2014-2020. The first refers to the mandatory greening requirements introduced in 2015 regarding the preservation of permanent grassland, crop diversification and having ecological focus area (EFA), the observation of which allows receiving direct payments - basic payment alongside greening payment. The general rule is that farms with more than 15 ha of arable land ensure that at least 5% of their arable land is EFA. The area under catch crops or green cover was one of the available options countries could choose to be considered as EFA, and one ha of catch crops is counted as 0.3 ha of EFA (Regulation 1307/2013). While greening is a compulsory requirement set by the CAP, agri-environment measures go beyond mandatory standards and provide additional environmental benefit (Sulima, 2016).

The possibilities to declare the area under catch crops as EFA in the Baltic Sea region countries is summarized in Table 1. For Germany the case of Bavaria has been studied as it is the state with the largest arable land area.

Catch crops are not defined as one of the categories eligible for fulfilling of the EFA requirement only in Estonia and Finland. In other Baltic Sea region countries both under-sowings and intercrops classify for the EFA. Overall, under-sowings should consist of grasses and/or legumes, while intercrops should be a mixture of at least two crops. The most flexibility for intercrop species is provided in Poland as the eligible crops are defined quite broadly (cereals, oilseeds, fodder, legumes and melliferous plants), followed by Denmark (in general case).

Considering the dates by which EFA intercrops should be sown and dates until which they cannot be destroyed, generally they have to be maintained for about 60 days in the Baltic Sea countries, with the exception of Bavaria, where the mandatory period is almost 140 days, and Poland, if the option of winter intercrops is chosen. In Denmark, intercrops should be maintained for about 80 days, only for some crops the period is 60 days.

Generally, there is a requirement that EFA intercrops should be followed by a different main crop than the catch crop. It is forbidden to apply plant protection products during the period of the maintenance of intercrops. In Bavaria, catch crops can be used as a pasture for sheep or goats. Also, in Denmark defined uses of EFA catch crops are allowed if an appropriate green mass of catch crops can be ensured. To avoid double financing, it is not possible to declare the same area of catch crops for agri-environmental support and as EFA at the same time.

The available data of 2016 in Figure 1 indicate that the area under catch crops accounts for 30% of the total area declared as EFA in the EU-28. In Denmark, almost all EFA is comprised of catch crops and green cover, followed by Germany and Poland. At the EU-28 level, more popular option than catch crops has been only nitrogen fixing crops (47%). These two choices both can be considered as more productive options, which could largely explain their popularity. When explaining the preference towards catch crops of German farmers, the easy implementation, possibility to integrate in crop-rotation, continuing cultivation of the land, established management practices, erosion protection, maintenance of soil fertility, land cover as a shelter for wild animals were identified, with disincentives being reducing water availability and challenge to determine possible crop combination (Zinngrebe *et al*., 2017). In Denmark, the fact of established management practices arising from the mandatory catch crop growing requirement and the

Table 1

**Catch crops as EFA in the Baltic Sea region countries (based on requirements for 2018)**

| Country | Types | Variety of species | Sowing date | Termination date |
|---|---|---|---|---|
| Latvia | under-sowings, intercrops | under-sowing of grasses and legumes; mixture of a minimum of 2 intercrops[1] | by September 1 (intercrops) | after October 31 (intercrops) |
| Lithuania | under-sowings, intercrops | under-sowing of grasses or legumes; mixtures of a minimum of 2 intercrops[2] | from April 1 to June 30 (under-sowings); from June 30 to August 15 (intercrops) | after October 15 (or until sowing of winter crops (under-sowings); or 8 weeks after sowing of a mixture) |
| Estonia | - | - | - | - |
| Poland | under-sowings, intercrops | under-sowing of grasses or small-seed legumes; mixtures of at least 2 intercrops[3] | from July 1 to August 20 (stubble intercrops); from July 1 to October 1 (winter intercrops) | after October 15 (or 8 weeks after sowing of a mixture) (stubble intercrops); after February 15 (winter intercrops) |
| Finland | - | - | - | - |
| Sweden | under-sowings, intercrops | under-sowing of grasses and/ or legumes; mixture of at least 2 intercrops[4] | before September 1 (intercrops) | from November 1 |
| Denmark | under-sowings, intercrops | under-sowing of grasses and/ or legumes; mixture of at least 2 intercrops[5] | by June 30 (under-sowings); from June 30 to August 1 or August 20 (intercrops) | from October 20 (or 8 weeks after the harvesting of maize (under-sowings)) |
| Germany (Bavaria) | under-sowings, intercrops | under-sowing of grasses and/ or legumes; mixture of at least 2 intercrops[6](max 60% for one crop; grasses max 60%) | by October 1 (intercrops) | after January 15; after February 15 |

[1]summer rape, Italian ryegrass, white mustard, oil radish, oats, phacelia, buckwheat, summer vetch, winter vetch, rye, beans, peas or fodder radish.
[2]listed in Regulation on direct payments (December 4, 2015 No. 3D-897).
[3]cereals, oilseeds, fodder, legumes and melliferous plants (mixtures cannot consist of cereals only).
[4]beet, red clover, buckwheat, oats (spring), phacelia, barley (spring), oil radish, Persian clover, bristle oat, ryegrass, rape (spring), turnip rape (spring), rye (spring), triticale (spring), radish, sunflower, subterranean clover, Sudan grass, tagetes, wheat (spring), vetch, white mustard, pea. The mixture must not contain any other than these crops.
[5]cereals, grasses, cruciferous plants, chicory and honeycomb (by August 1); spring barley, common rye, perennial rye, hybrid rye or oats, cruciferous plants, honeycomb (by August 20).
[6]listed in Appendix 3 of DirektZahlDurchfV (Regulation on the implementation of direct payments).
Source: based on the support requirements available from the national agricultural support paying agencies.

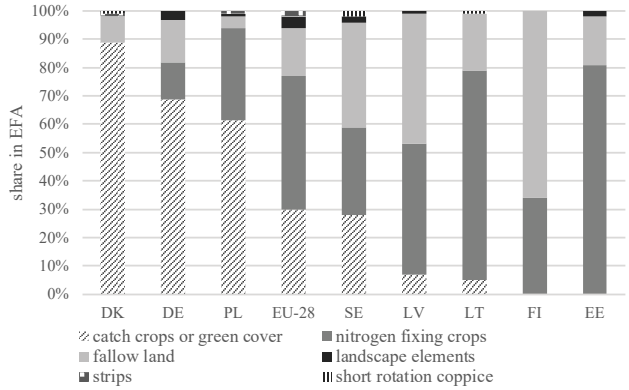


Figure 1. Composition of EFA in the Baltic Sea region countries in 2016.
Source: based on DG Agri (2018) data.

possibility to declare mandatory catch crops also for the EFA could be the main explaining factor for its high share. As the growing of catch crops is related to additional production costs, this could be one of the reasons for small popularity of catch crops in Latvia so far because farmers lack experience and confidence about the benefits that catch crops can provide at the farm level.

The overview of the support to catch crops under agri-environment and climate measures of the RDPs

Table 2

**Catch crops within agri-environment measures of RDPs 2014-2020 in the Baltic Sea region countries**

| Country | Name of the measure | Crops | Support rate | Supported area | Min area | Sowing date – termination date |
|---|---|---|---|---|---|---|
| Latvia | - | - | - | - | - | - |
| Lithuania | *Growing of catch crops on arable lands* | oil radish, white mustard, clover, vetch and their mixtures | 134 EUR $ha^{-1}$ | arable land | - | by September 15 – after March 1 |
| Estonia | *Support for environmentally friendly management (10.1.1)* – main activity (package of management requirements); – additional activity of water protection (one-year) | agricultural crops providing plant cover | -50 EUR $ha^{-1}$; -5 EUR $ha^{-1}$ | arable land | -30%; -50% | by November 1 – after March 31 |
| | *Regional water protection support (10.1.2)*, 1) keeping land under winter vegetation (+ Support for environmentally friendly management (main activity)) | agricultural crops providing plant cover | 7 EUR $ha^{-1}$ (+50 EUR $ha^{-1}$) | arable land in Nitrate Vulnerable Zones | 60% | by November 1 – after March 31 |
| Poland | *Sustainable agriculture (Package 1),* one of the requirements for land use | intercrops | 400 PLN $ha^{-1}$ (93 EUR $ha^{-1}$) | arable land | - | by October 1 – from February 15 |
| | *Protection of soils and waters (Package 2)*, Intercrops (Variant 2.1) | mixture of a minimum of 3 plant species (max 70% for dominant plant or cereals) | 650 PLN $ha^{-1}$ (151 EUR $ha^{-1}$) | arable land in target area[1] | - | by September 15 – from March 1 |
| Finland | *Plant cover on arable land in winter (07)* (+ Balanced use of nutrients (01)) | agricultural crops providing plant cover (including catch crops) | from 4 EUR $ha^{-1}$ to 54 EUR $ha^{-1}$ [2] (+54 EUR $ha^{-1}$) | arable land in target region and other regions | 20%[3] | - |
| | *Biodiversity in arable land environments (09),* catch crops (+ Balanced use of nutrients (01)) | catch crops (under-sowings, intercrops) | 100 EUR $ha^{-1}$ (+54 EUR $ha^{-1}$) | arable land | - | by August 15 – from October 1 |
| Sweden | *Reduced nitrogen leakage*, activity – cultivation of catch crops | forage grass or forage grass in mixture with forage legumes (max 15%); white mustard; oilseed radish or radish; rye (autumn) or Italian ryegrass | 1,100 SEK $ha^{-1}$ (107 EUR $ha^{-1}$) | arable land in Nitrate Vulnerable Zones | - | no specific dates[4] – from October 10 (forage grass, white mustard and radish); from January 1 (rye and Italian ryegrass) |
| Denmark | - | - | - | - | - | - |
| Germany (Bavaria) | *Winter greening with catch crops/wild crops (B35/B36)* | catch crops (under-sowing, intercrops); wild crops (approved seed mixtures – wildlife-friendly catch crops) | 70 EUR $ha^{-1}$; 120 EUR $ha^{-1}$ | arable land | at least 5%; max 10 ha for wild crops | by October 1 – after February 15 |

[1]areas particularly at risk of water erosion, problem areas with low humus content and areas particularly exposed to nitrates from agricultural sources.
[2]4 EUR $ha^{-1}$, if plant cover is 20%; 18 EUR $ha^{-1}$ in the target region and 9 EUR $ha^{-1}$ in other regions, if plant cover is 40%; 36 EUR $ha^{-1}$ in the target region and 11 EUR $ha^{-1}$ in other regions, if plant cover is 60%; 54 EUR $ha^{-1}$ in the target region, if plant cover is 80%.
[3]may be implemented also by reduced tillage; in other areas, plant cover may be implemented in full with reduced tillage.
[4]catch crops should be able to develop well and pick up nitrogen after harvesting the main crop.
Source: based on the information from national RDPs 2014-2020 and the support requirements available from the national agricultural support paying agencies.

2014-2020 in the Baltic Sea region countries is summarized in Table 2.

**Latvia** and **Denmark** are the countries with no agri-environment support provided for the growing of catch crops in their RDPs. At the same time, Danish farmers have experience of growing catch crops because catch crops have been a mandatory part of the implementation of the Nitrate Directive in Denmark since the late 1980-ties. Farms with an annual turnover over DKK 50,000 (~ EUR 6,700) and a total area of 10 ha or more, should establish a minimum amount of catch crops (10% or 14% of arable land for farms according to the amount of the use of livestock manure). If farmers do not comply with the requirement, fertiliser quota for the farm is reduced correspondingly. In addition to the common mandatory catch crops, there are two other schemes included in the latest Danish Nitrate Action Programme: a general catch crop scheme for holdings using organic manure, and targeted catch crop scheme which is designed as a *de minimis* aid scheme for voluntary establishment of additional catch crops in order to avoid an increase in N leaching, as in 2015 the Danish government cancelled the reduction of nitrogen application standards for farming' (EPA, 2018).

There is no directly targeted agri-environment support for catch crops in **Estonia**, though catch crops are supported as one of the environmentally friendly practices along other agricultural crops on arable land serving as a plant cover on at least 30% of eligible land under the measure 'Support for environmentally friendly management' (main activity). In addition, it is also possible to select a one-year 'Additional activity of water protection', which requires that at least 50% of eligible land is kept under winter vegetation. 'Regional water protection support' is a specific measure targeted at Nitrate Vulnerable Zones, when the land kept under winter vegetation makes at least 60%.

A single targeted agri-environment measure for catch crops per country is available in **Lithuania** and **Sweden**. Agri-environment support measure 'Growing of catch crops on arable lands' has been introduced in Lithuania since 2018, and under the current support scheme only a limited number of post-harvest catch crops can be grown (oil radish, white mustard, clover, vetch and their mixtures). Catch crops cannot be mowed, and the biomass of catch crops has to be incorporated in the land before the sowing of the main crop.

In Sweden, the measure 'Reduced nitrogen leakage' with its activity – cultivation of catch crops – is available for Nitrate Vulnerable Zones. A limited number and use of catch crops are allowed – grasses should be grown as under-sowing in the main crops; white mustard, oil radish and radish can be grown as under-sowings and intercrops; rye and Italian ryegrass can be used as intercrops only after potatoes and vegetables.

In **Poland** and **Finland**, agri-environment support for catch crops is provided both in a directly targeted and indirect way. In Poland, there is one catch crop specific agri-environment measure, while another measure stimulates the growing of catch crop within a set of requirements for sustainable land management. Package 2 'Protection of soils and waters' of Agri-environmental-climate action (M10) targets the growing of catch crops by its Variant 2.1'Intercrops'. The support is provided in designated areas particularly at risk of water erosion (about 8.2%), problem areas with low humus content (around 3.6%) and areas particularly exposed to nitrates from agriculture (7.4%). Intercrops should be used as a mixture of a minimum of 3 plant species, their biomass has to be incorporated in the land. Generally, package 1 'Sustainable agriculture' concerns the diversification of agricultural crops within sustainable land management. The requirements also provide that in one year the additional practice as growing of intercrops should be implemented, as well as growing of intercrops can be chosen from additional practices that should be implemented in another year.

In Finland, the growing of catch crops is targeted through agri-environment measure 'Biodiversity in arable land environments (09)', which is a parcel-specific operation. Catch crops may be grown as under-sowings or intercrops, plant species and plant varieties that are suitable for the area should be grown. At the same time, farmers have to apply for the measure 'Balanced use of nutrients (01)', a farm-level operation that is a precondition for making a commitment on parcel-specific operations. There is another agri-environment support measure 'Plant cover on arable land in winter (07)', where growers of catch crops can benefit along other farmers providing plant cover in winter if the vegetation is maintained until the following spring. The parcel-specific operation is implemented in all parts of the country, but the requirements are more stringent in the target region (about 70% of arable land) for plant cover in winter.

In **Bavaria**, the measure 'Winter greening with catch crops/wild crops (B35/B36)' is targeted at catch crops. It covers catch crops grown as under-sowings and intercrops, and wild crops. The latter are specially approved seed mixtures – wildlife-friendly catch crops. The termination of catch crops may only be mechanical. Growers of catch crops can benefit also in some specific cases provided by some other agri-environment measures.

Contrary to the EFA, catch crops under agri-environment measures have to be maintained till the spring in all analysed countries, with the exception of

Finland and Sweden, and it is generally common that the use of plant protection products and also fertilisers is prohibited on catch crops.

Different approaches are used at the national level for listing catch crops eligible for agri-environment support. In some countries (e.g, Lithuania, Sweden and Poland) the list of crops is rather closed, while in Finland the choice is left to farmers for picking the most suitable crops to the local conditions. This could depend on the objectives set in each country for the specific agri-environment measure. The more directly the support is targeted at catch crop benefits, the more precise list of supported crops and higher support rates are applied.

**Conclusions**

1. The possibility to fulfil the greening requirement of direct payments towards the EFA by catch crops is applied in most Baltic Sea region countries (except Estonia and Finland), with quite similar approach. The EFA fulfilment by catch crops can contribute to the decrease of the share of arable land that is left bare over the winter in Latvia.
2. The main benefits associated with catch crops is the reduction of nutrient leaching from the soil, transfer of nutrients to the next crop, improving of soil quality, reduction of soil erosion, as well as mitigation of climate change.
3. Considering the environmental benefits of catch crops, they are supported through public funds of RDPs allocated to agri-environment and climate actions in directly and/or indirectly targeted way in the Baltic Sea region countries. As Latvia has similar environmental problems, it could also introduce relevant agri-environment scheme for catch crops.
4. The benefits of catch crops can translate also at a farm level, mainly associated with lower N inputs and resulting in lower costs for mineral fertilisers.
5. The case of Denmark implies that there is a confidence about the environmental and farm-level benefits of catch crops. To promote the understanding and confidence about the benefits of catch crops in Latvia, local field experiments are necessary.

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# BALANCED SCORECARD FOR SELECTED CONFECTIONERY COMPANIES LISTED ON THE WARSAW STOCK EXCHANGE IN POLAND

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**Abstract**
Business managers report the need for modern methods to improve the implementation of organizational strategies. Translating the strategy into activities and monitoring its implementation poses a serious challenge for the management of modern enterprises. The article aims to present proposals for multidimensional performance measurement with the help of *Balanced Scorecard* (BSC) for selected Polish listed companies in the confectionery industry. The authors' original solution within the framework of the BSC construction is extending the range of perspectives for assessing performance compared to the card proposed by Kaplan and Norton by the perspective of suppliers and CSR, and the appropriate selection of measures for this assessment.
The article is based on literature studies and analysis of information included in business strategies, financial statements and reports on the operations of selected confectionery companies. Research on the use of multidimensional performance measurement using BSC, taking into account the additional perspectives of suppliers and CSR, help to better understand the relationship between economic, social, and environmental aspects of a company's operations.
**Key words**: Balanced Scorecard, performance measurement, strategy, CSR, confectionery industry companies.

## Introduction

The condition for effective management of each enterprise is obtaining multidimensional information about the effects of its operations. This particularly applies to enterprises that are dynamically developing and operating in a highly competitive environment. This group of enterprises includes companies dealing in confectionery. The shortage of multidimensional information about the company's performance concerns mainly larger companies, for example, those raising capital on the stock exchange. These performances should be measured. However, the measurement should not be narrowed down to the results of running a business in financial terms, but to also take into account the non-financial indicators. This is connected with the necessity to select appropriate tools in this area. The concept of measuring the results of the company's activities presented widely in the literature are multidimensional cards of achievements, among them the Balanced Scorecard – BSC, developed by Kaplan and Norton (1992). It is discussed in international and national literature on the strategic management of agribusiness companies, and finds wider and wider applications in practice. For example, it was implemented in Zeneca Ag Products, USA (Kaplan & Norton, 2001), in arable farming in Germany (Paustian, Wellner, & Theuvsen, 2015), in a dairy farm with small-scale production in Brazil (Cardoso *et al*., 2017), and in an agricultural company of plant, animal and processing production (bakery) in Romania (Brezuleanu *et al*., 2015). The concept of using BSC in milk processing in Poland was proposed by Pietrzak (2008), in agri-food companies by Jaworska, Nadolna (2010); while Jaworski & Kondraszuk (2013) presented the premises for the use of this card on a farm. Soliwoda (2016) reviewed the previous BSC implementations in terms of challenges (difficulties) and opportunities resulting from the practical application of strategic financial management of agricultural enterprises.

Numerous authors emphasize the necessity of close cooperation of agribusiness enterprises within the supply chain, which requires the use of performance measures other than financial ones. The use of the BSC method in managing the supply chain in this area of activity was discussed by Brewer (2002), Hernandez, Rickert & Schiefer (2003), Bigliardi & Bottani (2010). The aforementioned authors claim that although the BSC concept was not designed for supply chains, it provides a good guidance for the selection of key performance indicators. Noteworthy are also studies on the possibility of using BSC for management in farms operating within producer groups Noell & Lund (2003).

The purpose of this article is to propose the construction of a balance BSC for a multidimensional assessment of performance results for selected companies in the confectionery industry, listed on the Warsaw Stock Exchange.

For the purposes of the article, the following research tasks were formulated: 1) study of the theoretical aspects of BSC; 2) identification of strategies and directions of their implementation in the surveyed enterprises of the confectionery sector; 3) proposal of multidimensional performance measurement using BSC, taking into account additional supplier perspectives and CSR, which may help managers of these enterprises in making decisions that take into account all aspects of the company's operations. A qualitative study was carried out on source documents of selected companies, which was preceded by a review of available publications on the subject.

**Materials and Methods**

The source material for research is information mentioned in business strategies, financial statements and reports on the operations of selected three Polish listed companies operating in the confectionery sector for the years 2016-2017. The sample selection was purposive. The confectionery sector has development potential and a very significant contribution to the Polish economy. The demand for sweets continues to grow (KPMG, 2014). While selecting the companies, the volume of production and share in the market were taken into consideration. The selected companies are listed on the Warsaw Stock Exchange (WSE). They are: Otmuchów S.A., Wawel S.A., and Colian S.A.

Otmuchów S.A. has been operating on the Polish confectionary production market for over 50 years. It has been operating as Zakłady Przemysłu Cukierniczego OTMUCHÓW Spółka Akcyjna since 1997. Currently the company hires about 800 people and conducts their production activity in three plants. In Otmuchów, plants producing gumdrops and chocolate products are located, while in Nysa there is a plant producing breakfast cereals. The value of the company's assets at the end of the third quarter of 2018 amounted to PLN 202,390,000, while the EBITDA ratio was PLN 3,208,000. The next company is Wawel S.A., which originated as a chocolate factory. It was founded in Kraków in 1898. In 1922, it became a joint-stock company, and since March 1998 its stocks have been listed on the WSE. Currently the company hires about 1000 people. Its core business is the production of chocolate products, wafers and sweets. The value of the company's assets at the end of the third quarter of 2018 amounted to PLN 741.703,000, and EBITDA to PLN 22.974,000. The last company is Colian S.A., which is currently a family business. It was created from the merger of many plants, such as Jutrzenka, Goplana, Kaliszanka, Solidarność, as well as Ziołopex, and Hellena. In 2008, the activities of the capital group based on the 'Jutrzenka' S.A. stock company were consolidated, the shares of which were listed on the parallel market on May 16, 1995, and on the primary market on April 23, 1997. The company currently hires about 1700 people. Its activity includes production of sweets, confectionery, and beverages. The company's assets at the end of the third quarter of 2018 amount to PLN 1,252,319,000, and EBITDA to PLN 2,236,000.

The research is exploratory. The main method used in the article is the method of source analysis and the method of deduction and induction. Taking into consideration the specificity of the sector, the BSC developed by Kaplan and Norton was modified by the authors and used for the purposes of the study.

**Results and Discussion**

The BSC is a tool supporting the implementation of the adopted business strategy (Porter & Kramer, 2006). It constitutes a comprehensive concept related to the measurement and evaluation of its performance (Nita, 2014). It makes it possible to transpose the company's vision and strategy into specific goals and operational measures, which are assigned to at least four perspectives: financial, client's, internal processes, and learning and growth (Kaplan & Norton, 1992, 1996). For the purposes of business management in the confectionery industry, it is necessary to supplement and extend the classic configuration of Kaplan and Norton's balanced performance card with suppliers' perspective and the CSR perspective.

*Identification of strategies and directions of their implementation in selected enterprises of the confectionery industry*

The use of BSC to assess the performance of confectionery enterprises requires analysis of the strategy of the units under investigation and the directions of its implementation. The analyzed period covered the years 2017-2018. The classification of strategies in particular units and the directions of their implementation are presented in Table 1.

On the basis of analysis of information from Table 1, it can be concluded that the choice of strategy is largely determined by the current position of the company on the market. Moreover, implementation of the strategies adopted in the surveyed group of enterprises is very similar and focuses on several basic elements, such as: increasing market share, developing distribution networks on domestic and foreign markets, diversifying production, improving the quality of products offered, reducing production costs, CSR.

*A proposal of perspectives and measures of a balanced performance card for the surveyed companies*

The point of departure while creating BSC is to define defining the general objectives of the surveyed companies within its previously distinguished perspectives (Tables 2-7). The discussion of the BSC planes begins with the financial perspective, as the goals and measures of this perspective allow, on the one hand, to define the financial objectives of the implemented strategy, and at the same time constitute the target tasks for other BSC areas. The general objectives contained in the financial perspective (Table 2) were adopted after analyzing the strategic possibilities of selected economic units presented in table 1. The objectives formulated in the financial area result from the life-cycle phase of the enterprise and the possibilities of its growth and development.

It is generally assumed that the main goal of an enterprise is to meet the expectations of the owners in terms of maximizing the company's value. For

Table 1

**Strategies and directions of their implementation in selected enterprises of the confectionery sector**

| Strategy assumptions | Directions of implementation of the adopted strategy |
|---|---|
| Otmuchów S.A. | |
| Striving to become a leader on the domestic confectionery market | Expansion of sales network, growth and diversification of sales carried out in the area of private label and B2B; focus on servicing large customers running network sales; achieving a two-digit dynamics of sales revenues in strategic segments and a two-digit EBITDA margin in 2016-2020. |
| Gaining new foreign markets | Diversification of sales directions; undertaking marketing activities aimed at acquiring foreign markets; increase in the share of exports in total sales (by 2020 – 40% of sales revenues). |
| Ensuring the quality of raw materials and guaranteeing their deliveries | Diversification of suppliers of raw materials and services, which guarantees stability and safety of production; implementation of the supply chain; the use of increasingly higher quality raw materials (quality standards); ongoing monitoring of the prices of strategic raw materials as well as trends on the market. |
| Improving the quality and aesthetics of products as well as customer satisfaction | Adjustment of products to new nutritional trends; elimination of unhealthy ingredients from products (e.g. palm oil, phosphates); disinvestment in the area of pellets and crisps; marketing of innovative, high-quality products in the breakfast and cereal products segment; introduction of distinctive packaging for products. |
| Intensification of pro-social activities | Charity work; activities aimed at forming healthy eating habits among children and adults; sponsoring sports and recreational events; activities for the protection of the natural environment. |
| Wawel S.A. | |
| Increasing the share in the domestic market and foreign markets | Acquisition of new clients; increasing sales for export; expanding product assortments; communication consistency of all product brands; permanent contracts with retail and discount chains. |
| Ensuring the appropriate quality of raw materials and products as well as customer service | Organization of cooperation with producer groups; production of exceptional, highest quality sweets; 'Good ingredients' project – improved recipes that do not contain unnecessary preservatives, dyes or artificial flavors. Instead, they opt for high quality cocoa beans, lecithin from certified soybeans (without GMO), gradual elimination of palm oil; employment of experts on 'healthy nutrition'; product quality certification; monitoring customer satisfaction. |
| Ensuring proper relationships with suppliers | Concentration on long-term contracts with suppliers of raw materials and services; conclusion of future contracts for purchases of raw materials from abroad. |
| Increasing innovation and production flexibility | Expansion of distribution channels; analyzing market trends and directions of research and development works in the industry in order to provide the Company with a competitive position on the market through the development of the product portfolio, and organize and conduct work on new research projects as part of the Research and Development Office. |
| Intensification of pro-social activities | The activity of the 'Wawel with the family' foundation; implementation of the 'You feel well, you do well' strategy through which the company wants to put people in a good mood and motivate to do good; implementation of socio-consumer programs, CSR activities 'Heart is growing', the consumers can dedicate part of the payment for the product to charity; pro-ecological activities. |
| Colian Holding S.A. | |
| Increase in market share | Expanding the sales and export network by building strong regional and international brands; introduction of 'impulse' and occasional products; maintaining the important role of business in the area of B2B sales and private label, including the development of cooperation with key clients in Poland and abroad; improvement in profitability through the diversification of sales channels, including export development. |
| Development of own brands | Creating employee motivation systems to submit innovative ideas; introducing the 'blue ocean strategy' based on finding a product niche on the market. |
| Improving the quality of products | Implementation and maintenance of the Quality Management System (quality certificates HACCP and ISO9001, certificates of IFS (International Food Standard) BRC (British Retail Consortium) trade standards; creation of recipes. |
| Pro-social activities | Undertaking pro-ecological activities; sponsoring sports and recreational events. |

Source: own study based on data from the financial statements of listed companies selected for the analysis.

Table 2

**Financial perspective in BSC – goals and measures of their implementation**

| General objectives | General measures | Examples of activities |
|---|---|---|
| Raising ROE. | Return on equity (ROE). | Increasing the company's profit rate. Optimization of the use of assets. Optimization of financial structure and costs. |
| Increasing revenues from sales and profits. | Value of sales revenues. Net profit. | Balancing sales growth to financial possibilities. Taking actions using the opportunity to increase the price. |
| Optimization of costs. | Sales costs. | Eliminating unprofitable products, replacing unprofitable products with new, more profitable products. |
| Optimization of the use of assets. | Revenues from sales to total assets. | Intensification of activities for improving the productivity of assets. |

Source: authors' research.

this reason, in the financial perspective, achieving this goal is determined by the company's ability to continue and develop in the long run. Due to the fact that the surveyed companies are in the phase of maturity, sales revenues may increase as a result of the expansion of sales of products and goods to other countries (exports). Enterprises in the maturity phase should also be oriented towards cost reduction as well as better use of assets and optimization of the financial structure.

The next stage of 'mapping' the strategy is defining general goals in the area of the client (Table 3). They were determined based on the analysis of strategic possibilities in the aspect of further development of the analyzed enterprises. Increasing the share in the domestic and international market is possible thanks to gaining new customers and increasing the satisfaction of existing customers with the company's products. It also contributes to an increase in sales revenues

In the short term, an increasing market share is associated with the intensification of marketing activities aimed at expanding the sales network and winning foreign markets. In the long-term, it is particularly important to act to improve the company's image and increase the level of customer satisfaction, which is influenced by the high quality of products and goods offered, as well as their competitive price. The diversity of products that increases the attractiveness of the company's offer is also important. It affects the level of customer loyalty, contributing to the re-selection of the products of the individual.

The goals in the financial and customer areas should be related to the objectives in the perspective of internal processes and learning, growth, suppliers and

Table 3

**Customer perspective in BSC – objectives and measures of their implementation**

| General objectives | General measures | Examples of activities |
|---|---|---|
| Increasing the share in the domestic and international market | The share rate in the domestic market; the share rate in the international market. | Intensification of marketing activities; development of online or foreign sales. |
| Achieving a high level of customer satisfaction and increasing their loyalty | Customer satisfaction index (results of the survey); the number of customers who buy products again to the number of customers; the number of customers willing to recommend products to the number of customers. | Intensification of marketing activities. |
| Achieving high quality and safety of products | The percentage increase in expenditures on improving the quality of products to the previous period; fair labeling of products, as well as the number of detected irregularities associated with it; quality and safety of products, as well as the number of detected irregularities associated with it. | Taking technological initiatives. |
| Improving the image and creating the company's brand | The percentage increase in funds for promotion and advertising to the previous period, including funds for educating consumers on issues related to commercial activities, e.g. to increase consumers' ability to make informed decisions about complex goods, services and markets, to better understand the impact of their decisions on the economy, the environment and society and to promote sustainable consumption. | Intensification of marketing activities; brand promotion; taking actions to educate consumers on issues related to commercial activities, including the supply chain. |

Source: authors' research.

Table 4

**Perspective of internal processes in BSC – objectives and measures of their implementation**

| General objectives | General measures | Examples of activities |
|---|---|---|
| Reduction in the number of errors in the execution of orders and shortening the time of order fulfillment | Number of justified complaints during the year; waiting time for order fulfillment. | Implementation of integrated IT systems (e.g. for order tracking); improving employee qualifications. |
| Development of distribution channels | Number of new distribution channels in a year | Introducing online sale |
| Reduction of the unit cost of production | The amount of the unit cost of production. | Introduction of modern technologies. |
| Modernization of the machinery park | Ratio in % of outlays for the purchase of new machinery to the net asset value. | Purchase of new machines and equipment. |
| Increasing the work safety of employees | Outlays on protective clothing, apparatus, etc., in relation to the previous period. | Actions to improve working conditions. |

Source: authors' research.

CSR. It allows to increase the efficiency of operations and motivate employees to implement the company's strategy. Objectives in the perspective of internal processes for the needs of sustainable enterprise growth are presented in Table 4.

Taking action to increase the quality of the products offered may positively affect the image of the company. Similarly, so can the implementation of business strategy related to the social aspect – increasing the work safety of employees. Constant improvement of production efficiency requires investing in a modern machinery park. It contributes to the reduction of production costs and helps to optimize the structure of company costs (financial perspective), thanks to which there is the possibility of increasing margins on certain products and competing with the price while maintaining the existing margins on others. The reduction of costs is also conducive to the change of the financial structure due to the possibility of financing larger interest from the obtained external capital. The purchase of new machines and equipment also allows to increase the company's production capacity. The image and satisfaction of customers is also impacted by ensuring timely delivery of products, which is connected with the development of distribution channels and the introduction of IT systems for tracking deliveries. The improvement of the efficiency of customer service is also significantly influenced by reducing the number of errors in the execution of orders and shortening the expectations for their fulfillment.

At the BSC level, concerning growth and learning, the objectives related to employee development were defined above all (Table 5). It affects the effective implementation of tasks in the previously discussed BSC perspectives.

Table 5

**Perspective of growth and learning in BSC – objectives and measures of their implementation**

| General objectives | General measures | Examples of activities |
|---|---|---|
| Raising employee qualifications | The level of expenditures on the development of employees in relation to the plan; average number of training hours per one employee. | Acquiring EU funds for further employee training; organization of employee training at the headquarters of the unit and outside it. |
| Increased employee productivity | Revenues from the sale of products – consumption of materials and energy / number of employees. | Organization of employee training; building employee incentive system. |
| Increasing employees' access to modern technologies | The amount of IT expenditure in relation to one employee. | Introduction of a modern order fulfilment system. |
| Development of employee incentive system | The number of employees covered by the incentive system. | Development of integration programs. |
| Motivating employees to propose innovative ideas | Number of ideas submitted per 1 employee. | Creating a motivational remuneration system (bonuses, prizes). |

Source: authors' reserch.

Table 6

**Supplier's perspective in BSC – objectives and measures of their implementation**

| General objectives | General measures | Examples of activities |
|---|---|---|
| Quality of relations with suppliers | Supplier satisfaction index; number of loyal suppliers in relation to the total number of suppliers | Implementation of programs regarding compliance with standards of integrity and partnership |
| Quality of transactions | Average duration of obligation fulfillment; durability of cooperation: the number of contracts kept to the total number of contracts | Undertaking activities to improve the quality of cooperation |
| Managing the supply chain | Number of suppliers; number of contracts with suppliers; number of actions aimed at cessation or prevention of the negative effects of activities within the supply chain | Integration of suppliers around production plants. Undertaking initiatives supporting the creation of local / regional business agreements |
| Securing the supply of raw materials in the long/short period | Share of raw material purchased on the basis of long-term contracts with agricultural producers | Intensification of marketing activities Undertaking activities for the use of financial instruments |

Source: authors' research.

Table 7

**The perspective of CSR in BSC – objectives and measures of their implementation**

| General objectives | General measures | Examples of activities |
|---|---|---|
| Environmental perspective | | |
| Care for the natural environment | Expenditure on environmental protection in relation to operational cost plans. | Actions to reduce pollutant and waste emissions. |
| Raising the ISO audit assessment | The number of ISO and HACCP certificates confirming the high quality of products | Acquiring funds for environmental protection |
| Social perspective | | |
| Raising the quality of relations with the public | Enterprise image (survey); transparency of information about the company's activity, including the percentage of disclosures about CSR | Increasing the transparency of business information; taking actions for the local community |
| Supporting local development | The amount of funds for infrastructure, the number of social initiatives taken and the amount of funds to support them, the amount of funds for charity, and the number of jobs created, including for people with disabilities | Supporting social and local initiatives, charity activities, sponsoring |
| Compliance with the law, ethics and honesty | Number of detected violations of legal norms, as well as actions to eliminate them; number of actions against bribery and corruption (policy, procedures for the company and its employees). | Taking actions to comply with the law |

Source: authors' research.

The development of a company also depends on employees who understand the strategic goals of the enterprise. Therefore, it is necessary to supplement knowledge and improve the qualifications of employees through training. It is also advisable to change the motivational system of employees with a view to shaping their behaviors oriented towards achieving the goals of the business and linking incentive systems with the implementation of the company's priorities. Highly qualified employees motivated to submit innovative ideas create and introduce new products offer interesting design, fast service and professional advice. Reducing the number of incorrect orders and shortening their execution time depends not only on the qualifications of employees, but also on their access to modern technologies. Increasing the access of employees to modern information technologies allows to improve or introduce modern systems of order fulfillment and to develop distribution channels, e.g. by introducing online sales.

In order to meet the requirements of the market, ***confectionery*** industry enterprises should have ensured and secured supplies of raw materials for production (Table 6). On the one hand, this involves contracting supplies, i.e. supplying raw materials on the basis of long- and short-term contracts concluded with groups of agricultural producers, fruit and vegetable producer groups and organizations, and

on the other hand – establishing cooperation with producer groups that will be able to provide the adequate amount and quality of raw materials. For this reason, this perspective is particularly needed to provide information to optimize the supply chain.

The perspective of environmental protection can be considered in the context of obtaining quality certificates as well as other pro-ecological activities (Table 7). The construction of CSR meters may be based on areas defined according to GRI or ISO 26,000 (GRI and ISO 26,000, 2010).

Confectionery enterprises should care for the environment, taking pro-ecological measures to minimize their negative impact on the environment. This possibility is provided by the management of by-products and post-production. It is also important to meet the quality standards compliant with HACCP and ISO 9001 and ISO 220000. Such actions also serve to improve the company's image, which translates into financial results.

**Conclusions**

As it follows from the considerations, the BSC for confectionery companies proposed in the article may be the basis for the construction of a system supporting management of these companies and early warning against threats. The proposed multidimensional performance measurement can be applied to all groups of food industry enterprises cooperating within the supply chain. Due to the specific nature of the operations of selected enterprises, it was proposed to include the perspective suppliers and CSR in the assessment of performance. The proposed measures of performance in the field of CSR support the assessment of the effects of the company's operations and determination of areas that require further improvement, which allows to recognize the potential negative effects of its impact on the environment more efficiently, and thus enables their prevention and mitigation. For individual perspectives, general objectives and performance measures as well as examples of actions enabling the implementation of the intended goals have been identified.

The management of the performance of confectionery companies, including CSR, can be used to improve their operations and contribute, among others, to:

1. improving the efficiency of the company's operation and strengthening its competitive position,
2. improving the image and reputation of the company, as well as relationships with particular stakeholder groups,
3. increasing the involvement of individual groups of stakeholders in building shared values,
4. developing activities, including the introduction of innovations, enabling, among others increasing the safety and quality of products, efficient cooperation, supporting local, regional and national development, or improving the quality of life of local communities.

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# ROLE OF THE EUROPEAN FISHERY FUND SUPPORT IN THE DEVELOPMENT OF THE LATVIAN COSTAL AREAS

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**Abstract**
Purpose of the paper is to assess contribution of the European Fishery Fund (EFF) and European Maritime and Fisheries Fund (EMFF) in the development of coastal areas. The article reviews particulars of implementation of the Fishery Funds in various planning periods, in more detail analysing the implementation impact in the period of 2014-2020, based on analysis of the needs, goals and projects of the current period. Even though the European Fishery Fund (EFF) in Latvia is being implemented since 2007, there is a lack of scientific publications on its impact on the coastal development.
EMFF for the period 2013-2020 has a dual role in the development of coastal areas – as a development tool of the fishery sector and as a development tool of communities in the fishery areas. It is implemented by using community-led local development (CLLD/LEADER) approach. In case of Latvia, a multi-fund approach – EFF/EMFF and European Agricultural Fund for Rural Development (EAFRD) is already being used for two planning periods.
We conclude that the impact of EFF/EMFF on the development of coastal areas is more directed at development of infrastructure of the coastal communities but is less engaged in the fishery development matters - accordingly increasing other activities and preserving historic and cultural heritage for development of tourism and place of residence in the coastal area in interaction and in addition to EAFRD rural development measures of the coastal areas.
**Key words**: EMFF, CLLD, coastal areas, multi-fond.

## Introduction

Subject is important as contributions of the aforementioned fund in terms of money are rather significant: the planned EMFF public funding in Latvia for the period of 2014-2020 is EUR 140 million, but together with the state funding – EUR 182.7 million. Contribution of EMFF in the development of coastal communities is mostly related to measures of the 4th priority implemented by CLLD. Public funding in the amount of 15 million EUR is provided for them.

CLLD approach prescribes to establish the areas important for the fishery whereto drafting of the local development strategies is applicable. These strategies are created by the Fisheries Local Action Groups (FLAG) or simply LAGs from the period of 2013-2020, with a participation of public, local government and business representatives in the decision-making institutions, respecting local needs and planning and implementing support measures carried out in cooperation between the institutions. Support is given to the fishery sector and territorial communities related to fishery. CLLD in the EU Common Fishery Policy was taken over from the EAFRD funded LEADER approach of the Common Agricultural Policy (Ex-post evaluation …, 2017). During the period of 2014-2020, the fishery measures are implemented either separately (single-fund approach) or jointly with other funds (multi-fund approach). Integration of both funds mostly leaves an impact on development of communities and especially on formation, development and diversification of small companies, as well as on creation of jobs, where Latvia has a positive experience (Scoping study …, 2015). Additionally, the impact is directed at life quality, identity, improvement of the living environment of the coastal communities which may not be assessed in a short term (Ex-post evaluation …, 2017).

A sectoral policy was created in the scope of the fishery fund, which is integrated in the development of local areas (Phillipson & Symes, 2015). Such approach makes you ask a question, how effective it was for the sector itself and for the territorial community. Several authors indicate that initially innovative approach in the development of the fishery areas has been forgotten, partially relating it to the EU framework, which reduces significance of the social role, contradicts with neoliberal approach and application of sustainability principles in specific areas, affecting viability of the fishery community (Symes & Phillipson, 2009).

In practice, there is a transfer from restriction of fishing to fishing in inshore waters, diversification measures, support to maritime communities (Bartłomiejski, 2011). It is noted that communities where a decisive role is played by the small-sized coastal fishing, great emphasis is placed on solutions based on local knowledge, considering ecological, economic, social and management aspects (Symes, Phillipson, & Salmi, 2015). Return to initial LEADER principles is also on the agenda of the next programming period after 2020 (Beyond 2020 …, 2017).

Even though CLLD measures are being implemented in a comparatively short period of time, there are publications, where their efficiency has been reviewed (for example, Capgemini Consulting, 2014; Symes, Phillipson, & Salmi, 2015; Walle *et al*., 2015). At the same time, this subject has not been sufficiently viewed in the scientific literature of Latvia. Several

studies concerning EFF and Operational Programme for the Latvian fisheries sector (OP 2007-2013) implementation are available (please refer to Benga, 2014; Baltic Consulting …, 2011, Justification …, 2013; Analysis …, 2012), which partially review areas significant for fisheries (ASF) coastal community development matters.

Purpose of the paper is to assess the contribution of EMFF in the development of coastal areas. The following objectives have been set for reaching the goal of the paper: to assess the current scientific studies on the development of coastal areas in connection with EFF/EMFF, analyse implementation specifics of EFF/ EMFF in the development context of the Latvian coastal areas, evaluate costal support measures in the period of 2014-2020 and their provisional results.

The hypothesis of the article – the impact of the fishery fund is mostly directed at compensating activities for reduction of the fishery sector's role, which jointly with EAFRD form a supplementing effect for the development of coastal areas.

**Materials and Methods**

Foreign and Latvian scientific studies, European Commission materials and other special literature has been used for the preparation of the article. Operational Programme for the Development of Fisheries 2014-2020 (OP 2014-2020), strategies developed by the LAGs, and, laws and regulations of Latvia and the European Union have been reviewed. A combination of quantitative and qualitative analysis methods has been used in the paper. A context analysis method was used to evaluate LAGs needs. In order to specify conclusions on EMFF impacts, a survey of LAGs administrative managers was conducted in 2018, consultations organized, and partially structured interviews with the sector specialists, LAGs and fishermen representatives were carried out. Numerical materials were gathered by using the Rural Support Service (RSS) IS information for a time period up to 2019. Considering the peculiarities for implementation of the programme for 2014-2020, the project application (planned) data was used for the analysis.

**Results and Discussion**

Financing of the fishery funds in Latvia is available since 2004. Initially (2004-2006) the EU available funding of the Financial Instrument for Fisheries Guidance (FIFG) was more than EUR 24 million, and more than 380 projects were supported.

The goal of the EFF for 2007-2013 was to facilitate sustainable development in fishery sector and areas important for the fishery, increasing competitiveness of the sector and balancing fishing capacity with the available fish resources. Total public funding for OP 2007-2013 exceeded EUR 166 million, including from EFF in the amount of EUR 125 million. The 4th priority direction 'Sustainable development of the areas important for fisheries' was intended for improvement of life quality in the areas important for fisheries and increasing their attractiveness, using CLLD approach. Creation of small fishery and tourism infrastructure objects, an offer of related services, diversification of economic activity, and restoration and development of historic fishermen villages was supported (Operational Program …, 2007).

In accordance with OP 2007-2013, areas significant for fisheries (ASF) based on the total number of persons employed in the fisheries in the country and a total number of companies in the country was established. ASF encompassed 24 Fishery local action groups (FLAG). They incorporated both coastal and inland areas. ASF in 2007-2013 were directed at updating, development and implementation of the measures supported by the Rural Development Programme (RDP), paying very little attention to the problems of the fishery (Study on the implementation …, 2014). Majority of the projects were related to the improvement of the living environment and not specifically fishery, infrastructure (Analysis …, 2012). This is confirmed by an allocation of funding in the FLAG strategies among priorities, where an activity 'Restoration and development of the villages where fishery activities are carried out' is dominating (Baltic Consulting, 2011). Allocation of funding in the coastal FLAG projects among activities is 73% for the restoration and development of villages, 25% – for fishery and tourism infrastructure and services and 2% for economic restructuring and diversification (Benga, 2014). In addition, it was established in the studies that 14 of 24 FLAGs are located in inland territories without industrial fishing (Walle, 2017).

Coastal areas were established in a strip of 15 km from the coast of the sea where additional funding for restoration of the village infrastructure was planned. Coastal ASF support was more directed at small coastal fishermen and processors of local produce. Support to coastal small volume fishing in the period of 2007-2013 in Latvia was, however, weakly pronounced and formed just 2% of the total number of OP 2007-2013 4$^{th}$ axis projects (Walle, 2017).

It was partially determined by the peculiarities of the programme itself - an amount of EFF funding was too small for the large companies, while access to these resources by small companies and home producers was complicated due to various reasons related to fulfilment of strict requirements and necessity for co-funding (Analysis …, 2012).

EFF and EAFRD were implemented by a partial multi-fund approach, which was partially started to be implemented already in the period of 2007-2013. It means that a single strategy and different action plans

were in force, and different executive institutions with an administration could exist. Fund recording was strictly separated (Benga, 2016).

Different designations are used, i.e. LEADER – RDP, CLLD – for OP both periods. There is a uniform LAG, including both EMFF and EAFRD measures, a single management - partnership - deciding authority and executive institution (administration), a uniform strategy, encompassing two funds, while CLLD strategy actions are separated for each fund. Such structure allows optimizing administrative costs.

The second role of the Multi-funds may be related to concentration of means of two funds in ASF, which makes us to ask a question regarding a risk of the fund overlapping, which is confirmed by the similar potential activities of EFF/EMFF and EAFRD. There are contradictions between the development of the sector and location. The sector is exterritorial and related to all EFF/EMFF priorities; the development of the location may be projected in the EMFF 4th priority. Similarly, it pertains to EAFRD concerning ASF. It makes us ask a question how EMFF integrates into this system, and to whom and how much it gives to the local community and the sector.

In the regulatory framework, funds are partially separated, for example, in respect of development of strategies, while they are common for the cooperation projects, and separated in respect of implementation and activation of strategies. It must be noted that the measures of public activation are implemented, using EAFRD funding. The requirements in the uniform framework (Cabinet Regulations) are also made in accordance with the relevant EAFRD and EMFF funds. Each fund has a different strategy-implementation framework.

In the period 2014-2020, ASF determination principle was changed based on deficiencies of the previous period, establishing that it shall contain only the areas of the coastal administrative units – cities and parishes bordering the sea, except for Riga, but including 3 large cities – Liepaja, Jurmala and Ventspils. EMFF measures are implemented by 6 LAGs bordering sea. The length of the coastal area and several persons employed in fishery were selected as the criteria for establishing of ASF and allocation of funding (Justification …, 2013). It means that 6 LAGs at the costal ASF may receive both EMFF and EAFRD funding (except in the large cities), while only RDP EAFRD funding is available in the LAGs inland areas. Funding of both funds is different in various ASFs, while EMFF funding has much more importance in coastal area, which is determined by historically and geographically established comparatively smaller employment of the coastal area residents in agriculture, closer connection of residents to fishery (Figure 1).

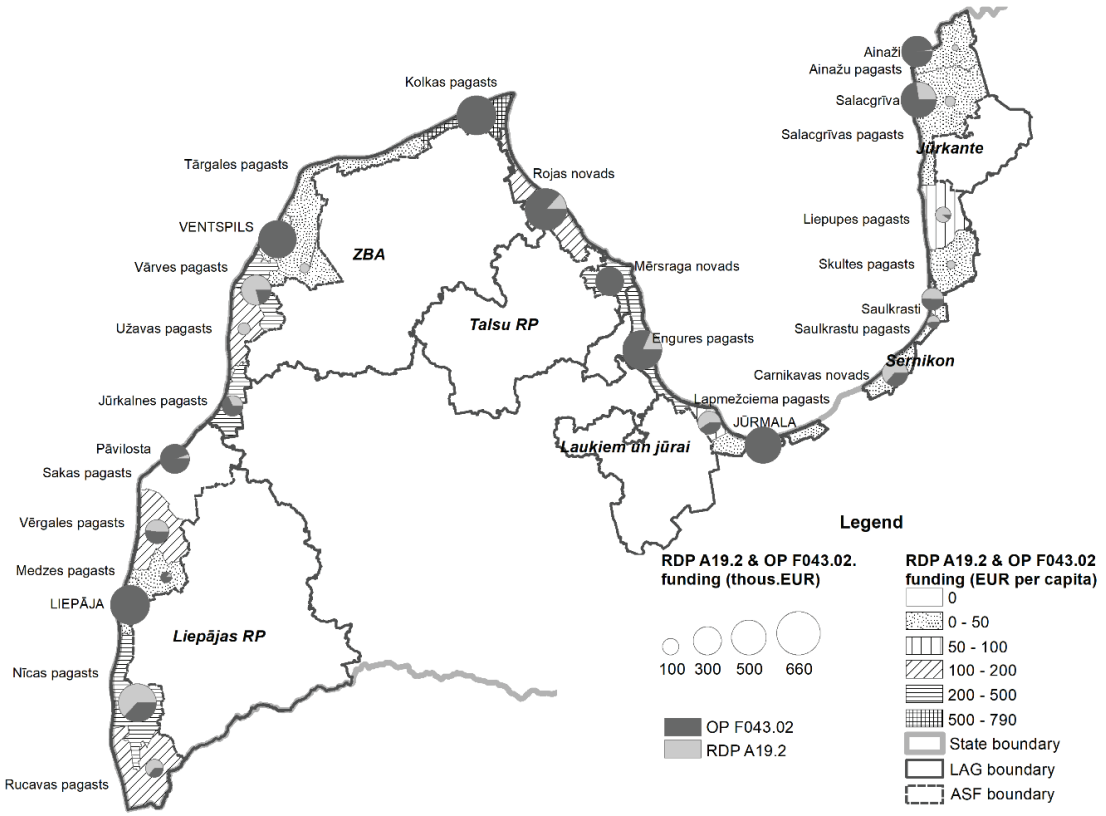


Figure 1. Public funding to ASF of the projects being implemented in OP 2014-2020 and RDP measures.
Source: Authors calculation based on RSS IS.

Analysis of the needs defined in the LAGs strategies is based on the strengths and weaknesses of the SWOT analysis and sections of the strategy needs, as well as a LAGs manager survey. Context analysis allows highlighting the following common needs: improvement of infrastructure, knowledge, natural values, heritage, services, business, whereto needs for jobs and labour force are strongly related. Demographic and population problems are also important. Knowledge has been mentioned both with strengths and weaknesses. LAGs indicate in strategies the communication problems between a local government and NGOs, lack of leaders, motivation, limited opportunities for the life-long education and youth development, business knowledge. Interest in studying, trade skills, opportunities for interest education, competence in cultural area, creative activity of youth is at the same time mentioned as an advantage.

The needs identified in the sections of needs of the LAGs strategies are mainly related to business and companies, innovations, services, tourism. Jobs, education, use of local resources are emphasized relatively less. The aforementioned needs may be integrated and understood as parts of other needs; the analysis therefore does not allow making precise conclusions on the LAGs needs (Figure 2).

In general, needs are subjected to terms of the funding, appropriate EMFF and EAFRD measures are not always separated in the strategies.

Needs on the level of goals appear in general manner and are not always related to a specific fund. On the level of actions, LAGs strategies separate funding of the funds. In 6 LAGs strategies, 18 actions pertain to EMFF. Actions expressly include fishery and economic diversification, use of infrastructure and natural resources and reduction of climate changes, which in general conforms to defined needs. Results of surveys allow concluding that comparatively larger contribution of projects is in development of infrastructure, facilitation of public activities and LAGs operation. In addition, the greatest effect is indicated in the aspects attributed to maintaining of population (jobs, social environment and services). In turn, the lowest rated project contribution pertains to inclusion of low-income individuals and reduction of poverty, as well as business development, which only partially conforms to the needs included and actions planned in the strategies.

The problem is in linking with specific needs, and it means a gap between defining the needs expressed by LAGs communities and the funding linked to administrative process – allocation of funding between actions, rounds of the project tenders and linking thereof to OP 2014-2020 activities. Actions of LAGs strategies are not always able to depict a complete spectrum of needs, but the strategy development and implementation animation procedures not always can address the actors and inform them on opportunities provided by the projects. As the result, for example, activities directed at joint projects and replacement of the main stationary engine are not applied in the projects, even though they are very topical for the fishermen.

The most important OP 2014-2020 measure which is intended to facilitate coastal development is F43.02 measure 'Community-led implementation of local development strategies'. An amount of EUR 14.7 million is planned for it in the entire period.

103 projects are in the implementation process in the measure F43.02 as of 08.01.2019 (status-approved, monitoring has been initiated), from which 56% are

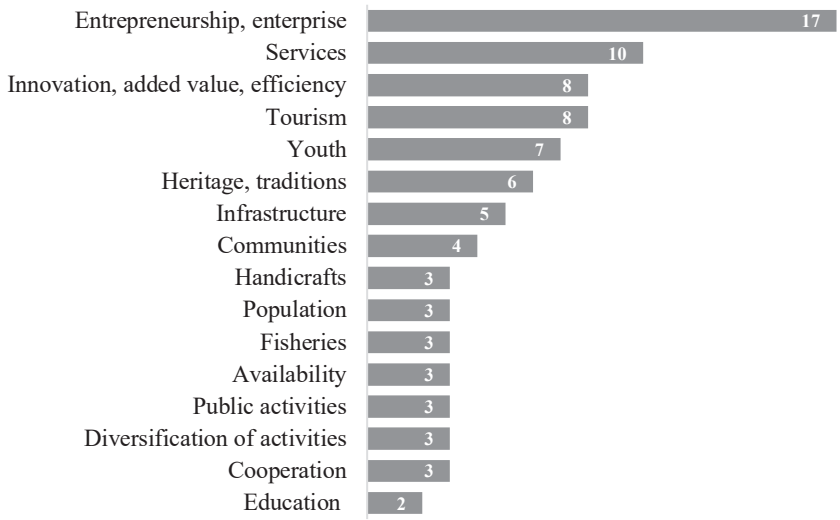


Figure 2. Proportion of key words of the needs defined in coastal LAG strategies.

Source: Created by authors, based on LAG strategies.

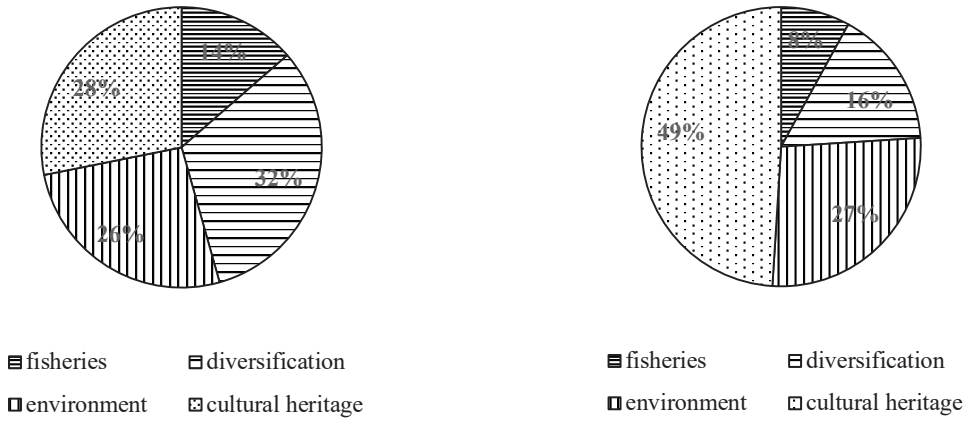


Figure 3. A number of projects in F043.02 measure of the OP 2014-2020 and public funding (according to application data) in the measure.

Source: Compilation by authors from RDS IS.

completed. The total disbursed amount is EUR 3.5 million, which is 24% of the total public funding amount of the measure. Public funding for the projects in the implementation process forms EUR 7.3 million, which is half of the planned amount in this measure.

Despite the fact that facilitation of economic activity has been recognized as the most important need in the LAGs strategies, the majority of approved projects is related to environmental and climate goals or preservation of cultural capital. Assessing the measure based on the number of projects in the measure activities, we can see domination of diversification projects (mostly for development of tourism), contrary to the investment in the projects directly related to fishery. More than half (54%) of the projects are directed at public activities, which is an investment in the development of ASF communities. Environmental and climate project goals mostly include improvement of beaches, tourism infrastructure (creation of nature trails, construction of access roads and parking lots) and similar activities. A significant part of the projects is related to preservation of fishing cultural heritage in the coastal villages. The main directions of operation in this direction: renovation of buildings and structures (gathering centres, churches and other historic architecture), renovation of fishing boats and cutters, creation of parking lots and introduction of infrastructure. Several projects are related to preservation of the Livs cultural heritage. Only 10% of all projects have relation to coastal fishing. It may be seen from the above that support to coastal areas mostly facilitates the local infrastructure development (including, to a great extent, directed at tourism), but the impact on development of local fishing is rather small. There is in general a comparatively small impact also on facilitation of economics (Figure 3).

If the volume of eligible costs is compared in activities, they differ even more. Costs of the projects related to fishery form 8% of the total costs of the projects in implementation process, and diversification projects form 16%. At the same time, projects of public nature directed at the environmental and cultural objects form 76% of the total project public funding. Thus, the measure makes the main contribution in the development of ASF communities, less in the fishery (Figure 3). Environmental and cultural projects indirectly can also be related to facilitation of economics, for example, tourists are attracted by creating recreational place or a museum exhibition.

CLLD approach is directed at support to small business, which is confirmed also by the restrictions of the project funding. Micro companies (up to 9 employees) form more than 90% of the number in fishery and aquaculture and half of the fish processing companies. In accordance with the information provided in LAG interviews, they often have problems with co-funding of projects, but the largest companies select to participate in the 5th priority measures with larger funding and shorter time for approval of projects. It partially explains small interest in fish processing projects in the 4th priority. Additionally, micro companies are often not ready to handle administrative matters - accounting, preparation of projects, take responsibility for progress of the projects. It requires additional investments and individual approaches in the LAGs work with the fishermen for their activation.

Taking into account the goals of the social and territorial cohesion, the main indicator by which the project results are measured is a number of newly created jobs. This is the sole indicator selected by Latvia for evaluation of OP 2014-2020 4th priority outcome. In accordance with the plan, 70 new jobs are planned to be created in the coastal areas with the help of EMFF. The projects currently being implemented prescribe for creation of 63 jobs, including in fishery sector – 18, outside the sector – 45. The jobs are planned mostly in the sectors related to fishery – in processing of fish products, services, tourism and trade. New jobs

are not planned directly in fishing and aquaculture, yet in accordance with the project applications, 29% of new jobs indicatively can be related to fishery, which includes projects in all fishing and aquaculture stages from acquisition to sale. 71% of all planned jobs are mostly related to tourism and services. We may conclude from this that contribution of the measure in creation of jobs may be related mostly to economic diversification but not to fishery. It must be noted that creation of new jobs in the project applications is not a mandatory precondition; therefore, only 1/3 of the total number of projects plan to create them. In addition, almost all newly created jobs pertain to the projects of economic nature.

The involvement of youth and life-long learning has been emphasized in the LAGs strategies, the EU regulation and national framework, while insufficiently prescribed in the LAGs strategies actions and projects. It is recognized in the interviews with the LAGs and Latvian fisheries network that interest currently is rather small. Fishery has large initial investments which interfere with interest in this area. There is an opportunity to inherit infrastructure or to purchase it from the existing fishermen. It, in general, reduces further sustainability of development in the local ASFs.

**Conclusions**

1. Publications on development of coastal fishery areas allow concluding that the impact of the Fishery Fund is mostly directed at compensating activities for reduction of the fishery sector's role.
2. Experience of Latvia points at investments mostly for preservation of coastal area infrastructure and cultural heritage, but less for strengthening the role of fishery in local economics.
3. Use of the multi-fund approach may be rated as supplemental to development of coastal areas, allowing using of available funding in a more rational manner.
4. Experience of two periods in the use of EMFF in facilitation of coastal development allows forming a more comprehensive view at the community development matters, an opportunity to learn and improve the LAGs strategies and implementation tools.
5. Even though the LAGs strategies have a pronounced need for the business support and thus also for jobs, it is to a smaller extent indicated in the projects, which attests to failure to link identified needs to the implementation goals and actions of the LAGs strategies. If we evaluate results of the strategies, it is useful to look at it not only in respect of the goals and actions but also in respect of the needs.
6. CLLD is a tool for development of small fisheries which is not always indicated in the projects. It requires more involvement of LAGs in the communication process, on one hand, and simplification of requirements, on the other hand.
7. EMFF gives a significant contribution to development of ASF communities, especially in infrastructure.

Even though neither OP nor LAGs strategies have clearly defined allocation among activities, the project analysis of 2014-2020 period allows concluding that absolute majority is directed at infrastructure and equipment projects for the public benefit community, and very little at fishery, creation of new jobs in the sector, which confirms the initial hypothesis.

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# METHODS OF FINANCIAL STATEMENT ANALYSIS FOR NON-GOVERNMENTAL ORGANISATIONS

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**Abstract**
Public participation is needed for nongovernmental organisations (NGO) to function and exist, as the public plays the role of investors by supporting the NGOs financially and thereby providing a quorum needed for the organisation to operate and make decisions. NGOs provide services for defending public interests, and the NGOs members carefully assess their gains from involvement or participation continuation in public organisations, just as if choosing a good or service for consumption. The level of society activity in NGOs sector is low in Latvia comparing with the Western world. To increase it, it is required to contribute to the public's trust and NGOs transparency. Organisational performance analysis is one of the ways how to provide members with information on performance and funding use, as the members of NGOs wish to be sure that their membership fees and other financial support are effectively used to achieve their goals and defend the interests of their members.
The research aims to analyse financial analysis methods used in the NGO sector. The research tasks were set: 1) to analyse the substance of financial analysis of NGO, and 2) to identify shortcomings for a comprehensive analysis of NGO. The research has found that as public participation in NGOs increases, it becomes increasingly important to provide financial transparency in the NGO sector in order to contribute to the public's trust in the NGOs and make it possible to verify the consistency of funding use with the organisation's goals and performance.
**Key words**: non-governmental organisations; financial analysis; statement analysis; financial ratios.

## Introduction

The origins of financial analysis, according to some bibliographical sources, date back to the 15th century, as it was needed to identify the financial contribution an investment in securities made. Financial analysis is employed throughout the world, and the long history of it is also evidenced by findings of researchers in economics that are still present in modern bibliographical sources (Phillips *et al*., 2012). Regardless of the place in the world where an analysis is done, it maintains its goal of providing comprehensive information on the financial status of the entity. The goal of any economic entity is to make profit, and financial analysis is a way how to achieve it prudently. Despite the fact that a good or service is sold, and the customer pays for it on a certain date, the obligations assumed for the period between the sale and the payment moment have to be met as well (Morris, 2011). For this reason, bibliographical sources often describing financial analysis as the analysis to predict bankruptcy or monitor financial health are used (Tian & Yu, 2017). Most often, the public believes that financial analysis is needed only for banks to make sure the enterprise has enough assets to meet its liabilities, or for investors to verify that the enterprise is going to pay dividends and its share price might be expected to increase. In reality, the results of a financial analysis are useful to a broad circle of individuals, including employees, managers, competitors, state administration, etc. (Phillips *et al*., 2012). Financial analysis is part of a set of activities focusing on trends in the industry, innovation, customer satisfaction, market share and other factors. In addition to the financial focus, a system for assessing the nonfinancial aspect has to be created, depending on the specifics of the entity analysed as well as the technological contribution, quality, innovation, etc. (Eccles, 2008). Financial analysis is not limited to conventional calculation methods in assessing liquidity, stability, asset turnover and profitability. The key functions of analysis have remained, yet mutual competition encourages combining new calculation methods, designing new operational strategies and, in addition to financial performance indicators, trends in the industry and economy have to be predicted. A standardised calculation methodology is mainly employed by statistical and industry trend reports.

Most scientific literature sources state that enterprises use financial analysis for making higher profits. An adapted calculation methodology could be employed for performing a financial analysis for NGOs having no purpose of making profit. In both cases, funds are needed for the operation of an organisation, which have to be allocated prudently. An entity's annual financial reports and their annexes are used for performing basic calculations. The scope of analysis depends on available information. Publicly available information allows performing a financial analysis by conventional methods, while the managers of the entities analysed, who had access to specific data, had an opportunity to make a detailed analysis. Financial reporting and accounting are regulated by the relevant legal framework, and due to mutual competition among the entities, only minimum information stipulated by the legal framework is publicly available. For this reason, to perform a complete analysis of the performance of an organisation, the results have to be compared with the average in the sector or

industry concerned or benchmarked against other organisations. The comparison could be done by using statistical data on the sector or industry concerned or reports of each individual organisation.

The research aims to analyse financial analysis methods used in the NGO sector. To achieve the aim, the following specific research tasks were set:

1. To analyse the substance of financial analysis of the NGO;
2. To identify shortcomings for a comprehensive analysis of the NGO.

## Materials and Methods

To carry out the research, the authors used relevant research papers, information provided by the Central Statistical Bureau (CSB), laws of the Republic of Latvia and Cabinet regulations and the *Lursoft* database. The research used the following methods: monographic, descriptive, analysis and synthesis as well as logical construction. Described financial analysis methods are compared with averages for the NGO sector and agricultural NGO financial performance indicators. The averages for the NGO sector were acquired from the study by the Latvian Civic Alliance (2016), while the data on agricultural NGO financial performance were acquired by analysing NGO annual reports available in the *Lursoft* database. The research analysed five largest horizontal level national agricultural organisations in Latvia that were active in the Advisory Council of the Ministry of Agriculture for agricultural nongovernmental organisations, which is an advisory and coordinating collegial institution. Its purpose is to contribute to the agricultural industry through balanced and sustainable policies by assuming shared responsibility for agricultural and rural development (Zemkopības ministrija, 2017).

## Results and Discussion

*Substance and purpose of financial analysis*

An analysis of financial reports or financial analysis allows assessing the financial status of an enterprise by using available current and historical data – the enterprise's current and future financial status – for making economic decisions (Robinson, 2009). Basically, anyone of us who does financial planning deals with financial analysis daily, only the extent and the goals to be achieved differ.

The purpose of financial analysis is to give comprehensive insight into an entity or industry in order to provide motivational information to potential cooperation partners. Annual reports used in financial analysis contain historical information that could not be changed, which allows critically assess the situation in the enterprise and acquire a safe assessment (Jegers, 2013). Financial analysis has to have two major characteristics concerning information – relevance and faithful representation. Information is relevant if it makes a difference in decision making, and it is a faithful representation if it fully depicts the economic substance of business activities. It is more useful if it is comparable, verifiable, timely and understandable (Phillips *et al*., 2012).

Most often, the users of financial reports and results of a financial analysis as the key source of information are banks and investors who make decisions on cooperation with the enterprise (Phillips *et al*., 2012).

Sometimes, however, the opportunities given by annual reports and financial analyses are underestimated (Figure 1); the reports have to be analysed by the board to verify how much the organization raised versus the expectation for the period; by creditors to verify how much their donation represents as a percentage of the total amount raised (Haber & Schryver, 2019); by national institutions to project tax revenues and plan tax rate change, etc. The financial stability of an enterprise is determined by the solvency and competitiveness of it, which is characterised by an opportunity for it to steadily develop and meet its liabilities. An analysis of performance has to have a possibility to compare the current performance with that in previous periods and with competitor performance. Therefore, annual reports are produced by a common methodology. In Latvia, the key source of information for financial analysis is an enterprise's annual financial report, which is a

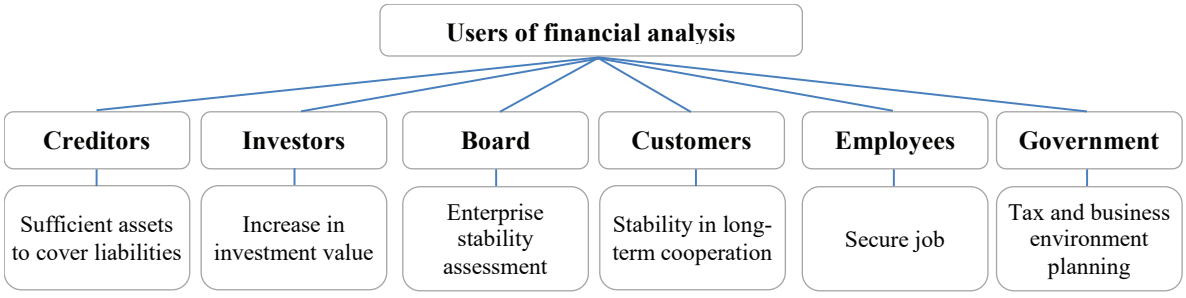


Figure 1. Users of financial analysis and their gains from the analysis results.

Source: authors' construction based on Phillips et al. (2012) and Haber & Schryver (2019), 2019.

publicly available document that contains information on financial performance as at the beginning and end of a year. Small legal entities, including associations and foundations, in Latvia are organising the accounting process in accordance with national laws and Cabinet regulations, not using international accounting standards. The main regulations for NGOs in Latvia are *the Law on Accounting* and *Cabinet regulation No. 808 of 2006 – Regulations Regarding Annual Reports to Be Submitted by Associations, Foundations and Trade Unions* (Leibus *et al*., 2018).

The bibliographical sources have insufficiently focused on financial analyses of the NGO sector in comparison with those of enterprises. The importance of NGOs financial analysis has same as enterprises. Here should remember the key differences, that the purpose of any NGO is not profit-making comparing with enterprises; however, the investors and NGO members, just like in the case of enterprises, are interested in the way funds are allocated and in returns concerning the defence of public interests.

*Financial performance analysis in the NGO sector in Latvia*

The NGOs must follow their financial stability, because they are responsible for their members for the funds they spend and achieved results, as well as The Associations and Foundations Law (2004) stipulates that nongovernmental organisations are responsible for their liabilities just like other legal entities. The right selected financial statement analysis methodology is a way to improve the transparency. The differences in balance sheet items between NGOs and enterprises (Table 1) give an explanation why it is necessary to use different calculation equations. An enterprise's financial report consists of a balance sheet and a profit/loss account, while an annual report of an association or foundation consists of a balance sheet and a revenue/expenditure statement (Leibus *et al.*, 2018). In both cases, a balance sheet maintains its key properties – the assets indicate available funds, while the liabilities show the origin of the available funds. Both balance sheet sides are equal, and the balance of each item is given for the last date of the reporting period. Considerable differences in balance sheet items for the liabilities side are observed. An expanded balance sheet for an enterprise is approximately two-fold longer than that for associations and foundations, giving more accurate explanations for the origin of funds or creditors. The key items of equity capital for an enterprise represent share capital, reserves, retained earnings of the accounting period and earnings of previous years, whereas the equity capital of associations and foundations consists of three items – the basic fund, the reserve fund and target funds. The basic fund represents long-term investment, while the reserve fund is the surplus of revenues after expenses have been deducted. The use of target funds is important for large associations engaged in various fields of activity if donors wish the funds to be allocated for a particular activity. In contrast, the use of funds by small associations can indicate the wish of their members to make the allocation of funds more transparent. The assets items are almost the same for NGOs and enterprises, yet the assets of associations often consist of cash, fixed assets and intangible assets, whereas for enterprises a significant item is inventories that represent available goods to be sold to make profits or a source of finance in case of financial instability.

A profit or loss account for enterprises is much more important than a revenue and expenditure statement for associations and foundations, as it

Table 1

**Comparison of balance sheet items between associations, foundations and enterprises**

| | Associations, foundations | Enterprises |
|---|---|---|
| Assets | Long-term investment:<br>I. Intangible assets<br>II. Fixed assets<br>III. Long-term financial investment<br>Current assets:<br>I. Inventories<br>II. Receivables<br>III. Securities<br>IV. Cash | Long-term investment:<br>I. Intangible assets<br>II. Fixed assets, investment property un biological assets<br>III. Long-term financial investment<br>Current assets:<br>I. Inventories<br>II. Receivables<br>III. Short-term financial investment<br>IV. Cash |
| Liabilities | I. Funds:<br>1. Basic fund<br>2. Target funds<br>3. Reserve fund<br>II. Long and Short-term debt | Equity capital:<br>1. Share capital<br>5. Reserves<br>6. Retained earnings or uncovered losses<br>Long and Short-term debt |

Source: authors' construction based on Regulation Regarding the Associations' and Foundations' Annual Financial Statements (2006) and Regulation Regarding the Conduct and Organisation of Accounting (2003), 2019.

shows the economic performance of an enterprise aimed at making profits and ensuring the operation of the enterprise. In contrast, the NGO revenue and expenditure statement gives informative insight into the key items of revenue and expenditure. The key purpose of NGOs is not to have an excess of revenues over expenditures but to perform the tasks defined by their members, and if the expenditures exceed the revenues, a higher membership fee can offset the gap. Additionally, the NGO sector is advised to the extent possible to have an excess of revenues in order to safeguard themselves against cost and price level fluctuations.

NGOs are part of society, and the governments are interested to improve society engagement that indicates a positive cooperation between both parts in democratic states. It is for this reason, that NGOs receive a lot of benefits comparing with enterprises. These benefits are sometimes used unfairly, and different methods of performance analysis incl. financial analysis is a way how to keep a positive image of NGOs.

The diversity of available information has to be considered when choosing a calculation methodology for financial analysis. Various equations could be designed, yet it has to be taken into account that publicly available information can less explain the performance of and processes in the NGO than insider information can do. The authors conclude that the study by the Latvian Civic Alliance (2016) indicated that some items of revenue/expenditure statements such as *Other Revenue* or *Other Expenditure* can reach even 30% of the total, and the Regulation Regarding the Associations' and Foundations' Annual Financial Statements (2006) does not prescribe that the mentioned items have to be detailed. That is why it is not possible to identify the source of finance or the purpose of expenditure for a considerable amount of funds by the use of publicly available information. Calculating performance indicators, it has to be considered whether the data are objective, and it is not useful to apply a lot of equations to acquire the results on which no conclusions could be made.

Overall, financial performance indicators could be divided into the following four categories: 1) liquidity, 2) stability, 3) asset turnover, 4) profitability indicators, or according to their broad types: revenue, expenditure and administrative as well as balance sheet indicators (Robinson, 2009).

*LIQUIDITY RATIO* is one of the most popular financial analysis indicators, which belongs to balance sheet indicators. Each Ashley & Faulk (2010); Holman, Ihrke & Grasse (2010), Hammond (2015) has defined a liquidity ratio in a different way, yet the basic idea is the same – it is *a ratio of current assets to liabilities*. Totally, there are at least four types of liquidity ratios, as stated by Bogužs (2010), and the calculation results are affected by the balance sheet items used. The authors point out that the standard equation for liquidity ratio calculation is the most appropriate for the NGO sector. The calculation could use various equations, yet differences in the results are insignificant. According to the study by the Latvian Civic Alliance (2016), the key current assets items of the NGO sector are cash and receivables, 53.6% and 31.9%, respectively, as the other assets items such as inventories (materials and goods) and securities have low proportion in the total assets. In the NGO sector, the proportion of long-term debt is only 5%; however, an analysis of balance sheets of agricultural enterprises reveals a lack of long-term debt. A liquidity ratio shows the financial stability of an organisation and allows assessing the financial possibility to cover liabilities. In Latvia, according to the study by the Latvian Civic Alliance (2016), the ratio for NGOs is 1.6 or within normal limits.

However, the above-mentioned equation for calculating a liquidity ratio for agricultural NGOs in Latvia has not been employed, as the proportion of their liabilities, on average, was 7.9% of the total balance sheet liabilities and their current assets reached 94.9%, of which 90% was cash, and the remaining 10% was debt and inventories. The NGOs managed to save relatively a lot of financial resources, and they had almost no short-term debt. This means a liquidity ratio for the agricultural NGOs can reach several hundreds. In the situation where NGOs have a low proportion of liabilities, the authors suggest using *a ratio of current assets to key expenditure items*. Unlike a convention enterprise, an NGO's main resource is its employees being remunerated for their work. The main costs of organisations are also technical expenditures, yet the technical expenditures, compared with remuneration, are more elastic, and the quality of services provided by the organisations is not affected by reduction in the technical expenditures. For agricultural NGOs, *a ratio of cash to remuneration expenditures* indicates the capability of the NGOs to steadily remunerate their employees for a period by use of disposable funds. The lowest ratio was half a year, whereas the highest was 2.6 years. A liquidity ratio similar to the authors' one was suggested by Hammond (2015) who proposed calculating *a ratio of assets to average monthly expenditures* to identify the period over which the organisation is capable to ensure its operation by means of disposable assets.

*STABILITY RATIO* is similar to the liquidity ratio; it shows the extent of NGO independence from creditors. Chiang (2016) suggests calculating it as *a ratio of liabilities to assets* or *liabilities to funds*. The former one shows the proportion of borrowed capital in the organisation total, while the latter one shows

the proportion of liabilities in the total funds or equity capital. It could be expressed as a ratio or a percentage, which does not change the substance of it, as it is a typical structural indicator. A very high ratio could create problems regarding the future solvency of the organisation or borrowing funds. For example, Bogužs (2010) has defined a stability ratio as *a ratio of funds to the balance sheet total*, yet the authors point out that basically it is the same indicator, which has been reversed, as total liabilities are equal to total assets, and in the NGO sector liabilities consist only from funds and liabilities (Latvian Civic Alliance, 2016).

*ASSET TURNOVER* and *PROFITABILITY ANALYSES*, unlike conventional financial analyses, are not appropriate for the NGO sector. Technically, the calculation methods could be adapted. A ratio of asset turnover shows how effectively disposable assets are used. In the NGO sector, however, the key balance sheet items are current assets, of which the key one is cash, and debts. The situation with profitability analyses is similar, as profitability indicates the efficiency of performance, showing profit earned on the assets invested. The purpose of NGOs is not profit-making, yet the NGOs are not prohibited to perform economic activities, including making profit that is used to cover expenditures related to their basic activity, project implementation, etc. Accordingly, to some extent, it is possible to perform asset turnover and profitability analyses for NGOs, identifying returns on the resources utilised, yet it could not be done by using only publicly available information – annual reports.

To some extent, NGOs have to operate profitably, with an excess of revenue, in order to save funds for unexpected expenditures or revenue fluctuations. One of the ways of calculating profitability is to identify an *excess of revenue over expenditures* or *subtract expenditures from revenues*; the result shows whether the NGO had a surplus of funds in the reporting year.

The scientific literature most often refers to a *profitability ratio* such as a *ratio of revenue less expenditures to total revenue.* Ashley & Faulk (2010); Holman, Ihrke & Grasse (2010); Hammond (2015) gave three terms for this ratio: 1) *Full cost coverage*; 2) *Operating margin*; and 3) *Savings indicator*. This ratio is expressed as a percentage showing the organisation's capability not only to operate in a long-term and cover direct and indirect expenditures by its revenue but also to make provisions for unexpected expenditures. Too large provisions might indicate inefficient use of funds that could be allocated for other projects.

*Operational reserves* show also *profitability ratio*, which indicate whether financial resources are sufficient to ensure further activities without borrowing from external sources, and is calculated as follows: *available assets, except equity capital, are divided by total cost*. An operating reserves' ratio has to be at least 0.25 or at least three-month expenditures have to be covered. This ratio indicates how many months an organisation can ensure its operation without borrowing from external sources. According to the Latvian Civic Alliance (2016), the self-sufficiency ratio for the NGO sector of Latvia is estimated at 33.9%, and at least four-month expenditures could be covered by the disposable funds of the NGOs. The authors point out that this ratio does not play an essential role in specifying the financial capacity of the NGO if the NGO has a safe and balanced cash flow. An essential role is played by the ratio if the NGO, for example, participates in EU-funded project proposal competitions; the project costs are covered after the project has been completed or after submitting an intermediate report – before the project costs have to be covered by the organisation itself. For the agricultural NOGs analysed, this ratio ranged from 22.1% to 108.2% in 2017. The organisations with a ratio of above 100% had accumulated financial resources that are sufficient to cover one-year expenditures.

The above-mentioned ratios could be calculated using a relatively small amount of data that are available publicly. The data shown in annual report annexes have to be employed as well. Even though the legal framework for accounting for associations and foundations prescribes that annexes are also part of an annual report, yet publicly available sources – agricultural NGO annual reports – had no annexes. In a situation where extra accounting data are available, it is possible to do a detailed analysis and accurately identify the weaknesses and strengths of the organisation. However, it has to be taken into account that just like enterprises, organisations compete against one another, and they are not interested in disclosing more information in their annual reports than it is required by the relevant legal framework.

A detailed financial analysis involves various structural calculations that mainly pertain to a detailed analysis of revenues and expenditures. The need to do a detailed analysis is determined by revenue and expenditure statement items such as *other revenue* and *other expenditure*. For the NGOs analysed in the study by the Latvian Civic Alliance (2016), the mentioned items represented 34.5% and 64.3%, respectively. In contrast, for only a few agricultural NGOs analysed the item Other expenditure reached 45%, while the item Other expenditure was considerable for all the NGOs, and in some instances even reached 80%. Both items represent a significant amount of funds that could not be assessed using publicly available information in relation to whether the funds are spent on the goals of organisations and how effectively the funds have been spent.

The existence and activity of any individual is characterised by disposable funds. Accounting regulations for the NGO sector prescribe that revenues have to be classified into six categories: *membership fees; donations and gifts; inheritance; government subsidies; revenues from economic activity; other revenue*. The sources of revenue could be diverse; therefore, it is important to verify the *STABILITY OF THE SOURCES OF REVENUE.* This is a typical structural ratio. It is expressed as *a ratio of revenue to total revenue for each source of revenue,* and it is compared with that for the previous period.

The sources and amounts of finance for NGOs can vary from year to year; therefore, this ratio allows assessing safe sources of revenue and making financial forecasts. There is no range set for this ratio, and it has to be assessed for each individual organisation. A too high ratio for some source of finance might create problems concerning the solvency of the organisation in case the amount of finance received from this source decreases. It is important to assess the stability of sources of finance when drawing up a budget for the next year and planning projects. According to the study by the Latvian Civic Alliance (2016), the key sources of finance for NGOs in Latvia are *economic activity* and *other revenue*. Their economic activity involves consultations, training, holding educational and NGO popularisation activities, etc. Other sources of finance are project activities, property management, contract work, etc. Government subsidies received by the NGO sector made up 6.8% of their total finance in 2014. Even though the NGOs surveyed by the Latvian Civic Alliance (2016) indicated membership fees as their key source of finance, this source of finance comprised only 1.7% of the total revenue of the NGOs analysed, yet remuneration accounted for 25% of their total expenditures, exceeding the amount of membership fees approximately 14.6-fold. In view of the low participation of the public in NGOs, the NGOs are not able to fully cover their costs by only their membership fees and pay motivational salaries to their employees without using other sources of finance.

*EFFICIENCY OF REVENUES* have to assess the NGOs, i.e. how much resources have been invested to attract the finances – *the cost of attracting the revenues is subtracted from the amount of the revenues acquired*, thereby calculating the net amount. The second way of calculation represents a ratio of *costs incurred to revenues acquired.*

*EFFICIENCY OF A PROGRAMME,* Similarly to revenue analyses, the implemented by the NGO, which indicates the share of cost of a particular activity in total cost, has to be also assessed. This ratio could be calculated if the cost of a particular activity is known; the cost compared with the result of the activity allows assessing the efficiency of the activity or the sufficiency of finances for the further implementation of the activity. The ratio is calculated by *dividing expenditure on a particular programme by total expenditure*. Most often, this ratio is used by an NGO's members to assess their satisfaction with the results achieved and make a decision on their further membership in the NGO. Target donations could be made in order to allocate funds only to a particular programme. The efficiency of a programme could not always be determined by means of a ratio; most often, in the NGO sector it has to be assessed based on the work done.

NGOs receive various subsidies from the government as well as tax relief (Yetman & Yetman, 2016); therefore, the government is interested in receiving feedback and making sure the government-funded activities contribute to employment, NGO sector development, public participation, tax revenues etc. Communicating with national institutions about the role of the NGO sector, the NGOs can defend their interests by means of financial analyses of taxes paid to the government, specifying the amounts of total revenue, total expenditure or total subsidies that are paid back to the government as labour taxes, the value added tax, etc.

*Possibilities of financial analysis results compared*

To perform a complete analysis, conclusions and explanations have to be provided as well as factors affecting or being able to affect performance have to be identified in addition to the ratios calculated. Drawing up conclusions, the specifics of the NGO sector or the organisation have to be taken into consideration. The results have to be compared with the average in the NGO sector or benchmarked against those for other organisations, yet the comparison with other industries or legal forms of business have to be done cautiously.

In business, where more statistics are available, a comparison is easier to do, and some institutions responsible for statistics regularly perform calculations of averages for industries. At present in the NGO sector, however, a comparison is possible only if performing analyses of individual organisations. The databases of *Lursoft* and the *CSB* provide diverse information on legal entities – their annual reports and balance sheets –, yet the information is classified according to the NACE 2.rev classification, and a shortcoming of this system is that it is not possible to select annual report information by legal form – an enterprise or NGO. Theoretically, aggregate data on the NGO sector could be acquired from the *S* section of the NACE classification, yet it has to be taken into account that the *S* section has three divisions, and NGOs are included in the section *S94* – activities of public, political and other organisations – without providing a more detailed classification up to the level of class (with a four digit numerical code) or

by kind of legal entities. According to the 2017 data on economically active entities in Latvia, the section *S* was represented by 23.7 thousand legal entities, of which 20.5% were associations and foundations, while 62.9% were self-employed individuals and 16.6% were other legal entities that, unlike NGOs, had other economic activity purposes, including profit-making, which considerably changed the composition of financial indicators for the entities included in section *S*. Even though the *CSB* provides financial data on legal entities included in section *S*, division *94*, this division reported on only 4055 economically active nongovernmental organisations or 38% of the total, which was a too low proportion to characterise the overall financial situation in the NGO sector. Other NGOs are classified under the other NACE sections, which was due to *Cabinet Regulation No.779 of 22 December 2015 Regulations Regarding the Classification of Associations and Foundations;* the purpose of the regulation was to classify NGOs by a kind of activity and to contribute to the quality of statistics and organisational transparency in accordance with the uniform legal entity classification standards. A potential solution is to compliment the statistical sources by one more statistic that classifies legal entities by kind of activity.

The Latvian Civic Alliance does regular studies on the NGO sector, and in 2015 it surveyed 423 NGO representatives and analysed 99 NGO annual reports. The NGOs were selected from each region of Latvia and represented 11 kinds of activity. However, as indicated by the Latvian Civic Alliance itself, the financial analysis results differed from the survey results. This means that the number of NGOs analysed by the Latvian Civic Alliance was too small to perform a high-quality analysis and identify averages for the NGO sector.

**Conclusions**

1. Despite globalisation, changes in the economy and developments in the world, financial analysis is still necessary for stakeholders to get insight into the financial condition of the entity analysed. The methodologies of analysis and basic calculation functions are the same throughout the world, which are adapted to the accounting system of each particular country and the legal form of the entity analysed.
2. The publicly available associations and foundations annual reports provide with much less explanation as enterprises annual reports, but the financial analysis methods for associations and foundations are equally effective, which contribute to the transparency of NGO activities and the public's trust in them.
3. NGOs receive a lot of benefits/ government relief comparing with enterprises, that is why the performance analysis is a way how to show that the status of NGOs is used fairly; no hidden profit-making activity; funding's are spent under control; and organisations are able to perform liabilities.
4. Financial analysis is one of the complex analysis methods whereby relevant calculations are performed and conclusions are drawn, and it is important to compare the results with averages for the NGO sector or industries or benchmark them against those for other organisations. To make a comparison with the average in the NGO sector, the CSB of Latvia has to complement its statistical selection criteria by a criterion of legal forms.

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# DEPOPULATION IN RURAL AREAS IN POLAND – SOCIO-ECONOMIC LOCAL PERSPECTIVE

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**Abstract**
The article deals with the issue of rural population decline in Poland in 1995-2017. The aim of the study was to present the phenomenon of depopulation involving a decrease in the number of people living in rural areas in Poland at the local level. Based on the literature, the potential effects of depopulation on local development were indicated. The data of the Central Statistical Office and the results of own research carried out in three rural communes in 2019 were used. The occurrence of regional differentiation of rural depopulation processes in Poland was found. Analyzing the phenomenon at the local level, it was found that as much as 38.6% of rural communes were characterized by depopulation (a loss of over 5% of the population), including for 10.7% of communes, the population decline in the analyzed period was more than 15%. These areas can be considered as problem areas. A particularly unfavorable situation occurs in eastern Poland and the Opolskie Voivodeship. There was a positive correlation between the loss of population and the development of own revenues of communes' budgets. Studies show that the phenomenon of depopulation is mainly caused by a negative natural increase, which was preceded by a migration outflow associated with the lack of jobs in rural areas.
**Key words**: depopulation, rural areas, population, problem areas.

## Introduction

In recent years, the population has been decreasing in Poland and according to data for 2017 is 38.4 million people (CSO, 2019), which is 99.5% compared to the population in 1995. On a general scale, the population in cities decreases slightly, and increases in the countryside. The phenomenon of population shrinkage, including the outflow of rural population, also occurs in other countries (Cena & Fernandez-Cavada, 1986; Johnson & Lichter, 2019; Kotowska & Jóźwiak, 2003; Kuczabski & Michalski, 2013; Li, 2015; Shrinking… 2017). The course and intensity of population outflow processes from rural areas in Poland varies over time and in space (Bański, 2005, 2008). The outflow of people is caused by unfavorable economic processes or low competitiveness of the area in relation to other areas to which the population migrates. Looking historically at the shaping of the rural population (Eberhardt, 1994), it can be stated that in the period after the Second World War there was a significant population outflow in rural areas, which was compensated by a high birth rate (Bański, 2008; Gawryszewski & Potrykowska, 1988). In 1946, there were 15.6 million people living in the rural areas, i.e. 66% of the population of the country (Bański, 2008). In 2003, the rural areas were inhabited by 14.7 million people, that is only 38.4% of the total population, while in 2017 there were 15.3 million people living in the villages (39.9% of the total population) (CSO, 2019). Currently in rural areas in the face of a weakening birth rate (in 2015 it was negative at -0.1), migration processes play an increasingly important role in spatial diversity of the population (Eberhardt, 1994). Locally, it depends on individual features and functions of rural areas, largely location and communication with cities and is the result of changes in the economy, i.e. system transformation in Poland after 1989 and access to new labor markets after Poland's accession to the EU in 2004. In the majority of rural areas, the cumulative problems mainly of economic nature (especially, low profitability of work in agriculture, unavailability of non-agricultural jobs, high unemployment) push rural population to cities (Li, 2015). The population growth is characterized by rural areas located around large cities (Biegańska & Szymańska, 2013), thanks to which there is a positive migration balance in the countryside (Bański, 2005) identified for the first time at the beginning of the 20$^{th}$ century.

In the literature on the subject, two types of depopulation are usually distinguished: the traditional type of depopulation in the area where the main reason for depopulation is migration outflow (negative migration balance) and so-called a new type that is caused primarily by natural losses (negative natural growth). It can be concluded that the new type is a consequence of long-term traditional depopulation (Bucher & Mai, 2005; Celińska-Janowicz *et al.*, 2010). The term depopulation is understood as the process of depopulation of a certain area, i.e. the population decreases (Szukalski, 2015). Based on previous research (Eberhardt, 1989; Strzelecki, 1995), ), it was assumed that areas where depopulation occurs are characterized by a population loss of more than 5% over a longer time horizon, areas with a population decline of more than 15% were identified as those with extreme depopulation.

The literature indicates that the identified problem of population loss is the basis for the identification of population problem areas or areas with demographic depression (Bański, 2002; Śleszyński *et al.*, 2017; Zagożdzon, 1998). Depopulation and unfavorable

demographic changes are also connected with the features of the peripheral regions (Penzes, Pasztor, & Tatrai, 2015). In the scientific work on depopulation, the authors most often focus on the diagnosis of changes in the population. An innovative approach is to show the process from the point of view of the authorities of a specific territorial unit (local level) and to show the relationship between changes in the population and the amount of income in the local budget, which is an important instrument for supporting local development.

The aim of the paper was to present the phenomenon of depopulation in the rural areas in Poland at the local level. To reach the purpose, the following tasks have been set: 1) to indicate the potential socio-economic effects of depopulation for local development; 2) to determine the intensity of the rural population decline at the regional and local level; 3) to indicate the determinants and effects of population loss in rural communes, especially the impact on communal budgets.

## Materials and Methods

The research process took place in successive stages. Based on the analysis of the literature on the subject, the potential socio-economic effects of local development were identified. In the next step, using the data from the Central Statistical Office (CSO, 2019), changes in the number of population in rural areas were determined at the regional (voivodship) and local level (rural communes)[1]. Relations between changes in population, migration balance, natural increase and the amount of own revenues of communes were indicated. Then in 2019, in-depth research was conducted in deliberately selected 3 rural communes (computer assisted telephone interview with employees of commune offices), in which the largest outflow of population in the years 1995-2017 was found. The research period covers the years 1995-2019, which is related to the availability of population data in public statistics. Data analysis was based on the linear regression method. The results were presented using maps, tables and graphs created using the MapInfo and Statistica software.

## Results and Discussion

*Depopulation at the regional level*

In 1995-2017, the decrease in the number of people was found in 6 Polish regions out of 16 existing ones (Figure 1). The largest population loss occurred in the Podlaskie and Opolskie voivodships, and was respectively 11.4% and 10.1%. The Eastern Poland is a densely depopulated area, which confirms the results obtained earlier by other authors (Bański, 2008). This may result from the specific location of the regions making up Eastern Poland at the external EU border and the fact that they are included in the peripheral and underdeveloped regions. In other regions there was an increase in the number of people living in the countryside, which was the highest in Pomorskie (125.4%), Wielkopolskie (112.3%) and Małopolskie (111.7%) voivodships. The number and importance of cities located in the region (Śleszyński *et al.*, 2017), to which the rural population migrates in search of better

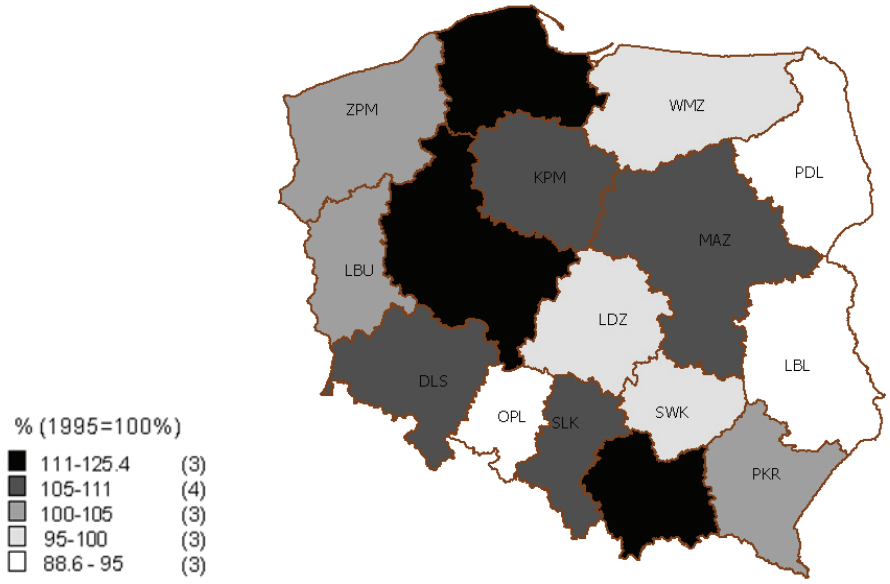


Figure 1. Changes in the number of rural population in Polish regions in 1995-2017 (%).

Source: compiled by the author based on CSO (2019) data.

[1] In Poland, there are (as of 2017): voivodships (16), counties (314) and communes (2478); there are 3 types of communes: rural (1555), urban (302), urban-rural (621).

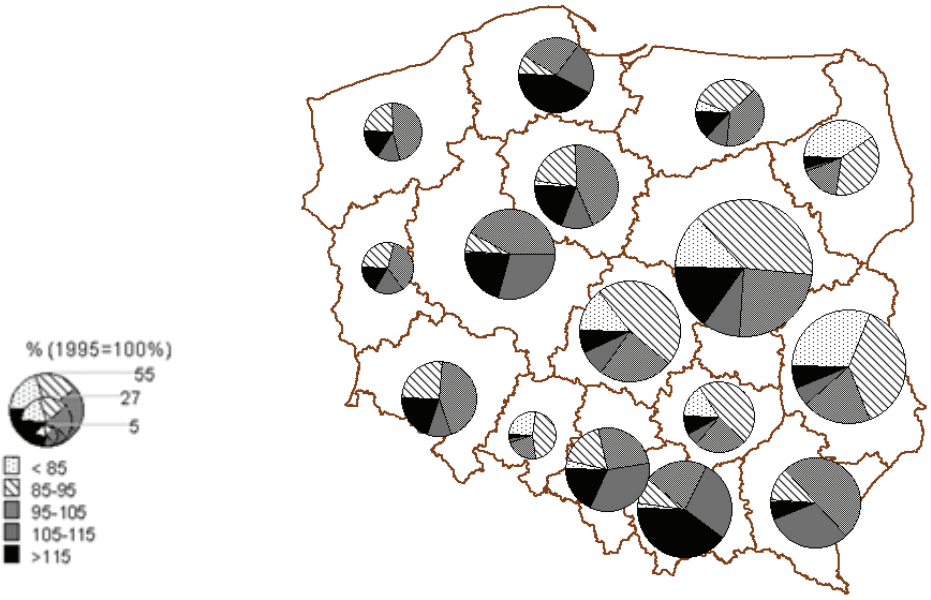


Figure 2. The structure of rural communes in Polish regions according to changes in the population in 1995-2017.

Source: compiled by the author based on CSO (2019) data.

living conditions, is of great importance in explaining the existing differences between regions.

Individual regions were internally differentiated in terms of population outflow from rural areas, which can be observed by analyzing population changes in 1995-2017 at the local level (communes) (Figure 2). In Poland, as much as 38.6% of rural communes were characterized by depopulation (a loss of over 5% of the population), of which 10.7% were rural areas with a loss of more than 15%. Communes in which the depopulation process was found out predominantly prevailed in the regions such as Podlaskie, Opolskie, Lubelskie, Świętokrzyskie and Łódzkie. Particularly worrying is the high percentage of communes where the population reduction was greater than 15%. This applies to the following voivodships: Podlaskie, Opolskie and Lubelskie, in which these communes accounted for 41%, 31% and 28% respectively. These areas can be considered as problem areas (Zagożdzon, 1998), where the disadvantageous phenomenon of a large population loss causes internal anomalies and requires external help (Szlachta, 1984). The most favorable situation was in the following voivodships: Małopolskie, Pomorskie and Śląskie, where rural communes characterized by an increase in the number of population were predominant.

*The effects of depopulation at the local level*

Previous studies show the existence of many adverse effects of population outflow in various spheres associated with local development. These include, among others: changes in the structure of the population by age and gender (Stasiak, 1992); changes of the family and local communities (including the impediment of caring and care functions towards weaker members of the family, including the elderly)) (Stockdale, 2002; Szukalski, 2015); changes in the economic structure of the population; lowering resources on the labor market, weakening entrepreneurship and innovation (Celińska-Janowicz *et al.*, 2010); deformation of the local market of goods and services; problems in the real estate market (a drop in their prices due to low demand and inheritance)); decrease in anthropopressure (Szukalski, 2015); inefficiency of the local public finances system; increased costs of infrastructure maintenance (Li, 2015; Mann, 2004), especially social infrastructure. As a result, the depopulation areas are characterized by low competitiveness. It also indicates the beneficial effects of depopulation, ie an increase in the safety of life (Szukalski, 2015) and the opportunity to improve the functioning of agriculture through the enlargement of farms (Bański, 2002).

To determine the consequences of changes in the population for local development, the amount of own income of rural communes, which mainly includes local taxes, was used. In reference to the various types of depopulation in the literature (Bucher & Mai, 2005), the natural increase and the migration balance were used. In order to estimate the impact of individual variables on the development of own revenues of rural communes, a linear regression analysis was applied (Figure 3 and 4). Based on the first of the estimated models (Figure 3), a positive relationship can be found between the analyzed variables (r=0.3853). This means that if the natural increase increased by a unit, the income increased by PLN 161.2 thousand.

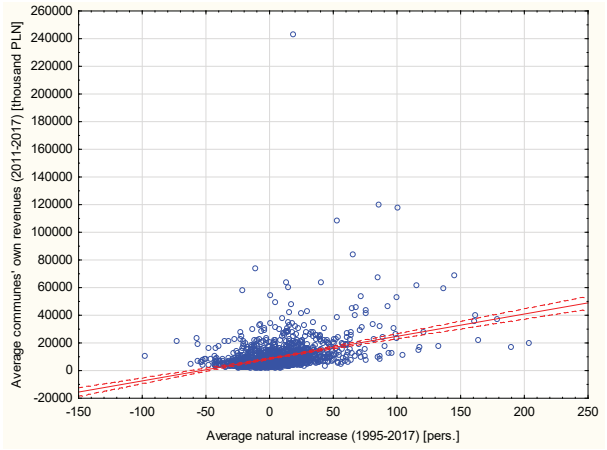


Figure 3. Natural increase and changes in own revenues of rural communes in Poland.
Source: compiled by the author based on CSO (2019) data.

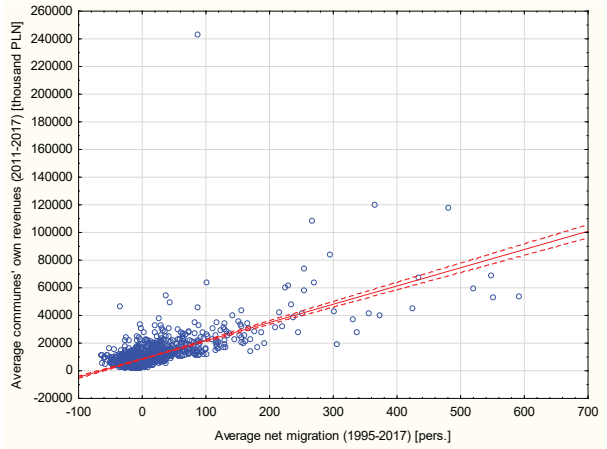


Figure 4. Migration and changes in own revenues of rural communes in Poland.
Source: compiled by the author based on CSO (2019) data.

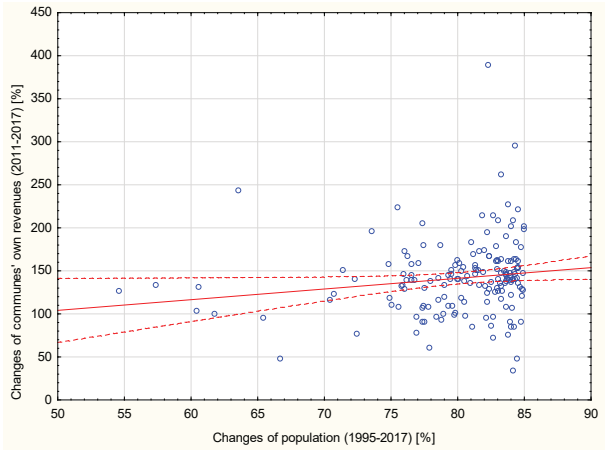


Figure 5. Change in the number of population and change in the amount of own revenues of rural communes in Poland characterized by extreme depopulation.
Source: compiled by the author based on CSO (2019) data.

Positive dependence was also found between the migration balance in the commune (Figure 4) and the amount of own revenues of communes (r=0.6845). If the migration balance changed by a unit, the revenues increased by PLN 131.9 thousand. The relationships found were statistically significant.

Figure 5 shows the dispersion of communes characterized by a large loss of population (extreme

Table 1

**Characteristics of analyzed rural communes affected by depopulation in 1995-2017***

| Specification | | Czyże | Orla | Dubicze Cerkiewne |
|---|---|---|---|---|
| Population in 2017 | | 2034 | 2770 | 1567 |
| Changes in the population number 2017-1995 (%) | | 61.77 | 63.61 | 65.43 |
| Population density per 1 km$^2$ | 2017 | 15 | 17 | 10 |
| | 2002 | 20 | 23 | 13 |
| Average annual net migration per 1000 population 2003-2017 | | -2,8 | -1,2 | -2,6 |
| The average annual natural increase per 1000 population 2002-2017 | | -18.7 | -16.7 | -18.8 |
| Average annual loss of population 1995-2017 (%) | | 2.16 | 2.03 | 1.90 |
| Population in the pre-productive age (%) | 2017 | 11.8 | 13,4 | 10,8 |
| | 2002 | 13.4 | 13.3 | 13.5 |
| Population in post-working age (%) | 2017 | 38 | 39.8 | 40.7 |
| | 2002 | 38.9 | 40.4 | 39.6 |
| Feminization rate (persons) | 2017 | 105 | 108 | 104 |
| | 2002 | 104 | 108 | 98 |

* years depending on the availability of statistical data

depopulation), which was linked to changes in the amount of own revenues. There is a positive, relatively weak relation (r=0.1548) between the analyzed variables. This is due to the fact that in the group of communes in which there is a large outflow of population, the occurrence of such communes was found, which, with the same changes in the population, achieve different levels of own income. This may mean that a group of communes where depopulation occurs is heterogeneous in terms of functions performed, employment of residents, which may translate into different types and sizes of inflows that make up their own income (taxes on real estate, agriculture, forestry, transport and participation in central taxes, i.e. PIT and CIT).

Three neighboring rural communes, located in the Podlaskie voivodship, i.e. a region where the largest outflow of population in the analyzed period was recorded, was selected for in-depth studies. The general characteristics of the communes are presented in the Table 1.

All studied communes are characterized by low population density, which is decreasing year by year. One can speak of a permanent, yearly population decline, which concerns the area of the whole commune, not only selected villages. The surveyed representatives of communes pointed out that currently the population decline is caused by low natural increase, which is confirmed by data from official statistics (CSO, 2019). For a long time, older people are a large part of the community, the number of deaths is high, few children are born (about 10-20 a year). In the case of migration outflow, observed mainly in previous years, it was pointed out that young people would travel permanently in search of work to cities in the region and other large cities in Poland. Residents of the studied communes also went abroad (Germany, Belgium, Iceland), in this case the migrations were of a chain nature. The inflow of new inhabitants is rarely observed, mainly due to the poor quality of soils hindering farming in agriculture and the lack of jobs in the commune. Only in the Orla commune there are large economic entities offering jobs outside agriculture (wood panels factory, wind farms). A factor attracting new residents (1-2 people) are natural values of the area (Białowieża Forest). In the commune people who are interested in peaceful life in the countryside (Szukalski, 2015), pensioners or people for whom the new house is a second house, used for recreational purposes settle. There is also an influx of Ukrainians who choose the examined communes due to their close location and differences in the possibilities of individual development that exist between Poland and Ukraine. Taking up work remotely is difficult due to limited access to the Internet.

As consequences of depopulation the area was pointed to low tax revenues to the commune's budget, high costs of infrastructure maintenance: the commune office, health center and schools (Li, 2015; Mann, 2004). Municipal authorities have taken measures to adapt the infrastructure to real needs, but sometimes there is no way to change, for example, in the commune there is one school that cannot be closed. In the future, this situation may result in the necessity to incur even higher costs of infrastructure maintenance. Uninhabited homes remain in the care

of their families or neighbors, sometimes find new buyers or, in the case of land, new tenants (Bański, 2002). There was no indication of very low prices on the local real estate market.

**Conclusions**

On the basis of conducted research, the following conclusions can be reached:

1. A characteristic feature of rural areas in Poland is their wide diversity in terms of changes in the population, which is visible in the intra-and inter-regional approach. On the one hand, there are areas characterized by depopulation, where, due to the loss of population, numerous adverse consequences of the socio-economic sphere may appear i.e. unfavorable population structure, deformation of the labor market, inefficiency of local public finances, problems with development and maintenance of infrastructure and significantly impede local development. This applies to as much as 38.6% of rural communes, particularly unfavorable situation in Eastern Poland and the Opolskie Voivodeship. On the other hand, there are communes located in the vicinity of large cities with very large population growth, which may also constitute a barrier to development. Maintaining such a large diversity in the long term may result in problems in socio-economic development at a level higher than the local one.
2. The positive correlation between the loss of population and the development of own revenues of communes' budgets allows us to think that in the context of local development, among many consequences of depopulation, it is precisely the reduction in budget revenues of local governments that is particularly dangerous. Decreasing revenues of communes combined with the need to incur higher budget expenses related to, among others, aging of the population, dispersion of settlements, high infrastructure maintenance costs will significantly and even more than currently limit the possibilities of financial stimulation of socio-economic development processes at the local level.
3. Qualitative research indicates that at first the population loss in the analyzed communes was caused by migration outflow related to the lack of jobs in rural areas. Over the course of time, the main cause of depopulation became a negative natural increase. This shows how important it is at local level to stimulate entrepreneurship and create new jobs outside agriculture.

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# STUDENTS' EXPECTATIONS TOWARDS THEIR COURSEMATES IN THE ACADEMIC ENVIRONMENT

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**Abstract**
The social environment of a university, which is comprised of students, teaching staff and parents, play an essential role in the educational process. Students' decisions, learning and attainment could be considerably affected by relationships with their coursemates in particular. The present research therefore aims to examine students' expectations towards their coursemates in the academic environment in Latvia. The research surveyed 979 students at Latvia University of Life Sciences and Technologies (2016-2018). The research has found that for students, the study process involves not only learning but also common events with their coursemates as well as informal relationships. Comparing the role of coursemates and the informal influence of parents and teaching staff, the respondents preferred the involvement of their coursemates. Larger differences in opinion were found for the informal role of teaching staff in learning. Of the respondents, 47% expected teaching staff to be friends, while 29% slightly agreed that the teaching staff had to be authorities and knowledgeable specialists, which indicated that it was important for some students to disassociate formal relationships from informal ones between students and teaching staff. The dispersion of opinions that could be observed for some variables might be explained by the specifics of the programmes the students represented. Statistically significant differences in opinion were found between bioscience and engineering students in relation to the attitude of teaching staff to students, parental support and coursemate support in learning ($p<0.05$) – the bioscience students more often favoured informal relationship aspects.
**Key words**: coursemates, higher education, students' expectations.

## Introduction

In the educational process, an essential role is played by the social environment of a university, which is comprised of students, teaching staff and parents. Even though research investigations into this problem are done (Orska, 2006; Licite *et al*., 2018), they mainly focus on general education schools rather than universities. However, the social environment of universities considerably affects the ability and opportunities for young individuals to analyse and assess ongoing processes, build up their research skills and master their professional competences, thereby being formed into personalities (Burceva, 2006). The mentioned aspects are largely affected not only by teaching staff but also by coursemates who often become not only friends but also advisers in study matters.

For many years, scientists did research to reveal the influence of coursemates on the life and academic performance of students at universities. According to the research investigations, relationships with coursemates played some role in shaping behaviours, students' lives and educational outcomes or academic achievements (e.g. grades) (Cook *et al*., 2007; Vaquera & Kao, 2008; Carbonaro & Workman, 2016). In addition, it relates to educational expectations (Hauser *et al*., 1983). Many researches show the importance of coursemate relationships and contexts that lie between friendship networks and study results (Frank *et al*., 2008; Payne & Cornwell, 2007). For this reason, universities often introduce mentoring programmes, with mentors being senior students who focus on the wellbeing of students and the integration and retention of students in the university's life (Etzel *et al*., 2018). However, as pointed out by T. Brodaty and M. Gurgand (2016), the influence of coursemates on the study process has been little researched. The research investigations mainly focus on the role and influence of teaching staff in the study process (Carrel & West, 2010). The present research therefore **aims** to examine students' expectations towards their coursemates in the academic environment in Latvia. To achieve the aim, the following specific research **tasks** have been set: 1) to give insight into the theoretical aspects of the role of coursemates in the study process; 2) to analyse the roles students assign to their coursemates at Latvia University of Life Sciences and Technologies.

## Materials and Methods

The first part of research paper is built on the analysis and synthesis of scientific literature which, allows describing the theoretical aspects of the role of coursemates in the academic environment. The second part is dedicated to the results of a survey that was organized in Latvia University of Life Sciences and Technologies to analyse students' expectations towards their coursemates in the academic environment. It is one of the largest universities in Latvia that has introduced a monitoring programme being implemented by senior students. A three-year longitudinal survey (2016-2018) was conducted to identify the opinions of students. The survey involved 979 first-year students from the programmes of bioscience, engineering and social sciences. The survey focused on students' expectations towards their ideal higher education and university environment (Licite & Janmere, 2018; Licite *et al*.,

2017; Licite & Janmere, 2016) and their opinions on the role of their coursemates in the study process.

The survey measured the opinions of students based on a set of variables – each variable represented some different aspect: academic environment boundaries, coursemate status, virtual communication with coursemates, coursemate support in study matters, parental support in study matters, assessment of attainment, support in learning, teaching staff status and teaching staff attitudes to students. Besides, some of the variables revealed a broader context of students' opinions that pertained to the informal involvement of parents and teaching staff. Nine variables, which constituted a reliable scale with high internal consistency ($\alpha$=0.71), were employed to measure the opinions of students.

Each of the variables consisted of two assertions; respondents had to choose one of the two assertions that most fit their values and rate it on a scale from 1 to 7:

- *Academic environment boundaries (V1)*: common events with coursemates vs the academic environment is intended only for learning.
- *Coursemate status (V2)*: coursemates are good friends/acquaintances vs coursemates are competitors.
- *Coursemate support in study matters (V3)*: coursemates provide help and support in study matters vs only teaching staff give advice on study matters or everything is achieved independently.
- *Assessment of attainment (V4)*: coursemate recognition for attainment is important vs everyone has to be aware of his/her assessment of his/her own attainment.
- *Support in learning (V5)*: instruction given by coursemates help in learning a topic covered during a class vs instruction given by teaching staff is sufficient to learn a topic covered during a class.
- *Virtual communication with coursemates (online vs. offline) (V6)*: a shared account is available in social media for fast communication with coursemates vs a shared email account is available for tackling study matters.
- *Teaching staff status (V7)*: teaching staff as friends vs teaching staff as authorities, knowledgeable individuals.
- *Teaching staff attitude to students (V8)*: teaching staff perceive students as colleagues having equivalent knowledge vs teaching staff perceive students as less knowledgeable individuals and seek to teach them everything.
- *Parental support in study matters (V9)*: parental support in study matters vs decisions on study matters are made by students themselves.

If respondents agree with the first assertion in the pair of assertions referring to the importance of informal relationships, they rate it in the range of 1-3 points, whereas if the respondents agree with the second assertion in the pair of assertions referring to the importance of the formal approach to the study process, they rate it in the range of 5-7 points; 4 points indicate a neutral opinion. A value of each variable (from 1 to 7) has no numerical significance in absolute terms, yet it serves as a relative comparison showing a distance towards one or the other assertion.

**Results and Discussion**

*Theoretical aspects of the role of coursemates in the study process*. The scientific literature often refers to the essential role played by the social environment in the study process (Rudin *et al*., 2018) – coursemates in particular. The scientific literature substantiates the positive influence of coursemates by a number of arguments. First, communication and mutual interaction affect the other party effectively. Second, individuals identify one another with similar individuals and can thus influence each other, incl. regarding decision-making, information exchange etc. (Giordano, 2003). It is believed that individuals copy the behaviour of one another during the social learning process (Boyd & Richerson, 2009) and cooperate with one another. It is also stressed that the coursemates who have become friends represent a significant source of social capital. Scientists point to the influence of coursemates on educational attainment (Lomi *et al*., 2011; Flashman, 2012). At the same time, however, students might perceive their coursemates as competitors (Giordano, 1995) rather than friends because they often struggle for government-funded study places at universities. One can conclude that there is a dilemma: on the one hand, coursemates are perceived as friends and advisors, while on the other hand they represent threats or competitors.

Nevertheless, despite competition among students in universities, relationships with coursemates are very important for modern students. Coursemates often become good friends on the condition that their relationships are based on understanding and mutual respect. Although individuality is essential, "fitting in" is of equal importance to them. They feel very strongly about living up to the expectations of their peers and their communities (Goldgehn, 2004). They mutually exchange their experience and ideas and therefore the experience of the coursemates who are also friends can considerably influence their decisions and daily life, even more than the views of authorities (e.g. teaching staff) do. Nowadays students are particularly concerned with what peers think (Lipkin & Perrymore, 2009). Besides, communication often occurs not face-to-face but virtually (Gardner & Eng, 2005).

Furthermore, young individuals prefer working in a team or group to working individually (Howe & Strauss, 2000). Students prefer to go to a place at the university where to talk with their peers and also to study. According to N. Howe and W. Strauss (2000), nowadays students can better understand one another as well as peers than the generation that was at the university 10 years ago, yet they worse understand teaching staff. This could be explained by the fact that they trust their coursemates more than teaching staff (Manuel, 2002). Students prefer verifying facts and developments to listening and simply trusting what teaching staff say (Gardner & Eng, 2005).

Descriptions of a relationship between modern students and teaching staff indicate that the students expect strong and friendly relationships with the teaching staff, just like with their parents (Epstein & Howe, 2006). Modern students identify themselves with parental values and feel very close to their parents (Gardner & Eng, 2005), which indicates the essential role of their parents not only in their daily lives but also in the study process. Parents are perceived as friends rather than authorities; therefore, students often turn to their parents for advice and appreciate it. In view of the role of parents, the role of an academic advisor includes more of a parental function with regular meetings and personal attention (Eckleberry-Hunt & Tucciarone, 2011). It is important for students that teaching staff perceive them as personalities, as they wish to feel special. Care and attentiveness what young individuals expect from teaching staff is associated with the role of parents. In childhood, the modern youth received parental care, attentiveness and protection – they were 'special'; accordingly, they expect the same in the academic environment (Gardner & Eng, 2005). Research investigations point out that nowadays communication with students has to be made in understandable language for them and a focus has to be placed on positive mutual relationships (Goldgehn, 2004). In this situation, of course, a dilemma is faced: whether teaching staff are today perceived as friends and advisers, or they are knowledge givers.

*The empirical research results* acquired at Latvia University of Life Sciences and Technologies support an idea about peers' importance in general. Theoretically, the study process is a formal, organised, systemised and controlled way of learning whereby primary social interaction occurs between students and teaching staff. In practice, however, if analysing a comfortable learning process, students see the boundaries of the study process broader, admitting that it involves not only acquiring knowledge but also common events with coursemates. With different levels of agreement, 76% students saw common events with their coursemates as an integral part of a comfortable academic environment, while 10% saw the academic environment as only a place for learning. This means that for modern students, the boundary between formal and informal is blurred. This is supported by the fact that with the highest level of

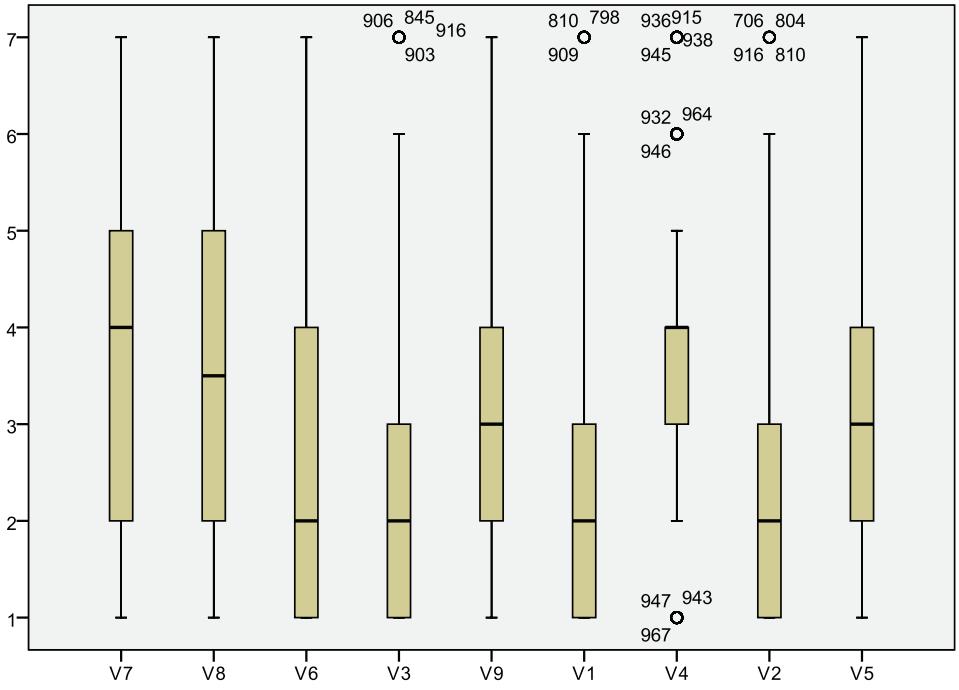


Figure 1. Students' opinions on the role of coursemates, teaching staff and parents in the study process.

Source: authors' construction based on data of the research study 'Students' expectations towards higher education' (2016-2018).

agreement (SD=1.33), most of the respondents (83%) admitted that they would like to see their coursemates as friends or acquaintances rather than competitors. A similar tendency for coursemate involvement was observed in relation to coursemate support in studies. Most of the respondents shared the opinion that the help given by their coursemates was important for them and that they did not have to rely only on teaching staff or themselves (M=2.28; SD=1.44).

However, the analysis of the respondents' opinions on the role of their coursemates only in learning activities, and not in the study process as a whole, reveals that the opinions varied, and the level of agreement on the assertions concerning the role of informal relationships was not as high as that for coursemate status and support as well as the boundaries of the study process.

Compared with the findings of the above-mentioned research investigations, the present research found that coursemate recognition was less important for the respondents, as only 41% agreed it was important (M=3.80; SD=1.61). However, the opposite assertion – everyone has to be aware of his/her assessment of his/her own attainment – was supported to a greater extent: 25% agreed with it, while 34% gave the neutral rating. The results indicate that support for informal relationships was not unambiguous, and slight differences were observed among the variables. It is also evidenced by the respondents' ratings of class topic learning: with different levels of agreement, instruction given by coursemates was important for 53%, while 47% relied only on teaching staff in learning class topics or did not give a particular rating (M=3.48; SD=1.57).

As regards virtual communication, the dispersion of the respondent opinions was high – 66% favoured the role of online communication in social media and preferred it to offline communication. For the purpose of dealing with study matters, 18% preferred email communication, while 17% had no opinion (M=2.80; SD=1.96).

A comparison of the role of coursemates and the informal influence of parents and teaching staff revealed that the respondents preferred the involvement of their coursemates. Parental (family) support for study matters, as opposed to their own responsibility, was important for 60% of the respondents (M=3.08; SD=1.74), while coursemate support was important for 83% (see above).

The dispersion of the respondent opinions for the informal role of teaching staff in studies was found to be higher. An assertion that teaching staff represent friends was supported by 47%, while 29% slightly agreed that the teaching staff had to be authorities and knowledgeable specialists (M=3.66; SD=1.76). Accordingly, it was important for some students to disassociate formal relationships from informal ones between students and teaching staff. This, however, does not mean that they unanimously expected authoritative attitude from teaching staff: 50% believed that the teaching staff had to treat students as colleagues, while 29% admitted the teaching staff had to teach everything because the students were less knowledgeable than they were (M=3.62; SD=1.67).

The dispersion of the respondent opinions that was characteristic of some variables could be explained by the specifics of the study programmes the respondents represented. Statistically significant differences in opinion were found between bioscience and engineering students in relation to the attitude of teaching staff to students, parental support and coursemate support in learning ($p<0.05$) – the bioscience students more often favoured informal relationship aspects. Besides, statistically significant differences in opinion were found also between engineering and social science students, as the engineering students supported informal relationship aspects less. The opinions of social science and bioscience students statistically significant differed only in one variable – coursemate support in study matters ($p<0.05$), which was expected mostly by the social science students.

**Conclusions**

1. The social environment of a university, which is comprised of students, teaching staff and parents, play an essential role in the educational process. To acquire more knowledge, it becomes increasingly important to make strong informal relationships in the academic environment, incl. the relationships with coursemates, which can affect the academic performance of the students. Friendly relationships, based on trust and mutual understanding, are expected from teaching staff as well. This, to a great extent, is associated with family values and the influence of parents, which is significant in the study process as well.
2. The research revealed the specifics of the role of coursemates in the academic environment where, on the one hand, students seek friends, while, on the other hand, they wish to disassociate the formal aspects of the academic environment (learning, attainment assessment) from the informal ones. Even though the students' ratings of the informal involvement of teaching staff and parents pointed to the priority role played by their coursemates, the students' opinions in some aspects were quite dispersed owing to the different study programmes they represented. Engineering students wished less to rely on their coursemates than social science students did.
3. With different levels of agreement, majority of students saw common events with their

coursemates as an integral part of a comfortable academic environment, while 10% saw the academic environment as only a place for learning. This means that for modern students, the boundary between formal and informal is blurred.

4. The research showed that coursemate recognition was less important for the respondents (41% agreed it was important). However, the opposite assertion – everyone has to be aware of his/her assessment of his/her own attainment – was supported to a greater extent. The results indicate that support for informal relationships was not unambiguous, and slight differences were observed among the variables.
5. As regards virtual communication, majority of respondents favoured the role of online communication in social media and preferred it to offline communication. This means that for modern student online communication is important and it strengthens relationships between coursemates in academic environment.
6. The research results are useful for universities that enhance their academic environments, placing a special focus on the aspects of the social environment that contributes to the integration of students in the life of the university, increase the academic performance of students and hinder the students' decisions on interrupting their studies. Besides, the research reveals the values of modern students, the awareness and analysis of which is important in higher education marketing.

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# PECULIARITIES OF RURAL SOCIAL INFRASTRUCTURE MANAGEMENT

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**Abstract**
This paper summarizes the results of a theoretical study as well as practically oriented research about the concept of managing the social sphere of the village and considers the problem-perspective field of development the social infrastructure management in the villages of the Republic of Kazakhstan.The chosen topic is relevant as an insufficiently studied scientific problem, and also has practical significance for the well-being and stable development of rural areas.
The study describes the scheme of management of the rural social infrastructure in the Republic of Kazakhstan from the standpoint of object-subject, methods and results. Interviews of the rural population were conducted about the satisfaction with the rural social infrastructure and attitude towards the work of local governance. Rural settlements of Mangystau oblast currently have an average not significant level of social infrastructure development, and the level of satisfaction of residents in different areas with its condition varies from very low to sufficient.
The most important principles for the development of definition of rural social infrastructure management and its functions have been highlighted with the help of a comparative analysis of various approaches.
According to the results of the study, it was concluded that the development of promising directions of management the rural social infrastructure requires a comprehensive study and evaluation of the facilities, mechanism and principles of this management and the identification of its current problems with regional development tasks.
**Key words**: rural population, social environment, local government, quality of life, rural social infrastructure (RSI).

## Introduction

The relevance of the scientific problem being studied is primarily due to the fact that by the present moment the management of RSI is fragmented, poorly systematized. Traditional solutions in this area are not sufficiently incorporated and often do not take into account the long-term development prospects of rural areas, all needs of current and future generations of rural residents. The theoretical foundations that were formed decades ago turned out to be unsuitable for creating innovative management of RSI that meets its present interests. For this reason, the multi-component definition of the management of the RSI and its principles should be defined and justified.

In modern conditions, the rural social environment is characterized by a low level of equipment and material means, a small amount of services provided, and insufficient funding. Over the past decades, the demand for social benefits and services in rural areas has remained high and often unsatisfactory, while their supply has been narrow and obviously insufficient. As a result, the rural population does not have free choice of residential premises, quality education and high-quality medical care; there is insufficient availability of goods and services which has a negative impact on the life quality. Contemporary rural life conditions have lost stability, creativity, and rural residents have become the lowest paid labor. All of the above actualizes attention and interest in the management of the social environment of rural life.

*The problem of research*: to reveal the essence and content of the concept of social infrastructure, identify the conditions for the development of the rural social infrastructure in the Republic of Kazakhstan, identify the problems of managing the social infrastructure of the village in the Republic of Kazakhstan.

*The aim of the study***:** to analyze rural social infrastructure's development level of Kazakhstan and highlight specific problems with its management.

*Objectives of the study:* to conduct a literature review on social infrastructure development problems; conduct interviews with village residents about the existing problems in the social infrastructure of the Mangystau oblast of the Republic of Kazakhstan; identify the main problems in the management of social infrastructure in rural areas of the Republic of Kazakhstan.

## Materials and Methods

The study of the rural social infrastructure management is extremely important in connection with the problem of achieving the well-being of its inhabitants, directly related to the level and quality of life of the population of any country. Social infrastructure is a multidimensional phenomenon; therefore, it would be a mistake to evaluate it from the point of view of any one opinion. To study the scientific views on the problem of managing rural social infrastructure, we reviewed the studies of the following authors: Д. Баландин (2014), V. Atkociuniene, G. Vaznoniene, & R. Pakeltiene, (2015), В.Ф. Стукач (2015), В.Н. Бобков (2018), G. Vaznoniene, & I. Kiausiene, (2018), I. Manggat, R. Zain & Z. Jamaluddin (2018).

The methodological basis of the study was a systematic, regulatory and integrated approach in

solving certain problems. Well-known research methods data collection, literature review, data systematization, comparative and logical analyses, interview, induction, deduction, logical reasoning was used in this paper.

Scientific-theoretical research is aimed at clarifying the terminology and the substantive foundation of the concept of 'rural social infrastructure'. A content analysis of the evolution of approaches to the study of RSI was conducted.

The empirical research was conducted in Mangystau of Kazakhstan. 12,200 respondents from several rural areas of Mangystau oblast were questioned in a phone interview.

**Results and Discussion**

Based on the specific tasks, as well as the specifics of the research, scientists use different approaches to determine the content of the category 'social sphere (environment)'.

One of the most common is the economic, more precisely economic and sectoral approach to the interpretation of the social sphere, essentially as a synonym for the concept of 'social infrastructure'.

E.B. Тишин (2017) gives the definition 'social sphere' concept from the standpoint of the structural-functional approach, revealing it in two manifestations: through the social infrastructure and complex of its industries and through the social space, covering the system of social relations, numerous social connections.

Social infrastructure can be understood as a system of relations between citizens for the effective use of resources related to the implementation of social programs, maintaining the standard of living and incomes of citizens, for building employment potential and economic growth in a multi-level system. Social infrastructure determines its place in the national economy in accordance with various possibilities to meet the social needs of citizens (Тылл, Есенгельдин, & Мухамедиева, 2016).

The scientific category of 'infrastructure' in relation to the social sphere of the village (SE) received a number of definitions given by scientists from different countries of the world, a brief overview of which is presented in Table 1.

Thus, above mentioned definitions and a more extensive analysis of the RIS research allow us to conclude that today there is no unambiguous definition of this economic category, no single opinion on its structure.

The term 'social infrastructure' is also mentioned in the context of quality of life as its main component (Бобков, 2018). This draws attention to the fact that the

Table 1

**The evolution of rural social infrastructure term**

| Author, year of publication | Definition |
|---|---|
| Berry, 2011 | Processes, programs, events, services, networks and actions that support individuals and families to meet their social and personal needs in a particular place through personal growth, social interaction, support of social services and the development of rural communities. |
| Светлаков & Зейкин, 2012 | RSI includes infrastructure of labor activity (organization of industrial site, transport services, road construction, public service communications, personnel training), social infrastructure (trade, public catering, housing and communal services, domestic services), social security (pensions, support for the poor, physical culture and sports, environmental protection, health care), spiritual culture and the labor sphere (public education, cultural objects, art. |
| Сюсюра, 2012 | A set of economic sectors, often its non-productive sphere, associated with the provision of goods and services that meet the needs of people and form the conditions of their daily life activity of the inhabitants of the village. |
| Atkočiūnienė, Vaznonienė, & Pakeltienė, 2015 | RSI as it is a territorial and spatial system of interrelated types of economic and social activity and relations creating conditions for functioning of ecosystems, creation of physical and social capitals used by the individuals and communities to satisfy individual and social needs. |
| Омаров, 2015 | A set of social objects located in the territory of a rural settlement and implementing target tasks of a social and economic nature, the solution of which is aimed at ensuring the vital activity of the population. |
| Стукач, 2017 | A complex of interconnected and mutually complementary material elements that are in the maximum accessibility and spatial-temporal proximity to spheres of human activity, aimed at meeting a wide range of needs of the entire rural population and creating conditions for the development of human capital. |
| Vaznonienė & Kiausiene, 2018 | RSI as social economic system it forms the living environment features, promotes or reduces the attractiveness of a living space; social infrastructure services enhance or decrease local community wellbeing depending on its development level, supply and accessibility of services. |

material base and intangible assets of the infrastructure should provide a choice of alternatives for goods and services with good quality. This may concern such aspects as the choice of housing, household services, medical services, social protection, employment, freedom of movement, educational opportunities and spiritual development, as well as leisure.

We share the opinion and position of scientists who believe that the RSI is a complicated complex. RSI includes: a rural territory that is economically equipped for the public and individual life of rural residents; organizations and institutions of the social and services sectors; as well as the management system of functional development of the RSI, ensuring the safe livelihoods for the population working and living in this rural area (Баландин, 2014).

According to this definition, the following features of the RSI in modern conditions can be distinguished:

- first of all, it is a complex of interconnected and mutually complementary material and social objects, aimed at creating favorable conditions for the life of the rural population;
- the operation of the RSI aims to meet the needs of not only agricultural producers, but also all other groups of the rural population, including children, pensioners, the disabled, and others;
- the creation and development of RSI facilities on the territory of a rural settlement should be the most important task of local governments.

The essence of a RSI as a system category revealed through diverse functions: public, targeted and specific. Thus, performing public functions, the RSI has a significant impact on the entire national economy of the country.

Target functions of RSI are aimed at implementing the tasks for which its facilities are organized and functioned, while specific ones are subordinated to the goals of the socio-economic development of the village and improving the quality of life of rural residents.

The role of infrastructure in rural development is increasing due to new challenges – globalization, climate and demographic changes. Improving the infrastructure and quality of life in rural areas experiencing an aging population and migration of young educated people can attract domestic investment in order to expand education and labor market opportunities and so support social inclusion (Модернизация инфраструктуры…, 2016).

The authorities at three levels carry out the management and control of the social sphere; the powers at each of them are legally delimited:

- Macro: state (President and Government of the Republic of Kazakhstan).
- Mezo: departmental (ministries of social profile) and regional (relevant governing bodies).
- Local (city and district akimats).

According to the G. Vaznoniene, R. Pakeltiene, (2017) local residents' needs may be analysed on various levels. The depth and width of research of the local residents' needs determines not only the level of needs analysed, but also the level of the analysis: community, eldership, municipality, region, etc. Analysis of area-specific residents' needs and trends is possible only if the level of development of the area is taken into account.

We presented the management scheme of RSI in the Republic of Kazakhstan from the standpoint of object-subject, methods and results in Figure 1.

Based on the presented model, the management of the social sphere of the village, in our opinion, is a complex of legal, organizational, social, economic and financial measures taken by the authorities and public representatives of the rural community in order to implement the provisions of state and regional programs and achieve a better quality of life for local people.

When implementing measures of regional regulatory impact in ensuring the sustainable development of the social system, particular importance should be given to the basic human needs. First, the living conditions, it is one of the basic human needs. Secondly, the services provided by local executive bodies are medical, educational services, utilities, street lighting, transport links, etc. (Солтангазинов, Амирова, & Кадырова, 2019).

It should also be understood that the main owner of RSI facilities in rural areas at present is the state and its bodies that 'set the tone' and determine the main parameters of the development of the social environment in rural areas of the republic. Due to the relatively small experience of the movement of the Republic of Kazakhstan in the direction of sustainable development of rural areas, one has to admit the existence of a considerable number of problems in the field of RSI management.

Interview of village residents in the Mangystau region of Mangystau oblast of the Republic of Kazakhstan, conducted in early 2018 and covering 12, 200 people, provided additional information on the attitude of the population to the work of local governments (rural akimats), to determine the degree of satisfaction of rural residents with the level of RSI development (Table 2). To conduct the study, a research group was created and a questionnaire was developed, the survey was conducted by phone, the respondents were aged 20-70 years who have lived there for more than three years, which is 32% of the total region's population.

Sociological survey showed that only 81.5% of the rural population of the region is fully satisfied with the work of government bodies, 18.5% are satisfied with the work of the administration. But still rural residents

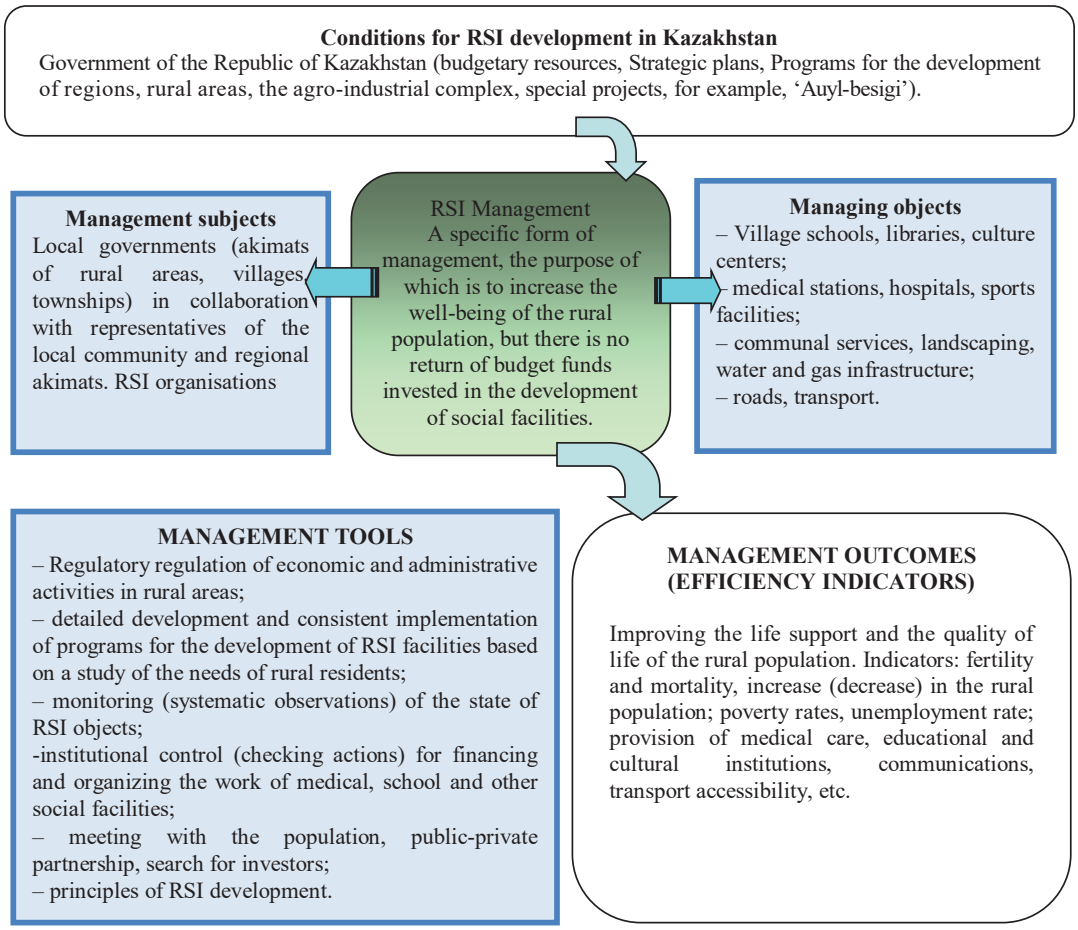


Figure 1. Contemporary model of RSI in Kazakhstan.

Table 2

**Distribution of respondents' answers to the question: 'To what extent are you satisfied or dissatisfied with the condition of the following aspects of your life in a village?' (%)**

| Parameters | Satisfied | Dissatisfied |
|---|---|---|
| 1. The quality of school education | 90.1 | 9.9 |
| 2. Medical services' quality | 86.3 | 13.7 |
| 3. Employment opportunities | 56.9 | 43.1 |
| 4. Road and passenger transport infrastructure development | 64.1 | 35.9 |
| 5. The level of development of telephone communications, Internet | 86.4 | 13.6 |
| 6. Social services work performance (assistance for disabled people, family support, etc.) | 89.3 | 10.7 |
| 7. Local authorities work performance | 81.5 | 18.5 |

Note: compiled by the authors on the basis of systematization of empirical research data.

are dissatisfied to the most significant degree: employment opportunities, roads and passenger transport, and the quality of school education. The best reviews were obtained on the work of telephone communication and the work of social services.

Meanwhile, the Common European strategic guidelines imply the following principles for the implementation of rural development policies:

- self-financing and decentralization of management;
- partnership of stakeholders with the participation of local government, private organizations and the public;
- hierarchy – maintaining the correspondence between the size of a settlement, its administrative and economic significance,

the service area and the number, size, and functionality of objects located in a rural area (Газизов, 2014);
- complexity and complementarity – the presence of a complete set of elements, their spatial complementarity and consistency (Алашбаева, 2013);
- balance – maintaining sectoral proportions between the social infrastructure at the level of the region and at the level of an individual settlement;
- spatial concentration and territorial availability of objects;
- sufficiency – provision of population with objects in the volume necessary for the full development of all members of society (Ахинов & Калашников, 2016);
- equitability – ensuring equal access to facilities for all consumers;
- completeness of reflection of existing and potential threats (Хилинская, 2018).

Another problem of the management of RSI is a significant variation in the issues of identifying indicators that most fully characterize the level of development of the social environment in rural areas and at the same time show the effectiveness of management efforts to modernize it. In the model presented by authors (Figure 1), some of the most common social standards are listed.

For example, social quality of life is a complex indicator that combines economic and social aspects and is expressed in such indicators as income and expenses, poverty level, guarantees of social protection and support, low unemployment rate, and development of social facilities. These indicators are widely used in the works of both domestic and foreign researchers, and are also used by statistical agencies of almost all countries of the world and international organizations. However, in modern conditions of development of social relations, it is necessary to take into account the existing shortcomings of these indicators.

According to the latest approaches, 'with radically reduced levels of resource use, the work of various infrastructure systems must be integrated and regulated in such a way as to rethink the assessment of current infrastructure' (Албеков & Хайтаев, 2018).

However, the process of integration and coordination does not happen itself, it must be managed according to certain principles. It is necessary to discuss with the stakeholders the main principles for RSI management: coordination of principles 'from top to bottom' and 'from bottom to top'; satisfaction of social needs and local initiatives; partnership and division of responsibility; involvement of local residents and decentralization of decision making processes; continuous study, professional development and stimulation of self-esteem; integrity and hierarchy; innovations, readiness for changes, efficiency; ecology (Atkociuniene, Vaznoniene, & Pakeltiene, 2015).

The third, most acute problem of managing the RSI in Kazakhstan is the absence of its well-functioning mechanism, which is reflected in the following difficulties:
- 'fragmentation' and dispersedness of objects of the social sphere, due to the specifics of rural settlement, making it difficult to use them efficiently;
- accommodation in villages mainly of grass-root elements of infrastructure, providing services of daily and periodic demand (kindergartens, secondary schools, clubs, canteens, etc.);
- insufficient provision of the population with infrastructure, poor material and technical equipment of social infrastructure institutions and insufficient staffing;
- profitability of social infrastructure, due to the nature of the activities carried out and the low solvency of the rural population (Roelich *et al.*, 2015).

It should be noted that rural areas of the country themselves are complex and many problematic objects of management, which is manifested in:
- unevenness of the rural population's demand for a number of social infrastructure services, predetermined by the seasonality of agricultural production and the maintenance of personal subsidiary farming, determines the rhythm of the activities of these objects;
- lack of opportunity for the rural population to choose a service provider, since many sectors of social infrastructure in rural areas are a sphere of natural monopolies;
- long time spent by rural residents to receive services due to the low territorial availability of infrastructure facilities.

Д. Баландин (2014) identified four groups of principles that should underlie the management of the sustainable development of RSI:
1) economic principles (equitable distribution, rational use of natural resources, growth of incomes of the rural population);
2) social (increase in the duration and quality of life of the rural population);
3) common (consistency, purposefulness, continuity, balance, efficiency);
4) institutional (improvement of public administration institutions);
5) development of self-government bodies of the rural population; formation of social capital in rural areas, etc.

Sustainable development of rural areas can be achieved if all types of resources, as well as work on the development of rural infrastructure, social welfare of the rural population are combined into a single multi-sectoral complex of interrelated activities (Ибришев *et al*., 2018).

In our opinion, this system of principles of management of RSI is one of the most complete. In addition, we believe that one of the most important principles of management of RSI facilities in Kazakhstan should be the maximum accessibility and spatial-temporal proximity of the RSI branches deciphering the spheres of life of a rural resident. Thus, effective management of the development of RSI is possible only with the use of appropriate tools and principles that represent the ways and means of managing the social sphere and infrastructure, as well as the basic conceptual framework for the regulation of social processes and phenomena.

**Conclusions**

1. RSI in Kazakhstan represents a set of legal, institutional, social, economic and financial measures taken by government and community representatives of the rural community in order to implement the provisions of state and regional programs and achieve a better quality of life for the local population.
2. The definition of three levels RSI management should be improved. Especially the integration of the concept of sustainable development, the principles of RSI have to include all types of resources, as well as work on the development of rural infrastructure, social welfare of the rural population should be combined into a single multi-sectoral complex of interrelated activities.
3. The effective management of the development of RSI is possible only with the use of appropriate tools and principles that represent the ways and means of managing the social sphere and infrastructure, as well as the basic conceptual framework for the regulation of social processes and phenomena.
4. The results of a sociological survey in the Mangystau region showed that despite significant amounts of funding for rural health and educational organizations, vast majority of rural residents is not completely satisfied with the quality of their services. The r*oad and passenger transport infrastructure* can be a bottleneck of Kazakhstan economy, since the problems of transportation system facilitate the infrastructural restrictions and create the threat of deceleration of social development of the country.
5. The study revealed that, along with the positive trend of growing attention to the management of RSI in Kazakhstan, there is a negative tendency to insufficient substantiation of the principles and tools of social policy in the village, the weakness of local governments in addressing the pressing problems of developing the social environment of rural areas. A small part of rural population is fully satisfied with the work (related to the management of RSI) of government bodies, the majority is only partially satisfied.

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# AWAITING INDUSTRY 4.0: TRANSFORMATION OF TERTIARY EDUCATION IN THE BALTIC COUNTRIES AND FINLAND

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**Abstract**
Baltic States and Finland are vibrant regions with similar sized population and historical experience. Their adaptation to the new digital era is undermined by lack of professionals. Across the EU a major reason for labour shortage in science, technology, engineering and mathematics (STEM) fields professionals lies in the insufficient supply of higher education graduates due to stagnant enrolment rates in STEM fields. The aim of this research addresses the existing trends in tertiary STEM education in Finland, Estonia, Latvia and Lithuania. This includes the tasks of analysing the quantitative trends (enrolment and graduation) in the HEIs of Baltics and Finland over the period from 2013 to 2017 as well as analysing the structural changes taking place in the respective higher education systems from 2013 to 2018. The Baltic States combined have numerical advantages in terms of young people, and young professionals (25-34 year olds) with tertiary education. However, in terms of the number of students and graduates Finland is at the forefront. The largest proportion of students enrolling in STEM fields lie within Finland (33.9%) whereas the smallest one is in Latvia (24.0%). Finland is also a leader in the share and total number of information and communication technology (ICT) graduates. In the period 2013-2017 Latvia's results improved in two (5th and 6th) of the STEM study fields, Lithuania made a remarkable result in one STEM (6th) field by 46.9%, Estonia saw a relative increase in the 5th and 6th study field while Finland experienced a numerical decrease in all three STEM fields.
**Key words:** higher education, regional disparity, integrated development.

## Introduction

The advances in computer technologies and machine learning capabilities in the industry have led to a shift in labour market needs and further increased the need for STEM capable professionals. STEM study fields are Natural sciences, mathematics and statistics (5th field), Information and Communication Technologies (6th field), Engineering, manufacturing and construction (7th field) (UNESCO, 2015). They are seen as especially important for fostering innovation and economic growth. Many countries try to increase the rate of students taking up STEM education, or to attract highly qualified immigrants with degrees of given field. In OECD countries among tertiary-educated adults, in 2016 an average of 25% had been studying STEM fields (OECD, 2017a).

The term 'Industry 4.0' i.e. '4th industrial revolution' standing for 'Digitalization of Industry' has first been used in 2011 by the German Ministry of Education and Research (Bundesministerium für Bildung und Forschung) in their high-tech strategy 'Zukunftsprojekte der Hightech-Strategie (HTS-Aktionsplan)' describing the industry based on Cyber Physical Systems (BMBF, 2019). The Industry 4.0 integrates cyber-physical systems and the Internet of Things (IoT), big data and cloud computing, robotics, artificial-intelligence systems and additive manufacturing and is expected to evolve in an exponential rather than at a linear pace (European Union, 2017).

There is an understanding that the higher education is a fundamentally important prerequisite to help society to adapt to the changing environment and allow individuals to increase their competitiveness in the changing labour market (Knight, 2012). According to the UK Government Office for Science, for countries in order to succeed in the new age of industry both the technological expertise and professional skills have to be prepared ahead of time. Likewise, the volume and detail of data captured by businesses in presence of the IoT will further increase, which in turn will allow companies both to become more efficient and better understand their customers as well as personalise products. For these reasons the popularity of STEM study subjects has to be increased. (Foresight, 2013). Also, the European Commission stresses the need for the education to tandem with the technology development, in order to avoid the deepening of the digital divide which could cause subsequent erosion of the social capital base (European Union, 2017). Across the EU, a major reason for the shortage of both Information, communications and technologies (ICT) and other Science, technology, engineering and mathematics (STEM) professionals lies in the insufficient supply of graduates from higher education to meet the increasing demand. Too few young people are enrolling to study STEM subjects at higher education. In order to tackle the shortage of STEM graduates, the EU Member states are using various measures incl. supply stimulus: investing in education and training; using reserves of labour and skills; reskilling employees. Some countries have developed national strategies to encourage people to study and work in STEM, ICT and R&D i.e. research and development (CEDEFOP, 2016).

As mentioned by the European Centre for the Development of Vocational Training (CEDEFOP) the goals of Baltic States and Finland in the new digital

era are hindered by the ageing population and lack of professionals (CEDEFOP, 2016) who are needed to succeed in the Industry 4.0. In terms of this research, the Baltic States are viewed both as independent countries and as a region and is compared with Finland – a developed country in economical as well as R&D and education terms (OECD, 2017b) – the country which has long been a role model for the Baltic countries in different fields, most notably the education.

*Aim of the research:* Investigate the higher education tendencies in the Baltic countries and Finland in terms of quantitative and structural developments in the corresponding higher education institutions (HEIs) as a reflection of the changing future industry needs.

*Tasks:*

1. carry out analysis of the quantitative (number of students overall and by study fields) trends in the HEIs of Lithuania, Latvia, Estonia (Baltics) and Finland over the period from 2013 to 2017;
2. investigate the structural changes taking place in the higher education systems in Lithuania, Latvia, Estonia and Finland over the period from 2013 to 2018.

## Materials and Methods

*Research methods:* scientific research, comparable analysis, descriptive statistics.

*Research sources and materials*: research is based on statistical data from the EUROSTAT, OECD, documents, research from various scientific sources of institutional background focused on the period from 2013 to 2018. The research has been carried out in the spring of 2019.

*Research limitations:* the research focuses on the period since 2013, due to data availability and comparison related reasons. The type of tertiary institutions (public or private) as well as the citizenship of the students was not taken into account in this analysis due to data detail level limitations. Thus all students included in the statistics of a given country are treated as local students.

*Research approach*

The research includes analysis of information on the enrolled students and graduates according to their field of studies in the STEM fields of higher education systems in the Baltic countries and Finland. The basis for the research is comparable datasets on tertiary education systems therein (Eurostat, 2019). The summarized statistics include summary indicators on both the part-time and full-time International Standard Classification of Education (ISCED) 5$^{th}$, 6$^{th}$, 7$^{th}$, 8$^{th}$ level students. The approach on the research on the higher education institutions has changed significantly over time. Authors underline some topicalities: (1) the mission of HEIs as a driving force of entrepreneurship thus increasing the overall prosperity (Radinger-Peer & Pflitsch, 2017); (2) the role of HEIs in the commercialization of knowledge (Goldstein & Rehbogen, 2013); (3) the role of HEIs in ensuring of regional sustainability (Goldstein, 2010).

## Results and Discussion

As of 2018 the population of Finland (FI) was 5 513 130 people, of Estonia (EE) – 1 319 133, of Latvia (LV) – 1 934 379, and of Lithuania (LT) –2 808 901 people. In the Baltic States, there were altogether 6 062 413 people – almost 10% more

Table 1

**Total number of students studying in tertiary education, graduates ISCED 6-8**

| Country students (stud.) /graduates (grad.) | | Year | | | | | Change in period 2013-2017 (%) |
|---|---|---|---|---|---|---|---|
| | | 2013 | 2014 | 2015 | 2016 | 2017 | |
| EU-28* | stud. | 19 617 528 | 19 532 167 | 18 385 922 | 19 589 999 | - | - |
| | grad. | – | 4 752 477 | 4 609 701 | 4 473 830 | - | - |
| EE | stud. | 64 806 | 59 998 | 55 214 | 51 092 | 47 794 | -26.3 |
| | grad. | 10 867 | 10 190 | 10 491 | 10 262 | - | -6.6 (till 2016) |
| LV | stud. | 94 474 (77 126)* | 89 671 (72 618)* | 85 881 (69 776)* | 84 282 (69 089)* | 82 914 (68 325)* | -12.2 ( -11.4)* |
| | grad. | 21 610 (17 416)* | 17 345 (13 820)* | 17 021 (13 236)* | 15 796 (12 320)* | 14 587 (11 727)* | -32.5 (-32.7)* |
| LT | stud. | 159 695 | 148 389 | 140 629 | 133 759 | 125 863 | -21.2 |
| | grad. | 39 265 | 33 130 | 32 205 | 29 683 | - | -24.4 (till 2016) |
| FI | stud. | 309 009 | 306 080 | 302 478 | 297 163 | - | -3.8 (till 2016) |
| | grad. | 52 730 | 53 878 | 56 829 | 56 066 | 56 136 | -6.5 |

* study fields ISCED 5-8
Source: authors' calculations based on Eurostat, 2019.

Table 2

**Proportion of students in ISCED 5-8 study field**

| Study field ISCED 2013-F | Country code | ISCED 6 | | | ISCED 6-8 | | | |
|---|---|---|---|---|---|---|---|---|
| | | Proportion (%) | | $\bar{x}$ (%) | Proportion (%) | | $\bar{x}$ (%) | Numerical change in the period (%) |
| | | 2013 | 2017 | | 2013 | 2017 | | |
| 5th field – Natural sciences, math and statistics | EU-28** | 8.2 (in 2014) | 8.8 (in 2016) | 8.6 | - | 7.9 (in 2016) | - | - |
| | EE | 4.2 | 5.0 | 5.0 | 5.1 | 6.1 | 6.1 | -11.8 |
| | LV | 2.0 | 3.0 | 2.8 | 2.7 (2.2)* | 3.3 (2.8)* | 3.3 (2.8)* | 10.8 (11.3)* |
| | LT | 3.1 | 3.4 | 3.3 | 3.4 | 3.8 | 3.6 | -11.0 |
| | FI*** | 5.4 | 5.0 (in 2016) | 5.3 | 5.8 | 5.6 (in 2016) | 5.7 | -7.1 |
| 6th field – Information and Communication Technologies | EU-28** | 4.5 (in 2014) | 4.8 (in 2016) | 4.8 | - | 4.1 (in 2016) | - | - |
| | EE | 8.6 | 9.8 | 9.1 | 7.6 | 8.7 | 8.0 | -15.9 |
| | LV | 4.4 | 6.8 | 6.0 | 4.8 (4.6)* | 6.5 (6.2)* | 5.7 (5.5)* | 12.5 (18.8)* |
| | LT | 2.4 | 4.8 | 3.2 | 2.2 | 4.1 | 2.9 | 46.9 |
| | FI*** | 9.6 | 9.5 (in 2016) | 9.4 | 9.2 | 9.1 | 9.1 | -5.0 |
| 7th field – Engineering, manufacturing and construction | EU-28** | 16.5 (in 2014) | 15.1 (in 2016) | 15.7 | - | 15.4 (in 2016) | - | - |
| | EE | 15.2 | 15.0 | 15.5 | 16.8 | 16.3 | 16.8 | -28,3 |
| | LV | 15.9 | 18.7 | 18.0 | 16.3 (15.6) | 16.8 (16.6) | 16.4 (15.7) | -9.7 (-6.8)* |
| | LT | 20.0 | 21.7 | 20.7 | 18.0 | 19.4 | 18.3 | -15.1 |
| | FI*** | 20.6 | 20.1 (in 2016) | 20.6 | 19.2 | 18.8 | 19.1 | -5.5 |

* Tertiary education data (ISCED levels 5-8)
** Tertiary education data (ISCED levels 5-8) available only for 2016, ISCED 5 for period 2014-2016
*** Tertiary education data (ISCED levels 6-8) available for period 2013-2016, ISCED 6 for period 2013-2016
Source: author's calculations based on Eurostat (2019).

than in Finland. When analysing the so called young adults' (aged 18 to 34) cohort, Finland had 1 154 564 young adults, Estonia – 280 786, Latvia – 397 872, Lithuania – 599 053, while Baltic States combined had – 1 277 711 young adults – by 10.7% more than Finland (Eurostat, 2018).

Thus, in regional terms, the Baltic States have a combined advantage in the number of young people. In terms of education in 2017, Finland had 41.3% young people with tertiary education (age group 25-34 years), Estonia – 43.0%, Latvia – 41.6%, Lithuania – 55.6%. Meanwhile, in the age group of 55-64 year-olds with tertiary education Finland had 38.5%, Estonia –36.4%, Latvia – 27.1%, Lithuania – 29.5% (OECD, 2017c). Thus, in the last 30 years an increase can be seen in the overall tertiary education attendance in the Baltic countries, especially in Latvia and Lithuania. It should be noted that only in Latvia there are short-term tertiary (ISCED 5) study programmes (including STEM field).

Substantial differences can be noticed in terms of the number of enrolled students and graduates in-between Finland and the Baltic States (Table 1).

On an ISCED 5-8 scale Estonia had 51 092 enrolled students and 10 262 graduates, Latvia – 84 282 (excl. ISCED 5 - 69089) students and 15 796 (excluding ISCED 5 – 12 320) graduates, Lithuania – 133 759 students and 29 683 graduates, totalling at 269 133 students and 55 741 graduates. Meanwhile, Finland had 297 163 students, i.e., 10.4% (excl. ISCED 5 – 17%) more than Baltic States and 56 066 graduates i.e. 0.6% (excl. ISCED 5 – 7.3%) more than Baltics. The fact that the actual number of enrolled students and graduates is higher in Finland than in Baltics

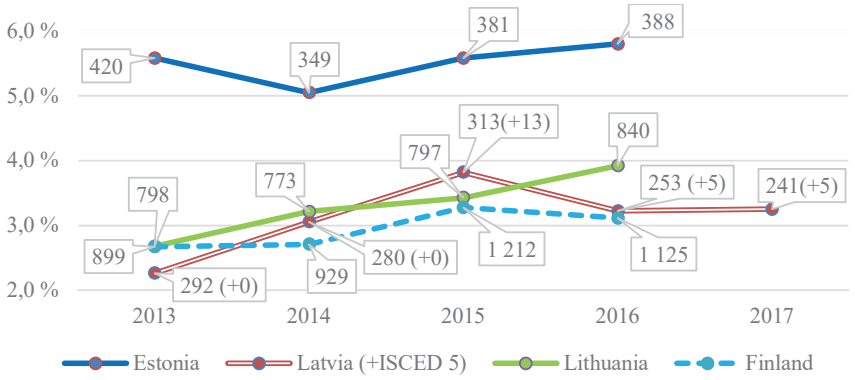


Figure 1. Share of Natural sciences, mathematics and statistics field among ISCED 6 graduates (%), number of graduates (source: author based on Eurostat, 2019).

despite falling behind in the population indicators (as described before) can be explained by Finland's extensive education export to foreign citizens.

When comparing Lithuania, Latvia, Estonia and Finland according to the divisions per study field, differences can be observed (Table 2). In terms of enrolled students in STEM fields (ISCED 5-8) from 2013 to 2017, Finland is leading with a combined median value of 33.9%, followed by Estonia (30.9%), Lithuania (24.8%) and Latvia (24.0%). In the 5th Natural sciences field the Baltic States have had a relative increase – in Latvia from 2.2% (2 051 students) to 2.8% (2 283), numerical increase (nom. inc.) of 11.3%; in Lithuania from 3.4% (5 352) to 3.6% (4 765), numerical decrease (num.decr.) of -11.0%, in Estonia from 5.1% (3 320) to 6.1 (2 929), num.decr. -11.8%; while Finland has had a relative downward trend from 5.8% (17 941) to 5.7% (16 669), num.decr. -7.1%. In 6th ICT field: Latvia had a relative increase from 4.6% (4 353) to 6.2% (5 172), nom.inc. 18.8%; in Lithuania – from 2.2% (3 510) to 4.1% (5 156), nom.inc. 46.9%; in Estonia – from 7.6% (4 940) to 8.0% (4 155), num.decr. -15.9%; while in Finland – from 5.8% (28 469) to 5.6% (27 042), num. decr. -5.0%. In the 7th Engineering field Latvia and Lithuania have witnessed a relative increase: in Latvia – from 15.6% (14 744) to 16.6% (13 742), num.decr. -6.8%; in Lithuania – from 18.0% (28 773) to 18.3% (24 439), num.decr. 15.1%; while in Estonia – from 16.8% (10 867) to 16.8% (7 794), num.decr. -28.3%; and in Finland – from 19.2% (59 239) to 19.1% (55 959), num. decr. -5.5%.

Both relative and numerical increase in the number of students in the 5th Natural sciences field was seen only in Latvia, in 6th ICT field – in Latvia and Lithuania, in the 7th Engineering field no country experienced dual increase, while only Latvia and Lithuania had a relative increase. It should be noted that over the period from 2013 to 2017 only Latvia has managed to increase both relative and numerical results in more than one (5th and 6th) STEM field, while Lithuania had made remarkable results in the 6th field – a numerical increase of 46.9%; however, it should be noted that in this case the threshold was specifically low – only 2.7% in a relative share. Estonia and Finland had experienced numerical decrease in all three STEM fields, despite relative increase for Estonia in 5th and 6th study field.

When analysing the changes in terms of graduates (grad.) (Figure 1) in the 5th Natural sciences field in 2016: Estonia is leading with the highest share (5.8%, 388 grad.), followed by Lithuania (3.9%, 840 grad.),

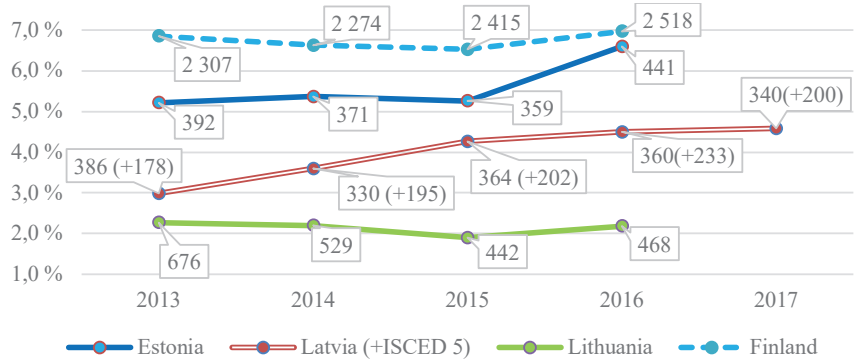


Figure 2. Share of Information and Communication Technologies field among ISCED 6 (+ ISCED 5) graduates (%), number of graduates (source: author based on Eurostat, 2019; OECD, 2017a).

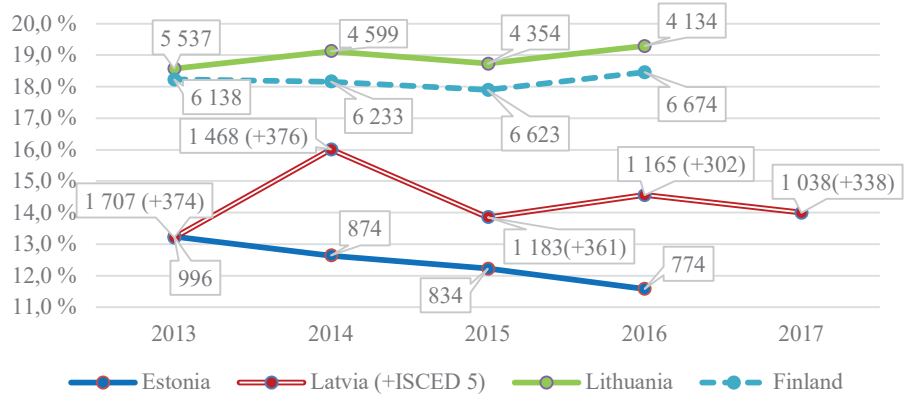


Figure 3. Share of Engineering, manufacturing and construction field among ISCED 6 students (%), number of students (source: author based on Eurostat, 2019, OECD, 2017a).

Latvia (3.1%, 258 grad.), and Finland (3.1%, 1 125 grad.). Combined numerical value in the Baltic States – 1 978 graduates which is by 75.8% higher than that of Finland.

In the 6th the ICT field (Figure 2) in 2016: Finland was leading with the highest share of graduates per field (7.0%, 2 518 graduates), followed by Estonia (6.6%, 441 grad.), Latvia (4.5%, 593 grad.), and Lithuania (2.2%, 469 grad.). It can be seen that over the period the output number has only increased in Finland (from 2 307 to 2 518 graduates) and Estonia (from 392 to 441 grad.). In the case of Latvia, a decrease in the numerical value – from 564 (2013) to 540 (2017) ICT graduates can be seen, while correspondingly only 386 and 340 were bachelor graduates, while the rest were short-cycle tertiary graduates. In 2016, the Baltic States' combined result value was 1796 graduates, which is by 40.2% lower than that of Finland.

In the 7th Engineering field (Figure 3) in 2016: Lithuania is the leader with the highest share (19.3%, 4 134 grad.), followed by Finland (18.5%, 6 674 grad.), Latvia (14.6%, 1467 grad.), and Estonia (11.6%, 774 grad.). The combined number of graduates the Baltic States total 7 755 graduates, which is by 16.2% higher than that of Finland.

According to a skills forecast by 'Danish Technological Institute' (EC, 2015) for the period 2013 to 2025, the demand for STEM professionals (both for expansion and replacement demand) in industry would be the following: Estonia – 19 400, Latvia – 74 140, Lithuania – 22 290, in Finland – 109 780 professionals and associated professionals. The total supply of STEM professionals in the given countries reached the following: in Estonia – 11 234 graduates or 57.9% of the projected demand, in Latvia – 17 582 (23.7%), in Lithuania – 31 572 (141%), and in Finland –78 176 (71.2%). Thereby Lithuania and Finland are in a better situation, with Estonia catching up, while Latvia is struggling to meet the labour market demands.

*Structural reforms in HEIs*

In Latvia concerns exist about the fragmentation of tertiary study programmes whose number despite the decrease of student population (by 38% between 2005 and 2017) have increased by a third (EC, 2018). Structural reforms to optimise the higher education institution network are missing. In order to strengthen the quality assurance, career tracking was introduced in 2018 (EC, 2018). In order to promote STEM, the share of publicly financed study places was increased in STEM fields (EC, 2018), thus increasing share of enrolled students (Table 2). The share of foreign nationals studying in Latvia reached 5.5% in 2017 (Eurostat, 2019). In Estonia, there is a deficit of STEM graduates – only 12.8 per 1 000 people (20-29 year olds) compared to 19.1 (EU-28 average). Their skills-set is insufficiently aligned to labour market needs (EC, 2018). In the ICT field, despite the latest increase in the number of ICT graduates, the unmet demand in the industry remains explicitly high (EC, 2018). As noted by the Education, Audiovisual and Culture Executive Agency (EACEA) over the period Estonia has introduced changes to the Higher Education Act which included new quality requirements and has increased doctoral grants (EACEA, 2019). No significant mergers of universities have taken place in the period of 5 years. The share of foreign nationals studying in Estonia reached 6.8% in 2016 (Eurostat, 2019). In Lithuania, the EU leader in terms of tertiary educational attendance of people aged 30-34, the total number of students from 2012 until 2017 has fallen by 36.8 %. There are concerns about the higher education system's efficiency and quality. In order to tackle these challenges, Lithuania launched a series of reforms to consolidate the network of universities and strengthen the accreditation system (EC, 2018). In 2018, the Lithuanian Parliament passed two resolutions: on the consolidation of five state universities in Kaunas into two, and on merging the Šiauliai University (ŠU) with Vilnius University

(VU) (EACEA, 2019). In order to improve the study quality, Lithuania has joined the 'Eurograduate' pilot, which is testing the possibility to introduce a Europe-wide graduate tracking system (EC, 2018). In 2016, only 2.6% of graduates in Lithuania were from abroad (Eurostat, 2019). In Finland, in 2018 as a result of a merger between the University of Tampere and Tampere University of Technology the second largest university in Finland by number of students was established (the second of only two private universities in Finland) – Tampere University (UWN, 2019). In terms of study quality, career tracking (started in 2004) was extended to all public universities in 2016 (EC, 2018) thus creating a space for synergy in-between the technology and social sciences, which is a future prerequisite for development of Industry 4.0 In 2018, a proposal was submitted for amendments to the higher education law to ensure easier access to higher education and enable the provision of modules as continuous professional development (EACEA, 2019). The share of foreign nationals studying in Finland reached 7.7% in 2017, down from 8.1 in 2016 (Eurostat, 2019).

**Conclusions**

1. In 2018, the combined population of Baltic States reached 6 062 413 people, which is by 10% more than that of Finland with 5 513 130 people. Among the young adults' (aged 18 to 34 years) cohort Baltic States surpassed with 1 277 711 young adults, i.e. 10.7% more than that of Finland (1 154 564 young persons). Thereby in terms of population the Baltic States has a numerical advantage over Finland.
2. On an ISCED 5-8 scale Finland had 269 133 enrolled students (17% more) and 56 066 graduates (0.6% more) than the Baltic States combined – 253 940 students and 52 265 graduates accordingly. The actual number of enrolled students and graduates is higher in Finland despite lagging behind in terms of share of population with higher education among young adults (age group 25-34 years) – which could be explained by Finland's extensive education export to foreign citizens who do not settle in the country after graduation.
3. In terms of number of students enrolled in STEM fields (ISCED 5-8) in the period from 2013 to 2017, Finland was leading with a combined median value of 33.9%, followed by Estonia (30.9%), Lithuania (24.8%) and Latvia (24.0%).
4. In 2016 in terms of number of graduates in STEM study fields, the results of Baltic States combined were greater than those of Finland in the 5$^{th}$ Natural sciences field (by 75.8%) and in the 7$^{th}$ Engineering field (by 16.2%). Meanwhile, Finland had an upper hand over the Baltic States combined in the 6$^{th}$ ICT study field (by 40.2%).
5. Over the period 2013 to 2017 in terms of the number of students enrolled in the 5$^{th}$ Natural sciences field, only Latvia had both relative and numerical increase, Lithuania and Estonia – a relative increase and numerical decrease, Finland – both relative and numerical decrease. In the 6$^{th}$ ICT field Latvia and Lithuania both had a relative and numerical increase, Estonia – only a relative increase with numerical decrease, Finland – a relative and numerical decrease. In the 7$^{th}$ Engineering field both Latvia and Lithuania experienced only a relative increase with a numerical decrease, while Estonia and Finland both experienced a relative and numerical decrease.
6. Overall, in the period from 2013 to 2017, in terms of students studying in HEIs, only Latvia managed to increase both relative and numerical results in more than one (5$^{th}$ and 6$^{th}$) STEM field, Lithuania made a remarkable result in one STEM (6$^{th}$) field by staggering 46.9%. This achievement however can be explained by the specifically low start margin – 2.7% relative share in 2013. Estonia (despite a relative increase in 5$^{th}$ and 6$^{th}$ study field) and Finland experienced numerical decrease in all three STEM fields.
7. The advances in computer technologies and machine learning capabilities have increased the demand for STEM capable professionals. In terms of Industry 4.0 ready professionals, currently Finland has a technological advantage in ICT field over the Baltic States. The merger of University of Tampere and Tampere University of Technology is an example of creation of environment for synergy in-between the technological and social sciences, which is a future prerequisite for the development of Industry 4.0
8. In terms of the total supply of STEM professionals, in 2017 Lithuania was a leader with 141% of the projected demand, followed by Finland (71.2%), Estonia (57.9%) and Latvia (only 23.7%). The mediocre results in Latvia indicate a sustained deficit of STEM professionals and further struggles to meet the labour market demands in the mid-term and long-term.
9. The research on enrolled students and graduates in STEM fields show that the Baltic States and Finland have both similar and different tendencies as well as different strategies for pursuing improvements in higher education to increase the number of students in STEM related study fields. In terms of a further research, it would be beneficial to carry out an in-depth statistical study on the factors (public spending on higher education, higher education policy, structural changes to university network, activities for promotion of STEM studies, etc.)

which may had an influence on the STEM study process trends as well as on enrolment all of the observed countries.

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# CROSS-BORDER ASSIGNMENT – THE STUDY METHOD SUPPORTING INTERNATIONALIZATION OF SMEs AND LINKAGE BETWEEN HEIs AND INDUSTRY

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**Abstract**
The variety of study methods used at universities still is conservative and more pragmatic, but there is an increasing tendency to change study methodology to more and more student-centred and to focus on the students' ability to become valuable workforce for SMEs. The necessity for development of study methods clearly demonstrates the research problem. At the same time, universities are facing pressure from governmental authorities to internationalize – student and teacher mobility, international partners and projects are highly recommended.
The main process at universities is the study process. But also internationalization should support the study process and students in achieving practice-based learning outcomes. Facing these challenges, NOBANET network of universities has elaborated and piloted the study method Cross-Border Assignments (CBA) linking students' future ability to successfully incorporate in the job market and the requirement for internationalization of studies.
The aim of this article is to introduce and assess the CBA as a method to involve student work and students to engage in entrepreneurship problems. The authors have collected and analysed feedback of 10 CBAs implemented in 6 different universities. The feedback was received by using questionnaires with mainly closed questions. The results show that companies are satisfied with students' work and they also appreciate teachers. The main conclusion about assessment of this method gives valuable contribution to scientific literature as a description of modern study method and good practice in linking HEIs and SMEs. Gratitude is expressed to the Nordic Council of Ministers for funding NOBANET project and project EKOSOC-LV, part 5.2.2. and INTERFRAME-LV.
**Key words**: Cross-Border Assignments, study method, NOBANET, Internationalization, SME.

## Introduction

Internationalization of SMEs has a very high priority today in the main EU, interregional and national development plans. But many challenges like special support measures to increase SMEs' awareness of available opportunities have been identified in the internationalization process (e.g. European Commission, 2011; OECD, 2009).

At the same time, Higher Education Institutions (HEIs) have to adopt a third strategic direction called knowledge transfer (named also a third mission) in addition to teaching and research (Laukkanen, 2003; Van der Sijde *et al*., 2014; Trencher *et al*., 2013). HEIs constantly try to use various forms of cooperation in order to enhance competence development and competitiveness of SMEs. With the internationalisation of higher education, HEIs also expand their teaching and research to include cooperation with local and international partners (Jongbloed, Enders, & Salerno, 2008). An important part of the strategy for HEIs is managing external relationships with industry. These findings give overview of actuality.

Close collaboration of HEIs and SMEs increases the capacity for regeneration and renewal in research, enhances the social impact of research and promotes the creation of new innovations and increases the competitiveness of the national economy as well as the development of the society that is based on knowledge and know-how. Universities, business and industry benefit from working together in flexible international partnerships. The university has a role in facilitating access to knowledge: scientific publications, seminars, workshops, and informal relationships can also be important ways of transfer of academic knowledge to the private sector (Şerbănică, 2011).

This article introduces a solution that can be used in creating useful relations between HEI, SME and students. Research is aimed at analysis of feedback from 10 Cross-Border Assignments (CBAs) implemented in 6 different universities, as experience from an ongoing Nordic-Baltic project NOBANET.

*The research question is*: can CBAs contribute and be used for the successful cooperation among cooperation partners like HEIs and SMEs.

The article has three main parts:

1) Insight to Nordic-Baltic Network for Internationalization of SMEs (NOBANET);
2) Cross-border assignment as a tool supporting SMEs internationalization;
3) Stakeholders' evaluation to the CBAs and its implementation process.

## Materials and Methods

From the point of view of SMEs, Europe 2020 was the EU's growth strategy for the coming decade. The EU has a strategy to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion (European Centre for the Development of Vocational Training, 2013).

The Small Business Act (SBA) for Europe adopted in June 2008 and reviewed again in 2011 recognises the important role of SMEs in the economy and aims to promote SMEs' growth by helping them tackle barriers to go international that hamper their further development. The CBA seeks to provide support to SMEs to benefit from the growth of markets, in particular by providing support to improve access to international markets (European Commission, 2011). One of the possibilities for the SMEs to respond to those challenges is to cooperate with universities.

The main risks of cooperation are the lack of coordination and information problems. SMEs might also be afraid of so-called supplementary costs – public universities are known for standards and an excessive documentation with long and complex procedures and limits (Dan, 2013). Therefore, SMEs are more eager for the informal cooperation, because they are interested in a rapid and flexible access to economic and relevant information; they are mostly cost-sensitive and welcome the possibilities to cooperate without high-level bureaucracy and with low costs.

From the point of view of HEIs, in a knowledge society HEIs are expected to deliver value through teaching, research and knowledge transfer (Davey *et al*., 2014). At the EU level HEIs are asked to provide incentives for structured partnerships with the business community. HEIs should support the identification of those skills that graduates are expected to have when entering the labour market, develop appropriate governance structures, cooperate with companies to identify and provide appropriate training/retraining programmes, support the exchange, sharing and creation of knowledge through increased mobility between universities, research organizations and business (European Commission, 2009). Although there are some reasonable exceptions, cooperation between HEIs and business in Europe is still in the development stage (Davey *et al*., 2011).

What HEIs benefit from cooperation with SMEs among other outcomes are the design and delivery of programmes that are relevant to current and future business needs, ensuring progression opportunities at every level of achievement and a smooth transition between the different environments of universities and business. (Wilson, 2012). Dan (2013) adds that the main advantages for the teachers are that they can more freely choose study methodology, new research fields open, teachers have the possibility to test the study results, the new methods and techniques, subjects content can be updated with the cooperation results and also access to knowledge from the industry.

Many sources also point at obstacles for HEIs and business cooperation. The HEIs may have conservative management, lack of entrepreneurial culture and lack of incentives to individuals/academicians (Pukka, 2012). Also, lack of flexibility and responsiveness and overcomplicated systems and bureaucracy with poor communication ability have been named (Healey *et al*., 2014). Companies refuse cooperation because of HEIs' outdated curricula and academicians' poor ability to demonstrate cooperation value to employer and employee (Wedgewood, 2011). Both sides often emphasize lack of finances and time (Wedgwood, 2011), problems related to appropriation of results, communication problems, duration of the studies/ project and cultural differences (Mora-Valentin, & Ortiz-de-Urbina-Criado, 2009), lack of mutual trust, difficulties in accessing resources for innovation, differences in objectives, organizational cultures, timetables and expectations, lack of appropriate structures (Șerbănică, 2011). The vast majority of academicians of all levels of HEI and business experience agree that funding barriers and bureaucracy within HEIs are the most relevant obstacles. (Davey *et al*., 2011). In general, the cooperation with business is an indicator for HEIs' competitiveness on the market for education services, trainings and research (Dan, 2013).

All background researches discussed in this article introduce the main reasons for HEIs and SMEs to go international and to develop necessary tool - CBA to improve methods and methodology level of business study programmes in HEIs which joined the NOBANET network.

*1. Insight to Nordic-Baltic Network for Internationalization of SMEs (NOBANET)*

The NOBANET programme worked out the methodology for cooperation of SMEs and HEIs in a study programme and at methodology level. The reality is that most academicians are not engaged at all in university- business cooperation (UBC) or only at a low level whereas at the institutional level, most HEIs engage to some degree of UBC (Davey *et al*., 2011).

NOBANET offers tools to achieve changes in HEI to develop entrepreneurial mind-set and achieve entrepreneurial institution (Källström & Lescevica, 2014). The practical activities and tools at the study programme delivery level must support changes in HEI. The NOBANET idea started as a network of universities – Arcada UAS (FI), Vidzeme UAS (LV), University of Acureyri (IS), Estonian Entrepreneurship UAS (EE), TTK UAS (EE), Kauno Kolegija/UAS (LT), School of Education and Communication at Jönköping University (SE), Westerdals Oslo School of Arts, Communication and Technology (NO), Lillebaelt Academy (DK), and SME support institutions – Valmiera Business and Innovation Incubator (LV), GO International Finland (FI), AIESEC in Finland, Union of professional business graduates in Finland in 2013. International markets offer substantial opportunities for SMEs, but SMEs face challenges in access to

Table 1

**A matrix format explanation of cooperation between HEIs and SMEs (Compiled by the authors, according to the presentation materials of NOBANET, 2017)**

| Beneficiaries | Students | HEI | SME | Faculty/academicians |
|---|---|---|---|---|
| Results from the programme | These topics | Potential and new students | Potential employees | E-learning tools |
| | Practical examples/ cases | Equipment (software) | Expertise | NOBANET network and virtual resources |
| | Potential jobs | Finances | Rise of competences (target market knowledge) | New teaching methodology and tools |
| | Internship places | Research projects | Competition advantages | Practical experience |
| | Research projects | Reputation | Reputation | Contacts with enterprises |
| | Foreign language and teamwork skills | Up to date curricula | Trainees | |

foreign market information and financing, locating customers and understanding cultural differences (European Commission, 2011).

Data about SMEs in the EU can be found in many annual reports of the European Union (European Commission, 2011). They provide an overview of the size, structure and importance of SMEs and their contribution to growth and jobs.

The overall aim of NOBANET is to create and widely disseminate new knowledge on successful internationalization of Nordic and Baltic SMEs. This aim is achieved through close cooperation between HEIs and SMEs in 6 Nordic and Baltic countries.

Faculty, students and companies work closely together and across national borders, within educational courses and through cross-border assignments in companies (NOBANET, 2017).

The objectives of NOBANET are to:

1. Develop new learning materials on internationalization of SMEs;
2. *Implement real-life projects on internationalization;*
3. Develop partner HEIs curricula to include internationalization of SMEs;
4. *Create models for sustainable cooperation between HEIs and SMEs.*

Particularly, the second task is aimed at the CBA development and the fourth is aimed at the promotion of cooperation between HEIs and SMEs. NOBANET management team also has developed and presented more matrix type models (NOBANET, 2017) (Table 1).

NOBANET management group recently developed cooperation model, which was accepted and adopted by all stakeholders. This model shows the main tools

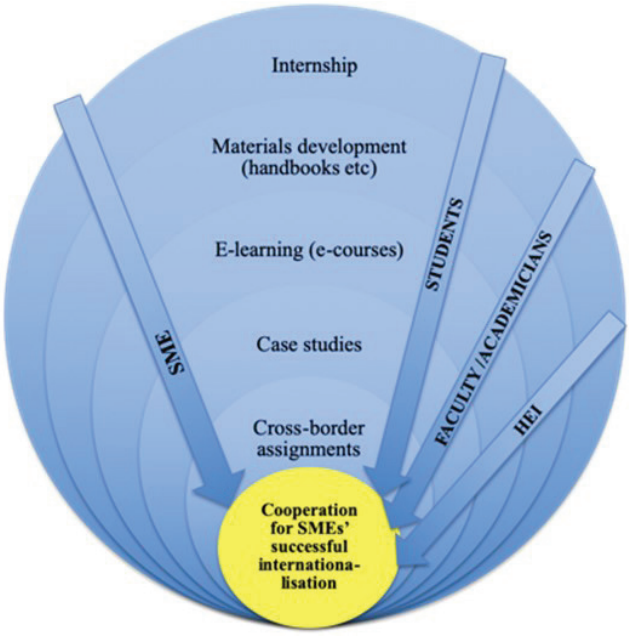


Figure 1. HEIs and SMEs cooperation model for successful internationalization (Created by the authors).

at study delivery level, which are used to gain the expected results (Figure 1). The model also gives a possibility to use it for describing and presenting NOBANET project results and goals.

In the present article, we focus on the cross-border assignment as one of the most powerful and simple tools to achieve quick and clear results in the field of SME and HEI cooperation. The tool enables to get practical experience and feeling of success and therefore motivates all the parties to continue with cooperation even on a larger scale.

*2. Cross-border assignment as a tool supporting internationalization of SMEs*

The Cross-border Assignment (CBA) is a tool for mediating the companies' research tasks for the target country's students. The CBA's main purpose is to support development and internationalization of SMEs and to offer students real-life assignments. The assignments take place in Nordic-Baltic teams where businesses and students work together over national borders.

Real-life cross-border assignments also provide incentives to try out new and innovative teaching methods. To get a better idea of the nature of the CBAs, one example is described. Icelandic company, Inspiration Iceland, was interested in entering the Finnish market, and through NOBANET programme they asked students of Arcada UAS to do marketing surveys to find the right customer segment for them.

Through this assignment, the students gave valuable information to the company about the potential of the Finnish market, possible customer segments and input for marketing campaign. The company now is preparing to enter the market. The CBA implementation process (Figure 2) starts from the NOBANET project coordinator and SME to describe the SME's needs concerning the internationalisation and idea how the students can help to meet those needs. The CBA description is prepared together. NOBANET also secures that SME's needs are taken into consideration in a structured way in education. If needs of the SME are different, the CBAs can, for example, help SMEs to develop international market entry plans, create communication materials, produce case stories, participate in international business fairs, test products and services, cooperate in work placements abroad and many more.

CBA is useful for all the three involved parties – students, universities and SMEs. For the students, the assignment will lead to a more output-driven learning experience. There are multiple reasons why SMEs should cooperate with the target country (market in which SMEs would like to enter) HEIs through NOBANET. First of all, through this cooperation SMEs have the access to the researchers (students and teachers/experts) who understand the culture, environment and local peculiarities of the target country. This, in turn, ensures that activities are suitable for the target market and other solutions, which are based on requirements, traditions and best practices of the target country. Research in the target country is already the first stage in the market entry process

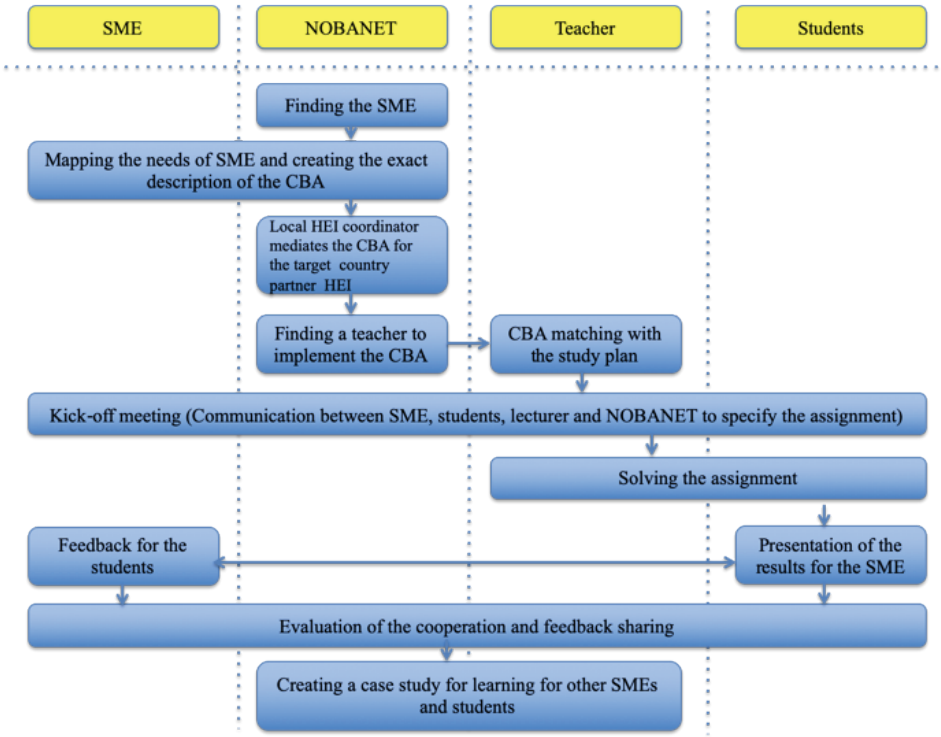


Figure 2. CBA implementation process (Created by the authors).

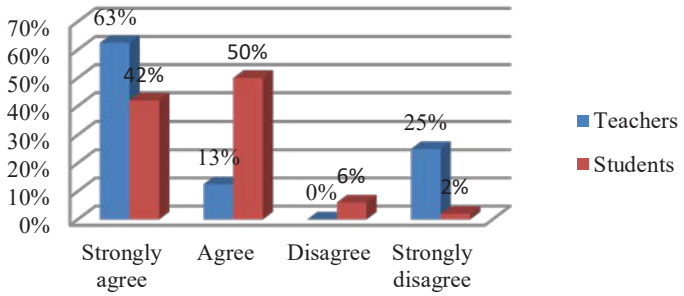


Figure 3. CBA's relevance for study method, %.

Source: created by authors.

and activities through CBA implementation process already start to introduce the SMEs' product or service in the target country. The first positive contact between an SME and an HEI may lead to further in-depth cooperation – new researches, product development, internship, employment, etc. The NOBANET project has already increased cooperation between HEIs and SMEs.

*3. Stakeholders' evaluation of the CBAs and its implementation process*

The main idea of this evaluation is to assess the CBA as a study method from the perspective of the involved parties – academicians/teachers, students and SMEs or in other words - stakeholders. The evaluation *method* included all six HEIs participating in the programme and the main result was that altogether 8 CBAs were implemented during the project. *The evaluation methodology* included questionnaires for key participants – teachers, students and SMEs representatives. Questionnaires contained only closed questions. The main data collection method was filling out the questionnaires printed on paper or registered online. *The main process of the CBA implementation is given in Figure 2* and also *the evaluation steps* are brought out. The data collected from this evaluation is the main origin for this research. The teachers also were asked to comment on the CBA from the pedagogical point of view. Altogether, evaluation is based on feedback of *9 teachers, 76 students and 9 representatives of SMEs*. Three different questionnaires were used to collect feedback – students', teachers' and SMEs' feedback questionnaires.

All forms included open and closed questions, some of the questions were similar to allow comparing stakeholders' opinions. Also, the structure of the questionnaires was similar, starting with the questions about general satisfaction of the process and method, then questions about the method implementation process and concluding with suggestions for the future.

*4. The main results of this survey*

The outcome from the usage of CBAs was evaluated by teachers and students. In most cases, teachers and students are satisfied with working on real life cross border assignments (Figure 3).

Teachers also acknowledge that during the particular project students learned a lot about the particular topic, which was the focus of the CBA (Figure 4). Teachers identified that there could be more detailed case descriptions, but, in most cases,

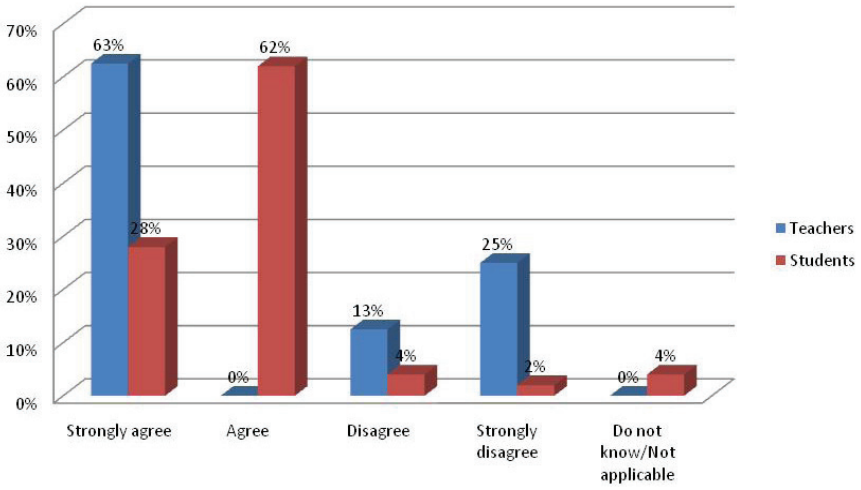


Figure 4. CBA's suitability to learn specific topic, %.

Source: created by authors.

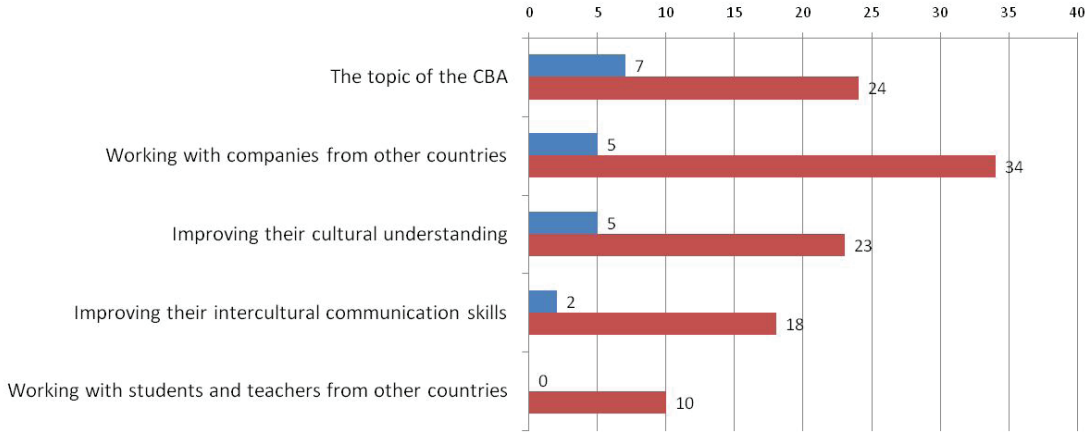


Figure 5. The most valuable aspects of CBAs, weighed numbers.

Source: created by authors.

it was compensated with answers from companies. It was also recognised that students and teachers were lucky to have new cases instead of the usual ones.

Teachers brought out that in some cases CBA helped to learn general key-competences and CBA's support to increase specific competences depends on the aim and content of the CBA.

Real partnership among students, teachers and companies, possibility to apply theory to practice were mentioned as the biggest benefit from collaboration with the company.

Teachers and students were also asked to validate certain aspects of the assignment. They were allowed to choose three aspects maximum. The evaluation results are in Figure 5.

Besides, teachers were asked what they would do differently if they had a chance to do the same assignment again. Four teachers did not want to change anything. Some teachers and students acknowledged that they would form smaller groups (one group had 8 and more students). Teachers would investigate more about the case before choosing it – whether there is enough information and whether the company and students are both interested in the result. Students identified that they would divide roles more specifically in the group, making sure that all are participating and investing effort.

From the pedagogical aspect, the teachers brought out also some other nuances concerning CBA implementation. As most of the CBAs were about target market research, the teachers highly appreciated that dealing with CBA situation gave students a wide range of possibilities to demonstrate the main skills in applying basic economic and business management theories and economic activity regulation principles in making managerial decisions, analysing and evaluating the changing business environment, adopting timely and cost-based decisions ensuring the efficient operation of organizations (companies).

*SME representatives highly evaluated* the possibility to give real-life tasks to students. They also appreciated the chance to learn from reports. Companies identified importance to investigate potential market before entering. The strong point is a fresh look at their everyday life problems that they have evaluated as highly professional. Finally, they acknowledged that they got very valuable information by paying nothing more than time and effort to help with information supply on time. This is highly appreciated by students and academic staff and CBA implementation should be continued and developed as training method for sharing with other HEIs.

**Conclusions**

The aim of the present article is to introduce and assess the CBA as an appropriate method to get entrepreneurs to involve student work and students to engage in entrepreneurship problems. The aim is fulfilled and also gives the answer to the research question.

NOBANET as a project is very important for establishing common relationship between different universities in 6 countries and SMEs. Especially those SMEs that joined the project with their cross-border assignments (CBA), were the first pioneers to explore the system to see whether it works in the favour of internationalization. All the stakeholders involved in CBA confirmed that this study method is useful for all parties. CBA is the main tool in NOBANET project to support internationalization of SMEs. The model of cooperation for internationalization has been tested and approbated.

During the project and according to the participants' feedback, also the drivers and obstacles of the model and CBAs are clearly identified.

In general, the main drivers are:

- Undertaking of joint field study/research;
- Production and collection of study materials;

- Co-creation of long-term economic, cultural and social benefits;
- Co-creation of grasp between study and work, theory and practise;
- Coaching students how to network, cooperate;
- Development of a critical, demanding and innovative approach to the study process and real-life cases;
- Enabling the use of modern learning technologies (e-learning).

At the same time also the obstacles were clearly identified and the most important for all the parties were misunderstandings because of poor communication – unclear goals and expectations, weak language skills, too infrequent communication, etc. For the future research, parties also brought out the problems concerning the organisation of joint work/ division of responsibilities and belated interest from SME representative during CBA. Despite the above mentioned obstacles, all the implemented CBAs were successful and supported internationalization of SMEs and gave valuable information to start using CBA as a study method in higher education. Therefore, the new method introduced and assessed gives already significant contribution to the existing network of HEIs in NOBANET. Information about this method has been and will be disseminated to other HEIs and SMEs. The CBA method will be more researched in the next application rounds and developed further. The novelty of this method so far puts emphases on learning environments, where universities and businesses collaborate over distances, crossing borders and jointly creating new knowledge that helps to strengthen internationalization of HEIs and SMEs.

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# TOURISM PLANNING AND STRATEGY IMPLEMENTATION: PRACTICE IN MUNICIPALITIES OF LATVIA

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**Abstract**
The aim of this paper is to summarise the experience gained at different levels of tourism destination planning in Latvia, identify the problems encountered during strategy planning and implementation, analyse the causes, and search for solutions.
Theoretical aspects of the tourist destination planning have been extensively reviewed in publications, yet the research on what main problems planners have faced during the planning process, has been insufficient. In the last twenty years of Latvian tourist destination planning, at different levels, part of the plans were developed as documents; however, not all of them were implemented.
The qualitative research summarises the experience of municipalities and tourism destination planning in Latvia.
The research results show formally drafted tourism development documents of different levels and types in Latvia conform to modern planning theory and practice. In some case's even the latest knowledge and experience, create unique, innovative and competitive solutions.
Tourism planning at the local level is often a painful process which raises a number of unresolved issues and unimplemented activities. The most significant differences observed from a comparison of theory and good planning practices in tourism development planning in Latvia are that the planning process is implemented within the boundaries of one municipality without taking into account the larger boundaries of tourist destinations. The involvement of entrepreneurs has only been formal and major, large-scale investment projects have not been planned or implemented.
**Key words**: tourism planning, planning process, implementation.

## Introduction

With the tourism industry returning to full-fledged international operations in Latvia in the 1990s, rapid tourism development began not only in the capital, but also in its regions. As tourism, especially international tourism, was a new economic sector in many places, the first tourism development planning documents were drafted. Drafting such tourism development documents in municipalities with little or no experience in tourism development (Inskeep, 1991) is a good way of defining key development guidelines, including all stakeholders, balancing demand with supply, optimizing benefits, respecting the interests of the local population and ensuring sustainable tourism. The first tourism development plans were originally developed as sections in integrated city and district tourism plans (Kuldiga District Tourist Development Plan, 1997; Rezekne Development Plan, 1997) or as separate documents (Aluksne District Tourism Development Concept, 1997; Jurmala Resort Development Strategy, 1997, Ventspils City and District Tourism Development Concept, 1999). Later (2004-2007), special tourism development and marketing strategies were developed by Liepaja, Cesis, Limbazi, Valka, Bauska and Jurmala (Klepers, 2012).

With the abolishment of districts following the administrative territorial reforms (2009), the first long-term and medium-term planning documents expired and new tourism development plans and strategies were developed. Pursuant to the Spatial Development Planning Law of the Republic of Latvia, sustainable development strategies, development programs, spatial plans, local plans, detailed plans and thematic plans are developed at local level (Saeima, 2011). Local governments have developed long-term strategies, development and action plans for tourism development. Development is planned in the long term (up to 25 years), in the medium term (up to seven years) and in the short term (up to three years) (Saeima, 2008). The Tourism Law stipulates that the competence of the municipality is to determine the development prospects of tourism and ensure measures for tourism development. To obtain resort status, a site must at least have a medium-term development plan (Saeima, 1998).

Cabinet Regulations No. 737 (Cabinet of Ministers, 2014) defines the process of drafting planning documents and the content of documents of different levels. It says that research as much as possible should be used for policy assessment. The development plan content includes: characterization of the existing situation, goals set and directions of action, measures developed to achieve the goal, their performance indicators, deadlines and institutions involved. The planning process also aims to identify problems, propose solutions and assess the potential impact of these solutions. The Development Planning System Law sets out 12 basic principles that reflect modern planning approaches: for example, the principles of sustainable development, openness, participation, monitoring, assessment and topicality (Saeima, 2008). Tourism guidelines (Policy Priorities) are defined in

the Sectoral policy guidelines for Local Governments (MEPRD, 2019). Thus, the country has established a good normative documentation base, which ensures drafting development plans of different levels and sectors, including the tourism sector, in accordance with the latest tourism planning approaches, including a local government oriented and sustainable tourism development planning approach (Hall, 2008; Yan & Morpeth, 2015; Cooper & Hall, 2016).

As the need for a sustainable long-term strategy is defined at the national level, tourism planning also emphasizes the need for strategic orientation and involvement of various stakeholders in the planning process (Ritchie & Crouch, 2000; Simpson, 2001; Ruhanen, 2004), stressing both stakeholders' impact (Dredge & Jamal, 2015), and the power relationship between stakeholders (Bowen, Zubair, & Altinay, 2017). Scholars analysing the modern planning process recognize the importance of cooperation between diverse stakeholders (Lin & Simmons, 2017), at the same time affirming that this is a complex negotiation and agreement process between the public and private sectors (Drege, 2006; Hall, 2008, Dapkus & Dapkute, 2015). In today's global tourism, the competitiveness of destinations plays a significant role and it depends on a number of factors (Ritchie & Crouch, 2003; Crouch, 2010; Dwyer *et al*., 2009), among which networking, public and private partnership are stressed (Hall, 2008; Armenski, Dwyer, & Pavluković, 2017).

Some of the tourism development plans in Latvia have only been developed as documents and the planned activities have not been implemented or implemented only partially. For the enhancement of the planning and policy development process it is necessary to understand the course of the planning process, problems, complexity, get to know the success stories (Dredge, Jenkins, & Whitford, 2011), to ensure a more critical assessment of practice (Dredge & Jamal, 2015). When drafting new documents, it is important to understand the reasons why long-term or short-term plans for these tourist destinations have not been implemented. One of the challenges of Latvian tourism is to implement the latest strategic planning documents for tourism planning (Atstāja, Brīvers, & Līviņa, 2011).

The aim of the research is to summarize the experience of planning of tourism destinations at different levels in Latvia, to identify and generalize the problems encountered in the planning process and implementation of strategies. The main tasks of the research are: 1) to analyse the tourism planning documents of different levels and types; 2) to interview planning experts and gather their experience; 3) to identify the problems and challenges that may arise during the planning process; 4) to elaborate the recommendations for local governments to be taken into account when developing good, feasible tourism development plans.

**Materials and Methods**

A qualitative research design has been selected for the study. It analyses secondary data such as normative documents related to spatial and tourism development planning and policies, planning documents for tourism development of different municipalities.

The main research results are based on results gathered through primary data - in-depth interviews. The survey sample was designed to identify those with varied and more extensive experience in tourism planning. Given the peculiarities of a small country and the limited number of experts, the sample is small – 14 interviewees (study participants P=14). Of the 14 interviewed persons, five are experienced tourism planning experts, three – regional tourism representatives (Kurzeme, Vidzeme, Zemgale) and six tourism planners who have participated in integrated development of regions and cities and tourism development planning in cities such as Bauska, Cesis, Jurmala, Kuldiga, Liepaja and Ventspils. In order to better understand the experts' experience in the planning process and planning results, the documents drafted by the experts were analysed. A total of 24 development planning documents of different levels and types were analysed. These include three Destination (Cluster) and Regional Tourism Development Strategies/ Plans (for Gauja National Park, Kurzeme Region and Nature Park Ancient Park of the Abava River), 10 – Municipal Tourism Development Documents (Liepaja, Jurmala, Bauska, Salaspils), eight Local Government Integrated Development Strategies and Programs, and three Nature protection plans for territories developed between 2008 and 2017. Their relevance to the knowledge of tourism planning theory, normative documents, strategies, actions for their implementation were assessed.

The interviews were conducted directly as audio recordings. The average interview time – 1.5 hours. The interviews included questions about: 1) the planning process, its course and obstacles; 2) analysis of the situation and its reflection; 3) the definition phase of policy and actions and key challenges. The interviewees were not limited and could express their opinions and experiences about the successes and failures of individual case planning processes, the lessons learned during the process. The analysis of the results included problems that were repeated at least twice in the interviews.

**Results and Discussion**

Summarizing and analysing the responses obtained during document analysis and interviews, it emerged that similar problems exist in each of the three steps

mentioned above (organizing and conducting the planning process, situation analysis and developing set of actions). They are further described in the analysis of results, explaining their possible objective causes and the importance of subjective factors in finding solutions to these problems in previous studies and recommendations.

*Planning Documents*

The analysis of the text and content of the planning documents shows that they comply with the requirements of the normative documents. In two cases (Jurmala and Bauska City), they are based on research carried out specifically for planning purposes. The analysed planning documents have been drafted in accordance with modern planning theory and practice, using in some cases even the latest knowledge and experience, creating interesting, unique, innovative and competitive solutions, products, for example, Gauja National Park Tourism Cluster development strategy. Several major tourist centres, such as Sigulda, Cesis, Ventspils, have no separate tourism development documents, as the development of this sector is integrated into the city's overall development strategy and program.

*The Planning Process*

A common problem mentioned in the planning process was the limited time spent on drafting the plan. It is often too short to involve all stakeholders and discuss issues with citizens and so these two actions are often more formal. As one of the study participants noted '*Plans often needed to be extended due to lack of time*' (P4). '*There are situations where a lot of effort was spent on preliminary studies leaving not enough time for developing action plans*' (P8); therefore, in some cases (P2, P6, P7) the research process is carried out before the planning document is drawn up. '*Time is always too little, but not more than six months should be scheduled*' (P2).

External consultants, often consultancy firms, who have developed similar plans, because of 'their lowest tender bid' (P1), are involved in the planning process, so there is a greater risk of getting '*standardized*' (P11), less creative solutions. '*The problem is procurement terms, which often do not allow the best experts to be attracted*' (P6). Several experts, analysing their previous experience, said that municipalities that have just formally complied with regulatory requirements have also received more formal planning documents; that '*an unambitious development section can also be easily controlled by the commissioner*' (P11). In turn, several planners point out that the outcome depends on the professionalism and capacity of the local government planning department (P7) and the ability to define procurement terms and conditions (P4). Global practice shows that tourism development plans are drafted by experienced consultants, but in cooperation with public authorities and local government representatives (Inskeep, 1991), establishing tourism boards with competent leaders (Gunn & Var, 2002). In Latvia, in order to avoid a conflict of interest, a public procurement with a set of requirements for the planning group, which may not include municipal representatives is announced. Therefore, the commissioner has to foresee a sufficiently long planning period (at least a year), as well as effective communication between planners and local experts, regular reports and discussions on planned activities during the plan drafting process to prevent standard, traditional solutions. It is acknowledged that the knowledge of local inhabitants and their desire to exert their rights is increasing (Xue & Kerstetter. 2017); therefore, the planning process schedule should ensure full-fledged involvement of the local community and not just their formal involvement.

It was identified that during the drafting of various documents, especially in big cities and regions, the institutions involved had differing interests, power and level of involvement in the planning process. '*There are a lot of stakeholders in tourism that need to be taken into consideration, but we don't know how to cooperate and forget important players*' (P7). This is particularly the case when different departments are involved (P2, P5, P6, P8, P9, P11) whose interests overlap, such as tourism, culture, sports departments, but are accustomed to operate only within their own functions and budgets. Some officials, departments, are still bureaucratic, unable to look at problems creatively, innovatively for common goals. It was also acknowledged during the interviews that in some cases, the human factor (P5) – formal or informal power, hierarchy, interests of individual officials, managers - played an important role in the planning process and results. '*The most important role here is played by personal reasons, overlapping positions, historical resentment and even institutional resentment from the times of the USSR*' (P2). '*In many municipalities, employees do not understand tourism at all*' (P3). '*Officials misunderstand their importance and the regulatory framework is also outdated*' (P5). As in all municipal processes, different political interests and lobbying were observed in the tourism planning process, especially in municipalities with a more diverse political spectrum, stronger opposition (P2, P6). Previous studies have highlighted the importance of power relations (Islam, Ruhanen, & Ritchie, 2017), but it is acknowledged that only clearly existing explicit power relations are described and deeper inherited political forces are not analysed (Xue & Kerstetter, 2017). That is why there is even greater need for involvement of locals who are familiar with and understand the complexities of power, especially the various informal leaders, the local undercurrents.

Tourism planning experts also admitted that it is still quite difficult to plan tourism destinations that are larger than one municipality (P2, P3, P5, P6, P7, and P8). There has been historically no or weak co-operation among municipalities, and even sometimes '*historical resentment*' (P2). They have different financial situation (resources) and therefore it is also very difficult to raise finances and use them as efficiently as possible in the overall development of the tourist destination. '*Many collaborative ideas are not implemented either because no one wants to take the initiative, or because there is constant criticism from partners*' (P11).

Discussions with entrepreneurs during the planning process revealed a significant problem such as lack of trust in the municipality, lack of leaders, sometimes scepticism that nothing would change, or reliance on the local government that everything it does is right. '*There was scepticism among entrepreneurs about the possibilities to implement everything*' (P1). '*On the one hand, our entrepreneurs are active, but on the other hand, if everything is developing positively, entrepreneurs are less involved and let the municipality do everything*' (P7). It was concluded that the older generation would prefer a centralised top-down planning approach and expect these plans to bring them tourist groups. Entrepreneurs also lack a broader view of the place as a tourist destination and a variety of factors affecting its development. Similar causes of tourism planning failure have also been identified by Ruhanen, analysing tourism planning documents in Queensland, Australia, as local destinations do not see development in the wider context (Ruhanen, 2004).

Currently, tourism enterprises in Latvian municipalities are micro, small and medium-sized enterprises, whose financial situation prevents them from joining major projects, implementing more creative and innovative ideas. '*Latvian municipalities are not ready to promote innovation. In principle, no innovation that requires big investment is introduced*' (P3). It is a common industry problem that tourism companies are predominantly micro and small entrepreneurs who are primarily interested in solving operational problems and not in long-term strategies (Phillips & Moutinho, 2014). Expert interviews also confirmed the fact that success has been hampered by inadequate tourism terminology, differences in understanding terms even when speaking about the same type of tourism (e.g. health and medical tourism, MICE (meetings, incentives, conferences, and events) sector, culture tourism, etc.). '*First of all, it is necessary to define terms so that everyone interprets things or tourism types the same way*' (P6). The current situation will be improved by the amendments to the Tourism Law, where it is planned to update the necessary tourism terms and concepts. The communication of the country's long-term development strategy and its contents, and explanation of the role of each region and municipality can also help.

*Situation Analysis*

As already mentioned, it is necessary to evaluate the situation in the development plans and to build on existing or special research. Several problems have emerged in this area. Some experts had encountered a situation where the municipality had already drafted planning documents at the higher-level and hierarchy, whose goals, guidelines and strategies needed to be coordinated with action plans at the lower level. Difficulties arise when changes are needed in these higher-level long-term documents, but local authorities are reluctant to update and revise them, as their discussion and coordination requires more time. '*It is all now tied to an investment plan if there is no activity, then no activity can be implemented'* (P3). In general, however, it is noted that the goals of the tourism plans are very humble, in some cases even '*green or naïve*' (P2). It was also mentioned that the municipalities had well-developed planning documents for the previous period with a clear purpose, vision, actions, but the results had not been achieved and there is a dilemma whether to attempt to achieve the same unfulfilled goals, or to develop more realistic, achievable goals that match the existing situation. '*We often repeat, update plans, but don't work with the real situation*' (P6). The authors believe that in such cases, the plan commissioners, municipalities, city councils should have a flexible approach both in relation to the predetermined deadlines for drafting the plan and to the documents in force.

All the experts acknowledged that local governments lacked long-term comparative tourism research, especially on significant sustainable tourism aspects such as tourist satisfaction, local and entrepreneurial attitudes towards tourism development and statistics at the local or regional level, including tourism business data. '*The lack of data for tourism planning is a serious problem, as it is difficult to prove and plan things without data*' (P8). The data is either 'exaggerated' or modest because it does not show the 'grey' part of the sector (P3). '*We need to use official statistics to refer to the source, but the locals then say the data is unreliable because a part of the data was not taken into account*' (P2). '*There is a lot of data gathered by public authorities, but this data is not available to municipalities and businesses*' (P4). '*If enterprises do not give us the data, then we do not have it*' (P6). Performance indicators are not being used in evaluating the implementation of previous documents and actions, for example, evaluation of the effectiveness of marketing strategies or campaigns. This problem is also present in other countries as the plans are based on traditional tourism development

indicators (visitor number, lengths of stay, spending, etc.) and do not use sustainable development indicators and indicator systems (Ruhanen, 2004; Hanrahan & McLoughlin, 2015).

Almost all the drafted planning documents contain analysis of strengths, weaknesses, opportunities and threats (SWOT). And even the use of such a well-proven and popular method has highlighted some stumbling blocks. It turns out that the commissioners (municipal officials or officials) have not been critical enough in evaluating the resources of the municipality or tourist destination and their uniqueness. Sometimes they are too optimistic and do not want to see a critical assessment of the situation, especially when it comes to evaluating municipal activities. There are also difficulties in defining long-term external opportunities, where it is necessary to know the tourism development trends, economic and social situation trends, forecasts not only in the municipality, but also in the region, country, Europe and the world. '*Long-term development vision cause difficulties, but we do plans for the next 10 years, not for today*' (P7). Some of the interviewees admitted that the local community is not sufficiently involved in the process of analysing the situation, for fear of their criticism, although it is the local people who best know the situation and are interested in solving the current local problems. Researchers emphasize that in the SWOT analysis of tourism it is necessary to identify and understand the strengths and weaknesses of the geographical periphery of the destination (lack of developed infrastructure, dependence on one transport connection, etc.) (Koščak & O'Rourke, 2017).

*Policies and Actions*

During the research, great attention was paid to the activities and actions developed, their feasibility, role in tourism development and financing provisions. Experts while drafting action plans had encountered restrictions in national legislation (sometimes also a different interpretation of restrictions) regarding local government opportunities and responsibilities, especially in relation to business, competition and public-private partnerships (PPP). '*The municipality does not cooperate with businesses, so many good ideas are not being implemented*' (P1). In general, even large and strong municipalities lack attractive innovative ideas, do not attract large-scale investments, very often offer standard solutions, typical tourism products and services. This can partly be explained by the constraints imposed on municipalities regarding investment plans. '*Attracting finances is only described approximately. It was not known where these funds could be raised*' (P1). '*The plan included projects that were not realized in life*' (P1). '*Actions are changed frequently according to the real situation, so long-term plans lack funding*' (P7). Similar to previous planning periods there is a lack of common actions, investment policies among the various municipalities involved for drafting tourism activities and action plans. This can be attributed to a lack of knowledge, scarcity of resources and a lack of political will to cooperate. Nowadays, there is a need for proactive, sustainable action from municipalities to avoid the negative effects of tourism (Hanrahan & McLoughlin, 2015).

Since in the last decades the biggest funding for tourism development has come from the European Union, the content and activities of the developed plans reflect the objectives of EU project proposal calls of that period, focusing on one or the other tourism type, development tool or aspect. '*In recent years, we have already learned to use the EU project funding for targeted activities, but of course, compromises often need to be made to meet the project theme and requirements*' (P8). '*The problem is that the EU defines the problem and the municipality applies for the project to solve the problem which is not its problem*' (P2). Part of the development plans and programs (especially the strategy) is developed without a budget, or without linking it to an assessment of availability of funding. Therefore, when they are critically evaluated, it can be seen that the objectives set are not achievable. Often, the annual budget approach of municipalities is a limiting factor in the development of plans. That is, precise actions and funding are planned only for the current year, without a long-term view and goals, rejecting projects or activities that require more investment over a longer period. '*In Latvia, the principles of local government budgeting do not allow decision making for a longer period*' (P5). '*Ideas need a financial basis if the ideas are without a financial basis, they are not credible*' (P11). It has been observed that sometimes tourism development plans include actions and activities for the development of infrastructure that has little effect on tourism development.

Unfortunately, the aspect of populism was also observed while drafting plans in municipalities, especially before the local elections. Municipality council members, employees use the attractive brand of tourism as a development idea or slogan to maintain or gain voter confidence, but do not associate it with real activities. '*The city has been governed by the same party for 20 years, so nothing changes radically*' (P1). '*The power of the mayor as a party member is a cause for concern for the future*' (P7). '*Those who have not been in power will reap the laurels of tourism development*' (P5). '*Typically, everyone says they support tourism but do not follow it up with real work*' (P4).

And, of course, as in any other area, the implementation of any plan depends on their implementers. Latvian municipalities do not always

have sufficient and adequate human resources capacity, know-how to implement the decisions made, for example, in relation to the use of the latest technologies, communication with customers, actions to evaluate efficiency, etc. '*An ideal tourism plan should be linked to other municipal units, but it does not happen due to lack of the necessary knowledge*' (P6). '*There are already problems with infrastructure, human capacity, including knowledge*' (P7). Lack of entrepreneurial skills, necessity and importance, insufficient human capacity, especially in the bottom-up development model, were also identified in studies in Slovenia, Ireland and Scotland (Koščak & O'Rork, 2017). Managing tourist destinations requires adaptive capacity and flexibility (Islam, Ruhanen, & Ritchie, 2017). That is why continuous education of tourism entrepreneurs, developers and managers is necessary, both by organizing various seminars, exchange of experience and providing the latest professional and scientific literature and insights.

And a common problem noted was the art of compromise at different levels essential in situations where it is necessary to decide between actions, investments and available resources, especially if it requires unpopular decisions, or decisions where it is necessary to change local opinion, make efforts to persuade and get support. '*Each pulls to his own side. What common purpose and cooperation can we talk about?*' (P3). '*The municipality should create an environment for successful development of tourism and business*' (P7). '*The municipality has to show the way to both entrepreneurs and the locals, but then all have to work together*' (P2). As it has already been mentioned, public involvement is necessary in the planning process and discussion of documents. But it is also a decisive factor in the implementation of the plans (Åberg, 2018), because it allows us to recognize both the goals set and the consequences and impacts of tourism development.

**Conclusions**

The research results show that formally drafted tourism development documents of different levels and types in Latvia conform to modern planning theory and practice, apply in some cases even the latest knowledge and experience and create interesting, unique, innovative and competitive solutions and products.

As noted in theory and observed in Latvia, tourism planning at the local level is often an awkward and painful process (Millar & Aiken, 1995), which raises a number of problems, unresolved issues and unimplemented activities.

The most significant differences observed from a comparison of theory and good planning practices in tourism development planning in Latvia are that the planning process is implemented within the boundaries of one municipality without taking into account the larger boundaries of tourist destinations, the involvement of entrepreneurs has only been formal and major, large-scale investment projects have not been planned and implemented.

In order to address these problems, develop good, feasible tourism development plans, local governments need to:

1. Strengthen their leadership role and power to develop competitive and sustainable tourism destinations.
2. Implement PPP initiatives with clearly defined rights and responsibilities, as PPPs are an essential and critical factor in the development of competitive tourism destinations.
3. Acquire communication, cooperation, negotiation, agreement and compromise skills necessary for cooperation between the private and public sector, cooperation between municipalities, cooperation between municipalities and their inhabitants, cooperation between separate services or departments within a municipality.
4. Be aware of the importance of the human factor (especially in relationships between the various forces and the authorities, the willingness to cooperate, knowledge and creativity), seek mechanisms to prevent their negative effects and promote the involvement of creative, resourceful and knowledgeable professionals.

At the national level (Investment and development Agency of Latvia) it is necessary to create a journal dedicated to tourism research and practice, or an on-line platform where the tourism planning documents drafted, significant tourism research results and discussions on tourism development issues could be published. It would be a good tool for promoting tourism entrepreneurship education, which in today's rapidly changing world is one of aspects ensuring high quality tourism products and services.

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# DEVELOPMENT OF EDUCATIONAL TOURISM IN LITHUANIAN RURAL AREAS

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**Abstract**
Tourism development contributes to the vitality of rural areas: it increases employment opportunities for residents, promotes the development of relations among different business entities and attractiveness of rural environment. In this article, the situation regarding the development of one type of tourism – educational tourism – in Lithuanian rural areas, factors encouraging and limiting this development have been analyzed. The research question is what are the main problems regarding the development of educational tourism in rural areas. The aim of the research is to present relevant solutions after the analysis of the problems regarding the development of educational tourism in rural areas. Theoretical research was performed while applying methods of content analysis and synthesis of scientific literature and other researches. The method of case analysis was chosen to describe the state of the development of educational tourism and to identify main problems. In total 18 cases were analyzed (18 providers of the educational tourism services in rural areas). In order to collect necessary information, methods of semi-structured interview, analysis of secondary informational resources and direct participation in researched educational programs were applied. The development of educational tourism is promoted by the factors related to the environment of manor, historical place or nature as well as professional qualification, working experience, enthusiasm and ability to be flexible about customers' needs of actors responsible for rural development. Volatility of demand regarding educational programs, lack of specialists and challenges related to cooperation were identified as problematic issues.
**Key words**: education, educational tourism, rural area, types of tourism.

## Introduction

The decline of the importance of agriculture as well as problems regarding population of residents, infrastructure and employment in rural areas (Kuliešis & Pareigienė, 2014), encouraged academics and practitioners to search possible solutions related to maintenance of the vitality of rural areas while ensuring sustainable territorial development.

Researchers (Wang & Yotsumoto, 2018; Atkočiūnienė, 2011) follow the opinion that the development of tourism (or tourism products) has a positive effect towards the local, regional and national economy, society, culture and environment. The development of tourism can improve regional economy, for example, industry, employment, cooperation among business entities (Hermawan *et al.*, 2018). The benefit of tourism development towards rural development is scientifically based; however, dynamic environment causes the constant need to analyze situation, threats and opportunities for the development of tourism.

In scientific researches (Astromskienė, 2009; Atkočiūnienė, 2011; Wang & Yotsumoto, 2018), academics analyze the development of rural tourism; however, there are various types of tourism. In this article, the situation regarding the development of one type of tourism – educational tourism has been analyzed. To define educational tourism as a separate type of tourism is quite difficult, because it includes various elements of cultural, cognitive and countryside tourism (Richards & Wilson, 2007); however, a distinctive feature of educational tourism – the main (or secondary) priority – is learning process in a unique environment. While providing/using the services of educational tourism, the immediate interaction takes place between two interested parties: participants and organizers of education (Sie, Patterson, & Pegg, 2016). The organizers can be local communities, farmers, countryside tourism homesteads, museums, cultural centers (Sie, Patterson, & Pegg, 2016). Favorable conditions for the development of educational tourism exist in the rural area. Firstly, due to globalization and scientific and technological progress, the supply of educational tourism services grows, life cycle of tourism services is becoming shorter; however, in rural areas the situation is different – here the duration of tourism services is limited. Thus, the development of different types of tourism would cause a growth of supply. Secondary, tourists' purposes and motives are changing (Baležentis & Žuromskaitė, 2012; Carneiro, Lima, & Silva, 2015; Petroman *et al*., 2016). More and more often consumers prioritize learning about culture, local traditions and customs of the visited place. They appreciate an opportunity to try/create/learn/find out by themselves. Natural, not polluted environment makes this type of tourism even more attractive. Thirdly, the development of several related types of tourism, combination of agricultural business and tourism activities can encourage a synergy between different types of activities, for instance, development of educational tourism can reduce seasonality of rural tourism. The effect of synergy in different types of farm activities can be created by so-called 'conformity with the market', i.e. products of different activities (agricultural activities and other) are consumed by the same consumers, for example, products of beekeeping, horticulture are used in the educational programs. Also, the interest in lifelong learning has increased

as well (Carneiro, Lima, & Silva, 2015; Lane & Kastenholz, 2015). Finally, promotion of vitality of rural areas is one of the priorities not only among local inhabitants, but representatives of government as well. As a result, business development in rural areas is promoted by financial instruments. Scholars (Richards & Wilson, 2007) point out that the demand for services of educational tourism has been growing in rural areas recently, because it is an effective way to represent history, culture, traditions, wisdom of the elders; also, it increases the supply of educational services.

Thus, it is relevant to analyze how other types of tourism contribute to the development of rural areas and what kind of challenges are faced. Researches (Astromskienė, 2009; Pilipavičius, 2011) identify several problematic issues regarding development of rural business (not only rural tourism): weak cooperation, lack of professionalism and initiative, limited abilities to develop business in changing environment. On the other hand, the market of rural business is small. Rural business entities are not able to produce everything – this area is producing minor part of goods (Zaleckienė, 2015). The research question is what are the problems related to the development of educational tourism in rural areas. The aim of the article is to present possible solutions after the analysis of the problems regarding the development of educational tourism in rural areas.

**Materials and Methods**

Educational programs – one of the most important subjects of the educational tourism – were analyzed in order to perform an analysis of the development of educational tourism in Lithuanian rural areas[1]. Criteria and subcriteria of research object are summarized in Table 1.

In order to perform a detailed analysis of the development of educational tourism in Lithuania, case analyses were carried out (Table 2). Principles of recognition/popularity and accessibility for search were applied in empirical research related to the case analyses. Manors of Zypliai, Kiduliai and Gelgaudiškis were chosen due to wide range of suggested educational programs. Raudondvaris manor was chosen due to wide range of educational programs regarding handicrafts. Regional parks of Panemuniai, Nemunas loops and Tytuvėnai were chosen due to wide range of educational programs regarding nature.

In order to gather necessary information, different methods were applied: 1) semi-structured interview. This research method was used to gather necessary information regarding particular educational programs (how long they are performed, who choses topics, what type of problems occur while organizing educational programs, who the main participants of educational programs are, cooperation relations and etc.). During semi-structured interview 8 respondents (guides, representatives of communities, countryside tourism

Table 1

**Criteria and subcriteria of analysis of educational tourism in Lithuania (compiled by the authors)**

| Criteria | Subcriteria | Detail |
|---|---|---|
| Educational objects | Gastronomy<br>Handicrafts<br>Wildlife<br>Historical (architecture, old articles, famous people, historical places)<br>Cultural (tales, theater, dances)<br>Festive<br>Sports | Subjects were selected in accordance with L. Sie, I. Patterson & S. Pegg (2016) |
| Organizers | Manors<br>Rural communities<br>Countryside tourism homestead<br>Regional parks | Cases of rural communities and countryside tourism homesteads were chosen while following the principle of accessibility – key words 'educational programs of rural communities', 'educational programs of countryside tourism homesteads' were typed into Google web search engine (www.google.lt). |
| Seasonality | Full-year<br>Certain months<br>Seasons | |
| Participants | All<br>Children<br>Adults<br>Pupils<br>Families<br>Foreigners | |

[1] Rural area – a residential place of small number of inhabitants predominated by natural environment, landscape; the main activity of local inhabitants – agriculture (Pilipavičius, 2011).

Table 2

**Chosen cases (compiled by the authors) (N=18)**

| Educational tourism programs providers | Cases |
|---|---|
| Manors | Zypliai, Kiduliai, Gelgaudiškis and Raudondvaris (N=4) |
| Rural communities | Adomynė, Gižai, Lekėčiai, Virbalys, Biliūnai, Žiobiškis and Junkilai (N=7) |
| Countryside tourism homesteads | Dalgedai, Šušvė, Širvynė and Grikucis (N=4) |
| Regional parks | Panemuniai, Tytuvėnai ir Nemunas loops (N=3) |

homesteads, educators) were interviewed. Another method that was used: 2) analysis of secondary informational sources. Websites of chosen cases were considered as secondary informational sources. While applying this method, the information regarding the object, duration, price, number of participants, time of the chosen cases were gathered; Also, we used: 3) research while participating. In order to collect necessary information for empirical research, it was decided to participate in educational program and to communicate with organize and managers of educational programs.

The chosen research methods complement each other and help to solve the issue of the lack of information regarding the organization of educational programs, relations with other objects of rural development and etc.

Empirical research was carried out during the period from July to December in 2018.

**Results and Discussion**

The analysis of the cases showed that educational tourism has been developed in rural areas. Due to the lack of information, it is difficult to describe tendencies; however, the structural interview has shown that the majority of educational programs has been implemented more than one year (five years or more). Despite the fact that educational programs related to specific activities (businesses/handicrafts) predominate, the grouping of suggested programs suggests that programs offered in rural areas are quite diverse (Figure 1).

Structured interview with the suppliers of educational programs highlighted that topics of educational programs are related to environment (environment of manor, historical places, events), natural resources (flora and fauna), seasons, calendar of folk and religious celebrations.

The greatest variety and number of educational programs was identified in manors (7 – 10 educational programs in one manor). This is caused by the fact that there are enough resources in manors, for example, premises. In addition, manors are already attractive tourism destinations – the number of visitors is higher there. On the other hand, specialists who work in manors and educational programs are included in tourism routes. Organization and development of educational programs are more organized in comparison with other suppliers of educational programs, for instance, countryside tourism homesteads or rural communities.

Meanwhile rural communities, countryside tourism homestead offer limited number of educational programs (mainly one per day) due to limited resources (material, human). The variety of educational programs is also quite small: in rural communities 1-2 educational programs are offered, in countryside tourism homestead – from 1 to 7. The most popular educational programs in these objects

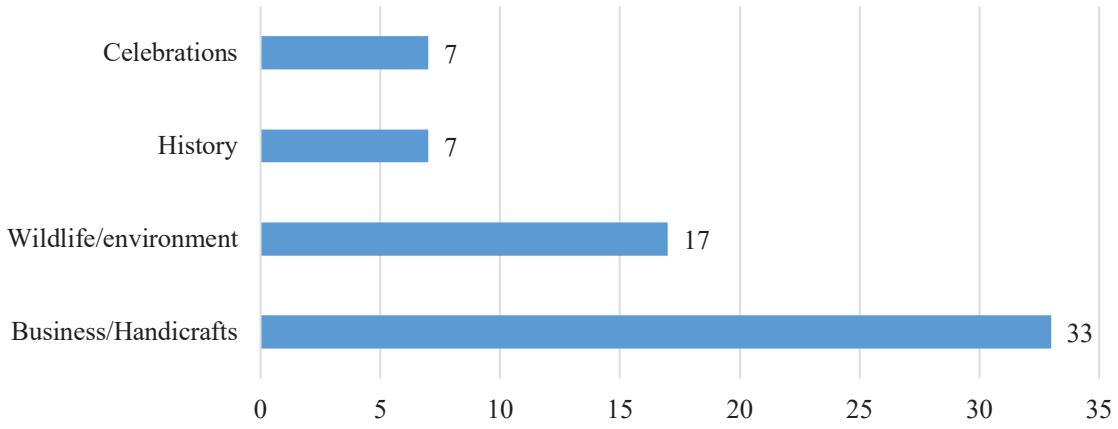


Figure 1. Division of educational programs according to the objects, units (N=18).

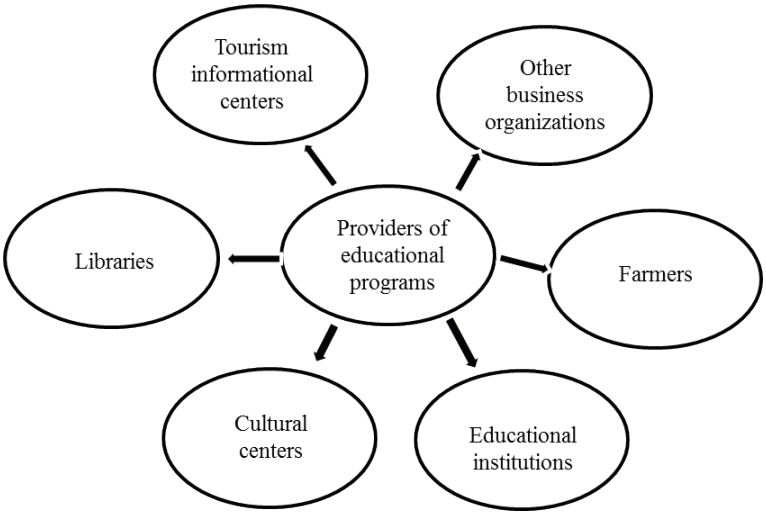


Figure 2. Involvement of other participants in development of educational tourism.

are gastronomical programs while the premises and tools are available.

In most researched cases educational programs have been implemented throughout the year except regional parks, where a distinctive feature is dependence on seasons (spring – summer – autumn). Educational programs in nature are not very popular in cold season. Representatives of rural communities also noted that not all educational programs are provided throughout the year or sometimes the number of participants can be limited due to the fact that not all their premises are heated during cold season.

Researched educational programs are oriented towards organized groups of visitors – groups of pupils, employees of companies, families, etc. Educational programs mostly are organized for citizens of our country. The variety of educational programs oriented towards the tourists from abroad is very small. Educational programs organized in rural areas are rarely included in tourism routes. Sometimes they are presented as the including part of the offered package of tourism services (for example, museum, excursion in the visitor center and education) and the interest of individual foreign tourist is not very big. On the other hand, the supply is limited by the lack of educators, especially of those, who can speak fluently and communicate in foreign language. Interviewed people stated that communication with the assistance of entrepreneurs significantly reduces the quality and attractiveness of educational programs.

The performed research confirmed theoretical statement that the development of tourism creates new relations and opportunities, involves other participants living in rural areas or cities (Figure 2).

The performed research confirmed that the development of educational tourism contributes to the development of rural areas: the popularity of rural community and area increases, a need to restore public places, environment rises naturally. Interviewed persons stated that while implementing educational programs they cooperate with farmers, rural communities, cultural centers, informational tourism centers, educational institutions, libraries, other business enterprises, which provide educational programs with necessary premises, inventory, tools (beeswax, honey, vegetables, cheese and other) that contribute to the popularity and advertisement of educational programs. This cooperation unites local communities, and the attractiveness of rural area increases at the same time.

In conclusion, it can be stated that educational tourism in Lithuanian rural areas is being developed, there is a wide range of suppliers and supply as well. However, the performed research enabled to identify many factors limiting the development of educational tourism in Lithuanian rural areas. It should be noted that it is very complicated to define one main problem. Firstly, the vitality of demand related to educational programs should be taken into account. In most cases, the product/service developed in rural area and based on limited local resources is devoted to tourists, not local inhabitants. Consequently, it is hard to plan the educators' employment, necessary resources and income from this activity. Therefore, the development of these activities is based on limited resources as well as implementation on minimal risk. Respondents of the interview stated that educational programs are booked for the weekends, holidays, during the period before public holidays (for example, Christmas, Easter, Saint John‘s Eve). A volatile activity causes difficulties in finding educators. Analyses of two cases showed that former educators left the country and went abroad, because they were not able to maintain family from this activity. And it is not easy to find the replacement for them. Therefore, flexible and various ways to solve this problem are found, for instance, the minimal

number of participants (for example, at least 10 participants) or the total price of educational program (100 Eur) regardless the number of participants. If tools and equipment necessary for the implementation of educational programs can be transported easily (for example, tools/equipment for wool felting, Easter egg dying) educators agree to implement their educational activities in school.

Secondary, due to decreasing number of citizens in rural areas and small towns (emigration to cities or abroad, high mortality) the number of sponsors and people able to organize and implement educational programs decreases as well. In this case, it is not enough to have specific knowledge (how to recognize footprints of wild animals, voices of birds, to knead dough properly, heat the oven). An educator has to know how to communicate with participants of educational program, encourage their interest, ensure the safety of participants, involve all participants in activities, be creative while transferring knowledge and experience. In addition, it is important to 'create, pack and sell' the service properly, evaluate the activity, identify problems and be able to solve them. Entrepreneurial competences (both general and specific) are very important.

Despite the fact that the research showed that there is cooperation among organizations/participants, the problem related to the stability of demand, the lack of entrepreneurial skills in rural areas, predominance of individualism cause difficulties in ensuring long term cooperation. It can be stated that it is an outcome of history of rural areas. After a long period of common wealth and work, a new type of subculture with new values has grown in the rural area; a need for community is not very relevant any more, individualism has taken its place. Various financial instruments promote communities and cooperation; however, this is not a natural process – thus, often it is short and based on certain interests. In order to increase popularity of educational programs, it is suggested including them in tourism routes – providers of educational programs have to communicate more with informational tourism centers (their network is developed throughout Lithuania). This would help to disseminate information more effectively, because tourists search necessary information regarding districts in these centers. The performed research showed that not in all cases communication with potential clients is effective: often the same person is both – an administrator and an educator. It takes a lot of time to order educational program or obtain necessary information about it. As a result, it is recommended to prepare a virtual calendar of educational programs – a client would have an opportunity to see when educational programs are available. In this calendar other relevant information could be provided, for example, it can be offered for one tourist to join the organized group if there is available vacancy and etc. Also, this calendar could be used as a platform for cooperation with informational tourism centers. Business environment is very dynamic. It does not mean that if specific knowledge and skills were useful one year ago, they will be relevant today. Informational technologies develop very fast, the needs and lifestyle of consumers are changing as well. Therefore, development of entrepreneurial competences has to become a constant process responding to changing environment and preserving traditions, values, uniqueness, sustainability related to environment and rural lifestyle.

**Conclusions**

1. The main providers of educational tourism services in Lithuanian rural areas are museums, manors, regional parks, rural communities, countryside tourism homesteads. Various educational programs have been offered to the tourists. They can be grouped according to the topics, which are the following: gastronomy, handicrafts, wildlife, history, culture, local festivals and sport.
2. The research identified the following problems of educational tourism development: lack of communication, weak cooperation, vitality of demand, lack of educators' abilities to develop business in changing environment.
3. Educators' learning, training of educators, improvement of marketing, development of partnerships would contribute to solving the identified problems.

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# DIMENSIONS AND ATTRIBUTES BUILDING CORPORATE REPUTATION OF RURAL BUSINESSES

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**Abstract**
Given the intensive competition between rural businesses, building and managing good corporate reputation of rural businesses is gaining its popularity among business owners, marketers as well as among scholars. Building and managing good corporate reputation is considered to be one of the crucial goals for businesses that leads to successful competition in ever changing business world. The aim of this research is to determine dimensions and attributes for building good corporate reputation in the framework of rural businesses. To reach the aim, this paper adopts analysis and synthesis of scientific and practical literature in the field of corporate reputation management and, focus group discussion. 23 attributes of corporate reputation representing 7 corporate reputation dimensions were generated from scientific and practical literature. Generated attributes were provided for the evaluation and discussion during the focus group discussion to 7 representatives of rural businesses' stakeholder groups, namely: customer, employee, supplier, business owner, media, local community, and expert. Empirical research proved 7 rural businesses' corporate reputation dimensions: Products & Services, Innovation, Workplace, Governance, Citizenship, Leadership and Performance, each of the dimensions constituting of 3-4 corporate reputation attributes. For the further research, quantitative research to test corporate reputation dimensions and attributes and calculate its weights in the context rural businesses is necessary.
**Key words**: corporate reputation, corporate reputation dimensions, corporate reputation attributes, reputation formation, reputation management, rural.

## Introduction

The construct of corporate reputation has gained a wide interest from theory as well as practice. The formation and management of good corporate reputation have become one of the most important tendencies in the management of organizations. Now in addition, rural businesses are coming to realize that they have much to learn in this area and that corporate reputation as a management technique is particularly appealing in the rural sector. Since corporate reputation formation and management of the rural businesses is quite a new topic, this sector lacks knowledge and tools how to build and manage good corporate reputation. Consequently, the question is not whether rural businesses should apply corporate reputation management but how, as certain corporate reputation management tools might not apply to rural businesses.

This paper focuses on dimensions and attributes of building and managing good corporate reputation in the context of rural businesses. The purpose of this research is to answer the question how to build and manage good corporate reputation of rural businesses.

The object of the research is corporate reputation formation and management in the context of rural businesses.

The aim of this research is to determine dimensions and attributes for building good corporate reputation in the framework of rural businesses.

The objectives of the paper are as follows: to analyze theoretical conceptualization of corporate reputation, its formation and management; to identify dimensions and attributes for building and managing good corporate reputation; to determine corporate reputation dimensions and attributes of rural businesses using focus group discussion method.

The paper consists of both theoretical and empirical analysis. The research methods used in the article include logical analysis, generalization and interpretation of scientific and practical literature. After the presentation of theoretical insights, research methodology is outlined, following with research findings. Finally, conclusions are stated.

The introduction of corporate reputation concept dates back to 1997 with the foundation of Reputation Institute (RI) and scholarly journal Corporate Reputation Review devoted solely to the topic. The founders of the institute and the journal, Charles J. Fombrun and Cees B.M. van Riel, are considered the key and most influential scholars in this topic. Since the establishment of RI and the first issue of the journal there is a great intensification of articles devoted entirely to the concept of corporate reputation.

Despite the broad interest among academics and practitioners in corporate reputation, there is a big confusion in the topic. Until now scholars and practitioners still argue on the definition of corporate reputation and the main components included in corporate reputation formation and management. Burke, Dowling, Wei (2018) believe that due to the fact that corporate reputation concept has been studied from various academic disciplines and stakeholder perspectives, there are many definitions in use. Pires, Trez (2018) agree that corporate reputation embraces a complex concept, with a diversity of definitions in the literature and this variety of concepts makes it

difficult to adopt one definition and one method to measure the construct.

Dowling (2016) defines corporate reputation as an individual's overall evaluation of a company. Caruana, Cohen, Krentler (2006) suggest that corporate reputation is similar to an attitude and is based on the company's key attributes, performance and behavior. Fong (2013) states that corporate reputation can be defined as the assessment of the firm's ability to create value and to meet consumer expectations in relation to given attributes. Similarly, Walsh, Beatty (2007) defines corporate reputation as customers' overall evaluation of the firm, according to their reactions to the firm's offerings and communications, as well as their interactions with it. Barnett, Leih (2018) suggest that corporate reputation at any point in time is understood and measured as an average, perhaps weighted, of what various constituencies think of the firm.

Scientific and practical literature provides a broad range of positive outcomes that good corporate reputation generates for organizations. Burke, Dowling, Wei (2018) believe that good corporate reputation acts as a signal of quality and a performance bond to internal stakeholders such as employees and external stakeholders such as customers. Because companies are expected to live up to their reputations, they generally endeavour to maintain or enhance stakeholder evaluations. Rindova, Martins (2012) supplement that from a strategic perspective, corporate reputation, has many of the attributes of an intangible asset because it is difficult for rivals to imitate, acquire or substitute, and can offer opportunities to gain a competitive advantage. It is possible to state that rural businesses having good corporate reputation might expect better organization performance, higher prices of products, higher customer attraction, bigger profits, higher market value, organizational appeal, customer/ employee satisfaction and many other important benefits.

In the academic literature, there is a number of contributions devoted to how organizations should build and manage their corporate reputation (e.g. Wiedmann & Buxel, 2005). The most commonly accepted view to the management of corporate reputation is that corporate reputation is created and managed by the actions undertaken within corporate identity and transmitted through corporate communications. It creates an image in the stakeholders' mind and in a longer perspective – a reputation (Gray & Balmer, 1998; Rindova, 1997). Gray, Balmer (1998) indicate that a favourable corporate reputation requires more than just effective communication effort; it requires a meritorious identity that can only be moulded through consistent performance, usually over many years. A coordinated communication programme can, however, reinforce and promote a positive reputation.

Building and managing good corporate reputation of rural businesses is of big importance as well because as Burke, Dowling, Wei (2018) argues a good (or poor) corporate reputation can enhance (decrease) the likelihood that a particular product will be chosen over competing products. According to authors, the primary mechanism by which this can happen is a halo effect whereby the overall evaluation of the company influences evaluations of the product's features in a way that is consistent with this overall evaluation. Arslanagic-Kalajdzic, Zabkar (2017) and Helm (2013) argue that good corporate reputation may increase customers' value perceptions because good corporate reputation represents a quality signal that reduces customers' search costs as well as the resources (time, effort, money) needed to supervise the relationship and ensure that organization does not engage in opportunistic behavior.

However, Cintamür, Yüksel (2018) prove that since corporate reputation is an issue and a stakeholder-specific phenomenon, different stakeholder groups may have different evaluations of corporate reputation and each stakeholder group's reputation may have different dimensions. Therefore, according to the authors it is possible to argue that dimensions of corporate reputation might vary among different industries and stakeholder groups and so should be measured in terms of a single industry and stakeholder group. It means that not only they believe that the dimensions and attributions of corporate reputation might vary from one industry to another, but it might also vary among stakeholder groups as well. That is why it is possible to state that corporate reputation should be treated in terms of specific industries meaning corporate reputation of rural businesses might demonstrate specifics compared to other industries.

**Materials and Methods**

To achieve the aim of the paper this research adopts analysis and synthesis of scientific and practical literature in the field of corporate reputation management. In order to determine dimensions and attributes for building good corporate reputation, general scientific research methods were applied as well – systematic analysis, evaluation, generalization, comparison and abstraction. To identify dimensions and attributes of good corporate reputation for rural businesses, qualitative research method – focus group discussion – was applied.

Focus group discussion was organized with heterogenous participants. Representatives of 7 different stakeholder groups were invited to participate in the focus group discussion. Focus group discussion involved one representative from each rural businesses' stakeholder groups: one customer,

one employee, one supplier, one business owner, one media representative, one local community member, and one expert in the field. Data from focus group discussion were analysed in a generalized mode, without taking into account neither represented stakeholder group nor demographic data.

A questionnaire was prepared for the focus group discussion. The questionnaire consisted of 23 closed questions provided in a form of statement. Before distributing the questionnaire, participants of focus group discussion were introduced with the aim of the discussion, its logic and expected result. Participants were also introduced with the rules of the discussion and were asked to introduce themselves to each other. The aim of the focus group discussion was to identify dimensions and attributes for building and managing good corporate reputation of rural businesses. Focus group discussion with the elements of semi-structured interviews was organized in February, 2019. The duration of focus group discussion was 1 h 30 min.

Participants of focus group were asked to evaluate each closed question-statement using the Likert scale. Likert scale consisted of 5 meanings, were 5 had a meaning of absolutely agree, 4 – agree, 3 – neither agree, nor disagree, 2 – disagree, 1 – absolutely disagree. Questions-statements representing attributes of corporate reputation were provided for the evaluation by structuring them according to the dimensions of corporate reputation. While filling in the questionnaire participants of focus group were allowed to ask questions to the moderator of focus group. This allowed collecting reliable data as participants were provided with the clear meaning of the statements provided in the questionnaire. After filling in the questionnaire, members of focus group discussion were also asked to provide their insights on every dimension and attribute of corporate reputation provided in the questionnaire.

Based on the participants' answers average meanings of each corporate reputation attribute were calculated. Such calculation of data resulted that those attributes that were as close as possible to the average meaning of 5 would be considered as very important corporate reputation attribute for building corporate reputation of rural businesses. Average meanings between 3.5-4.4 were considered as important attributes for building good corporate reputation of rural businesses. And average meanings between 2.5-3.4 were considered as having average importance. Lower average meanings were not identified during this research proving the reliability of the RepTrak tool that was used as a basis for this research.

The logic of this research was constructed based on the logic of testing validity of Reputation Quotient (Gardberg, 2006; Groenland, 2002) and corporate reputation measurement method constructed by Helm (2005). Since worldwide acknowledged corporate reputation management and measurement tools of RepTrak and Reputation Quotient were constructed using such logic, this research considers the selected method of research to provide reliable results. Research results collected during the focus group discussion with representatives of different stakeholder groups of rural businesses allows to identify what dimensions and attributes are used for building good corporate reputation of rural businesses.

**Results and Discussion**

In the scientific and practical literature most widely accepted views towards management and measurement of corporate reputation are based on social expectations. It is considered that social expectations reflect expectations of stakeholder groups towards the behavior of an organization and this describes its corporate reputation. In the last decade RepTrak became the most widely acknowledged and most widely used tool for the measurement and management of corporate reputation.

RepTrak tool was created by Reputation institute in 2006 and can be used for the measurement and management of corporate reputation. Van Riel, Fombrun (2008) indicates that RepTrak method is the first standardized and complex method that can be used at the international level for opinion measurement of various stakeholder groups. Vivader-Cohen (2007) states that RepTrak method is also used by the magazine 'Forbes' for annual World's most reputable companies rankings. RepTrak method is created in order to provide organizations with standardized framework for the identification of dimensions and attributes based on which corporate reputation is formed and managed (Reputation Institute, 2009).

RepTrak tool distinguishes 23 attributes grouped to 7 dimensions that are substantiated as valid criteria for the determination of stakeholder groups' support to the organization (Reputation Institute, 2009; Reputation Institute, 2018; Reputation Institute, 2019).

Exclusive attention in the RepTrak tool is given to 'RepTrak Pulse' tool that reflects the emotional connection of stakeholder groups towards an organization. 'RepTrak Pulse' tool provides 4 dimensions – Esteem, Admire, Trust and Feeling – that determine emotions of stakeholder groups and allow getting insights on the emotional attitude of stakeholder groups towards an organization. This can be considered as the emotional aspects of corporate reputation. This is justified by the fact that Reputation Institute (2019) defines it as the FEEL aspect of corporate reputation.

Scientists and practitioners from Reputation Institute that created RepTrak tool believe that corporate reputation can be managed through the

management of 7 very important dimensions of an organization. These 7 dimensions are internationally tested and proved to be the main aspects for building good corporate reputation. As Reputation Institute (2019) states, these 7 dimensions of RepTrak tool represent cognitive representation of stakeholder groups towards organizations. Reputation Institute (2019) defines it as the THINK aspect of corporate reputation.

A fundamental advantage of RepTrak tool is considered the fact that corporate reputation dimensions (van Riel, Fombrun, 2008) and indicators that constitute them (Reputation Institute, 2009) statistically do not depend on each other. Another key advantage of RepTrak tool is that all corporate reputation measurements are comparable between operating fields, countries and in time (Reputation Institute, 2009). As Reputation Institute (2019) indicates they measure 7600 companies per year, across 50 countries and 20+ different industries. They help organizations answer three key questions: (1) What is my reputation and how does it compare?; (2) How can I improve and protect my reputation?; (3) What is the business impact of better managing my reputation?

While RepTrak tool has been used internationally across 50 countries and in 20+ different industries this tool can be definitely considered as the most standardized tool for the management and measurement of corporate reputation of the companies from different industries. This leads to the logical assumptions that RepTrak tool might be the right and useful tool while building and managing good corporate reputation of rural businesses.

Cognitive consideration of various stakeholder groups in a form of perceptions and attitude is constructed towards 7 corporate reputation dimensions: Products & Services, Innovation, Workplace, Governance, Citizenship, Leadership and Performance. Each corporate reputation dimension constitutes of 3-4 attributes. Reputation Institute (2019), Van Riel, Fombrun (2008) and others grouped 23 attributes of corporate reputation around 7 dimensions that can be considered as the main aspects of corporate reputation management at organizations from any industry, including – rural. For this reason, author of this paper believes that below listed 7 corporate reputation dimensions and 23 corporate reputation attributes might be the right dimensions and attributes for building and managing good corporate reputation of rural businesses:

1. Products/ services: High quality; Good value; Stands behind, Meets needs.
2. Innovation: Innovative; First to market; Adopts quickly.
3. Workplace: Rewards fairly; Equal opportunity; Employee concern.
4. Governance: Fair in business; Behaves ethically; Open and transparent.
5. Citizenship: Societal influence; Supports causes; Protects environment.
6. Leadership: Well-organized; Strong leader; Excellent management; Clear vision.
7. Performance: Growth prospects; Profitable company; Financial results.

According to Reputation Institute (2019) perceptions of all 23 corporate reputation attributes grouped to 7 dimensions provide main corporate reputation outcomes that can be defined as behavioural intentions. It means that by building good corporate reputation based on the 23 corporate reputation attributes grouped to 7 dimensions companies, including rural businesses, can expect the following corporate reputation outcomes from their stakeholder groups: Purchase; Advocate for; Accept; Defend, Work for, Invest in. Reputation Institute (2019) determines the main KPIs for tracking the above-mentioned corporate reputation outcomes: Track of Sales, Loyalty, Profitability, Licence to operate and, Market value.

Researches conducted by Reputation Institute in the last 3 years (Reputation Institute, 2017; 2018; 2019) distinguishes the main global drivers of corporate reputation (Table 1).

Table 1

**Drivers of corporate reputation**

| | 2019 | 2018 | 2017 |
|---|---|---|---|
| Products/ Services | 24.4% | 21.6% | 20.5% |
| Innovation | 11.4% | 13.1% | 13.1% |
| Workplace | 9.7% | 10.8% | 11.6% |
| Governance | 15.7% | 15.0% | 15.0% |
| Citizenship | 13.9% | 14.1% | 14.4% |
| Leadership | 12.8% | 12.5% | 12.5% |
| Performance | 12.1% | 12.9% | 12.9% |

Source: derived by author from Reputation Institute (2017, 2018, 2019).

Reputation Institute (2019) proves that delivering on the dimensions of good Governance and Citizenship and, Products/ Services is highly important while striving to build good corporate reputation. Data from researches conducted by Reputation Institute in the last 3 years (Reputation Institute, 2017; 2018; 2019) shows that the main driver of corporate reputation is Products/ Services with the weight of 24.4% and its importance for building good corporate reputation is growing significantly each year.

Another very important driver of good corporate reputation that organizations must focus on is Governance described by such attributes as: Fair in business; Behaves ethically; Open and transparent. This dimension of corporate reputation constitutes 15.7% of overall reputation of an organization and its importance for building good corporate reputation has been also growing during the recent years. Citizenship described by such attributes as Societal influence; Supports causes; Protects environment is the third most important dimension for building good corporate reputation. Its importance is slightly decreasing in recent years and constitutes 13.9% of the total reputation in 2019.

Less important dimensions for building good corporate reputation would be Workplace (9.7%), Innovation (11.4%), Performance (12.1%) and Leadership (12.8%). Workplace described by such attributes as: Rewards fairly; Equal opportunity; Employee concern, is the least important dimension for building good corporate reputation between various stakeholder groups. However, when taking into account attitude of the employees', the position of this dimension would move from the bottom to the top.

Reputation Institute (2019) argues that corporate reputation dimensions can be divided into enterprise dimensions and product related dimensions. Dimensions of Products/ Services and Innovation are considered as Product related dimensions. The rest of RepTrak dimensions (Performance, Leadership, Citizenship and Governance) are considered as Enterprise dimensions. Research made by Reputation Institute (2019) shows that enterprise dimensions are of growing importance – while importance of product related dimensions is declining. In 2019, perceptions of enterprise – who you are – drives two thirds of corporate reputation vs. what you sell which accounts for only one third. However, when company is selecting dimensions and attributes for corporate reputation management dimension of Products/ Services would be considered as the most important for its stakeholder groups.

Since the aim of this paper is to distinguish dimensions and attributes that build good corporate reputation of rural businesses, the focus group discussion with the main stakeholder groups of rural companies has been organized. The focus group discussion with 7 participants representing different stakeholder groups has been carried out in order to evaluate which corporate reputation dimensions and attributes from the RepTrak tool are important while building good corporate reputation of rural businesses. Participants of focus group with the use of questionnaire were asked to evaluate the importance of each corporate reputation attribute for building good corporate reputation of rural business from the point of view of the representing stakeholder group: a customer, employee, supplier, owner, media, local community, expert. Participants of focus group were asked to evaluate the importance of 23 corporate reputation attributes grouped by 7 dimensions. After the evaluation each attribute and dimension of corporate reputation was discussed with participants of focus group by asking them to provide their opinion on why they think each corporate reputation attribute is important while building corporate reputation of rural businesses from their point of view of a represented stakeholder group.

Statements representing each corporate reputation attribute that were provided for the evaluation during the focus group discussion are listed in Table 2. This table also summarizes the results from focus group discussion providing main conclusions and evaluations from representatives of rural businesses' stakeholder groups. Results provided in Table 2 shows the average meanings of each evaluated attribute from the filled in questionnaires and commonly agreed evaluation from all 7 focus group participants.

Results from focus group discussion prove that dimensions and attributes distinguished in RepTrak tool provide a basis for building and managing good corporate reputation of rural businesses. Participants of focus group representing 7 distinct stakeholder groups agreed that all attributes provided for evaluation are very important and important aspects while forming their attitude towards rural business. Attributes evaluated as most important attributes of rural businesses' corporate reputation constitute the same three dimensions of Products/ Services, Governance and Citizenship that researches by Reputation Institute proved as main drivers of corporate reputation globally.

Research proves that the most important attributes that build corporate reputation of rural businesses are High quality and Meets needs, each having the average of 4.9 points and representing the Products/ services dimension. Other attributes – Good value (Products/ services dimension), Open and transparent (Governance dimension) with the average of 4.8 points were evaluated as very important attributes while building and managing corporate reputation of rural businesses as well. Attributes like Fair in

Table 2

**Dimensions and attributes that build corporate reputation of rural businesses**

| Dimensions | Attributes | Importance | |
|---|---|---|---|
| Products/ services | This organization offers high quality products and services | 4.9 | Very important |
| | This organization offers value for money in products and services | 4.8 | Very important |
| | This organization stands behind its products and services | 4.6 | Very important |
| | Products and services of this organization meets customer needs | 4.9 | Very important |
| Innovation | This organization is innovative | 4.6 | Very important |
| | This organization is first to market | 3.3 | Average importance |
| | This organization adapts quickly to change | 3.8 | Important |
| Workplace | This organization rewards its employees fairly | 4.6 | Very important |
| | This organization is concerned with its employees | 3.7 | Important |
| | This organization offers equal opportunities to its employees | 3.2 | Average importance |
| Governance | This organization is open and transparent | 4.8 | Very important |
| | This organization behaves ethically | 4.5 | Very important |
| | This organization is fair in the way it does business | 4.7 | Very important |
| Citizenship | This organization supports good causes | 4.7 | Very important |
| | This organization is environmentally responsible | 4.7 | Very important |
| | This organization has positive influence on society | 4.1 | Important |
| Leadership | This organization has strong and appealing leader | 4.2 | Important |
| | This organization has clear vision for it future | 3.1 | Average importance |
| | This organization has excellent management | 4.3 | Important |
| | This organization is well-organized | 4.7 | Very important |
| Performance | This organization performs better than expected | 4.1 | Important |
| | This organization is profitable | 4.3 | Important |
| | This organization has strong prospects for growth | 4.6 | Very important |

business (Governance dimension), Supports causes (Citizenship dimension), Protects environment (Citizenship) and Well-organized (Leadership dimension are also considered as very important attributes of rural businesses' corporate reputation with an average of 4.7 points.

Attributes that participants of focus group considered as of average importance are Clear vision (Leadership dimension) with the average of 3.1 points, Equal opportunity (Workplace dimension) with the average of 3.2 points and First to market (Innovation dimension) with the average of 3.3 points.

Results from the focus group discussion generate the need for further research on corporate reputation management in the rural context. Deeper quantitative analysis of different stakeholder groups opinion helping to determine the weights of rural businesses' corporate reputation attributes and dimensions would help to provide a better tool for building and managing corporate reputation of rural businesses.

**Conclusions**

Based on the analysis of scientific and practical literature it is possible to conclude that there are many definitions of corporate reputation in use. However, many authors define corporate reputation as a perception and/ or attitudinal construct.

Scientific and practical literature provides a broad range of positive outcomes that good corporate reputation generates for organizations. Hence, good corporate reputation creates trust between different stakeholder groups and can be considered as a strong competitive advantage.

During the research it was distinguished that it is important to build and manage good corporate reputation of rural businesses. However, dimensions and attributes of rural businesses' corporate reputation might demonstrate specifics compared to other industries. The focus group discussion with representatives from different stakeholder groups of rural businesses prove that the most important attributes that build corporate reputation of rural businesses are High quality and Meets needs linked to the Products/ Services dimension. Other attributes – Good value (Products/ Services dimension), Open and transparent (Governance dimension), Fair in business (Governance dimension), Supports causes (Citizenship dimension), Protects environment

(Citizenship) and Well-organized (Leadership dimension) should be considered as very important attributes while building and managing corporate reputation of rural businesses as well. Even though, attributes - Clear vision (Leadership dimension), Equal opportunity (Workplace dimension) and First to market (Innovation dimension) were considered as of average importance, rural businesses should not exclude them when building and managing good corporate reputation.

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# DIGITAL PERFORMANCE INDICATORS IN THE EU

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**Abstract**
Today technological progress is reshaping global economic development and changing the overall welfare of societies. Therefore, it is important to assess challenges and readiness of the European Union to use its capacity to ensure that technologies benefit people and bring them towards more inclusive societies enhancing opportunities to use artificial intellect for making health, education, agriculture, services and manufacturing industries more efficient and user friendly. The Digital Economy and Society Index analyses the digital performance of the EU Member States across five main dimensions: connectivity, human capital, use of internet, integration of digital technology, digital public services. However, despite intention to jointly develop Digital Single Market, the gap between the EU top digital countries and less digitally advanced countries remains large. The aim of this paper was to evaluate the digital performance indicators of the EU countries, in particular focusing to Poland and Latvia to assess their progress and potential of their human capital's digital skills. The research is based on theoretical literature studies on industrial revolution stages, European Union Commission documents, indexes and publications available in relevant public institutions such as ministries and industry reports. The research employed monographic method, analysis and synthesis methods as well as graphical data analysis. The research results give evidence that currently Poland's human capital is significantly better prepared for making use of future digital economy challenges than Latvia's human capital, and there is a close link between countries' R&D expenditures proportion of GDP and their human capital's readiness to integrate in digital economy.
**Key words:** digital economy, competitiveness, Poland, Latvia.

## Introduction

Klaus Schwab who is the founder and executive chairman of the World Economic Forum is aware that today the world is at crossroads due to the fact that more often society expresses its disappointment with national policies and global economics that are incapable to tackle the negative externalities of global economy future development. There externalities affect the environment pollution, social inequality, global immigration, culture clash etc. that results in emergence of populism and many other negative side-effects (radicalism, ignorance, apathy), which significantly threatens the global competiveness of Europe. Thus public trust in European business, governments, mass media and civil society has dramatically fallen during the last couple of years (Schwab, 2017). National governments are indeed under pressure to find appropriate regulations to control rapidly growing technologies such as artificial intellect, biotechnologies, innovative materials and big data analytics with all their exploitation consequences.

Since the 18$^{th}$ century, the global society has already been exposed to three industrial revolutions. In each of them, technology, political systems and society were forced to evolve thus fully transforming national economy industries and society values. The first industrial revolution is associated with Great Britain's textile industry that experienced enormous growth owing to invention of steam engine, followed by mechanization of other industries, development of more efficient transportation, distribution, exchange, communication etc. Despite the fact that this technological progress to a large extent contributed to colonialism with its externalities, all in all it made people wealthier and fostered further innovation development in the rich countries. Consequently, in the beginning of the 20$^{th}$ century, there was a wide range of products and services that gradually entered into private households' life (electricity, radio, combustion engine automobiles, TV, airplanes), which can be considered as the second industrial revolution and huge step forward the modern world. In the middle of the 20$^{th}$ century, first digital technologies emerged – computers that enabled people to store, edit, process and transmit digital format information, which was rapidly adopted in all industries of the advanced world economies, thus giving the way to the third industrial revolution. However, the 21$^{st}$ century has put forward new challenges – digital capabilities today are built on the knowledge and systems of previous three industrial revolutions, thus it gives a start to a new level of integrating humans and technologies' capabilities for more efficient products that comply with modern societies' needs. According to Schwab, they include several powerful clusters: artificial intelligence, robotics, additive manufacturing, neuro and bio technologies, new forms of transport (such as e.g. drons) virtual/augmented reality, innovative materials etc.

## Materials and Methods

The **aim** of the current research is to evaluate the digital performance indicators in the European Union Members States, in particular focusing to Poland and

Latvia to assess their progress and future potential. The following research **tasks** were set: 1) to analyse the EU Member States' performance in the World Economic Forum Global Competitiveness Index component 'Digital skills among population'; 2) to analyse the EU Member States' performance in selected Digital Economy and Society Index components focusing on evaluation of human capital's skills; 3) to analyse Latvia and Poland's national level activities to strengthen the digital skills of their human capital.

The introductory part of the paper is based on theoretical literature studies on industrial revolution stages. The practical research part is based on European Union Commission documents' analysis, international indexes and national level strategic planning data available in the relevant public institutions such as ministries and industry reports.

The research employed monographic method for theoretical literature studies, analysis and synthesis methods and graphical data analysis that were used in the process of WEF GCI and DESI data interpretation.

*Digital economy and skilled human capital in the European Union*

One of the indicators that is focused on evaluation of the countries' digital performance on the global scale is WEF Global Competitiveness Index (GCI). Since 2018 the index reflects a separate pillar (Pillar 6 – 'Skills'), which among many other index components evaluates the component 'Digital skills among population'. The results of GCI in 2018 gives evidence that such EU Member States as Sweden (among 139 countries ranked in the 1st place) and Finland (3rd place) today are at the top followed by the Netherlands (4th place) and Estonia (10th place). The lowest ranks among the EU Member States are taken by Poland (68th place), Spain (71st place), Greece (72nd place), Croatia (108th place) and Hungary (115th place). Such situation suggests that despite European Commission efforts to shape the EU's Digital Single Market Strategy that would maximize the growth potential of the European digital economy so that every European can enjoy its full benefit, the real situation reveals dramatic differences in the level of digital skills development among Members States. Since the economy and society of Europe need to make the most of digital, annual comparison of the Member States progress in digital performance is taken very seriously. The Digital Economy and Society Index (DESI) is a composite index that annually aggregates 30 relevant indicators on Europe's digital performance and analyses the evolution of the EU Member States, across five main dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, Digital Public Services (Digital Single…, s.a.). In this index, the weighted averages of these five dimensions are as follow: connectivity (25%); human capital (25%); use of internet (15%); integration of digital technology (20%); digital public Services (15%). As reflected in Figure 1, during the last five years EU average values of the five dimensions indicate a positive trend.

In DESI, the Human Capital dimension measures the skills needed to take advantage of the opportunities offered by digital economy. The Figure 2 shows that the performance of the basic and advanced digital skills in 2018 among the Member States significantly differ. Latvia and Poland are among those countries that lag behind the EU-28 average. No doubt, in a modern workplace digital skills are already highly demanded and in the future digital skills will be

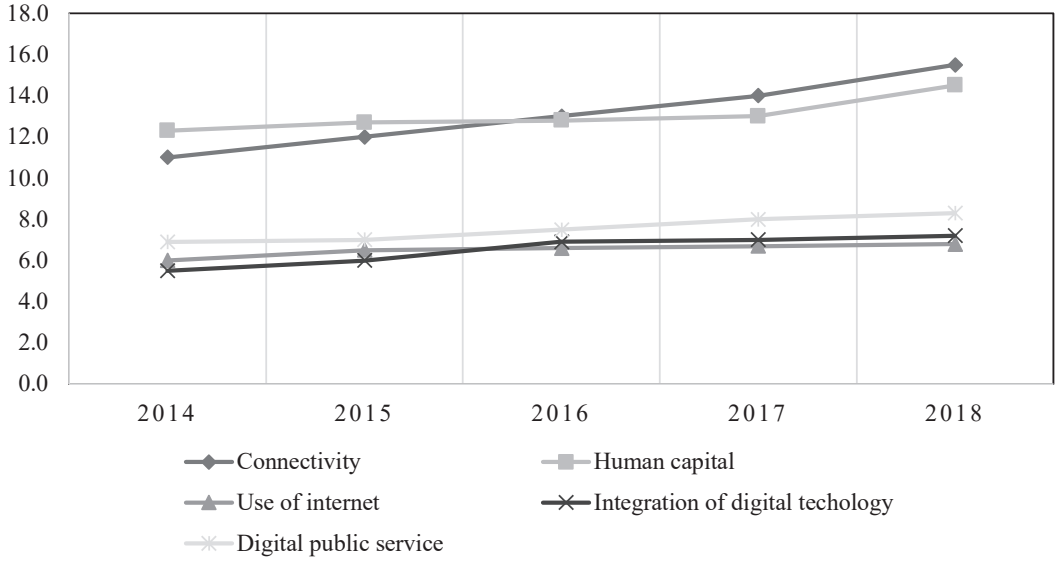


Figure 1. The dynamics of DESI five dimensions in the EU in 2014-2018 (weighted score).

Source: The Digital Economy and Society Index, https://ec.europa.eu/digital-single-market/en/desi.

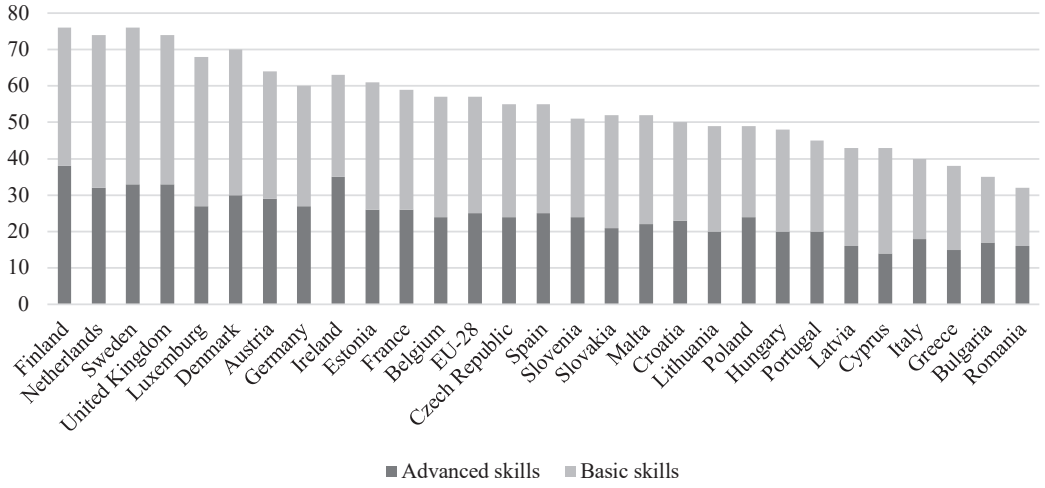


Figure 2. Basic and advanced skills of human capital in the EU in 2018 (weighted score).

Source: The Digital Economy and Society Index, https://ec.europa.eu/digital-single-market/en/desi.

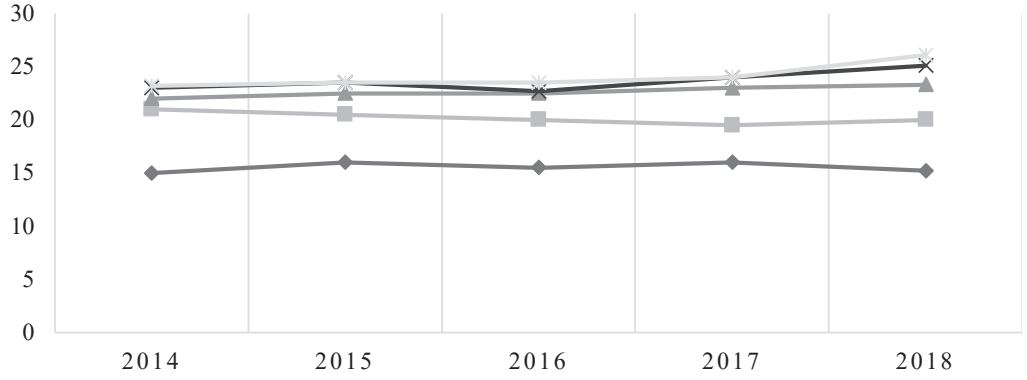


Figure 3. The dynamics of basic and advanced skills' development of the human capital in the EU-28, the Baltic States and Poland in 2014-2018 (weighted score).

Source: The Digital Economy and Society Index, https://ec.europa.eu/digital-single-market/en/desi.

even more vital. In the UK, already in 2015 the House of Lords stated that digital skills should be taught as a third core subject, and treated with same importance as numeracy and literacy Accordingly, the future competitiveness of the EU depends on its human capital's ability to master new skills and thus seize opportunities in digital environment to be able to contribute to the overall development of future economic sectors.

In fact, the closer insights of the advanced skills development in the EU-28 average, the three Baltic States and Poland suggest that all of them except Estonia have shown rather modest results (Figure 3).

The dimension 'integration of digital technology' evaluates the digitisation of businesses and e-commerce. Thus, by adopting digital technologies, enterprises can increase efficiency, cut down costs and better access their clients and business partners. Accordingly, the internet as a sales outlet enables better connection with export potential markets and provides opportunities for growth. The situation in 2018 reveals that business digitalization and e-commerce in Latvia and Poland naturally lag behind the EU-28 average (Figure 4).

However, keeping in mind the evaluations of the GCI-2018, the high evaluation of DESI in 2018 suggests that Spain, despite its low digital skills of population (72$^{nd}$ place) has achieved comparatively high integration of digital technology in business and is among the best in the EU, while Estonia despite its high 10$^{th}$ place significantly lags behind the EU-28 average, which is worth exploring.

*Potential of the European Union digital economy in the future*

According to CEEMET European Tech and Industry Employers, today Europe has the most educated workforce in all its history. Nevertheless, a serious barrier to developing digital competence is closely linked to the lack of adequate digital skills and competences in the education systems. Moreover, due to the rapid integration of new technologies such as artificial intellect, biotechnologies, innovative

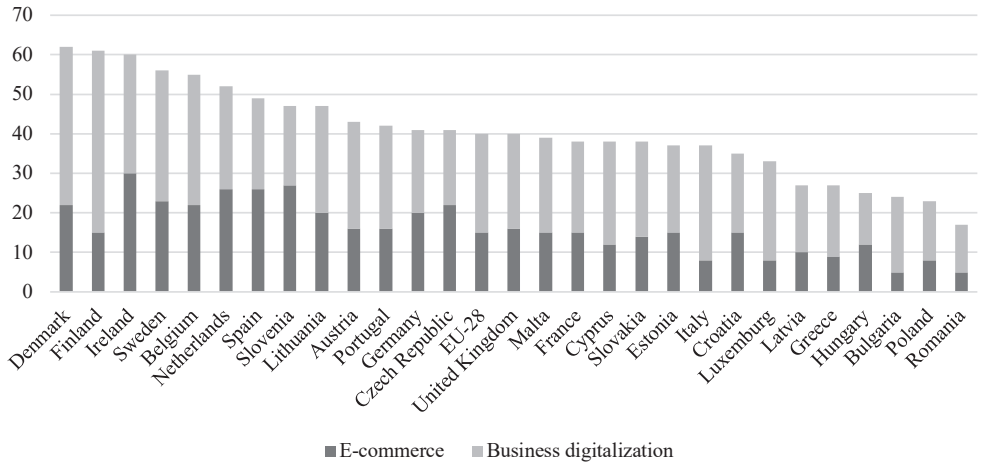


Figure 4. Integration of digital technology: business digitalization and e-commerce in the EU in 2018 (weighted score).

Source: The Digital Economy and Society Index, https://ec.europa.eu/digital-single-market/en/desi.

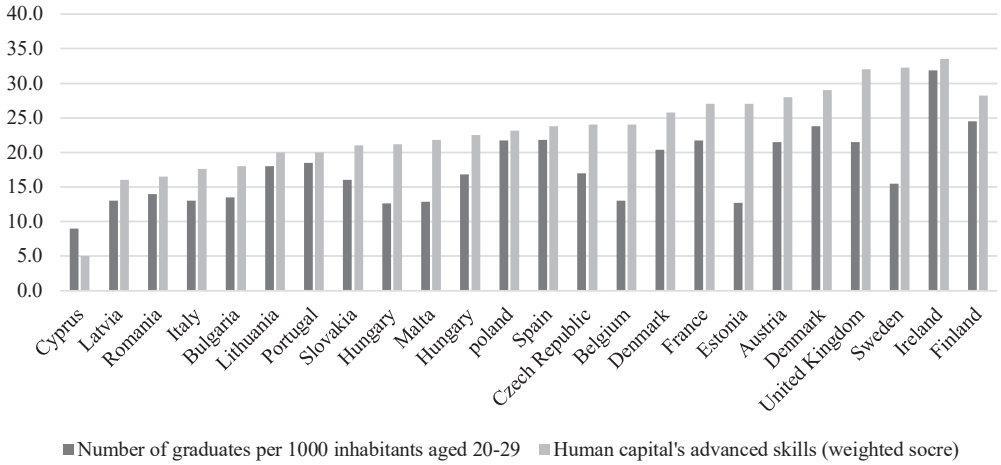


Figure 5. The number of STEM graduates per 1000 inhabitants and advanced skills evaluation of human capital (weighted score) in the EU in 2018.

Source: The Digital Economy and Society Index, https://ec.europa.eu/digital-single-market/en/desi.

materials and big data analytics in our life, EU's digital businesses are desperately short of STEM graduates. STEM is a curriculum based on the idea of educating students in four specific disciplines – science, technology, engineering and mathematics – in an interdisciplinary and applied approach.

According to the Figure 5, future estimates for digital economy development currently look better in Poland than in Latvia, while the absolute leaders of the EU are Finland and Ireland. The situation of Sweden, however, suggests that high level of population's advanced skills can be achieved without increased number of STEM graduates, which is worth exploring. Whereas Ireland has the largest number of STEM graduates per 1000 inhabitants, but in previously analysed GCI-2018 evaluation of digital skills of population Ireland is ranked only in 19$^{th}$ place, lagging behind Denmark, Estonia and Germany.

Both Poland and Latvia have emphasized the importance of digital skills development in their long-term strategic documents – 'Poland 2025: Europe's new growth engine' and 'Sustainable development of Latvia until 2030'. Accordingly, Polish and Latvian governments have involved their relevant Ministries in achieving these goals by setting specific tasks for them.

Since 2017, Polish government has been implementing the 'Operational Program Digital Poland'. The objectives of this program are:

- eliminating territorial differences in the ability to access high; bandwidth broadband internet;
- high availability and quality of public e-services;
- digital access to public sector information;
- digital access to scientific resources;
- training activities for the digital competences development.

In Latvia, the Information Society Guidelines for 2014-2020 have defined the following objectives:

- coordination and development of ICT projects according to e-GOV architecture;
- public service governance, quality regulation;
- implementation of Official electronic address;
- implementation of eiDAS (electronic identification, authentication and trust services);
- expand network of Unified Customer Centres;
- e-Skills and e-Awareness program.

Since 2015, extensive and interrelated national research projects have been supported by the National Research Program 5.2. 'Economic Transformation, Smart Growth, Governance and Legal Framework for the State and Society for Sustainable Development – a New Approach to the Creation of a Sustainable Learning Community (EKOSOC-LV)', which also have resulted in scientific publications (Pelse & Lescevica, 2016; Pelse *et al*., 2018) revealing Latvia's smart specialization aspects and current problems (which are closely related with the lack of qualified human capital) that hinder Latvia's smart specialization in Latvia's regions.

Both in Poland and in Latvia, there are specially developed frameworks for SMEs digital promotion policy and e-service development in public and private sectors. According to Kitchin et al. (2015), digital development also means wider access to different data. And the problem is who should finance this kind of services. There is no straight forward solution to funding digital data repositories that are not wholly core funded, with a number of general and specific challenges facing each repository, and each funding model having strengths and weaknesses. Moreover, education systems in Latvia and Poland currently are facing major reforms guided towards adaptation of study content and process to the changes in global economy. Digital transformation of businesses and public institutions depends on digital innovations. So the focus should be on encouraging various types of technological innovations, even on a small scale (Khin & CF Ho. 2018).

In case of Poland, in 2018 compared with the other nine countries that joined the EU in 2004 (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Slovakia, and Slovenia), it was among the best regarding the number of STEM graduates and human capital with advanced skills in this group of countries. Poland's progress is almost in line with the Czech Republic and lagging behind only Estonia, which is a convincing leader among these countries. The situation of Latvia is not so optimistic. Latvia's performance in relation of STEM graduates and its human capital development is poor, and only Cyprus currently has lower evaluation of these indicators. In authors opinion, the explanation to this problem is closely linked with the countries' R&D expenditures of GDP, which is annually reflected among other countries' innovation capacity indicators in the 12$^{th}$ pillar of the WEF GCI. In the countries with the best developed skills of human capital, the R&D expenditures in 2018 were significantly high – in Sweden – 3.3% and in Finland – 2.9% of GDP but in Ireland and Estonia – 1.5%, which is also considerably higher compared with Poland and Lithuania, which allocate accordingly only 1% of their GDP expenditures to R&D. However, the worst situation in 2018 was observed in Romania and Cyprus (0.5% of GDP) and Latvia (0.6%).

**Conclusions**

1. The theoretical studies of the three experienced industrial revolutions give evidence that technological progress always exposes existing technology, political systems and society to inevitable changes thus transforming national economy industries and society values. Therefore, today target-oriented and meaningful training of human capital's digital skills is important for any country regardless of its national economy specialization.
2. Despite intention to jointly develop Digital Single Market, the digitalization potential's gap between the EU wealthier countries and less wealthy countries remains large. Generally, the research results reveal that North European countries of the EU – Finland, Sweden, Denmark, Estonia and Ireland and the Netherlands showed best performance in 2018. The results of Lithuania and Latvia and Poland currently lag behind the EU-28 average. However, Poland's human capital is significantly better prepared for making use of future digital economy challenges as its number of STEM graduates on 1000 inhabitants is significantly larger than in other Member States such as Latvia, Romania, Cyprus, Italy, Hungary, Slovakia, Malta, Bulgaria.
3. The analysis of R&D expenditures in % of GDP gives evidence that wealthier Member States allocate more than 3% of their GDP to R&D, while such countries as Latvia, Cyprus and Romania in 2018 allocated only 0.5 – 0.6% of their GDP to R&D in their countries. Therefore, their future digital potential, namely human capital with advanced skills, is seriously threatened unless current national political guidelines are changed.

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# LIES ON LABELS, OR CASES OF MISLEADING CONSUMERS ON THE EXAMPLE OF VEGETABLE OILS

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**Abstract**
In 2018, the Polish Trade Inspection in the whole country carried out an assessment of unrefined vegetable oils and olive oils of various categories. First of all, the correctness of marking, physicochemical parameters, storage conditions, traceability of products and their dates of minimum durability were assessed. In total 380 batches of products were inspected. Results of the examination show that producers cheat consumers by providing, for example, untrue nutritional values or false information about dietetic or health traits. The purpose of this article is to determine what consumers should know to verify the correctness of information on product labels independently. The theoretical part of the article was based on the EU regulations analysis regarding vegetable oils properties, including the characteristics of olive oil. The empirical part concerned data from Polish Trade Inspection reports, as well as statistical data on production and sale of oil and olive oil from the portal Statista. In this article methods of documentary research and comparative analysis were used. For the main conclusion it can be assumed that products of poor quality or incorrect labeling can be found in each product category; therefore, consumers should pay attention to such elements as information in their native language, a full list of ingredients, or correct indication of nutritional values.
**Key words**: product labeling, vegetable oils, trade inspection, shortcomings.

## Introduction

More and more often consumers pay attention to the health properties of food and expect that food products will not only provide nutritional value, but also improve their health. It results from the growing awareness of consumers, shaped by promotional campaigns about health, and also by new legal regulations concerning food, especially pro-health and ecological products. Among the applicable regulations, the key one is the Regulation of the European Parliament and the EU Council No. 1151 of 2012 published in the Official Journal (OJ) of the European Union on quality schemes for agricultural products and foodstuffs (OJ L 343/1, 2012). The rules on the labeling of agricultural products and foodstuffs are set out in Directive 2000/13/EC of the European Parliament and of the Council of 2000 on the approximation of the laws of the Member States regarding to the labeling, presentation and advertising of foodstuffs (OJ L 210, 2000).

The 2000 directive specifically defines what product labeling is – according to paragraph 1.3, the labeling covers any words, particulars, trademarks, brand names, pictorial matters or symbol relating to a foodstuff and placed on any packaging, document, notice, label, ring, or collar accompanying or referring to such foodstuff. Thus the label does not have to be placed on the product itself. Moreover, the label cannot mislead the consumer as to the properties of a foodstuff, in particular as to its nature, identity, properties, composition, quantity, durability, origin or provenance, method of manufacture or production (Article 2.1). The label cannot suggest that a foodstuff has any special properties when in reality all similar foodstuffs have those properties. Thus, the directive orders the introduction of rules that apply to labeling which will prohibit using information which might mislead the consumer (OJ L 210, 2000).

In the case of labeling foodstuffs, including edible oils, the producer has to provide: 1) the name under which the product is sold; 2) the list of ingredients; 3) the quantity of certain ingredients, such as cereals containing gluten; 4) in the case of prepackaged foodstuffs, the net quantity; 5) the date of minimum durability or the "use by" date; 6) any special storage conditions or conditions of use; 7) the name or business name and address of the manufacturer or packager, or of a seller established within the Community.

The aforementioned directive emphasizes that labeling has to be subjected to adequate regulations, because it enables the consumer to make a conscious choice with full knowledge about the product. Labeling products has also a broader dimension – it allows to protect their originality, and supports fair competition of entrepreneurs on the market (Crescimanno, Di Marco, & Guccione, 2002).

## Materials and Methods

In February 2018, the Polish Trade Inspection (PIH) published a report on the assessment of commercial quality of unrefined vegetable oils and olive oil in different categories. This report became the basis for this article and it was also a premise for further analyses. Therefore, the empirical material consists of data from the Polish Trade Inspection's reports on the quality of foodstuffs and ways of their labeling in the light of the EU legal provisions. The purpose of this article is to determine what consumers

should know in order to independently verify the correctness of information on product labels. The empirical part was supplemented with statistical data on the production of vegetable oils and olive oils obtained from the Statista website (https://www.statista.com/). Therefore, methods of documentary research and comparative analysis were used in the article.

*Packaging and labeling – functions*

The packaging, as M. Zajaczkowski writes, is a product intended for packaging other products (Zajaczkowski, 2002). Of course, the main purpose of the packaging is to protect its contents during transportation and storage, but the packaging can also protect the product against theft or it can have promotional functions. Therefore, packaging should be designed not only in a way to protect the product but also to help sell it.

The functions of packaging depend on the stage of distribution of a product. There is always the protective function, that is, the situation when the packaging protects the product from external factors (for example, from insolation and temperature), or protects the environment against the action of the product (as in the case of chemical products). Before the product reaches the consumer, the logistic function is also important; it consists of the packaging facilitating the processes of transportation, storage, and the sale itself. The informative function is also necessary, as it allows to distinguish between particular products, as well as to determine their origin and purpose. The informative function is connected with the promotional function, assuming that the packaging should not only inform, but also attract the consumer's attention and give them positive associations. Therefore, the packaging is sometimes referred to as the 'silent seller,' advertising the product at the place of sale.

Of course, the function of packaging is associated with its purpose – transport packaging is designed to facilitate handling and storage; collective packaging – storage, unit packaging is supposed to inform and promote, and also make it easier for the consumer to take the product home. Information and promotional markings are placed on various types of labels. The labels inform the buyers and consumers about the characteristics of the products and their production, so that the customers have access to reliable data on those products. They also inform about registered trademarks and obtained certificates. Indirectly, proper labeling of foodstuffs contributes to the development of food production, and as a consequence to the achievement of rural development objectives.

The legal requirements on the content of labels, as it has already been mentioned, were published in Directive 2000/13/EC relating to the labeling, presentation and advertising of foodstuffs (OJ L 109). The document states that a label should contain certain essential elements, as presented in Figure 1. Apart from the elements listed in the figure, the producer can also include other information if that is needed from the consumer's point of view. Therefore, it can be a user's manual, or information about the content of alcohol.

Name, list of ingredients, or storage conditions are all obligatory information, however, EU member states can maintain their national regulations if the EU provisions appear to be too restrictive for some products. The packaging also often contains purely promotional information placed there in the interest of

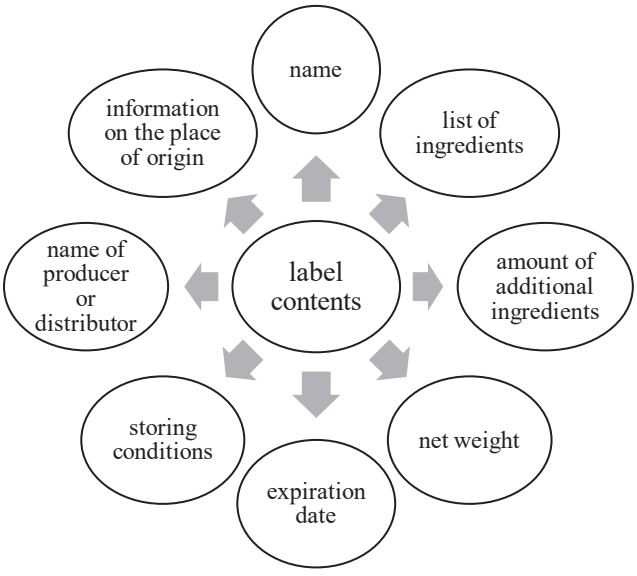


Figure 1. Obligatory information on foodstuff label.

Source: own study on the basis of Directive 2000/13/EC (OJ L 210, 2000).

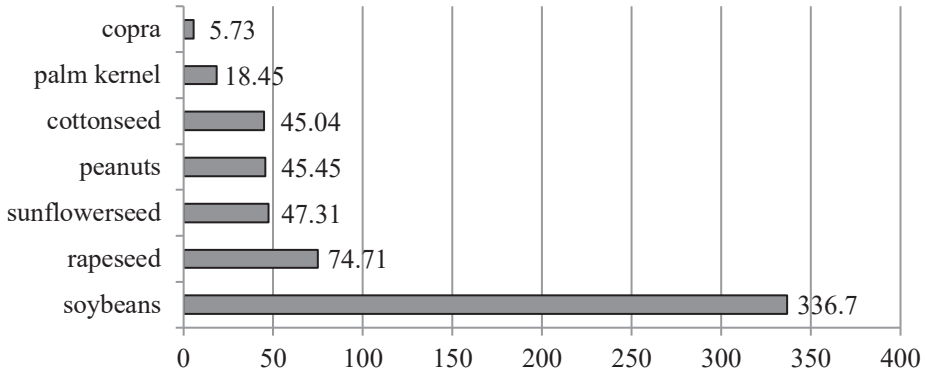


Figure 2. Worldwide oilseed production in 2017/2018, by type (in millions of t).

Source: Vegetable oils and fats (n.d.). Retrieved from: https://www.statista.com/study/21986/vegetable-oils-and-fats-statista-dossier.

the manufacturer, which, however, will not be subject to analysis in this article.

*Vegetable oils – characteristic of the category*

Any substance in the form of liquid fat can be called oil. Vegetable oils come from plants with high fat content and they can be obtained from seeds, fruits, or pits. For the most part, vegetable oils are used for consumption (Giansante *et al*., 2017). However, some are used in the production of cosmetics, and some as medicinal products. Oilseed crops include rapeseed, sunflower, flax, soy, poppy, cotton, coconut, hazelnuts, palm oil, cocoa, or European olive.

The global production of oilseed crops is dominated by soy – 336.7 million tonnes are produced annually (https://www.statista.com/study/21986/vegetable-oils-and-fats-statista-dossier/). Rapeseeds (74.7 million t) rank second, followed by sunflower (47.3 million t), and peanuts (45.45 million t). This is presented in Figure 2.

The world's leading soy producers include countries such as the USA, Brazil and Argentina. The USA is the largest producer (104 million tons per year), but Argentina is the largest exporter of soybeans, followed by Brazil ('Produkcja soi... '; Kavallari, Maas, & Schmitz, 2011). The largest exporter of sunflower seeds is Ukraine, while the largest producer of rapeseed oil in the world is China, and in Europe – Germany. The largest producer of palm oil is Indonesia – 35% of world production comes from this country.

An important component of the diet in many countries is olive oil. According to the regulations, several categories can be indicated: extra virgin olive oil, lampante olive oil (extra virgin olive oil whose acidity has exceeded the threshold of 2%), refined olive oil, crude olive pomace oil, as well as refined olive oil from olive residue (Commission Regulation (European Economic Community – EEC No 2568/91, Article 1). While the production of vegetable oil in recent years has been systematically growing (from 90.5 million tonnes in 2000/01 to 203.8 million t in 2018/19), the global production of olive oil fluctuates from 2.4 to 3.27 million t per year (Figure 3).

In many countries, the consumption of olive oil is growing – in Poland, it has doubled in the last 10 years. In addition, statistical data show that the import of all oil products to Poland in 2018 was larger than in the previous year, so the role of vegetable oil and olive oil in the life of the average Pole is growing.

**Results and Discussion**

In 2018, a Trade Inspection report was published, which examined olive oils and other oils in 85 commercial entities (in total, 380 batches of products were tested). The analysis covered 178 batches of olive oil from four categories admitted for retail sale and 202 lots of other vegetable oils, mainly unrefined ones. Both the quality of the products and the way of packaging and marking were investigated.

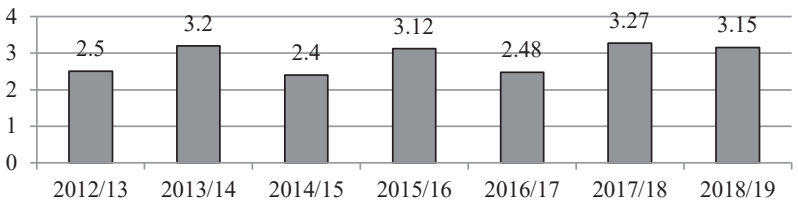


Figure 3. Production volume of olive oil worldwide from 2012/13 to 2018/19 (in millions of tonnes).

Source: Vegetable oils and fats (n.d.). Retrieved from: https://www.statista.com/study/21986/vegetable-oils-and-fats-statista-dossier.

Laboratory testing of the quality of oils and olive oil involves, among others, the determination of free fatty acids, determination of the peroxide value, wax content, composition and content of sterols and di-alcohols, as well as fatty acid composition. The packaging and marking of products must comply with EU regulations and national regulations such as the Act of 11 May 2001 on packaging and packaging waste, as well as industry standards such as Global Standard for Packaging and Packaging Materials created by British Retail Consortium and Institute of Packaging (BRC/IOP standard; http://www.haccp-polska.pl/opakowania.html).

In the published report, up to 73 batches (19.2%) were filed for various types of reservations and they concerned mainly the labeling of unrefined oils other than olive oil. Among the olive oil sold, only 21 lots (11.8%) were incorrectly labeled, while in the case of non-refined oils there were 52 batches (25.7%). It is significant that the quality parameters of olive oil were not questioned, so laboratory analysis did not show any irregularities. It should be added that in the case of olive oil, Regulation (EEC) No 2568/91 of 1991 on the characteristics of olive oil and olive-residue oil and on relevant methods of analysis applies (OJ L 248).

A detailed qualitative analysis was carried out on 48 batches of non-refined oils, with 9 batches being questioned (18.8%). In the tested products, non-compliance with the nutritional declaration was detected (for example, a lower content of omega-3 fatty acids in walnut oil, or a lower content of polyunsaturated fatty acids in rice oil, or a lower content of delta 5-avenasterol in rapeseed oil).

From the consumers' point of view, the possibility of verifying various information given on the packaging is the most important. The assessment of the packaging in terms of compliance with applicable regulations revealed irregularities in 54 batches of products (14.2%) – 20 lots of olive oil and 34 lots of other vegetable oils.

In the case of olive oil, the inspection showed the absence of:

- mandatory recommendation to store the oil in a dark and cool place, or an incorrect recommendation was given to store the oil at room temperature;
- a description of the category with regard to organic virgin olive oil of the highest quality;
- translations of certain information into Polish on olive oil labels;
- mandatory information on the country of origin of olive oil;
- proper presentation of the nutritional value, e.g. per 100 g instead of 100 ml.

Other oils were also examined, and in this case the most frequently found irregularities concerned the presentation of nutritional information, because the producers:

- did not keep the right order of nutrients;
- omitted compulsory elements, such as the content of fat or sugars;
- added information that should not be placed, for example, about the lack of cholesterol, which is animal fat and does not occur in plant products.

The second mistake was the incorrect provision of health information by the producers, e.g. that the oil is rich in vitamin A and the content of this vitamin was declared 3.3 μg $(100\ g)^{-1}$, when according to the regulations, the content should be at least 120 μg $(100\ g)^{-1}$. Sometimes the producers declared that oil was a source of vitamins A, K and E, without giving the amount of these ingredients. It was also stated on the labels that fat from coconut oil did not contribute

Table 1

**Results of quality control and the correctness of the markings for olive oil and vegetable oils**

| Irregularities | Olive oil | Other oils |
|---|---|---|
| Wrong quality parameters (lowered values) | | x |
| Incorrect information about storage method | x | |
| No category for oil | x | |
| No Polish translation of label content | x | |
| No country of origin | x | |
| Wrong nutritional value | x | |
| Wrong order of ingredients | | x |
| Omitting some information | | x |
| Giving irrelevant information | | x |
| Giving false information | | x |

Source: own study on the basis of Informacja z wyników kontroli jakości handlowej nierafinowanych olejów roślinnych i oliwy z oliwek (Information on the results of commercial quality control of unrefined vegetable oils and olive oil), Warszawa 02.01.2018, DIH-703-1(1)/18/AnŁ Retrieved from https://www.uokik.gov.pl/raporty_z_kontroli_inspekcji_handlowej.php.

to the growth of adipose tissue, for which there is no medical evidence. Among other irregularities, there was information that the oil was ecological, while it was produced using the industrial method. The audit also identified the lack of a Polish language version of mandatory information, such as the date of minimum durability or the country of origin of agricultural raw materials in the case of an organic product. In a few cases, the lack of documents confirming where the oil was purchased was also discovered, as well as the presence of expired oils (Table 1).

The opening of markets facilitated international trade and currently both national and foreign products can be found in every group of goods. However, the latter needs to come with translated labels, because without it the consumers will not be able to comprehend the information they need (Turner, 1995). Naturally, the current labels will not contain all the possible information and markings, but the consumers need to get reliable information on the features of the product and the process of its production (Tzilivakis *et al*., 2012), which applies also to vegetable oils.

The presented analysis shows that consumers should pay more attention to issues such as the order of ingredients on the labels, the value of quality parameters, or the declared nutritional values. They should also pay attention to whether the producers provide essential information and, most of all, whether the information is true. Vigilance of consumers should apply even to products registered thanks to a protected designation of origin or traditional specialty, such as Black Forest ham or Koryciński cheese. The inspections carried out by the Trade Inspection show that some of such products can also be questioned, for example, due to too much salt in cured meat or water in hard cheese. Because of this, the consumers have to deduce the information from the foodstuffs labels in their current format. It is quite difficult, as the consumers' knowledge about issues such as balanced diet is relatively poor (Shine, O'Reilly, & O'Sullivan, 1997). It can be stated here that consumer knowledge about healthy lifestyle and the specificity of particular products is extremely important. On the other hand, the average consumer is not able to verify many of the parameters; therefore, the provisions regulating the production process as well as the labeling of products are of importance.

**Conclusions**

In the countries where olive oil is not a traditional product, such as Poland, Germany, or the UK, the consumption of this product has been systematically growing. The consumption of other vegetable oils is also growing, so this group of products is important in the diet of modern people. The purpose of this article was to determine what consumers should know in order to independently verify the correctness of information on foodstuff labels on the example of vegetable oils and olive oil. The conducted analysis of the Polish Trade Inspection's report showed that the producers usually do not give the proper way of storing their product and they wrongly describe the nutritional values thereof. Therefore, the consumers should possess a certain amount of knowledge. In the case of olive oil, the consumers should also know about different categories of olive oil and differences between the Extra Virgin and Virgin oil (different acidity levels). In the case of other oils, the consumers should know about the obligatory information which should be present on product labels and, for instance, on the order of listing the ingredients. They should also be able to verify which information is indispensable, and which is untrue.

Certainly, the average consumer will not be able to verify many elements, such as vitamin content or acidity. However, much can be assessed independently, provided one has basic knowledge on the products they purchase.

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# CREATION OF SOCIAL INNOVATION IN RURAL AREAS

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**Abstract**
Social innovations are recognized as one of the most promising innovations in solving social problems in rural areas. When assessing the creation of social innovation, it should be noted that not only the goal and the result but also the whole process of creation of social innovation is important. The analysis of theoretical and practical research has revealed that traditional methods of solving problems in rural areas are not working, which consequently leads to search for innovative solutions. The most obvious social problems in rural areas, such as an aging society, youth departure, lack of breakthrough and innovative ideas, etc. can be noticed when assessing factors of social environment. At this stage, the solutions sought through the prism of social innovation can become those that will ensure the well-being of the rural area and support people living there. Social innovation is widely spread at the level of the European Union; however, in Lithuania, social innovation is taking just the first steps. The article analyses the case of Sėlynė village in Rokiškis region, during which social innovation that succeeded to unite rural community has been created. The article aims to analyse the process of creation of social innovation in rural areas from the theoretical point of view and to present the case of Sėlynė village of Rokiškis region. The main problem is the complex understanding of the creation process of social innovation.
**Key words**: social innovation, rural areas, creation, inclusion.

## Introduction

Rural areas are those regions that receive great attention today and are assessed through the search of their growth and breakthrough. Scientists also focus on social innovation in rural areas and search for its effective development and creation. Social entrepreneurship is one of the elements through which social innovation could likely be developed; however, in order for social entrepreneurs to create social innovation, people should clearly understand both the very concept of social innovation and the process of its creation adapted to the rural area.

The analysis of the process of creation of social innovation in rural areas from the theoretical point of view and introduction of the case of Sėlynė village of Rokiškis region is the aim of the research.

Social innovation is generally defined as the generation and implementation of new ideas about how people should organize interpersonal relationship or social interactions with the aim to meet common goals (Marcy *et al.*, 2007; Mumford, 2002). According to Phill *et al.* (2008), social innovation is not just a product, a process or a technology, but it can also be a principle, an idea, a piece of legislation, a social movement, an intervention or some combination of them. However, Moulaert *et al.* (2013) emphasizes that social innovation is not associated with certain products or achievements but relates to the process of creation of innovative social relationship between individuals and their groups (Moulaert *et al.*, 2013). Social innovation has become an alternative to complex and expensive innovation and is considered even more efficient and more influential in the scientific sources.

The concept of social innovation has not been always identical. The definitions of social innovation of the most significant authors are given in Table 1.

Table 1

**The concept of social innovation (compiled by the author of the article)**

| Scientific source | Statements |
|---|---|
| Tanimoto *et al*., 2007 | *Social innovation* is defined as improved activities, initiatives, services or processes to solve economic and social challenges faced by individuals and communities. |
| Heiscala, 2007 | *Social innovation* refers to changes in the cultural, legal and regulative structures of a society that both increase collective power resources and improve economic and social performance. |
| Pol, 2009 | *Social innovation* refers to innovative activities resulting from a response to a social need or improvement of life quality that can be spread through different organizations. |
| Caulier-Grice, 2012 | *Social innovation* refers to new solutions (products, services, models, markets, processes, etc.) that simultaneously meet social needs (more effectively than alternatives), also new opportunities, relationships or a better use of resources. Social innovation is focused on the enhancement of the society's capacity to act. |
| Matei *et al*., 2015 | *Social innovation* is a development of new ideas (products, services, models) to meet the unfulfilled social needs. Social innovation should be especially promoted in public sector, community groups or other public organizations. |

Having evaluated the development of the concepts of social innovation, the following can be noted: *social innovation is focused on the fulfilment of social needs through different types of social innovation involving the people concerned*. Moreover, researchers have identified three core dimensions of social innovation, which are as follows: satisfaction of human needs (content dimension); changes in social relations especially with regard to governance (process dimension); and increase in the socio-political capacity and access to resources (empowerment dimension) (Gerometta, Hausermann, & Longo, 2005).

A group of researchers Moulaert *et al*. (2005) analysed social innovation in 2005 with the aim to distinguish social innovation from innovation but used the key innovation elements to identify social innovation. A comprehensive analysis of social innovation, including the distinction of their types, identification of dimensions, cross-sectoral analysis and evaluation of results and processes was performed in later studies only during the period from 2007 to 2016 (Matei, 2015; Moulaert *et al*., 2005; Neumier, 2012). According to Dainienė *et al.* (2015), the interest in social innovation has started to increase since around 2000. The interest has grown as a result of the increasing need to analyse and overcome social challenges. Innovation focused on social problems includes social innovation, and institutions are one of the main participants in the process of social innovation. The introduction of social innovation has led to the introduction of clear types and classification of innovation. Since the biggest attention is paid to technological innovation which does not solve welfare problems, but can be measured and has a clear result, in scientific literature more attention is paid to the need of social innovation through the social perspective. According to the classical definition, a village is a little urbanized area surrounded by natural environment and has a low concentration of population (Vaznonis & Čiūtaitė, 2010). Atkočiūnienė (2008) has a similar opinion and says that a village is a territorial system characterized by natural environment and a small concentration of population forming territorial rural communities.

Rural areas in modern communities often come across with certain social and economic challenges. Čepienė (2011) emphasizes that rural communities often face with increasing social problems, such as poverty, unemployment, social exclusion and migration related problems that become relevant for both the individual and the entire rural community. Leliūgienė (2010) also highlights similar problems in rural communities: migration from one country to another, job search in other countries, unemployment, poverty, violence in society, growth of crime rate and addiction diseases. Business companies generally concentrate in cities and urbanized areas; therefore, there is a relatively high level of unemployment in rural areas. Unemployment and a lack of employment do not only cause financial difficulties, but also psychological problems: jobless people often feel frustrated and internal discomfort and those who fail to deal with a lack of employment start using alcohol, drugs and commit crimes (Mooney *et al*., 2014). Kazakevičius (2004) is of the same opinion and claims that people living in villages face with low employment and get low income which consequently result in a decline of life quality, also economic and social problems, such as poverty, unemployment, alcoholism, social exclusion, increased crime rates, increased number of children not attending schools, abandoned children, also socially and pedagogically abandoned children. It should be noted that rural communities come across with a huge amount of economic and social problems, which directly affect many members of rural community.

Social innovation can encourage changes of the people concerned to create social and power relations among the members of a certain community, affect governance principles and promote collective activities. Social innovation is grouped as process innovation. When there is a change in the inclusion models for the people concerned, a result of other social innovation is likely to happen. It is also necessary to emphasize that social innovation enables the society to participate in significant processes more actively; therefore, a change in the main governing structures is likely to happen by giving additional opportunities to the society (Moulaert *et al.*, (2013). Neumier (2012) is one of the first researchers who has started to study the impact of social innovation on the process of rural development. The researcher found out that social innovation, contrary to technological innovation, generally integrates into the processes of rural development more effectively and better involves participants, such as public and private sectors, also the sector of the people concerned. According to Neumier (2012), the creation of social innovation starts from the identification of the problem. In the opinion of the aforementioned researcher, the idea or identification of the problem by the people concerned, e.g. a new rural development program, etc. can be the initial impulse for innovation. It is then followed by the expression of interests, i.e. the change of behaviour or attitude focused on the change as common interest. Later on, the solutions are made, and collaboration is carried out. A group of people concerned decides to make essential changes and adopts new conditions.

While assessing various models of creation of social innovation and considering this process in rural areas, a model of social innovation in the rural area with extended actions and results has been made.

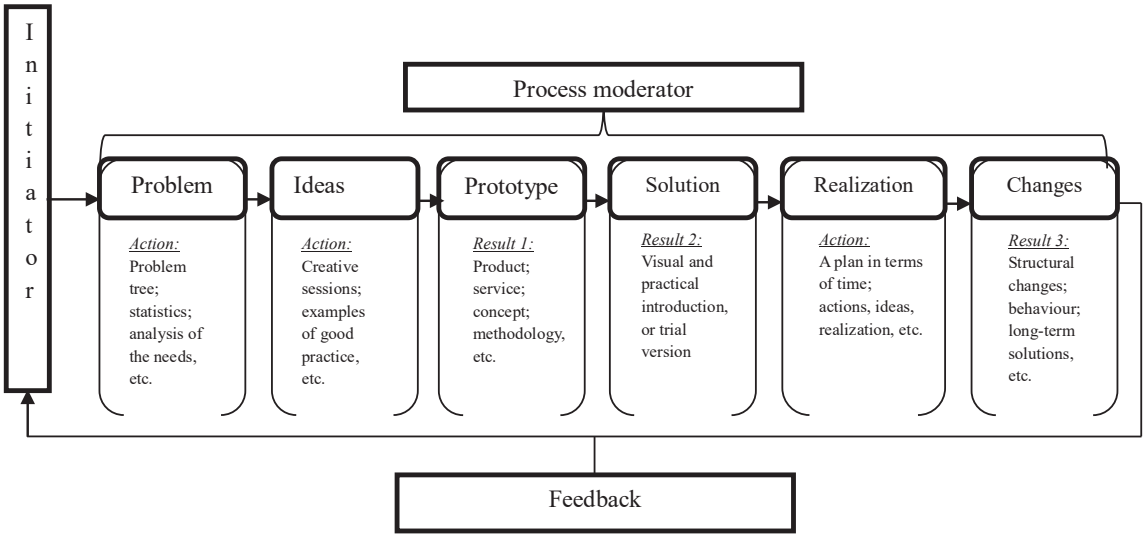


Figure 1. Creation of social innovation in rural areas.

The creation of social innovation is relatively consequent and structured. However, attention should be paid to the disclosure of each stage and actions made at that stage. The initiator is needed to start the process in the rural area. He can be a local leader of the community or an active member of the community who can motivate others to undertake actions. It should be also noted that a process moderator plays a significant role in the creation of the process, who can be the same process initiator or another active public leader. Different actions focused on the best result of the stage are made at each stage. A feedback can be also used for the evaluation of the result, the target recipient of which is the initiator of the creation of social innovation. This creation of social innovation is focused on the human capital, which is usually very strong in the rural area.

**Materials and Methods**

An interview as a qualitative research method has been chosen for the study. Socially sensitive issues of social innovation can be analysed by both quantitative and qualitative research methods; however, qualitative research methods are usually chosen in practice (Žydžiūnatė, 2017; Kardelis, 2016). The fact that social innovation is highly affected by the human capital in rural areas is also considered. Social leaders are often distinguished during the process of creation and are the main catalysts of the entire process of social innovation in the rural area. Also, a qualitative research method - an interview has been chosen because of a small rural community, which is distinguished for its especially strong social relationship and great inclusion of the society in the ongoing processes.

Introduction of the case of Sėlynė village where social innovation started to be developed is the aim of the empirical research.

There is a small community in Sėlynė village in Rokiškis region, which organizes various educational activities, events and other community gatherings. The community has started the realization of social innovation related to competence sharing since 2017. There are 150 residents and 30 members of the community in Sėlynė village; therefore, a convenient selection has been made and the most active ten members of the community have been selected for the interview. The interview consisted of ten questions including such issues as demographic situation, the main principles for the existence of the community and also research questions according to the model of creation of social innovation in the rural area. The interview focused on the evaluation of social innovation related to the system of competence sharing. The research was made in November 2018. One hour and a half was the average duration of the interview with each respondent. The respondents by gender are as follows: 8 women and 2 men. The average age of respondents was 42 years. Respondents are also active members of the community. Confidentiality has been preserved during the survey. The data of the respondents are summarized and systematized according to the research questions. The answers of the respondents are coded from R1 to R10. The respondents were notified about the process and the purpose of the research in advance. The aim of the research and the competence of the researcher to do a research in this field have been introduced to the respondents in advance.

It can be said that the extent of the researched group is enough to define the main principles of social innovation, which is in the process of creation in Sėlynė village in Rokiškis region. Moreover, based on the provisions of the study, the methodology, and proposals of the respondents, the cases of creation

of other social innovation can be also researched. The main risk of the study was associated with the emerging active community in Sėlynė village, which has little experience in the creation of social innovation. Nevertheless, a huge interest of the active part of the community and motivation to develop social innovation in the rural area has been noticed.

**Results and Discussion**

A successful development of rural areas depends on the activity of local groups and communities, and also on the inclusion of locals in fostering the rural area. Although the activities of local groups are not spread evenly (some are more active, others are passive), but the further the more innovative solutions of the community involving other members of the community can be noticed. That is why phenomena, such as social initiatives, social innovation and social entrepreneurship are emerging. However, the research in Rokiškis region has revealed that community organizations feel a lack of the following: knowledge about social innovation; creativity to create social innovation; there is a fear to create social entrepreneurship; trust in oneself and other community members; examples of good practice; and versatile management skills and competences. All these aforementioned factors are the main reason why there is such a slow access to social entrepreneurship and the stage of realization of social innovation is the most typical in the researched area. Yet, a tendency has been observed that the current EU funding for communities is directed towards the promotion of entrepreneurship of communities. The case of Sėlynė village in Rokiškis region will be further analysed below.

*Situation.* There are 150 residents and an active community in Sėlynė village. A local library, which is still open in the village, is the main place of the community gathering. Most often, the effectiveness of the whole initiative and community depends on the leader of the community. A social initiative (inclusion of rural residents who have left the village into the activities of the community) has been started in the community of Sėlynė village. The program is called the "Synergy of experiences". The main model of social initiative works through the inclusion of grown-up children who return to the village to visit their parents. Most often, grown-up children of the village move to some bigger cities and return to the village just to visit their parents. Thanks to active rural community, the returning grown-up children were offered to share their experience in the organization of activities in the rural community. The social innovation, which has been created in the community has encouraged the members of the community to actively involve the youth who no longer live in the village. Each person, who is involved in the activities according to his/her competences, which they have gained after they left the village, can share their experience with the community of the village in both organization of festivals, training and teaching other community members. Organization of the 'Festival of the blossom of Sėlynė village' is one of the best examples, which included marketing, publicity and creation of the concept of the event. And everything was made by the youth who no longer live in the village. Also, training and sharing knowledge, e.g. training in the management of social networks and communication, which was free of charge to the community attracted not only a great number of locals, but also people from other villages. Based on this program, there are plans to further involve more youth who have left the village and who would help to generate entrepreneurial ideas, prepare applications for projects and educational activities. A significant fact should be noted that all these activities are carried out without funding and are free of charge to the community. In this way, a close social relation among the members of the community who still live in the village and those who have already left the village, but still carry out activities in their village, is maintained.

*Initiator's profile.* According to the respondents, the initiator is especially significant, and she was one of the main initiators to promote the social innovation in Sėlynė. Yet, the respondents admit that it would be perfect to have one permanent leader who would direct the activities and encourage other community members.

*Process moderator.* According to the respondents, the program the 'Synergy of experiences' also highly depended on the moderator of the whole process. The role of the process moderator was especially significant at the stage of the idea and realization. The respondents noted they felt a close cooperation between the initiator and the moderator in the creation of the competence of social innovation.

*Problem.* A local action group of Rokiškis region precisely indicates all the problems of the region in its strategy, but the residents of the rural area were asked to evaluate the main problems on the Likert scale from 1 (a very little problem) to 5 (a huge problem). 'Mostly we feel we are an old village. The residents are of older age, while grown-up children moved to bigger cities,' says the respondent R2. A comment of one active member of the community about a lack of funding can be added to the aforementioned opinion. According to R4, 'most probably, we have ideas, but there is a lack of finance. Some initiatives are funded by the members of the community, but if we have bigger purchases, we need to prepare projects, but we do not know how to prepare them'. The respondents also emphasized that they are willingly waiting for the return of the youth, who can bring and share their latest

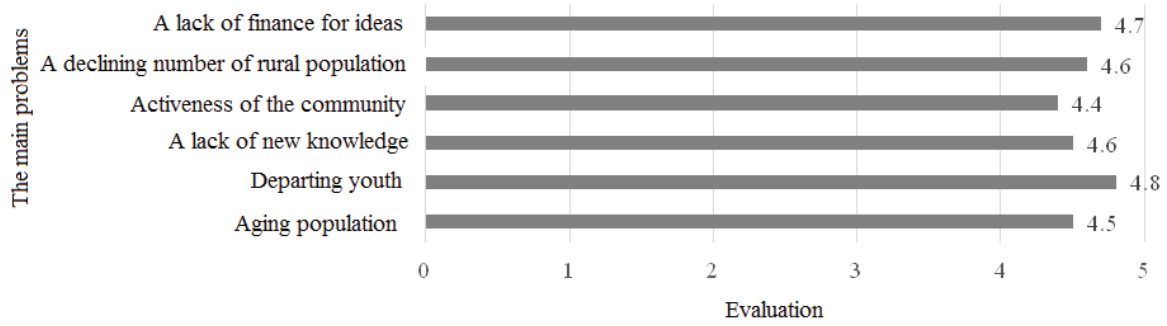


Figure 2. The main problems in rural areas (N=10).

knowledge, because the members of the community do not know about the latest trends and also have a lack of competence, which can be gained in the bigger cities. Bigger cities can offer the abundance of training or seminars, while in rural areas they are organized rarely. The respondents agreed that the problems cannot be easily solved, but creative solutions should be searched for.

*Ideas*. The aim of this question was to find out what principle is used to develop the ideas for solving a particular problem. According to the respondents, the problems are obvious, and therefore sometimes ideas arise extemporaneously, and they are sometimes generated during the meetings, and are rectified and elaborated. According to the respondent R6, 'the idea of synergy of experiences arose during the discussion, when it was considered what interesting activities can be organized for the community and how to attract more members of the community'. The theoretical part also analyses that creative sessions and other activities that stimulate the initial thoughts for generating the problem are suitable for generation of ideas.

*Prototype.* In case of the 'Synergy of experiences', the concept has been developed that provides goals, objectives and core activities. According to the respondent R5 and respondent R8, both the initiator and the process moderator worked on the fulfilment of the concept, and other community members only got involved in the process in the next steps. It can be seen that two responsible people are enough to develop the idea, and other people concerned can be involved when more work needs to be done. In this case, most of the respondents who participated in the interview supported this observation.

*Solution.* The solution of the 'Synergy of experiences' along with the visualization has been presented to the members of the community during the first event. According to the respondents who participated in the study, there was a clear interest of most members of the community and their willingness to contribute. Three main members of the community took the role of leaders. They have also distributed activities and offered their help in distributing and sharing work. It was important for other members of the community to get involved, but they did not want to take the initiative. According to the respondent R2, people are used to have a leader who leads the whole work, while other people do the job. A similar situation is in this project, where most people are waiting for someone to tell what they should do, because they do not want to take the lead. This observation can be supplemented with a statement of the respondent R3 that Sėlynė village does not have one and single leader. Someone usually takes a role of an initiator who initiates, generates ideas and acts. And next time there can be another initiator who will initiate other activities. There is, therefore, a serious lack of systematic arrangements. In scientific works, which analyse rural areas, it is noted that a role of social leader, who could unite and motivate locals or even show an example to others, is especially important in these locations where close social relationship is a common thing.

*Realization.* It is one of the main stages in which most members of the community get involved. The respondents, however, have been asked, in connection with this question, to assess the most common disturbances that interfere with performance and which impede the smooth implementation of the idea. The statements were assessed in a Likert scale from 1 (absolutely does not interfere) to 5 (very much interferes). According to the respondents, a lack of a clear vision is the matter that is the most interfering with the implementation of ideas. According to the respondent R3, 'it sometimes seems that we manage to reach a consensus, and discuss the idea, but later, when we start to work, leaders willing to fundamentally change everything appear. This makes people confused'. It can also be noticed that work sharing is another disturbance identified by the respondents. According to the respondent R1, 'you can sometimes understand that there were many people who wanted to do something, but they disappear when it comes to work leaving only few enthusiasts to do the whole work'. Planning of works is one of the main disturbances. It was described by

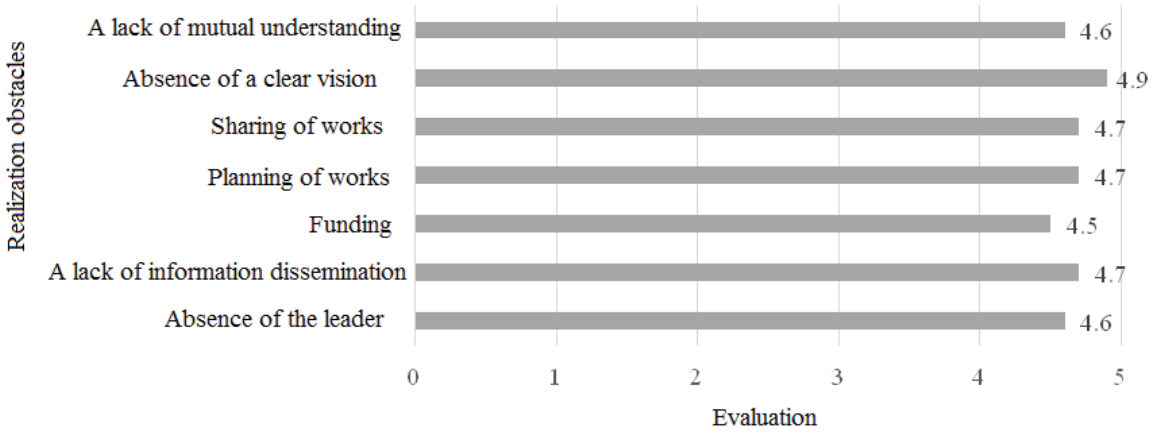


Figure 3. The main realization obstacles (N=10).

the most respondents as phenomenon of 'the last night' that is very common among many people, who skip preparatory works. Absence of information dissemination is another key disturbance. Although not many people reside in Sėlynė village, and there are very few members of the community, it sometimes seems that only the most active members are aware about the activities organised (the opinion expressed by R1, R4, R3, R7).

*Changes.* One of the stages of creating social innovation that shows whether social innovation is short-term or long-term, and what changes it has made in a rural area. As most respondents say, the 'Synergy of experiences' forced everyone to communicate with their loved ones, whether or not they could bring their competences to a rural area and share them with the community. According to R4, 'I have never asked my children for anything in the past. But now our good experience already shows that you only have to offer others to do something and they always agree'. Most of the respondents added that all young people get involved voluntary and they willingly contribute to community building. According to R6, the initial activities led to thinking about future activities that will focus on training and knowledge transfer in business creation, economic literacy, project preparation, etc. Although the 'Synergy of experiences' means the activities that are not fully structured, the statements of the respondents during the interviews suggested that this social innovation, that started a year ago, is characterized by great vitality.

*Feedback.* In order to find out whether the social innovation developed has proved to be beneficial, it is expedient to collect feedback. According to the respondents, in this particular case they trusted in feedback that is passed by word of mouth and collected no feedback. Opinions and experience-based assessment of young people who got involved in the activities have been assessed. A continuity of the social innovation the 'Synergy of experiences' has been also ensured through enthusiastic involvement of the members of the community.

Sėlynė village in Rokiškis region was selected for the case study. Young community of the village has developed the first social innovation, i.e. the 'Synergy of experiences'. The interview method that was used during the study revealed the opinion of the most active members of the community about the creation of social innovation in the rural area. The whole process produced both positive and negative experiences, the members of the community managed to identify the stages of each process, as well as the factors at the stage and the obvious directions of improvement.

**Conclusions**

Little research still has been done on the subject of the creation of social innovation in rural areas. However, social innovation, creation and rural areas, as separate elements, are analysed quite extensively. The theoretical analysis revealed that the community is the main factor in the rural environment, and there is a close social relationship between people who live in a rural area. Social innovation can become a solution to many persistent problems in the rural area that are difficult to solve. Consequently, the process of creation of social innovation in rural areas should be analysed in further studies at each stage throughout the development process.

Creating social innovation is a sensitive process and, as shown by the case study of one community that is based on interviews with respondents about the social innovation created, the process itself must be consistent. However, several critical moments become evident in each stage. During the process of creation of social innovation, the community also often faces the internal problems and encounters disturbances. It is also important to assess the inner synergy of the members of the community who are stimulated to act by interesting activities they are engaged in.

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# LITHUANIAN FAMILY FARM ECONOMIC SUSTAINABILITY: DOES THE INDICATOR MATTER?

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**Abstract**
The economic situation of Lithuanian agricultural sector faces with challenges in regards to family farms' income instability and income discrepancies between family farms. The aim of this paper is to assess the economic sustainability of Lithuanian sector at farm level across farm size classes in terms of physical size and by specialization. Furthermore, as the sustainability construction index method was employed as basis to conduct the research, the methodology aspects related to the number of indicators included in the set of indicators and the estimation of thresholds of sustainability intervals were empirically analysed. The findings of economic sub-index assessment indicates very good level of Lithuanian family farms as 68% of the sample farms were defined by medium level of economic sustainability. The assessment of family farms' economic sustainability by specialization revealed that the horticulture farms performed the highest economic sustainability and, at the other end of spectrum, the COP farms achieved the lowest economic sustainability. As regards the physical size of farms, the best economic sustainability was observed on the smallest farms in terms of size and on the largest farms, of less than 5 ha and from 500 ha or over, respectively.
**Key words**: economic sub-index, indicators, family farms, FADN, farming type.

## Introduction

The beginning in designing indicators of sustainability has come from the United Nations initiative, which launched the program of work on sustainable development indicators for the Commission on Sustainable Development after the Rio Earth Summit in 1992 (Dahl, 2012). Since then different methodologies, frameworks, indicators were developed and presented to assess sustainable development, and still, there is no generally accepted tool (Singh *et al.*, 2012). In the context of achieving sustainable development goals in the whole economy, agricultural sector plays an important role in terms of land management, rural areas development, food security, climate change, biodiversity and etc. A number of scientific research perform overview and systematization of scientific literature focusing on the sustainability assessment methodology aspects (Binder *et al*., 2010; Singh *et al.*, 2012; Marchand *et. al*., 2014; Schader *et al.*, 2014; De Olde *et al*., 2016). The analysis of agricultural sustainability at a farm level is suggested to be the most appropriate spatial unit in terms of the implementation of sustainable farm practices (Kelly *et al*., 2018). The sustainability analysis usually comprises of economic, environmental and social dimensions of sustainability. Therefore, recently the economic, environmental and social aspects of farms sustainability have been incorporated into farms' sustainability analysis (Zahm *et al*., 2008; Dantsis *et al.*, 2010; Gomez-Limon & Sanchez-Fernandez, 2010; Jane Dillon *et al*., 2016; Lynch *et al.*, 2016; Poppe *et al.*, 2016; Herrera, Gerster-Bentaya, & Knierim, 2016; Brennan *et al.*, 2016). Recently, European Union (EU) Farm Accountancy Data Network (FADN) has been employed by researchers for farm sustainability analyses across EU countries (Zahm *et al.*, 2008; Barnes & Thomson, 2014; O'Donoghue *et al*., 2016). However, the devised indictors differ and thus limit the comparison of results derived by different researchers.

The economic dimension of agricultural sustainability has become the subject of extensive research since 2010 (Baležentis, Namiotko, & Novickytė, 2018). Some attempts to assess Lithuanian farms economic sustainability revealed the problematic areas that should be considered in future aiming to increase sustainability level of agricultural sector (Dabkienė, 2018; Baležentis, Namiotko, & Novickytė, 2018; Vitunskienė & Dabkienė, 2016). Vitunskienė & Dabkienė (2016) conducted the analysis of Lithuanian family farms sustainability using farm relative sustainability index, which reflected all three dimensions of sustainable development, in 2003 and 2012. The results revealed that the economic sustainability of farms was low in both considered years. Two challenging areas that relate to farm risk management were identified. Lithuanian family farms showed inability to employ farm's capital (internal capacity) reducing the agricultural business risk and cope with income instability. As well the insurance policy was not suitable and favourable instrument for farmers as the way of stabilizing their income in case of losses due to unanticipated external events. Dabkienė (2018) presented the analysis of farms economic sustainability in 2014 with regard to farms' specialization. The findings highlight the need of monitoring farms' economic situation as the economic sustainability index value was estimated lower in 2014 than in 2012. The author organized experts' questionnaire in order to assign the weights to the developed indicators for family farm sustainability assessment. In the questionnaire, it was asked whether

there were any other indicators which should be taken into account. The experts suggested including the indicator addressed to farm's autonomy considering the importance of this criteria on farms' economic sustainability (detailed results of questionnaire presented in Dabkienė, 2018). Baležentis, Namiotko & Novickytė (2018) conducted the analysis of Lithuanian family farms economic sustainability in terms of farm investments, profitability and growth. The results disclosed economic sustainability problem areas of Lithuanian farms. The authors emphasize that the estimated low level of profitability and growth for the specialist granivores, grazing livestock, specialist dairying and field crops-grazing livestock combined farms may negatively affect their economic sustainability.

The current economic situation of Lithuanian agricultural sector faces with challenges achieving its sustainability (Lithuanian institute of agrarian economics, 2016). According to Eurostat data, Lithuanian agricultural factor income per annual work unit in 2018 stood at EUR 4.4 thou and was by 30% lower than in 2017. It could be stated that in 2018 the agricultural labour productivity was low as it only came to around 26% of the EU-28 level. In 2018, the entrepreneurial income, expressed as entrepreneurial income at real prices per family work unit, in Lithuania amounted to EUR 2.4 thou and it made 17% of the EU-28 level. The economic situation of Lithuanian family farms' is not even in terms of farm size. According to the EU FADN data, during the period of 2012–2016, regarding farms' economic size, the average value of Lithuanian family farm net income (FNI) per family work unit was the highest on farms with more than 500 Economic Size Units (ESU), whereas the lowest income was registered on farms from 2 to 8 ESU (EUR 2.7 thou and EUR 236.7 thou, respectively). The highest Lithuanian family FNI per family work unit, in terms of physical size (ha of utilized agricultural area (UAA)), over the period of 2013-2017, was registered on farms of 150 ha UAA or over and it was six-fold higher as compared with average income in farms. In 2017, Lithuanian family FNI per family worker, as compared to the average net earnings in the whole Lithuanian economy, was greater by 30%. However, the FNI per family work unit was not sufficient on farms in size classes up to 40 ha UAA, as income was lower than average earnings in the whole economy. It should be noted that small farms are predominant in Lithuania. According to Results of the Farm Structure Survey 2016, farms up to 40 ha UAA came to around 90% of all farms.

The need for family farms' economic sustainability monitoring and the results of aforementioned questionnaire survey inspired the aim of this paper, which is twofold: (1) to assess economic farm sustainability across farm size classes in terms of physical size and by farms specialization in Lithuania and (2) to evaluate the contribution of additional indicator, namely farm's income reliance on subsidies, to farms' economic sustainability sub-index value.

**Materials and Methods**

The sustainability construction index method was employed as the basis to conduct the research. The set of indicators with regard to family farms' economic sustainability assessment developed by Vitunskienė & Dabkienė (2016) were utilized. Based on proposed methodology by European Commission (2018), the family farms' income reliance on subsidies was measured as the ratio of total subsidies excluding on investments over the farm net value added. Lithuanian FADN 2016 primary data of 1301 family farms concerning economic activity were utilized. Table 1 shows the indicators and their data source to assess family farm economic sustainability.

All the indicators were normalized based on minimum and maximum value. The indicators accepted the values ranging from 0 (indicating low sustainability) to 1 (indicating high sustainability). The maximum values of indicators $e_1$-$e_8$ and the minimum value of indicator $e_9$ were considered as positive values in terms of economic sustainability. In order to solve problems of outlies, 5$^{th}$ and 95$^{th}$ percentile was used as a minimum and maximum value, respectively. Two economic farms sustainability sub-indices were computed for the evaluation of the impact of the added indicator for the assessment of farms' economic sustainability. The first sub-index consisted of equally weighted 8 indicators (notated as $I_{sub8}$) and the second comprised of 9 indicators (notated as $I_{sub9}$), thus the weights of the indicators equalled to 0.25 and 0.11, respectively. In the latter economic sub-index the variable indicating farms reliance on subsidies has been taken into account.

Based on the approach proposed by Savickienė & Miceikienė (2018) the thresholds values of farms' economic sustainability intervals were estimated. Based on descriptive statistics the upper threshold value of weak sustainability interval was calculated as follows:

$$Bw = \overline{X} - SD, \quad (1)$$

where by *Bw* – upper threshold value of week sustainability interval; $\overline{X}$ – mean of sub-index; and is standard deviation of sub-index.

The upper threshold of medium sustainability interval value was calculated according to the equation:

$$Bm = 2SD + (\overline{X} - SD), \quad (2)$$

where by *Bm* is an upper threshold value of medium sustainability level.

Table 1

**Economic sustainability indicators of the family farm**

| Notation | Variable | Indicator | Data source: FADN variables |
|---|---|---|---|
| $e_1$ | Labour productivity | Gross value added / Annual work unit (AWU) | SE410; SE425 |
| $e_2$ | Capital productivity | Gross value added / Total assets | SE410; SE436 |
| $e_3$ | Land productivity | Gross value added / Hectare (ha) of utilized agricultural area (UAA) | SE410; SE025 |
| $e_4$ | Solvency | Total assets / Total liabilities | SE436; SE485 |
| $e_5$ | Farm income | Family Farm income / Family work unit | SE430 |
| $e_6$ | Fixed capital formation | Gross investment / Hectare of UAA | SE516; SE025 |
| $e_7$ | Farm diversification | Revenue from other gainful activities (OGA) / Total farm revenue | Table 22 in Lithuanian FADN 2016 |
| $e_8$ | Farm risk management | Insurance costs / Total specific costs | Table 12 in Lithuanian FADN 2016, SE 281 |
| $e_9$ | Income reliance on subsidies | Total subsidies excluding on investments / Farm net value added | SE605; SE415 |

Table 2

**Economic sustainability intervals and farms' sample distribution according to sustainability level**

| Economic sub-index | Descriptive statistics | | | | Sustainability intervals/sustainability level | | |
|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Mean | SD | Low *(number of farms)* | Medium *(number of farms)* | High *(number of farms)* |
| $I_{sub8}$ | 0.07 | 0.67 | 0.31 | 0.11 | ≤ 0.20 *(211)* | 0.201–≤ 0.42 *(879)* | 0.421–≤ 1 *(211)* |
| $I_{sub9}$ | 0.06 | 0.65 | 0.32 | 0.11 | ≤ 0.22 *(211)* | 0.221–≤ 0.43 *(877)* | 0.431–≤ 1 *(210)* |

Farms sample distribution regarding to farms' sustainability levels are presented in Table 2.

The statistical analysis was conducted by SPSS 21. Kolmogorov-Smirnov and Shapiro-Wilk tests were used to verify the normality assumption of normalized values. The results indicated that normalized values did not follow a normal distribution. Therefore, the Kruskal-Wallis one-way analysis of variance was used to compare differences among the economic indicators values and sub-indices values across nine types of farming (specialization) and eleven farm physical size classes. A p value of $p<0.05$ was considered to be statistically significant. In describing the results descriptive statistic such as mean and the coefficient of variance (CV) were used.

**Results and Discussion**

Derived indicators attributed to agricultural economic sustainability at a farm level enable disclose problems on the farm or in a certain farm group. The lowest values for the whole farms sample were obtained for indicators related to farm's risk management issues: farmers were not engaged in the diversification of their economic activity and were not employing insurance instruments. These findings are in consisted with that estimated by Vitunskienė & Dabkienė (2016) and disclose long-term problem issues for Lithuanian farms.

The carried out analysis of economic indicators across farm specialization showed that the highest level of labour productivity was achieved on specialist cereals, oilseeds and protein crop (COP) farms and followed by specialist granivore (poultry, pigs) farms, whereas the lowest values were determined on horticulture farms. The highest capital productivity was achieved for specialist granivore farms, though the COP farms recorded the lowest capital productivity. The horticulture farms obtained the highest level of land productivity, whereas, the lowest result was achieved on the COP farms. The land productivity differs across farm specializations as the productivity gap between highest and lowest

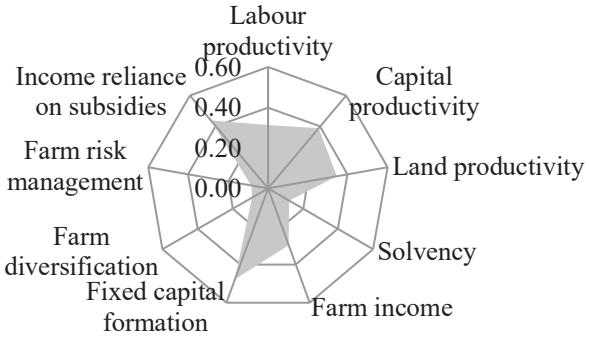


Figure 1. Sub-index of economic sustainability of Lithuanian family farms in 2016.

record was six-fold. The variation of solvency across farm specialization was apparent (CV 52%): permanent crop farms were the most solvent followed by grazing livestock farms, whereas, the least solvent were specialist granivore farms. The highest income per FWU was registered on specialist granivore farms followed by grazing livestock farms. The findings for fixed capital formation suggest that the horticulture farms invested most in 2016. Medium variation value of fixed capital formation (12.9%) was defined showing that in terms of investment farms across specializations were similar. Farm income diversification is an important indicator for farm viability, though the normalized values across farm specialization were low showing that small number of sample farms has received income from other gainful activities. Lithuanian farms had paid little attention towards insurance, though the variation of normalized values of the risk management indicator was distinct. The COP farmers were most interested in insurance as the way of stabilizing their income in case of losses due to unanticipated external events. The production support in terms of paid subsidies to farmers might negatively impact their decisions towards specialization or decrease their self-sufficiency level. The greatest reliance on subsidies was observed on farms specialized on grazing livestock. However, the low value of CV (9.2%) indicated marginal differences across farms' specializations (Table 3). Kruskal-Wallis test showed that the performances of economic indicators values notated as $e_2$, $e_3$, $e_4$, $e_5$, $e_6$ and $e_9$ in considered farm groups regarding farms' specialization were significantly different from each other at $p<0.001$ level, for indicator notated as $e_8$ values were significantly different at $p<0.01$ level and performances were not significantly different for $e_7$.

Table 3

**Lithuanian family farms economic sustainability indicators by farm specialization in 2016**

| Farm specialization | Labour productivity | Capital productivity | Land productivity | Solvency | Farm income | Fixed capital formation | Farm diversification | Farm risk management | Income reliance on subsidies |
|---|---|---|---|---|---|---|---|---|---|
| | $e_1$ | $e_2$ | $e_3$ | $e_4$ | $e_5$ | $e_6$ | $e_7$ | $e_8$ | $e_9$ |
| COP | 0.38 | 0.33 | 0.21 | 0.09 | 0.28 | 0.45 | 0.09 | 0.11 | 0.46 |
| General field cropping | 0.32 | 0.34 | 0.36 | 0.10 | 0.31 | 0.52 | 0.11 | 0.04 | 0.47 |
| Horticulture | 0.17 | 0.52 | 0.83 | 0.15 | 0.32 | 0.65 | 0.12 | 0.00 | 0.51 |
| Permanent crops | 0.23 | 0.50 | 0.52 | 0.26 | 0.26 | 0.45 | 0.10 | 0.02 | 0.46 |
| Specialist dairying | 0.28 | 0.46 | 0.45 | 0.12 | 0.31 | 0.46 | 0.09 | 0.10 | 0.42 |
| Grazing livestock | 0.29 | 0.38 | 0.35 | 0.22 | 0.34 | 0.53 | 0.08 | 0.10 | 0.38 |
| Specialist granivores | 0.36 | 0.58 | 0.70 | 0.03 | 0.44 | 0.46 | 0.07 | 0.02 | 0.49 |
| Field crops-grazing livestock, combined | 0.32 | 0.39 | 0.29 | 0.12 | 0.32 | 0.47 | 0.10 | 0.06 | 0.41 |
| Various crops and livestock combined | 0.13 | 0.41 | 0.45 | 0.11 | 0.21 | 0.50 | 0.07 | 0.03 | 0.48 |
| CV | 30.5 | 19.7 | 42.7 | 52.0 | 20.2 | 12.9 | 18.6 | 76.7 | 9.2 |
| Significance | *** | *** | *** | *** | *** | *** | NS | ** | *** |

Level of statistical significance are *p<0.05, **p<0.01, ***p<0.001 and NS – not significant

The farm labour productivity increases with the physical size of family farm. The highest level of labour productivity was achieved on farms from 50 ha and over. The variation of labour productivity among farm size classes was evident (CV 76.2%). The highest level of capital productivity was recorded on the smallest farms size class (of less than 5 ha). Medium variation of capital productivity values (CV 14.9%) indicates rather different situation across farm specializations. On contrary to the labour productivity tendency, the land productivity decreases with the physical size of family farm, though the variation of values across defined farm size classes was lower (CV 25.1%). The most solvent farms were determined on farm size class from 5 to 10 ha of UAA. The best farms in regards to their risk-bearing ability were found on farms from 5 to 10 ha of UAA, while the least solvent farms were observed in the largest size class (500 ha or over). Findings on family farm income distribution across defined farm size classes suggest that income depends on farm's physical size. The highest income was generated by farms on the largest farm size class (500 ha or over). The expenditure to the on-farm investment is one of indicators showing farmer's attitude towards farm's long term competiveness and ensuring farm's improvement of efficiency. Looking at normalized fixed capital formation values, the highest value of this indicator was observed on the smallest farm size class (of less than 5 ha), while the lowest values were determined on farms from 40 to 200 ha of UAA. The results reveal that the investments differed slightly across farm size classes (CV 8.8%). The most diversifying income from other gainful activities farms were found on farm size class from 5 to 10 ha of UAA. The insurance as a farm risk management tool was more widely used by farms on the largest farm size class (500 ha or over). The variation of farm risk management among farm size classes was apparent (CV 71.4%). The highest level of farms' income reliance on subsidies was achieved on farm size class from 40 to 50 ha of UAA. At the other end of the spectrum, farms on the smallest farm size class (of less than 5 ha) were least dependent on subsidies (Table 4).

Kruskal-Wallis test showed that the performances of economic indicators values notated as $e_2$, $e_4$, $e_5$, $e_6$, $e_8$ and $e_9$ in considered farms' physical size groups were significantly different from each other at $p<0.001$ level, for indicator notated as $e_3$ values were significantly different at $p<0.01$ level and performances were not significantly different for $e_7$.

Table 5 shows average values of economic sub-indices derived by farms' specializations and according to physical farm size classes. The derived economic sub-indices $I_{sub8}$ and $I_{sub9}$ values were almost identical, indicating little impact of farm's income autonomy

Table 4

**Lithuanian family farms economic sustainability indicators by farm size classes**

| Farm size classes of UAA | Labour productivity | Capital productivity | Land productivity | Solvency | Farm income | Fixed capital formation | Farm diversification | Farm risk management | Income reliance on subsidies |
|---|---|---|---|---|---|---|---|---|---|
| | $e_1$ | $e_2$ | $e_3$ | $e_4$ | $e_5$ | $e_6$ | $e_7$ | $e_8$ | $e_9$ |
| Less than 5 ha | 0.08 | 0.51 | 0.61 | 0.14 | 0.19 | 0.59 | 0.11 | 0.00 | 0.57 |
| From 5 to 10 ha | 0.04 | 0.30 | 0.40 | 0.22 | 0.19 | 0.50 | 0.14 | 0.06 | 0.54 |
| From 10 to 20 ha | 0.08 | 0.36 | 0.42 | 0.17 | 0.20 | 0.51 | 0.09 | 0.03 | 0.44 |
| From 20 to 30 ha | 0.13 | 0.42 | 0.42 | 0.15 | 0.21 | 0.50 | 0.07 | 0.08 | 0.45 |
| From 30 to 40 ha | 0.14 | 0.38 | 0.33 | 0.17 | 0.23 | 0.53 | 0.07 | 0.03 | 0.41 |
| From 40 to 50 ha | 0.17 | 0.40 | 0.30 | 0.17 | 0.23 | 0.45 | 0.10 | 0.06 | 0.40 |
| From 50 to100 ha | 0.28 | 0.42 | 0.32 | 0.16 | 0.27 | 0.46 | 0.11 | 0.07 | 0.42 |
| From 100 to150 ha | 0.40 | 0.43 | 0.33 | 0.09 | 0.31 | 0.45 | 0.08 | 0.11 | 0.44 |
| From 150 to 200 ha | 0.47 | 0.39 | 0.32 | 0.06 | 0.32 | 0.45 | 0.07 | 0.11 | 0.45 |
| From 200 to 500 ha | 0.56 | 0.35 | 0.32 | 0.04 | 0.43 | 0.47 | 0.10 | 0.11 | 0.44 |
| 500 ha or over | 0.59 | 0.32 | 0.29 | 0.03 | 0.56 | 0.48 | 0.07 | 0.21 | 0.46 |
| CV | 76.2 | 14.9 | 25.1 | 49.0 | 40.8 | 8.8 | 24.7 | 71.4 | 11.5 |
| Significance | *** | *** | ** | *** | *** | *** | NS | *** | *** |

Level of statistical significance are *p<0.05, **p<0.01, ***p<0.001 and NS – not significant

Table 5

**Lithuanian farm economic sub-indices values by specialization and family farm size classes**

| | Economic sub-index ($I_{sub8}$) | Economic sub-index ($I_{sub9}$) |
|---|---|---|
| Family farm specialization | | |
| COP | 0.29 | 0.30 |
| General field cropping, mixed cropping | 0.32 | 0.33 |
| Horticulture | 0.41 | 0.42 |
| Permanent crops | 0.35 | 0.36 |
| Specialist dairying | 0.32 | 0.33 |
| Grazing livestock | 0.32 | 0.33 |
| Specialist granivores | 0.39 | 0.40 |
| Field crops-grazing livestock, combined | 0.30 | 0.32 |
| Various crops and livestock combined | 0.30 | 0.32 |
| CV | 12.5 | 11.6 |
| Significance | *** | *** |
| Family farms size classes ha of UAA | | |
| Less than 5 ha | 0.35 | 0.37 |
| From 5 to 10 ha | 0.29 | 0.32 |
| From 10 to 20 ha | 0.28 | 0.30 |
| From 20 to 30 ha | 0.29 | 0.31 |
| From 30 to 40 ha | 0.28 | 0.30 |
| From 40 to 50 ha | 0.28 | 0.29 |
| From 50 to100 ha | 0.31 | 0.32 |
| From 100 to150 ha | 0.31 | 0.33 |
| From 150to 200 ha or over | 0.32 | 0.33 |
| From 200 to 500 ha | 0.34 | 0.35 |
| 500 ha or over | 0.35 | 0.36 |
| Total | 0.31 | 0.32 |
| CV | 8.6 | 7.6 |
| Significance | *** | *** |

Level of statistical significance are *p<0.05, **p<0.01, ***p<0.001 and NS – not significant

criteria to farms' economic sustainability values. Alongside, the developed sub-indices demonstrated almost the same tendencies and there were minor differences across specializations of farms and by physical size classes. The findings of sub-indices assessment indicates very good level of Lithuanian family farms as 68% of the sample farms were defined by medium level of economic sustainability (Table 2). With regard to the farms' specialization, horticulture farms performed the highest economic sustainability. The COP farms in contrast were the least sustainable from economic perspective. As regards the physical size of farms, the best economic sustainability was observed on the smallest-sized farms and on the largest-sized farms, of less than 5 ha and from 500 ha or over, respectively. There were greater differences in economic sub-indices values across specializations of farms than across physical farm size classes, indicating that the farms' specialization is more significant for economic sustainability than their physical size. Kruskal-Wallis test showed that the performances of economic sub-indices values notated as $I_{sub8}$ and $I_{sub9}$ in considered farms' specialization and physical size groups were significantly different from each other at p<0.001 level.

**Conclusions**

The findings of economic sub-index assessment indicates a very good level of Lithuanian family farms as 68% of the sample farms were defined by medium level of economic sustainability. The assessment of family farms' economic sustainability by specialization revealed that the horticulture farms performed the highest economic sustainability and, at the other end of spectrum, the COP farms achieved the lowest economic sustainability. As regards the

physical size of farms, the best economic sustainability was observed on the smallest farms in terms of size and on the largest farms, of less than 5 ha and from 500 ha or over, respectively.

The contribution of additional indicator, namely farm's income reliance on subsidies, to farms' economic sustainability sub-index value was minimal, though the reason for that could be more addressed to the aggregation method used in the research. Therefore, employing the sustainability index as a policy making decisions tool, the assignment of weights to indicators through methods such as the principal components analysis, expert questionnaire or others should be verified.

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# MODELLING IMPACT OF URBAN-RURAL INCOME CONVERGENCE IN THE EU

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**Abstract**
Urban-rural income convergence provides an opportunity to reduce the income inequality, ensuring cohesion and increasing economic output. The results show that urban-rural income convergence is a continuous tendency in the EU; the urban-urban income gap declines – rural population received 79% of net income of population living in cities in 2017 (in 2010 it was 69%). The rural population accounts for 27.3% of the EU and any changes have notable impact on the rest of the economy. Nationally the urban-rural income convergence dramatically differs amid the EU countries. In order to model an impact of urban-rural income convergence, a comparative-static approach that involves an input-output model is applied. Two scenarios are estimated for Latvia's economy: rural net income in Latvia is assumed to be 89% of cities net income (as in the Euro Area average) in both scenarios, in the first one the saving rate is constant; in the second rural households anticipate the additional net income as a gift (saving rate for extra net income is equal to zero). The results of the first scenario argue that households final demand expenditures increase by 4.5%, output by 2.7%. The largest increase of output is modelled in chemical products (8.9%), paper products (8.7%), electrical equipment (6.2%), pharmaceutical products (6.1%), textile (5.8%) industries. In the second scenario, the output increase: 3%. The results certify that the increase and convergence of income in rural areas are important even in advanced economies, such as the EU countries. The national and EU policies are welcome and can give notable impact on economic growth.
**Key words**: modelling, urban-rural income, income convergence, input-output.

## Introduction

Urban-rural income convergence provides an opportunity to reduce the income inequality, ensure cohesion and increase in economic performance and output regionally, nationally and in the EU. Distribution of population (and consequently income etc. data) by degree of urbanisation is important and offers valuable evidences for wide audiences as local municipalities, national governments, policy makers, companies and business organisations, education, scientific and research institutions and other organisations non-governmental etc. institutions. However, the effect and scale of urban-rural income converge process have not been determined.

Findings of other authors are controversial as many authors specialize in the urban-rural income gap in emerging economies for example, (Sicular *et al*., 2007) researched urban-rural income gap and its factors in China; (Zhang, Chen, & Zhang, 2012) examined the urban-rural income disparities in China in the long run; (Chen & Sun, 2014) researched and estimated the urban-rural income polarisation effect on the economic growth in China) and the results cannot be applied to the EU countries. The studies on advanced economies include a lot of national specifics as (Breau & Saillant, 2016) on Canada's rural income disparities by regions; and the research on Greece's economic performance of localities due to local income distribution (Prodromidis, 2008) that ensure valuable findings nationally but have limited application options in other cases and other countries. Many authors investigate the urban-rural income issue in the context of migration from rural areas to urban areas, as well as international migration). Based on the performed analysis of 65 countries, Young (Young, 2013) argues that one out of every four or five individuals raised in rural areas moves to urban areas as a young adult in order to increase net income and actually earns more than rural population that has not migrated. These issues are definitely linked and majority of countries continues to experience rural-urban migration process and the share of population living in cities increases.

The aim of the research is to model an impact of urban-rural income convergence on the national economy. For this purpose a comparative-static approach that involves an input-output model and scenarios, is applied. The research involves the analysis and detection of current trends in the EU regarding urban-rural income volume and dynamics focusing on urban-rural income convergence, input-output model building, elaboration of scenarios assumptions, and modelling the results. The analysis and findings suggest that sophisticated analytic and modelling tools give precise and valuable results.

## Materials and Methods

Despite the common understanding, the definitions of rural and urban (as cities) areas are various and different. Hence, initially, the rural and urban areas definition analysis is performed. According to the definition applied by Eurostat (Eurostat, 2019), the degree of urbanisation classifies local administrative units as cities (otherwise referred to as densely populated areas), towns and suburbs (otherwise referred to as intermediate density areas) or rural areas (otherwise referred to as thinly populated areas)

based on a combination of geographical contiguity and population density, it is based on and measured by minimum population thresholds applied to 1 km² population grid cells; consequently each local administrative unit belongs exclusively to one of these three classes.

The territorial classifications or typologies have been changed over the time in the EU. This problem has been detected by the EU policymakers and it is admitted that rural and urban areas concepts are used by a wide range of policymakers, researchers, national administrations and international organisations such as the Organisation for Economic Cooperation and Development (OECD), the UN and the EU (Dijkstra & Poelman, 2014). These two concepts are readily understood by the society, but a clear definition at the international level has remained elusive (Dijkstra & Poelman, 2014). Some international organisations and institutions completely rely on national definitions and compare the countries analysed on the basis of various typologies. As a result, it is impossible to ensure the data comparability and make regional (multi-national) or global conclusions on these essential issues.

The performed statistical data analysis and comparison of the Eurostat database and national statistical bureaus revealed significant data differences. Mainly, it is due to the differences in nationally applied territorial typologies, in other words, rural and urban areas nationally are defined differently. For example, in the Central Statistical Bureau in Latvia the share of population living in rural areas is stable (and fluctuates minimally in range of 31.7 – 32.5%) in 2005-2017 (Central Statistical Bureau of Latvia, 2019), but in Eurostat data on Latvia the share of population living in rural areas has changed significantly – from 52.7% in 2005 to 37.1% in 2017 (Eurostat, 2019). The same differences are detected by analysing data of national statistics offices of Lithuania (in 2005-2017 rural population share is 32.7% to 33.4% (Statistics Lithuania, 2019)) and Estonia (36.5% to 37.1% in 2012-2017 (Statistics Estonia, 2019)). This is an important point as Eurostat database includes data on income and expenditure, dwellings etc. on the basis of above-mentioned classification of rural and urban areas. If the national statistics are so different from the Eurostat data, new questions and new research directions for further studies arise; however, in this research the Eurostat database is selected as the core data source that ensures the data comparability in time and internationally within the EU. As a result, in the research the Eurostat territorial typologies are applied.

The research is based on the EU data and Eurostat classification. In general, in statistics according to Eurostat (Eurostat, 2019) urban areas refer to an aggregate composed of information covering cities as well as towns and suburbs (in other words, densely populated areas and intermediate density areas). An opposite concept is rural areas including thinly populated areas as stated before.

The research period is 2005-2017 (or till latest statistics available). Urban-rural income convergence is analysed on the basis of Median equivalised net income and Mean equivalised net income in 2005-2017 by the degree of urbanisation in the EU.

Income can be spent as a private consumption expenditure or saved (saving formation). Eurostat has published valuable experimental statistics on median saving rate by the degree of urbanisation that computed a ratio of savings to disposable income (Eurostat, 2017). This indicator gives a more sophisticated insight in actual urban-rural income, welfare and saving formation activity. However, as the data are experimental statistics, they are strongly limited and currently the data are only available on one year (2010). It offers valuable information for static analysis, but it is impossible to analyse dynamics or perform comparative-static analysis.

Household expenditures are mainly determined by net or disposable income subtracting savings created in the research, households final demand expenditures are applied in scenarios analysis in the input-output model.

The input-output model includes the basic identities that ensure the equilibrium in the economy (Equation (1) and Equation (2)):

$$x = Ax + y, \quad (1)$$

where x – output (vector),
Ax – intermediate consumption (matrix).
y – final demand (vector).

Latvia is amid countries that elaborate product-by-product symmetric input-output tables according to CPA classification.

Therefore, A is a matrix of technical coefficients, where each element aij corresponds to the volume of intermediate input of product i products to produce a unit of output of product j. Technical coefficients represent the direct cost structure of production of product j.

$$x = By, \quad (2)$$

where B – Leontief inverse (matrix), computed by Equation (3):

$$B = (I - A)^{-1}, \quad (3)$$

where I – identity matrix.

The use of primary factors (F) depends on the technology (technical coefficients of primary factors, showing the quantity of primary factors required per unit of output; L) and output of industry x (Equation (4)):

$$F = Lx. \quad (4)$$

The impact of urban-rural income convergence is modelled as the scenario analysis applying input-output model. In this research, the impact and the so-called what-if scenarios are evaluated in short term and medium term hence technological coefficients are constant. The what-if scenarios allow to estimate the quantitative effect of a certain (or given) change in the economy.

The research data analysis covers the whole EU, but modelling is executed on the case of one EU country – Latvia. The method and the scenarios are applicable to the EU countries facing similar research questions.

**Results and Discussion**

Urban-rural income convergence is a continuous process that is observable and assessable in a relatively long term in the EU. In 2017, Mean and median equivalised net income data by the degree of urbanisation are analysed and each indicator has its strengths. In 2017, mean equivalised net income in rural areas in the EU 28 countries was 16.75 thsd. euros or 80% of mean equivalised net income in cities. So on average a person living in rural area received net income that is equal to 80% of net income of cities inhabitant. The research aim is to evaluate the income convergence. And hence dynamics and time-series are more important than one year observation that can be biased by various economic, social, political etc. factors. The results of mean equivalised net income in rural areas as percentage of mean equivalised net income in cities in 2005-2017 reveals a stable and constant trend of the urban-rural income convergence and the so-called urban-rural gap has diminished (Table1).

As mean indicators in economics regarding income, wages etc. have some inbuilt biases (weaknesses) also median equivalised net income by the degree of urbanisation is analysed in order to have more detailed and representative results. The median equivalised net income statistics show lower absolute values regarding the income (as in 2017 median equivalised net income in cities in the EU was accounted for 17.93 ths. euro, but in rural areas – 14.96 thsd. euro or 83% of cities net income (Table 2)), but urban-rural income convergence is observable as a stable and constant trend as well.

Table 1

**Mean equivalised net income by the degree of urbanisation in the EU in 2005-2017**

| Area | Region | 2005 | 2010 | 2015 | 2016 | 2017 | 2017 vs.2005 | 2017/2005 |
|---|---|---|---|---|---|---|---|---|
| | | euro | | | | | | % |
| Cities | European Union | 15 879 | 18 483 | 19 853 | 20 372 | 20 990 | 5 111 | 32% |
| | Euro area | 17 196 | 20 673 | 21 190 | 21 721 | 22 223 | 5 027 | 29% |
| Rural areas | European Union | 9 898 | 12 893 | 15 998 | 16 229 | 16 748 | 6 850 | 69% |
| | Euro area | 13 219 | 16 559 | 18 721 | 19 000 | 19 723 | 6 504 | 49% |
| | | percentage | | | | | | |
| Rural areas vs. cities | European Union | 62% | 70% | 81% | 80% | 80% | *17% points* | x |
| | Euro area | 77% | 80% | 88% | 87% | 89% | *12% points* | x |

x-not calculated

Table 2

**Median equivalised net income by the degree of urbanisation in the EU in 2005-2017**

| Area | Region | 2005 | 2010 | 2015 | 2016 | 2017 | 2017 vs.2005 | 2017/2005 |
|---|---|---|---|---|---|---|---|---|
| | | euro | | | | | | % |
| Cities | European Union | 13 626 | 15 928 | 16 991 | 17 515 | 17 926 | 4 300 | 32% |
| | Euro area | 14 928 | 17 883 | 18 162 | 18 671 | 19 174 | 4 246 | 28% |
| Rural areas | European Union | 8 832 | 11 466 | 14 250 | 14 594 | 14 963 | 6 131 | 69% |
| | Euro area | 11 835 | 14 781 | 16 816 | 17 215 | 17 761 | 5 926 | 50% |
| | | percentage | | | | | | |
| Rural areas vs.cities | European Union | 65% | 72% | 84% | 83% | 83% | *19% points* | x |
| | Euro area | 79% | 83% | 93% | 92% | 93% | *13% points* | x |

x-not calculated

When urban-rural income differences are analysed on national level within the EU, the conditions are very diverse. In some EU countries, net income in rural areas is even higher than in cities. In the UK, the ratio of the net mean income in rural areas to net mean income in cities was 109% and in means of the median income – 108% and in Belgium the corresponding ratios were 104% and 115% in 2017 (Table 3). This indicates that urban-rural income convergence has taken place and there is no urban-rural income gap. However, the data on Bulgaria, Rumania, and Lithuania indicate that there is a severe income gap between urban and rural population – on average a person living in rural areas received less than 70% of national net income in cities.

The current analysis gives an insight in the present situation; however, the urban-rural income convergence is more important in the long run. The way the dynamics of urban-rural income gap changes in time reflects the actual urban-rural income convergence. In the majority of the EU countries, the urban-rural income gap has declined and incomes are distributed more equally in the national economies.

The analysis of the statistics on median saving rate by the degree of urbanisation in the EU indicates that saving formation is highly inhomogeneous in the EU – in Bulgaria (38.0%), Estonia (35.3%), Luxembourg (29.9%), France (29.1%), Italy (26.1%) and Poland (25.1%), 25% and more of disposable income was saved (not spent in a certain time period), at the same time – in Greece and Rumania societies used former savings and present-day saving rates were negative (-9.5% and -5.0%) (Figure 1). The urban-rural saving

Table 3

**Comparison of Mean and Median equivalised net income in rural areas (as share of net income in cities) in the EU countries in 2005-2017**

| Country | Mean equivalised net income | | | Median equivalised net income | | |
|---|---|---|---|---|---|---|
| | 2005 | 2017 | *2017 vs 2005 (%points)* | 2005 | 2017 | *2017 vs 2005 (%points)* |
| United Kingdom | 123% | 109% | *-14%* | 106% | 108% | *2%* |
| Belgium | 94% | 104% | *10%* | 101% | 115% | *14%* |
| Austria | 88% | 97% | *9%* | 91% | 103% | *13%* |
| Germany | 88% | 97% | *9%* | 91% | 102% | *10%* |
| Netherlands | 86% | 97% | *11%* | 94% | 100% | *6%* |
| Denmark | 90% | 94% | *4%* | 94% | 96% | *2%* |
| Czechia | 88% | 92% | *4%* | 93% | 95% | *2%* |
| Slovenia | 86% | 91% | *5%* | 90% | 96% | *6%* |
| France | 86% | 91% | *5%* | 87% | 94% | *7%* |
| Ireland | 74% | 88% | *14%* | 76% | 91% | *15%* |
| Italy | 80% | 87% | *6%* | 86% | 91% | *5%* |
| Finland | 83% | 86% | *3%* | 90% | 91% | *2%* |
| Estonia | 81% | 86% | *5%* | 83% | 83% | *0%* |
| Luxembourg | 105% | 85% | *-19%* | 110% | 89% | *-20%* |
| Greece | 83% | 82% | *0%* | 80% | 82% | *1%* |
| Sweden | 86% | 81% | *-5%* | 91% | 88% | *-3%* |
| Latvia | 69% | 81% | *12%* | 71% | 76% | *4%* |
| Slovakia | 80% | 79% | *-1%* | 84% | 84% | *-1%* |
| Hungary | 72% | 78% | *5%* | 76% | 75% | *-2%* |
| Spain | 76% | 77% | *1%* | 75% | 78% | *3%* |
| Cyprus | 81% | 74% | *-7%* | 89% | 79% | *-10%* |
| Croatia | x | 74% | *x* | x | 74% | *x* |
| Portugal | 67% | 74% | *7%* | 76% | 82% | *6%* |
| Poland | 69% | 72% | *2%* | 72% | 76% | *4%* |
| Lithuania | 65% | 66% | *0%* | 67% | 68% | *0%* |
| Romania | x | 56% | *x* | x | 54% | *x* |
| Bulgaria | x | 56% | *x* | x | 60% | *x* |

x-no value available; no data on Malta available.

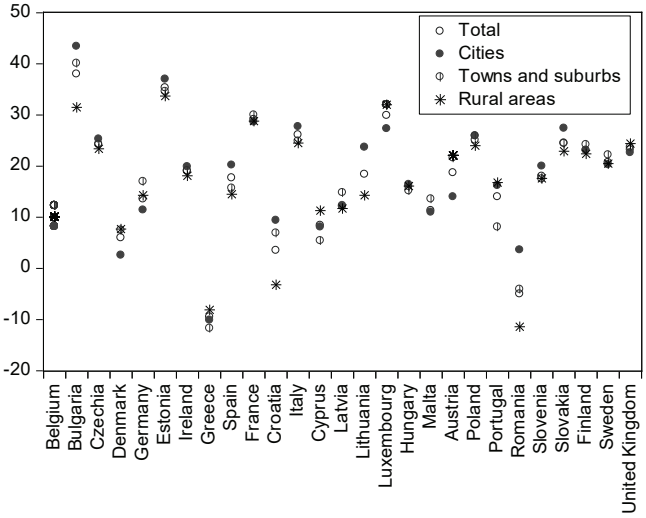


Figure 1. Median saving rate by degree of urbanisation in the EU (%).

rate analysis indicates that in the EU inhabitants of the cities save relatively more than rural inhabitants – the largest difference between cities and rural population behaviour regarding the saving formation is detected in Romania (in cities median saving rate was 3.6%, but in rural areas – -11.4% (difference 15.0% points), Croatia (9.4%; -3.2% and difference 12.6% points), Bulgaria (43.4%; 32%, and difference 11.9% points), Lithuania (23.7%; 14.3%; and difference 9.4% points), and Spain (20.2%; 14.5%, and difference 5.7% points). In Latvia, the saving rate in rural areas was 11.7%, while in cities – towns and suburbs 12.3% and total saving rate was – 12.1%.

To model the impact of urban-rural income convergence, two comparative-static scenarios are estimated taking into account the above-detected trends and assumptions (based on data analysed) in Latvia's economy:

1) rural medium net income in Latvia is assumed to be 89% of cities net income (as on average it is in euro area countries), it is assumed that the saving rate is constant – 11.7%. The other indicators (as share of population living is cities, cities net income etc.) are unchanged – *ceteris paribus*. This scenario involves computing the total rural net income, add to total net income in cities and towns and suburbs, apply saving rate and compute the impact on the economy;

2) rural medium net income in Latvia is assumed to be 89% of cities net income (as on average it is in euro area countries), it is assumed that the additional income is perceived by rural households as a gift and it is spent fully, hence saving rate is 0%. The other indicators (as share of population living is cities, cities net income etc.) are unchanged – *ceteris paribus*. This scenario involves computing the total rural net income, add to total net income in cities and towns and suburbs, and compute the scenario impact on the economy;

In addition, two more scenarios were examined but excluded of further modelling – regarding the impact on economy if rural population in Latvia receives the same net income per person as on average in the EU – due to equally fair payments within Common Agricultural Policy etc.; and the impact on economy if rural population in Latvia receives the same net income per person as in Estonia – due to equally regional (neighbouring countries) income convergence (in 2017 net mean income in rural households in Latvia was 7022 euros, but in Estonia 9947 euros (this scenario involved more assumptions regarding the consumer behaviour and spending activities to estimate accurate and credible results)).

The results of the first scenarios estimated by input-output model claim that the impact on the economy is observable and noticeable. In modelling the rural areas and cities population proportions and saving rate are fixed and only income is shocked in order to assess the income convergence effect. As a result, if income in rural areas are 89% of income in cities instead of 81% as it was in 2010 (the base year according to the latest input-output tables for Latvia), the total final consumption expenditure of households increases by 4.5%.

Households spend a lot on food, dwelling, transport etc. consumption purposes that can be either domestically produced or imported. It results in 2.7% increase of national output on various products and services. As households consume and spend on products and services of almost all industries, only the major impacts are analysed in detail. Table 4 shows the modelled full (direct and indirect) impact results of product output changes that are larger than 4% (output of products with the impact below 4% are not included in the Table 4).

Table 4

**Modelling results of the first scenario representing sectoral output change (%)**

| NACE/CPA CODE | Product or service | Impact |
|---|---|---|
| C20 | Chemicals and chemical products | 8.9% |
| C17 | Paper and paper products | 8.7% |
| C27 | Electrical equipment | 6.2% |
| C21 | Basic pharmaceutical products and pharmaceutical preparations | 6.1% |
| C13_15 | Textiles, wearing apparel and leather products | 5.8% |
| C26 | Computer, electronic and optical products | 5.3% |
| C22 | Rubber and plastics products | 5.3% |
| C03 | Fish and other fishing products; aquaculture products; support services to fishing | 5.3% |
| C10_12 | Food products, beverages and tobacco products | 5.2% |
| A01 | Products of agriculture, hunting and related services | 4.7% |
| T | Services of households as employers; undifferentiated goods and services produced by households for own use | 4.5% |
| L68A | Imputed rents of owner-occupied dwellings | 4.5% |
| I | Accommodation and food services | 4.4% |
| S96 | Other personal services | 4.3% |
| G47 | Retail trade services, except of motor vehicles and motorcycles | 4.2% |

Table 5

**Modelling results of the second scenario representing sectoral output change (%)**

| NACE/CPA CODE | Product or service | Impact |
|---|---|---|
| C20 | Chemicals and chemical products | 10.1% |
| C17 | Paper and paper products | 9.9% |
| C27 | Electrical equipment | 7.0% |
| C21 | Basic pharmaceutical products and pharmaceutical preparations | 6.9% |
| C13_15 | Textiles, wearing apparel and leather products | 6.6% |
| C26 | Computer, electronic and optical products | 6.0% |
| C22 | Rubber and plastics products | 6.0% |
| C03 | Fish and other fishing products; aquaculture products; support services to fishing | 6.0% |
| C10_12 | Food products, beverages and tobacco products | 5.8% |
| A01 | Products of agriculture, hunting and related services | 5.3% |
| T | Services of households as employers; undifferentiated goods and services produced by households for own use | 5.0% |
| L68A | Imputed rents of owner-occupied dwellings | 5.0% |
| I | Accommodation and food services | 5.0% |

The results of the second scenario estimated by the input-output model claim that impact on the economy is noticeable and relatively similar to that of the first scenario. As a result, if income in rural areas is 89% of income in cities instead of 81% that it was in 2010 (the base year according to the latest input-output tables for Latvia), the total final consumption expenditure of households increases by 5.0% if all additional income in rural households is spent.

As it is assumed that households perceive the additional net income as a gift, it is spent according to the consumption structure – spent a lot on food, dwelling, transport etc. consumption purposes that can be either domestically produced or imported. It results in 3.0% increase of national output on various products and services. Table 5 shows the modelled full (direct and indirect) impact results of product output change that are larger than 5% (output of products with the impact below 5% are not included in the Table 5).

Within the scenario analysis it was detected that there is a large impact on output of two products – Coke and refined petroleum products (C19) due to the fact

that it is almost completely import based industry and any, even minor, changes generate unreasonably high changes but in absolute figures the change is minor, and Mining (B) as it is relatively small production that is accompanied with significant changes in stocks and inventories (in final demand formations).

**Conclusions**

The findings demonstrate that urban-rural income convergence is a complex process that involved economic, social and environmental issues on regional, national and international level. The stable and continuous tendency of urban-rural income convergence that results in diminishing income gap illustrates the income equality and equal options to live despite actual regional location.

The results of direct and indirect impacts of the first scenario argue that the total final demand expenditures of households increase by 4.5% but the national output by 2.7%. The largest changes by industries/products are increase of output of Chemicals and chemical products (8.9%), Paper and paper products (8.7%), Electrical equipment (6.2%), Basic pharmaceutical products and pharmaceutical preparations (6.1%), Textiles, wearing apparel and leather products (5.8%). The results of the second scenario argue that output increases by 3%.

These results suggest that the increase and convergence of income in rural areas are important and essential process even in advanced economies, as the EU countries, the obtained modelling results certify it. The results indicate that national and EU policies are welcome and can give notable impact on national economic output and growth.

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# SERVICE QUALITY CONCERNS OF FARMERS SELLING THEIR PROPERTY THROUGH REAL ESTATE AGENCIES

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**Abstract**
In a period of economic prosperity, the real estate market is very active. The demand for real estate is causing the growth of prices, thus inducing people to sell their properties. As the easiest and often most convenient way of selling the property is partnering a real estate company, even 95 per cent of sales are provided through the mediation. However, the increasing demand in services is often leading to the decrease in service quality. It is worth mentioning that, while the amount of real estate agencies is increasing, service quality becomes the main competitive advantage for companies. In order to contribute to a body of knowledge on service quality, this research deals with a problem: what service quality is provided by real estate agencies to farmers selling their properties, and what service quality dimensions have to be improved. The research aims to establish the undermanaged dimensions of service quality obtained by Lithuanian farmers selling their property through real estate agencies. The determination of latter dimensions is crucial for real estate agencies achieving to successfully compete in the market of real estate in Lithuania. In order to reach the aim of the research, previously elaborated service quality models were analysed and adapted to a current research framework. The questionnaire survey was provided to establish a model of service quality real estate agencies expected by farmers selling their property. Finally, the four-dimensional REASQ model was established.
**Key words**: farmers, Lithuania, real estate, service quality.

## Introduction

When consumers need specialized competences and assistance to deal with their problems, they often search for professionals of service provision in such areas as law, brokerage, medical care, and real estate (Le & Supphellen, 2017). According to Azmi *et al.* (2015), property industry will never become static; therefore, real estate agencies are facing growing demand from both sides: sellers and buyers. According to data Ober-Haus (2019), the first half of 2018 in Lithuanian realty market was one of the most successful during the period of the last ten years. The intensifying competition in the property market is encouraging real estate organisations to seek for necessary competencies (Azmi *et al.*, 2015). Srinivasan (2017) emphasizes that a typical intermediation process in real estate industry undergoes later stages, i.e. discovery, matching, transaction, and special services'. Being intermediaries between property sellers and people who are searching for properties, real estate agencies are often responsible for marketing the property, the negotiation process, and for signing the final contract (Le & Supphellen, 2017). One of the ways of achieving business success in terms of gaining competitive advantage and maintaining corporate reputation is quality services (Baharum, Nawawi, & Saat, 2009).

Service quality assessment is one of the significant evaluation tools used to understand consumers' needs and wants by analysing customer experience and satisfaction regarding the services provided (Ghotbabadi, Feiz, & Baharun, 2015). The benefits of providing a better service to customers result in increased profitability of a company, more satisfied customers and their loyalty, customer retention and positive recommendations (Giese and Cote, 2000). Moreover, the research provided by Piscopo (2016) enabled concluding that a significant link between quality of services and corporate reputation exists. In case of entities that seek to have a service orientation, service quality is a key determinant of the company's success (Chiang & Perng, 2018). According to Vassiliadis, Fotiadis, & Piper (2013), in comparison to evaluation of product's quality, defining the service quality is a challenge. Explaining the phenomenon, Tuzovic (2009) directs that the 'intangibility' characteristic (according to the author, services have been defined in terms of four main characteristics: 'intangibility', 'heterogeneity', 'inseparability', and 'perishability') represents a problem of services evaluation by target consumers.

According to Baharum, Nawawi, & Saat (2009), in the service industry, e.g. real estate management, quality and its perception are very important. Analysing the quality of services in the real estate brokerage area, Seiler (2004) notices that the ability to deal with customers and maintain their relationships through superior service quality is an obligatory for any business irrespective of the type of industry. McDaniel & Louargand (1994) emphasize that perceptions of quality service and its components may differ between consumers and sellers. However, while service quality research is common in most industries, its roots in the real estate area are only starting to face the necessity to care about management of service quality (Seiler, 2004). According to Tuzovic (2009), research of service quality (also of e-service quality) can be found in such industries as financial services,

banks, shopping, hotels and catering, automobile services, and medical services; however, in the sector of real estate the concern with service quality is still low. The analysis of scientific literature in the field enables noticing that not much has changed during the last years: service quality research in a field of real estate is still scarce.

Therefore, the **scientific problem** solved in the article is: what service quality is provided by real estate agencies to farmers selling their properties, and what service quality dimensions have to be improved.

In order to contribute to a scientific discussion on service quality, **the object** of the research is service quality provided by real estate agencies to farmers selling their property, and **the aim** is to establish the undermanaged dimensions of service quality obtained by Lithuanian farmers selling their property through real estate agencies. To reach the aim, following tasks were set for the research:

- To determine theoretically the dimensions of service quality specific in real estate industry;
- To discuss the determined dimensions with representatives of real estate agencies and farmers selling their properties through the agencies;
- To elaborate and test service quality assessment model specific to real estate industry;
- Provide managerial suggestion for real estate agencies working with farmers.

**Materials and Methods**

According to Ober-Haus (2019), in 2018 market activity for large plots of land for development was rather weak. The number of publicly traded transactions was much lower than for example in 2017. Land plots located in strategically attractive urban locations continue to attract building companies, but transactions are taking under consideration only such risk-inducing factors as general commercial outlook, residential real estate market, site location characteristics, land acquisition legal terms, etc. The slowing down of stable commercial rents or the rise in house prices is forcing a more conservative approach to land sales prices. However, the lack of bigger plots of land located in central parts of the city enables maintaining the existing level of prices of land. Land prices in main parts of cities or other areas attractive for housing or business development (with detailed plans or building permits) are between EUR 400 and EUR 1 500 per $m^2$ or about 300-1000 euros per gross price, builds a $m^2$ of residential or commercial premises. Plot prices in residential areas (with detailed plans or building permits) start from EUR 60 to 200 per $m^2$; finally, it amounts to approximately EUR 70 – 200 per $m^2$ of the total floor space to be built. In 2018 in the Vilnius region, only small positive changes occurred in the market of individual houses. In the last 5 years, there have been no major changes in the offering of land in the suburbs of Vilnius. Plots of land offered for the construction of living houses are supplied by either private individuals, or developers suggesting a complete package of land plots sold (liaison, access roads and any other prosperity). For this reason, buyers have enough good choices and negotiating power. At the end of the year 2018, the prices of private houses with partial or full finish in the suburbs of the lower cost were EUR 20 – 30 per $m^2$. Prices of land offered for agricultural purposes, depending on a district, land quality and plot, start from 1,000 up to 5,000 euros per ha (Table 1). Rental prices for agricultural land are shown in Table 2. According to the data provided by Central Register, in the year 2018, total volume of land transactions in Lithuania increased by more than 6%. The activity of transactions in the Lithuanian land

Table 1

**Prices by types of agricultural land**

| Total area by purpose | Prices by types of agricultural land \| EUR per hectare (ha) | | | | |
|---|---|---|---|---|---|
| | Y2013 | Y2014 | Y2015 | Y2016 | Y2017 |
| Republic of Lithuania | 1956 | 2171 | 3025 | 3340 | 2163 |
| Vilnius county | 1135 | 1313 | 2207 | 2787 | 1911 |
| Alytus county | 813 | 1146 | 2081 | 2401 | 1789 |
| Kaunas county | 3197 | 2863 | 3271 | 3957 | 2554 |
| Klaipėda county | 1665 | 1538 | 3478 | 3137 | 2540 |
| Marijampolė county | 2200 | 3322 | 4014 | 4595 | 2827 |
| Panevėžys county | 1885 | 2839 | 3087 | 3575 | 2130 |
| Šiauliai county | 2334 | 3476 | 3333 | 3299 | 2880 |
| Tauragė county | 1819 | 2131 | 2470 | 2741 | 2093 |
| Telšiai county | 1323 | 1755 | 2375 | 2624 | 2504 |
| Utena county | 1125 | 982 | 1533 | 1835 | 1701 |

Table 2

**Rent price of agricultural land**

| Total area by purpose | Rent price of agricultural land \| EUR per hectare (ha) | | | | |
|---|---|---|---|---|---|
| | Y2013 | Y2014 | Y2015 | Y2016 | Y2017 |
| Republic of Lithuania | 78 | 80 | 80 | 81 | 99 |
| Vilnius county | 45 | 58 | 74 | 78 | 74 |
| Alytus county | 41 | 69 | 64 | 70 | 47 |
| Kaunas county | 93 | 82 | 81 | 99 | 92 |
| Klaipėda county | 50 | 74 | 87 | 99 | 67 |
| Marijampolė county | 93 | 95 | 109 | 84 | 80 |
| Panevėžys county | 69 | 77 | 93 | 64 | 91 |
| Šiauliai county | 82 | 91 | 76 | 99 | 160 |
| Tauragė county | 56 | 72 | 43 | 40 | 72 |
| Telšiai county | 72 | 89 | 79 | 72 | 100 |
| Utena county | 59 | 59 | 70 | 66 | 75 |

market in 2018 was very high and exceeded 2015-2017. It was 12% on average in 2018. The growth of land-related transactions in the Vilnius region was not so rapid, but the indicators are well above 2014-2016. Total number of land transactions in Vilnius in 2018 increased by 4% to 495 per month. In the county of Vilnius, all land transactions increased by 2% in 2018.

The efficiency of agricultural activity in Lithuania is increasing. Recently, agricultural investment in buildings, vehicles and machinery has grown rapidly. Accordingly, the need to have more workers on the farm has decreased, so their number has been decreasing, and the farms themselves are gradually increasing. All this shows modernization of Lithuanian agriculture. The available technical capacity allows for more efficient use of farmland and more income from agricultural activities. Although a large part of farmers' investments are still in agricultural machinery, machinery and vehicles, the data show that since 2009, there has been a decline in the number of farmers. The share of investments for land acquisition is constantly increasing. There is a growing need for farmers to grow, to have more land. The technical capacity currently available to farmers is unlikely to be fully utilized. For example, large investments in the upgrading of technology and productive capacity may be hampered by a lack of land or limited amount of activity. Therefore, there is a need for farmers to increase their existing land holdings, and the demand for land or its rent rises as demand increases.

In order to solve the problem of the research and reach the aim, service quality dimensions have to be established. Many models of service quality assessment can be found in scientific literature. The most famous model used to evaluate quality of services is SERVQUAL (proposed by Parasuraman, Zeithaml, & Berry, 1988). In this model, 22 items reflecting the dimensions of service quality were provided: tangibles, reliability, responsiveness, assurance, empathy. The model was extensively applied in service industry irrespective of services kind. Therefore, it can be stated that using a general model in specific services industry might lead to abstract results. Achieving to obtain more precise and industry-specific results, a model has to be adapted. The most famous attempt to model quality of services in the industry of real estate was elaboration of RESERV (abbreviation of Real estate SERVice quality) proposed by Nelson & Nelson (1995). According to the authors, SERVQUAL was not a realistic instrument to be used as a mean of identifying and contacting recent clients of real estate brokerage firms. The RESERV scale contains more dimensions in comparison to SERVQUAL, two dimensions were added: professionalism and availability. Considering the trend that in twenty first century many service providers have transferred their activity to the internet, Parasuraman, Zeithaml, & Malhotra (2005) suggested a 22-item E-S-QUAL scale of such dimensions as: efficiency; fulfilment; system availability; and privacy; and its 11-item subscale E-RecS-QUAL, containing three dimensions focussed on handling problems with services and inquiries: responsiveness, compensation, and contact. E-S-QUAL is the mostly applied scale for measuring quality of e-service (Gedik & Etlioğlu, 2018); therefore, it can be also applied in a framework of real estate services. Another attempt to elaborate a methodology for service quality measurement in real estate industry was by Chiang & Perng (2018). Authors suggested an innovative model for the improvement of service quality in the property management industry, which combined the SERVQUAL with Kano and the Refined Kano models. Therefore, general service quality dimensions

Table 3

**The final composition of question-form**

| Scale (source) | Dimension | Items in original scale |
|---|---|---|
| RESERV (Nelson & Nelson, 1995) | Tangibles | TANG1; TANG3 |
| | Reliability | REL2; REL3 |
| | Responsiveness | RESP1; RESP2; RESP3 |
| | Assurance | ASSUR1; ASSUR2; ASSUR3 |
| | Empathy | EMPA1; EMPA2; EMPA3; EMPA4 |
| | Professionalism | PROF1; PROF2; PROF3; PROF5; PROF6 |
| | Availability | AVAI1; AVAI2; AVAI3; AVAI4; AVAI6 |
| SERVQUAL (Parasuraman, Zeithaml, & Berry (1988) | Tangibles | E3 |
| E-S-QUAL (Parasuraman, Zeithaml, & Malhotra, 2005) | Efficiency | EFF1; EFF2; EFF3; EFF4; EFF5; EFF6; EFF7; EFF8 |
| | System Availability | SYS2; SYS3; SYS4 |
| | Privacy | PRI1 + PRI2 (mixed answer) |
| | Contact | CON1; CON2; CON3 |

(expanded into 32-item scale) were categorized as: A-Attractive; M-Must be; O-One-dimensional; and I-Indifferent. Further applying The Refined model of Kano authors introduced such attributes as HA-Highly attractive and LA-Less attractive; the M category was divided into C-Critical and N-Necessary; the O category into HV-High value-added and LV-Low value added; finally, the I category was divided into

Table 4

**Eigenvalues and their rotation**

| Component | Initial Eigenvalues | | | Rotation | | |
|---|---|---|---|---|---|---|
| | Total | Variance | Cumulative | Total | Variance | Cumulative |
| 1 | 10.501 | 47.730 | 47.730 | 4.424 | 20.110 | 20.110 |
| 2 | 1.569 | 7.131 | 54.861 | 4.130 | 18.772 | 38.882 |
| 3 | 1.181 | 5.368 | 60.229 | 2.968 | 13.489 | 52.371 |
| 4 | 1.094 | 4.973 | 65.202 | 2.823 | 12.831 | 65.202 |
| 5 | 0.927 | 4.213 | 69.414 | - | - | - |
| 6 | 0.782 | 3.553 | 72.968 | - | - | - |
| 7 | 0.688 | 3.129 | 76.097 | - | - | - |
| 8 | 0.655 | 2.978 | 79.075 | - | - | - |
| 9 | 0.603 | 2.743 | 81.817 | - | - | - |
| 10 | 0.561 | 2.551 | 84.368 | - | - | - |
| 11 | 0.529 | 2.404 | 86.772 | - | - | - |
| 12 | 0.505 | 2.294 | 89.066 | - | - | - |
| 13 | 0.425 | 1.932 | 90.999 | - | - | - |
| 14 | 0.350 | 1.593 | 92.592 | - | - | - |
| 15 | 0.320 | 1.455 | 94.047 | - | - | - |
| 16 | 0.280 | 1.272 | 95.319 | - | - | - |
| 17 | 0.255 | 1.159 | 96.478 | - | - | - |
| 18 | 0.202 | 0.920 | 97.398 | - | - | - |
| 19 | 0.196 | 0.892 | 98.289 | - | - | - |
| 20 | 0.151 | 0.688 | 98.977 | - | - | - |
| 21 | 0.129 | 0.588 | 99.565 | - | - | - |
| 22 | 0.096 | 0.435 | 100.000 | - | - | - |

P-Potential and CF-Care-free. However, the research was provided in a framework of property management, not of agencies' services.

Achieving to elaborate a measurement model adapted to a framework of real estate agencies and determine the dimensions of quality of services specific to real estate market, all the presented models were analysed and discussed with representatives of real estate agencies and farmers (selling their properties with the help of agencies) to compose a situation-specific questionnaire. After a thorough analysis of the model, it was decided that RESERV duplicates the main questions of SERVQUAL; therefore, the SERVQUAL questionnaire was eliminated from further analysis. The two questionnaires: RESERV and E-S-QUAL were analysed by the experts to compose a scale for real estate agencies' service quality for farmers. After evaluation, the newly elaborated questionnaire included 25 questions from RESERVE (one of those from original SERVQUAL, which was eliminated from RESERV; and one newly composed by unifying two statements from RESERV scale) and 15 items from E-S-QUAL scale (including all 3 items reflecting 'Contact' dimension of E-RecS-QUAL). The items from Kano model were not included to the questionnaire, in order to maintain simplicity for respondents: the Kano model's essence is different in comparison to other three; therefore, additional mental efforts might be needed to complete the evaluation. The final composition of the question-form is provided in Table 3.

The questionnaire survey was provided in February, 2019; the research sample was 106 farmers intending to sell their property (land or forest) through a well-known Lithuanian real estate agency (having 22 subdivisions in Lithuania). Selected farmers had to indicate the service quality level they expected from the real estate agency by rating the items in 5-point Liker type (1 – absolutely unnecessary; 2 – unnecessary; 3 – unobtrusive; 4 – necessary; 5 – obligatory).

The obtained answers were analysed with IBM SPSS Statistics v.20 software.

**Results and Discussion**

In order to elaborate the reliable scale for real estate agencies service quality measurement – REASQ scale, the reliability analysis was provided. Following the example of Chiang & Perng (2018), 18 statements having lowest Cronbach's α were removed from

Table 5

**Communality results**

| Item | Initial result | Extraction |
|---|---|---|
| REASQ1 | 1.00 | 0.535 |
| REASQ2 | 1.00 | 0.499 |
| REASQ3 | 1.00 | 0.662 |
| REASQ4 | 1.00 | 0.767 |
| REASQ5 | 1.00 | 0.650 |
| REASQ6 | 1.00 | 0.767 |
| REASQ7 | 1.00 | 0.625 |
| REASQ8 | 1.00 | 0.446 |
| REASQ9 | 1.00 | 0.723 |
| REASQ10 | 1.00 | 0.693 |
| REASQ11 | 1.00 | 0.614 |
| REASQ12 | 1.00 | 0.622 |
| REASQ13 | 1.00 | 0.821 |
| REASQ14 | 1.00 | 0.734 |
| REASQ15 | 1.00 | 0.730 |
| REASQ16 | 1.00 | 0.688 |
| REASQ17 | 1.00 | 0.659 |
| REASQ18 | 1.00 | 0.698 |
| REASQ19 | 1.00 | 0.600 |
| REASQ20 | 1.00 | 0.583 |
| REASQ21 | 1.00 | 0.732 |
| REASQ22 | 1.00 | 0.498 |

Table 6

**REASQ instrument**

| REASQ dimension | Item | Statement |
|---|---|---|
| Professionalism | PROF1 | Real estate offices should be conveniently located |
| | PROF2 | Real estate agents should dress in a professional manner |
| | PROF3 | Real estate agency should be dependable |
| | PROF4 | The commission or fee charged should be in keeping with services provided |
| | PROF5 | Real estate agents should be knowledgeable |
| | PROF6 | Real estate agents should always be willing to help clients |
| | PROF7 | Real estate agency should respond to client requests promptly |
| | PROF8 | Clients should not have to wait to get appointments with real estate agents |
| Trustfulness | TRUST1 | Real estate agencies should tell clients exactly when services will be performed |
| | TRUST2 | Real estate agencies should keep clients informed about matters of concern to them |
| | TRUST3 | Client should feel safe in their transactions with real estate agents |
| | TRUST4 | Clients' dealings with real estate agencies should be pleasant |
| | TRUST5 | Real estate agents should make every effort to understand the needs of their clients |
| | TRUST6 | Real estate agencies should protect their clients' interest and wellbeing |
| Online convenience | ONCON1 | It should be easy to find the information in real estate agency's website |
| | ONCON2 | Real estate agency's website should enable to complete transactions quickly |
| | ONCON3 | Information in real estate agency's web-site should be well organized |
| | ONCON4 | Real estate agency's website should load pages fast |
| Online reliability | ONRE1 | Real estate agency's website does not crash |
| | ONRE2 | Real estate agency's website should protect personal information |
| | ONRE3 | Real estate agency's website should have service representatives available online |
| | ONRE4 | Real estate agents should be available at hours convenient to their clients |

the questionnaire (the reliability level was 0.500). Therefore, 22 items (overall Cronbagh's $\alpha$=0.942) in the questionnaire remained for the analysis.

As the questionnaire was given for respondent evaluation without the indication of particular dimensions, factor analysis was provided to determine the structure of real estate agencies' service quality. Analysing the results, the KMO score was higher than 0.5 (0.901>0.5) and the Bartlett's criterion's sig. was 0.000. Therefore, data were considered as reliable and suitable to provide factor analysis. After calculating and rotating the Initial Eigenvalues, four factors were established in the questionnaire (Table 4).

After component rotation, four factors define more than 65% of variance. All the communalities are higher than 0.2 (Table 5); therefore, all 22 items of the questionnaire can be used in further analysis of real estate agencies service quality.

As the dimension reduction analysis shows, all 22 analysed items can be grouped to reflect four real estate agencies' service quality dimensions. As the initial questionnaire was composed of three previously elaborated questionnaires, its adaptation to the conditions of Lithuanian real estate agencies market leads to regrouping of items and renaming the dimensions. The final instrument for the assessment of service quality provided by real estate agencies to farmers selling their properties and the evaluation of items is provided in Table 6.

After grouping all items of the questionnaire to represent particular dimensions of service quality, their evaluations by respondents in terms of necessity has to be evaluated to provide managerial guidelines for real estate agencies working with farmers. As all items in the questionnaire were evaluated by respondents in 5-point Likert scale, the evaluation mean calculation is provided to obtain a holistic picture of the model. The dimensions' evaluation means are provided in Figure.

As shown in Figure 1, the most important service quality dimension for farmers selling their property through real estate agencies is online convenience. Considering the results there might be presumed that before directly contacting the real estate agency farmers are searching for the information about services, pricing and other service-related matters. Therefore, a proper management of online websites should become a distinct concern of real estate agencies. Moreover, real estate agency's website has to be clear and work

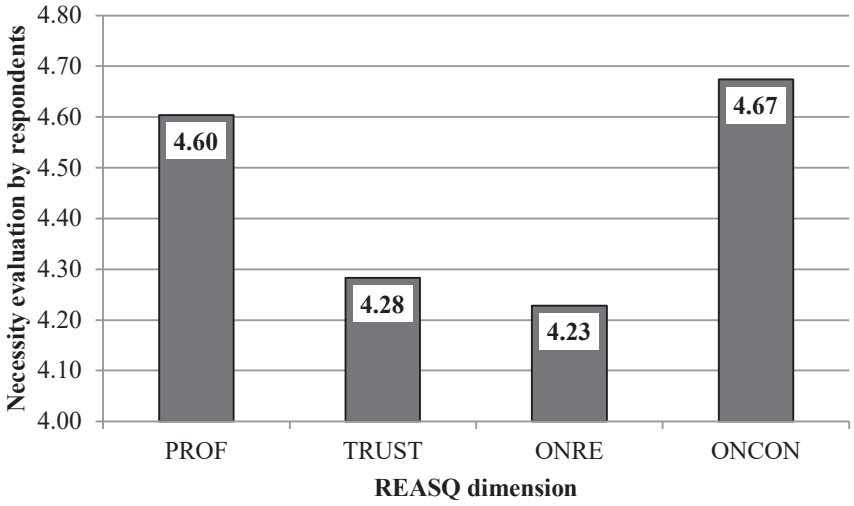


Figure 1. The evaluations of REASQ dimensions by farmers.

fast. The second very important dimension for farmers is real estate agency's professionalism. According to the results, this dimension encompasses visual appearance of the office and the staff, also, knowledge and fast pace of agents.

The two remaining real estate agencies' service quality dimensions were also evaluated as being more than necessary, but not close to obligatory.

**Conclusions**

The analysis of scientific literature related to service quality management enables noticing that extensive researches are being provided in various industries. However, when it comes to the real estate industry, the research is scarce. Several researches can be found related to real estate services management; however, none of them provides direct guidelines for the real estate agencies on how to properly assess their service quality.

In order to provide service quality research in real estate industry, a company can apply each of the models (i.e. SERVQUAL, E-S-QUAL, or RESERV), and the results will be obtained. However, if a company is achieving to get competitive advantage in the market, more precise service quality research is needed. The research provided in a framework of the services provided by real estate agencies encompassed the dimensions from all three analyzed models. The research results enabled the elimination of unimportant items from the scale; therefore, the newly elaborated scale can be applied in further research to better understand quality standards in the field of services provided by real estate agencies.

After adapting the existing questionnaires in a framework of real estate agencies' services provided to farmers, selling their property, four dimensions of service quality emerged. The dimensions were called: Professionalism, Trustfulness, Online Convenience, and Online Reliability. After analysing the respondent (farmers selling their property through real estate agencies) evaluations, the results showed that the most important dimensions were Online Convenience and Professionalism. Based on latter results it can be concluded that the importance of the Internet is obvious. Real estate agencies have to acknowledge that their customers (farmers in this case) are expecting to obtain many services online, without leaving their home. Online Convenience appeared to be the most important service quality dimension for farmers. Therefore, proper attention has to be paid to website creation and its maintenance. Another service quality dimension indicated as obligatory by farmers selling their property through real estate agencies was found to be Professionalism. Therefore, real estate agencies should also invest into their image by demonstrating their experience, intelligence and Know-How to consumers. Research results show that even visual appearance of the agency and its employees contributes to create the image of professional services.

The other two dimensions of real estate service quality – Trustfulness and Online Reliability – were considered as necessary but not obligatory. These dimensions can be considered as derivative: if Online Convenience and Professionalism is fulfilled, Trustfulness and Online Reliability also will be obtained.

By acknowledging the results obtained from the study, real estate agencies providing their services to farmers can easily improve their service quality and gain the image of professional and trustful companies. However, service quality research has to be performed constantly in order to monitor the changes in market needs and requirements regarding the quality. Also, the provided and approved questionnaire of REASQ can be used as a tool for company benchmarking and importance-performance analysis.

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# HOUSING VULNERABILITY FOR SENIORS IN LATVIA

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**Abstract**
The study concentrates on housing vulnerability during the post-crisis period in Latvia and how it has impacted vulnerable groups, particularly seniors. Housing vulnerability includes objective and subjective factors. Seniors 65+, especially those seniors who live alone are one of the vulnerable groups in sense of housing security. It could be characterized by parameters of housing quality and housing expenses adequacy. The EU policy examines perceptions of insecurity in few areas, including housing security and old-age income insecurity – of not having an adequate income in old age. The number of single senior 65+ households is increasing in both rural and urban areas. The study explores housing vulnerability for older persons – seniors 65+, one of social groups in disadvantageous economic situation. Authors explore how housing vulnerability affects seniors, especially those who are over the age of 65+ and are living alone. The challenging issues were construction of theoretical background integrating housing security during social changes in the post-crisis period with disadvantegous situation of seniors 65+. The comparative quantitative approach is based on data from descriptive statistics. The research design is quantitative comparative analysis. To make a comparison, there were selected two groups: single seniors 65+ and all households. The proposition is that in the post-crisis period housing vulnerability for seniors 65+ was decreasing, but differs from an average parameters of housing vulnerability for total population. The restriction of current study is analyses that covers only single seniors 65+. The results show significant differences in housing quality and proportional housing maintanace expenditures between single seniors 65+ and all households.
**Key words**: housing vulnerability, housing security, post-crisis period, seniors.

## Introduction

Housing is necessary for every person, regardless of its age, occupation and affiliation to an ethnic or social group. The requirements for qualitative housing may vary in different climatic conditions, influenced by certain social standards and historically established traditions. Providing an adequate housing is a challenge for different societies. It is influenced by the level of public welfare, accepted social standards, as well as specific laws and regulations.

Providing an adequate un suitable quality housing is one of the biggest challenges facing today's society in both big cities and rural areas (Eurofond, 2016). To provide housing for vulnerable groups is particularly difficult.

Seniors are individuals who belong to vulnerable groups. The concept of a senior can be defined using different age limits. In this article, referring to the elderly, authors prefer the notion of a senior rather than an elderly person. Over the past decade, seniors in English have been less and less often called elderly people or elder, instead offering a better name for older persons, older people or seniors. It is related to the topicality of the concepts of human dignity and respect in the international agenda of social policy (SIforAGE, 2016). Seniors as a statistical group from the age of 65 have been used in European Union statistics (Eurostat) to link this limit to the retirement age in most EU countries (Eurostat, 2019). The vulnarable groups including seniors are groups that are exposed to new social risks in a welfare state moving to a post-industrial society. Social policy professor Peter Taylor-Gooby of the University of Kent emphasizes that the transition to a post-industrial society is the cornerstone of the lives of those who belong to vulnerable groups (Taylor- Gooby, 2004). The Latvian law 'On State Pensions' establish the age for granting of the pension from 62 to 65 years (according to Section 11(1) of the Law on State Pensions and Paragraph 81 of the transitional provisions of the mentioned Law).

The proportion of single senior of 65+ households are increasing in post-crisis period in Latvia, in both rural and urban areas (CSB, 2019a).

Providing adequate quality housing for each person includes not only objective quality indicators (square meters, temperature, etc.), but also ideological and social support. The quality of housing is linked to other dimensions of quality of life (family life, personality development, social capital, etc.) as it is a place where they can be realized. The quality parameters and financial aspects are very important for older persons due to increased health and financial vulnerability.

The article will focus on the issues of housing vulnerability for seniors in Latvia in the post-crisis period (2010-2017). Insufficient housing security means vulnerability. In extreme situation it could be expressed as housing deprivation for seniors. The shelter services or institutional care are solutions for seniors who are coming into contact with extreem housing deprivation. The Law on Social Services and Social Assistance defines concepts: shelter, night shelter and long-term care institutions (LR Saeima, 2002) as social services and institutions, but seniors 65+ are not the main target group for these services. The concept of housing has a dual

meaning. This applies to housing functions as well as ownership and investment (Fahey & Norris, 2010). Housing vulnerability for seniors is characterised by parameters of housing quality and availability (financial parameters, maintenance difficulties) in the post-crisis period cover changes in the housing system after the global financial and socio-economic crisis (Elsinga, 2015).

The article on housing vulnerability will first analyze the theoretical approaches to the understanding of housing and the concept of possible home vulnerability, then outline the methodology of empirical research and analyze statistical data. Theoretically, housing vulnerability can be analyzed in the context of common social uncertainty, previously unknown risks and global processes.

Vulnerability issues in the public are addressed by Ulrick Beck's concept of risk society and the Zigmunt Bauman's uncertainty century (Bauman, 2007). Beck highlights crises and conflicts in risk society. Lack of housing and the problems of home improvement can be linked to poverty, crises, social exclusion and risks to housing security (Beck, 1992). Bauman associates the rise of uncertainty and fear in society with the increase in the influence of global forces, as global forces seem to be '*force majeure*' that cannot be resisted either by the individual or by the certain, especially the small state and society (Bauman, 2007).

The vulnerability of social groups is particularly acute as a result of the implementation of the neo-liberal policy of the late twentieth century. Neo-liberalism is a political philosophy that encourages individualism and market-based social and economic solutions while reducing government interference in the search for economic and social solutions. At a time when global change is demanding government interventions to mitigate environmental and socio-economic risks, an individual approach calls for government interference in decision-making and spatial planning processes. Governments have, to a certain extent, resigned from many national, regional and local housing issues. As a result, private players themselves have to deal with housing provision and quality issues. Such an approach promotes the perception of citizens as rational consumers who operate under conditions of access to information and are able to make the best choice. The social consequences are the diminishing influence of governments on housing policies at national and regional level. The contradiction of sustainable development is the demand for intervention in housing policy on the one hand, especially in improving the consequences of the crisis and the situation of vulnerable groups, and, on the other hand, the lack of appropriate instruments in the hands of governments as a result of the implementation of neo-liberal policies (Perkins & Thorn, 2012). As a result of less targeted government action, it is almost impossible for governments to develop a socially sustainable housing policy, while maintaining housing policy support for the most vulnerable.

Obvious problems in obtaining housing rental rights and mortgages can stimulate higher demand for social housing, moving to another place of residence and, in extreme cases, even homelessness. The liberal approach emphasizes the avoidance of a stigmatizing approach to victimization, which could diminish the awareness of each individual's rights to housing. Sometimes the liberal approach even avoids the use of concepts such as 'underclass' 'poor elderly', preferring the notion of vulnerable groups or 'disadvantaged groups' (Spicker, 2011). Cumulative disadvantage can be facilitated by failure of public housing policy, non-addressing the needs of individual of certain groups (Zobena, 2018). This is particularly important when it comes to social housing policies, which are aimed at ensuring certain standards and addressing the problems of social groups in vulnerable situation. Without solving the problem, a housing policy promotes reproduction of inequality (Rugh, Albright, & Massey, 2015). For example, without addressing the problems of denationalized tenants, neither they nor their family members can count on housing as property, seed capital for improving housing conditions. Citizens in poor quality housing may be at a higher risk of eviction because the new owners have an objective reason to demolish the house, make major repairs to it. Housing security means protecting against unexpected loss of home (eviction, relocation). If this happens, just follow the legitimate grounds and procedure (Payne & Durand-Lasserve, 2012).

In the article on housing vulnerability as a basis for a theoretical concept, a sustainable approach is used as well as a concept of housing functionality as a basic need in the context of the post-crisis housing solutions in post-communist countries. Housing quality parameters, their inadequacy to household needs and standards in disparities in home improvement in countries, regions, and between different types of households, as well as financial insecurity (perception of the ability to pay for housing costs) may manifest in vulnerable situation in certain (individual) group, risk of deprivation of housing and even lead the extreme manifestation of housing deprivation homelessness.

The results of the empirical study provide answers to questions about changes in housing quality and deprivation, as well as other factors affecting social insecurity. The ultimate consequences of housing insecurity can be manifested in housing deprivation, which is brightly manifested in homelessness.

The aim of study is to explore how housing vulnerability affects single seniors 65+ in the post-crises period.

There have been serious studies of housing issues in Latvia during the post-crises period (Parsova & Sidelska, 2017; Henilane, 2016), but these studies were not focused on housing vulnerability for single seniors. Previously some Latvian authors have studied housing deprivation, vulnerability, regional differences in housing quality (for example, Dobelniece & Rasnaca, 2016; Rasnaca, 2017), but the special focus on seniors' housing vulnerability is an innovative element. Seniors housing vulnerability has been mentioned in Central Statistical Bureau (CBS) publications (CSB, 2016). There are not many scientific publications about housing vulnerability of seniors in Latvia. The study about single seniors 65+ housing vulnerability discusses an innovative issue: up to now the topic has been rarely touched among social scientists in Latvia. The main tasks are: 1) to construct theoretical background based on ideas about a cumulative disadvantage and ideas of housing sustainability for seniors 65+ as a vulnerable group in housing provision; 2) to construct methodological frame for analyses of statistics; 3) to analyse results of differentiating parameters characterising housing vulnerability.

The hypothesis of comparative study is that housing vulnerability parameters allow to substantiate single seniors 65+ housing vulnerability considered as a disadvantaged group. To validate hypothesis, authors used sub-hypotheses:

1. Single senior 65+ housing quality parameters (cold and hot water supply, sewerege) are worse than all households quality parameters and it is financial burden to them.
2. Single senior 65+ housing maintenace expenditures are higher than for all households.
3. Single senior 65+ subjective perception of housing maintenance expenditure (as a heavy burden) influence on the household finansial situation is worse that for all households.

**Materials and Methods**

The research design is a quantitative comparative study. Housing quality is a multi-dimensional phenomenon, including physical and social parameters. The indicators of seniors housing vulnerability included parameters of housing quality and financial expenditures of dwelling. Housing vulnerability for seniors is characterised by parameters of housing quality and availability (cold and hot water, sewerage, and size of dwelling; objective and subjective parameters on housing maintenance expenditures). The post-crisis period cover changes in the housing system after the global financial and socio-economic crisis. The global socio-economic crisis took place in the years 2008-2009 (Elsinga, 2015). Global time framework for crisis was 2007-2008/9. The beginning of the socio-economic crisis was slightly lugged in Latvia, but it progressed rapidly. The international studies indicate that the post-crisis period began from 2010 (in political statements of Latvia, too).

In order to be able to explore how housing vulnerability affects single seniors 65+, authors used data that were obtained from Central Statistical Bureau (CSB) of Latvia data bases. The years of explicit socio-economic crisis were 2008-2009 (Kajaks, 2013; Auziņa-Emsiņa, 2014). 'From early 2010 onwards, Latvia's main economic indicators finally began to show signs of improvement' (Kajaks, 2013). The beginning of the post-crisis period can be considered both 2010 (Åslund & Dombrovskis, 2011) or 2011 (Eihmanis, 2013; Auziņa-Emsiņa, 2014). Authors of the current study consider the necessity to include the year 2010 in the post-crisis period analysis for more complete display of housing vulnerability for single seniors 65+. The time period that autors analysed the following data was eight post-crisis years and it indicates on statistical trends (EU-SILC, 2019; CSB, 2019). The post-crisis period was in 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2017. There is an insufficient data about housing for single seniors 65+ living in both rural and urban areas.

To make a comparison, there were selected two groups: single seniors 65+ and all households. First of all, authors analysed the statistical data on the the proportion of single seniors 65+ households in urban and rural area. Moreover, data about an average size of dwelling in square meters per household member in the post-crisis period in Latvia were analysed. Furthermore, parameters on housing quality were analysed (dwelling supply with hot, cold water and sewerage). In addition, housing maintenance expenditure per one household and influence on household financial situation were analysed. This parameter characterizes single seniors' 65+ subjective perception of housing maintenance expenditures.

Unlike statistical data where the particular target group is called single persons, authors of this article prefer to call this group single seniors, that way showing respect and dignity to them.

**Results and Discussion**

Although there are several studies conducted on household issues in Latvia, mainly they are focused on households policy analysis in context of quality of life. There are quite a few studies done on households property and ownership issues (Sidelska, 2013) and several studies done exploring households considering their financial aspect (Henilane, 2016), but one cannot find a research that specifically would be aimed to investigate housing vulnerability for seniors in Latvia.

According to CSB data, single seniors 65+ constituated 18.2% of urban households and 15.1% of rural households in Latvia.

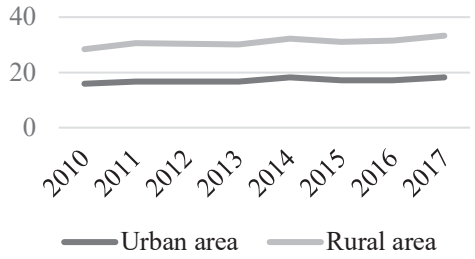


Figure 1. Proportion of single senior (65+) households in the post-crises period in urban and rural area in 2010-2017 in Latvia (%).

Source: authors' construction based on the data of Central Statistical Bureau of Latvia, 2019.

The proportion of single seniors 65+ households are slightly increasing during the post-crises period (Figure 1). It is not a direct effect of crisis, but partly due to exuberate outwards migration flows during crisis (Mieriņa, 2015) and ageing proceses in society.

The increasing proportions of single senior 65+ households in urban as well in rural area in Latvia could be described by ageing trend of Latvian population. Statistics show no evident differences between ageing trend in rural and urban area. The outward migration as the parallel process reinforces depopulation and housing size availability.

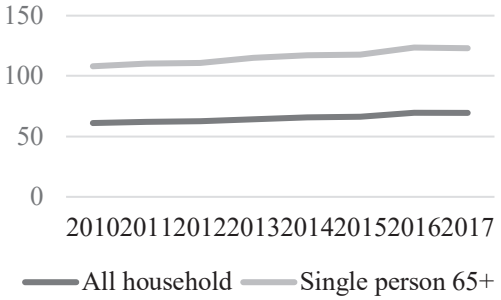


Figure 2. Average size of dwelling ($m^2$) per household member in the post-crises period in Latvia.

Source: authors' construction based on the data of Central Statistical Bureau of Latvia, Housing statistics, 2019.

Larger average size of dwelling space could be a positive factor of housing quality, but not for single seniors 65+. Larger dwelling space for seniors 65+ in Latvia means larger finansial burden necessary to pay from small pensions. More important housing quality indicator for single seniors 65+ is dwelling supply with different amenities. Seniors more often need medical and social care and better amenities could improve their life (SSE Riga, 2018).

Following data allows to analyse housing quality parameters: size of dwelling in $m^2$, amenities: hot water and sewerage.

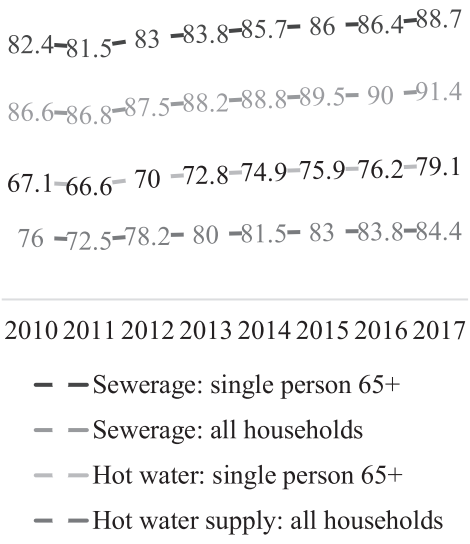


Figure 3. Dwelling supply with different amenities in post-crises period (%).

Source: authors' construction based on the data of Central Statistical Bureau of Latvia, Housing statistics, 2019.

First of all, the difference between single seniors 65+ and all households supply with different amenities (cold water, hot water and sewerage) are minor, but seniors' dwelling supply are lower by 2 – 5%. The most significant differences are in hot water supply (5.3%). Moreover, the supply with all three amenities incerase for seniors as well as for all households during the post-crises period. Furthermore, one of ten seniors 65+ still live in dwelling without severage (WC) (12.3%). Only 88.7% of all seniors 65+ have sewerage in their dwelling and 79.1% have hot water. Each fifth single senior 65+ still live without hot water in his dwelling (Figure 3). The proportion of single seniors 65+ living without basic amenities (hot water, WC) are ten times higher than in the EU (Eurostat, 2019a).

A very important indicator for housing vulnerability is financial availability – ability to pay housing expenditures.

Housing maintanance expenditure per one household has increased from 117.9 euro till 138 euro (all households) and from single seniors 65+ from 78.6 euro till 89.7 euro during the post-crises period. The sum for housing maintanance could seem rather small, but authors are taking into account that more than 50% of all age pensioners recieve less than 300 euro per month, including more than 40 000 persons with less than 200 euro per month (VSAA, 2019).

There are statistically (Chi-square <0,05) significant differences in housing maintanance expenditure per one household between all households and single person 65+ households (in 2017 13.5% and 25.5% respectively) (Figure 4). The difference in housing maintanance expenditures are rather stable during the post-crises period (from 11.2% to 13.9%).

The single seniors 65+ housing maintanance expenses are significantly higher than for all households. It could be understood as a sign for necessary changes in social housing policy.

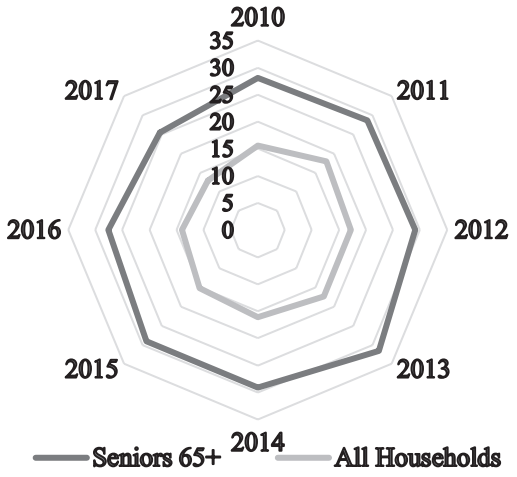


Figure 4. Housing maintenance expenditure as percentage of disposal income per one household 2010-2017.

Source: authors' construction based on the data of Central Statistical Bureau of Latvia, Housing statistics, 2019.

Housing maintanance expenditure influence on household financial situation is a subjective factor. It depends on subjective perception of difficulties to pay for housing and financial security.

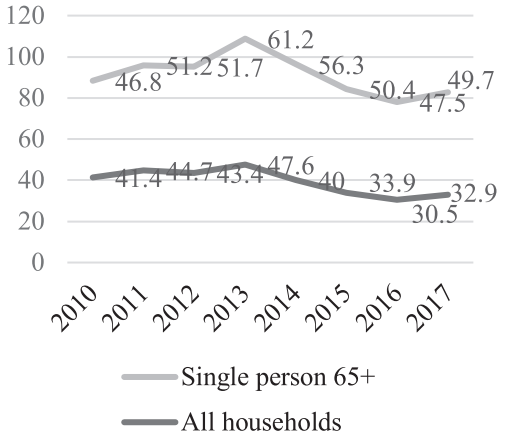


Figure 5. Housing maintenace expenditure (as 'a heavy burden') influence on household financial situation.

Source: authors' construction based on the data of Central Statistical Bureau of Latvia, Housing statistics, 2019.

First of all, overall perception of housing maintanance expenditures as 'a heavy burden' has decreased in the post-crises period in Latvia. Moreover, every third household reports about housing expenditure as 'a heavy burden' (32.9%). Futhermore, almost every second single senior 65+ expresses opinion that housing maintanance expenditure is a heavy burden for them (49.7%) (CSB, 2019). In addition, the gap between all households expressed perception of housing maintanance expenditures as 'a heavy burden' and single seniors 65+ joined this view have widened during the post-crises period. Finally, the proportion of single seniors 65+ who feel housing financial insecurity is very high – almost half of all single seniors 65+. To sum up: a) it confirms that single seniors 65+ is a vulnerable group, in a disadvantegous position compared with other househods; b) it is a signal for necessary changes in social housing policy. The data shows clear evidence about single seniors 65+ as a vulnerable group in a disadvantegous housing situation. It is not only about urban households, because there is only a slight difference between urban and rural households percieved housing maintanace expenditure as 'a heavy burden'.

**Conclusions**

1. The aim of article is reached by exploring how the housing vulnerability affects single seniors 65+ in the post-crisis period in Latvia. The objective and subjective factors were tested according to the available statistics. The quantitative comparative approach was used.
2. The housing vulnerability of single seniors 65+ are expressed to be more significant in housing supply with the basic amenities than with the size of a dwelling. The data on a subjective perception of housing expenditures as 'a heavy burden' approves use of term 'a vulnerable group in a disadvantageous position' for single seniors 65+ in Latvia. The housing deprivation level for single seniors 65+ is significantly higher compared to all households in Latvia and (in housing deprivation) to households in the EU. The level of financial burden compared to all households is significantly higher.
3. Sustainability and uncertainty theories let us understand effects of socio-economic crisis on housing vulnerability. The single seniors 65+ housing vulnerability is thematic novelty in the analysis of post-crisis proceses in Latvia.
4. Cumulative disadvantage could be observed analysing statistic data about housing maintanance expenditure. Almost every second single senior 65+ percepts housing maintanance expenditures as 'a heavy burden'. Comparative trends in financial vulnerability do not show improvements in the group's position.
5. The study results allow to validate and conform hypotheses. The available statistics is insufficient for deeper analyses of single seniors 65+ in rural/ urban comparision.

6. The analysed data shows a necessity to review social housing policy to reduce housing vulnerability for seniors 65+, especially for those who are single.
7. The main hypothesis is validated by sub-hypotheses:1) the housing quality parameters of single seniors 65+ are worse than all households (except dwelling size); 2) single seniors' 65+ housing maintenance expenditures are relatively higher than for all households; 3) single seniors' 65+ subjective perception of housing maintenance expenditure as 'a heavy burden'.
8. Methodological approach combining objective and subjective indicators and comparative approach for validation of hypotheses about housing vulnerability for one specific social group could be also applied for other social security risk groups.

**Acknowledgements**

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# TACTICAL MODEL FOR CONSTRUCTING A PROTOTYPE OF AUTOMATIZED ASSESSMENT OF TOURISM ECONOMIC IMPACT

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**Abstract**
The authors explore ways to combine the use of traditional and mobile positioning data (as Big Data) in assessing the economic impact (EI) of tourism in specific regional areas in line with the opportunities of the digital age. In order to provide an automated evaluation of the tourism EI, a study is being carried out resulting in technical development of a prototype for two interconnected digital applications – 'Data Bank' and 'Data Analysis' – as a unified solution for research in the e-environment. The study is based on the research work started in 2017 that resulted in the development of a theoretical strategic model for the construction of the prototype. Continuing the research, the aim of this publication is to develop a theoretical tactical (technological action) model needed for the practical development of the prototype, incl. for the identification of prerequisites to develop the Software Design Description (SDD) of the prototype. To this end, the technological capabilities and their collaborative effects have been investigated in line with the requirements included in the prototype Software Requirements Specification (SRS). Performing the qualitative research, the tactical model has been developed, which designates the practical construction of the prototype. It consists of a combination and joint operation of 4 platforms (servers) – Apache Ambari, Apache Hadoop Ecosystem, Drupal and Jupyter Notebook. The strengths of the model, the risky features as well as the future perspectives for the practical implementation of the goal have been discovered during the research.
**Key words**: tourism economic impact, prototype, automatized assessment.

## Introduction

Regional tourism authorities are increasingly interested in regional statistics of specific features of tourism, for instance the necessity for designing policies, the characteristics of tourism flows, the structure of supply and demand, etc. (UNWTO/INRouTe, 2013). Until recently, there was no standard for tourism research in areas that are affected by this inter-branch of the national economy, especially in the regional level assessments (Berzina, 2012). However, in 2013 the United Nations agency World Tourism Organization (UNWTO) developed the Guidelines for Socio-economic Measurement and Analysis of Regional Tourism. Their focus was on 4 main areas, including 'Tourism as an economic sector' and 'Tourism and sustainable development'. Assessment areas were as follows: supply, demand, employment, business demography, seasonality, economics, related infrastructure, social and cultural impact, etc. UNWTO admits that the 'economic impact' (EI) of tourism is a much broader concept than the 'economic contribution', and it must be estimated by applying models (UNWTO/INRouTe, 2013). This is largely in line with the methodology developed in 2012 in Latvia University of Agriculture (now Latvia University of Life Sciences and Technologies) for assessing the economic significance and the impact of tourism in specific regional areas (Berzina, 2012). The difference is that the Guidelines recommend: regional information should be georeferenced for the purpose of promoting the territorial analysis of tourism activity and other aspects. Such data supports the analysis by allowing the information collected in surveys to be presented spatially and mapped geographically (UNWTO/INRouTe, 2013). In this context, the experience of Estonia and some Asian countries is a vivid example in the world – traditional tourism statistics and spatial measurements are supplemented by the use of mobile positioning data (MPD) – Big Data (BD) (Berzina & Lauberte, 2018). The United Nations International Telecommunication Union (ITU) has concluded that success in BD analysis and cloud computing will accelerate innovation, significantly transform business, governments and societies worldwide (LETA, 2017).

The authors of the article have also studied the possibilities of combining the use of traditional and MPD in the assessment of the EI of tourism by automatizing the methodology developed in 2012 and supplementing it with the spatial dimension. It has to be admitted that the experience of Estonia has been accepted in the research from the beginning – the acquisition of MPD is possible from the towers of mobile network operators (MDT) (i.e. from MNOs). But in the near future, this research aspect could be reconsidered, as Latvia is in the process of searching for a fundamental solution in the potential use of MPD. Namely, on 01.01.2019 the amendments to the Electronic Communications Law (2004, with amendments made until 03.05.2018) came into force in the Republic of Latvia (LR), which stipulate that the Central Statistical Bureau of Latvia (CSB) has the right to use the data at the disposal of MNOs for the provision of statistics. However, there are no regulations of LR Cabinet of Ministers on how to ensure it (LR Saeima (the Parliament), 2018). There are on-going discussions on the development of the regulations and the result is not expected sooner than

a year or a year and a half (Skreija, 2019). Referring to the opinion of LR Data State Inspectorate (DSI), the creator of statistical information (CSB) is obliged, when creating information, to take into account the technological development tendencies in order to ensure the anonymity of statistical information. Taking into account the possibilities of future technologies, data can be obtained from new sources yet untapped in Latvia (Delfi Bizness, 2019). This means that the research on theoretical aspects of the use of MPD should continue, but only the scientifically tested synthesis of MPD should be used for the purpose of drawing conclusions. The first authors' research results were included in an international scientific publication in 2018, which presented research results that show the findings and propose a theoretical strategic model for building the prototype of two interrelated prototype components – 'Data Bank' and 'Data Analysis' (Berzina & Lauberte, 2018). In order to continue the research, also the prototype of a tool suitable for research in the e-environment is in the process of development. Prototype components are expected to be developed based on the theoretical findings discovered previously and during this study. The authors have developed the prototype Software Requirements Specification (SRS). The SRS includes the general requirements of the prototype and specific requirements, including limitations. For example, the prototype should be based on free software or an open source technologies, and its technical solution can be used in the future as a Platform as a Service (PaaS) on one of the cloud computing platforms. The prototype should provide automatized data processing and analysis insofar as possible, incl. the statistical verification of results. Continuing the work, the authors have successively come to choosing the tactics for further research and practical activities.

The aim of the research: Development of a theoretical tactical (technological action) model required for the practical construction of the prototype, incl. for the identification of prerequisites to develop the Software Design Description (SDD) of the prototype. Tasks: (1) to find out the most appropriate solution or a combination of technologies used for data collection, statistical analysis and their interaction, (2) to develop the tactical model for the construction of the prototype of the automatized assessment of tourism economic impact, (3) to find out theoretical strengths, weaknesses and future perspectives of founded solution or combination of technologies, (4) to create conclusions. The object of the research was to assess the technological possibilities in the construction of the prototype, but the subject of the research to determine the effects of the collaboration of technologies.

**Materials and Methods**

The study is a qualitative research based on applied and scientific literature and practical findings. The study uses the monographic, descriptive, abstract-logical methods, comparative analysis, analysis and synthesis. A significant range of information sources and technical, analytical descriptions are provided by the official websites of software developers. These frameworks were predominantly created in the United States (US), but the geography of their extensions has a peculiarity – open source technology extensions can be created by anyone anywhere in the world, just as they can be shared in the global public space.

**Results and Discussion**

In general, the prototype must be capable of operating with both traditional data and MPD. Data acquisition and storage is expected to be implemented through the prototype component 'Data Bank', which is going to be developed so that it includes the possibility to conduct surveys of visitors and entrepreneurs of the research area(s) (primary data acquisition) and integrates the external (secondary) data, including MPD. The prototype component 'Data Analysis' must be able to reveal the socio-economic character of travellers and business, to calculate the economic impact of tourism in research areas in specific regional territories, to perform the statistical analysis of results and to present the results in the spatial dimension.

*Technologies investigated for the prototype component 'Data Bank'*

The continued research by the authors based in this study on the requirements included in the SRS. To find out the most appropriate solution or a combination of them, there are numerous digital builder tools of online forms for surveys investigated.

According to the methodology of EI assessment, the surveys of visitors are to be prepared in three languages – Latvian, English and Russian, but the surveys of entrepreneurs – in Latvian (Berzina, 2012). However, this is not the only criterion in the platform analysis. It is also necessary to consider the number of possible surveys, the duration of a survey, technical possibilities and their limitations, staticality, etc. The free version of the survey creation platform visidati.lv has a restriction on the number of surveys created, the possible number of respondents, as well as on the duration of free use (three months) (VisiDati SIA, 2018). The limitation of the number of the created surveys was also identified for other platforms examined, such as Wufoo, SurveyGizmo, SurveyLegend (SurveyGizmo LLC, 2018; SurveyMonkey Inc., 2018; SurveyLegend AB, 2018). A limit on the number of respondents was identified for almost all analysed platforms except Surveyplanet, Wufoo, Google Forms (Google LLC,

2018; SurveyMonkey Inc., 2018; Survey Planet LLC, 2018). However, Wufoo also has limits on the number of survey questions and the number of fields to be filled out in addition to the limits on the number of possible surveys (SurveyMonkey Inc., 2018). There are no such limitations for Surveyplanet and Google Forms, but there are other limits (Google LLC, 2018; Survey Planet LLC, 2018) For instance, Surveyplanet supports the creation of surveys in 26 languages, but the Latvian language is not among them (Survey Planet LLC, 2018). For some of the platforms, such as TypeForm, SurveyLegend, the language choice option for creating a survey is available only in the paid version of the platform (SurveyLegend AB, 2018; Typeform, 2018) whereas Google Forms is free only for personal use. On the Google Forms platform a survey can be created in all three languages, but there is a major constraint in the survey interface language – there can only be one language, and this option is linked to the Google account configuration language parameter (Google LLC, 2018). While exploring the capabilities of platforms, the authors discovered that only in one of them, Webropol, it is possible to perform statistical analysis tests, but it can only be done using the paid platform version (Webropol Oy, 2018). Therefore, the platform data export capabilities required for the automatizing of data processing were also evaluated. The authors concluded that in most digital builder tools of online forms for surveys data export is only possible in platform paid versions. It is only available for free on the Google Forms, KwikSurveys, TypeForm, Wofoo platforms (Google LLC, 2018; Problem Free Ltd., 2018; SurveyMonkey Inc., 2018; Typeform, 2018). It could be argued that Google Forms would be the best choice for the platform to use, because it has no limit on the number of questions or the number of forms created, and the download of data is possible. However, it has a major drawback – its free version is only available for personal use and has no possibility for downloading data. All these constraints of various kinds hinder the creation of a convenient and static automatized calculation solution for assessing the economic significance and the impact of tourism. From the perspective of the solution sustainability, some of the platforms that were available free of charge no longer exist, other platforms are developed instead, but some have become a paid or subscription service.

Consequently, the authors explored the possibilities of using one of the open source content management systems for the prototype component 'Data Bank'. Given that not only data collection, storage, but also data sorting and analysis are expected to be carried out in the framework of both components of the prototype, additional requirements were imposed on the content management system. These include: (1) data security, (2) fast operation, (3) flexibility in form content creation, data sorting and display capabilities, (4) multi-user capability with a mechanism of creator rights, (5) ability to transfer the platform to one of the cloud computing platforms in the future. Therefore, the most popular free open source platforms Wordpress, Joomla and Drupal were explored and analysed (Ivanovs, 2018; POX, 2018). All 3 platforms are available as the service from the public cloud providers such as Google Cloud Platform, Amazon Web Services (AWS) and others. WordPress was originally designed as a blogging platform; therefore, it is more suitable for simple webpages like a blog, and performance is one of its weak points. Drupal is a lightweight platform, which is made for fast performance and is more secure by default installation. From these three platforms, Drupal has more features for managing content types, which will be useful for creating data views, and it has a better user permission management (Mening, 2018; Silverman, 2017). By studying the research results by different authors and the comparisons of these 3 digital tools, it can be concluded that Joomla is something in-between both (Mening, 2018; Morris, 2019; Silverman, 2017). Drupal is more of an enterprise content management system (CMS) solution and it is more popular among enterprise websites (Mening, 2018; Morris, 2019). These aspects convinced the authors that the development of the prototype component 'Data Bank' should be based on the open source CMS Drupal whereas for the acquisition and storage of MPD, the open source BD platform 'Apache Hadoop Ecosystem' has been selected since it has many appropriate libraries for managing and processing BD, including the support for statistical tests. These results of the authors' research were included in the scientific publication in 2018 (Berzina & Lauberte, 2018).

*Technologies investigated for the prototype component 'Data Analysis'*

According to the EI assessment methodology, the prototype component 'Data Analysis' should be able to perform the division of respondents into 13 segments (Berzina, 2012). It is the basis of the structure for further characteristics and calculations included in the assessments. Among the actions envisaged, the prototype should mainly perform the functions of summation and comparison (difference determination), in specific cases – division, multiplication and expression of results in percentage. From the technical point of view, these are not complicated procedures until the moment when the 'Data Analysis' should perform a statistical analysis of the results obtained. At this point the right choice of the programming language, support mechanisms, possibilities of result visualization, appropriate tools and other technical aspects become crucial. To provide

a functionality of automatized statistical verification of assessment results, the prototype component 'Data Analysis' must be able to carry out 7 kinds of statistical calculations, analyses and tests. To realize this aim, the usage of: (1) developing calculation procedures in the database management system (DMS) MySQL for traditional data, (2) developing calculating functions for traditional data using the Drupal native language PHP, (3) developing calculation procedures using the programming language R and/or (4) the programming language Python has been studied.

The MySQL and PHP – the Drupal native language are not so appropriate for the purposes of statistical analysis without a voluminous programming pre-work. The reason is that these kinds of statistical analyses have never been technically integrated in MySQL and PHP before. Until now, not all, but just some of them are integrated. There are several up-to-date publications confirming that MySQL is not suitable for large scale high-quality data analysis, and other solutions/ technologies are better suited for these aims (Diederich, 2018; Levy, 2016; Periscope Data, 2015). The MySQL optimizer is quite limited because it can execute queries using a single thread, but cannot scale among multiple computer processors cores (Diederich, 2018). The PHP language has some mathematical and statistical extensions that contain functions for statistical computations, but part of them are not documented. PHP is powerful, but not enough for statistical analysis (Ciucu, 2014). The 'Data Analysis' must be able to analyse both MPD and traditional data using a single language, solution. The language R is an environment for statistical computing and graphics that was initially written by Ihaka and Gentleman at the University of Auckland in New Zealand (The R Foundation, 2018). Python is a general purpose language and its greatest strength is a huge amount of libraries like SciPy – a Python-based ecosystem of an open source software for mathematics, science, and engineering, including spatial algorithms. For instance, Voronoi diagrams NumPy – the fundamental package for scientific computing with Python, Matplotlib – Python 2D plotting library, Blaze – query data on different storage systems like the Hadoop ecosystem (Spark, Hive) and other libraries (NumPy developers, 2018; Rodrigues & Overholt, 2015; SciPy developers, 2018; The Matplotlib development team, 2018; The SciPy community, 2018). There is an on-going debate in the research environment about which programming language is the most suitable and fastest for data analysis (Dataquest Blog, 2018; Data-Driven Science, 2018; EliteDataScience, 2017; Ray, 2018). Both are being actively developed in the world. As a result, the major constraints faced by users for a long time have been eliminated. The Python language has diminished the limitations on data visualization possibilities, while the R language – data wrangling (EliteDataScience, 2017). The Python language is becoming more popular in comparison with the R language, and not only because it is a general purpose language, but it is also increasingly used in Data Science and analytics (Piatetsky, 2018). As a result of the investigation, the authors concluded – the programming languages R and Python show the broadest usage for data statistical analysis in the scientific world.

For the purposes of the prototype component 'Data Analysis', there is a need for a tool that would simplify the technical-practical development in view of its complexity. Increasingly, the digital tool Jupyter Notebook is used in scientific research and publications in Data Science (Randles *et al.*, 2017; Unidata, 2019). The Jupyter Notebook is an open source web application that allows creating and sharing documents that contain a live code, equations, visualizations and a narrative text. The usage includes data cleaning and transformation, numerical simulation, statistical modelling, data visualization, machine learning, etc. The Jupiter Notebook has support for over 40 programming languages, including the Python and R language and it has integration with Apache Spark from the Apache Hadoop Ecosystem (Project Jupyter, 2019). It must be noted that the Apache Hadoop Ecosystem has its native notebook tool called Apache Zeppelin. However, when exploring the technical capabilities, strengths and weaknesses of both tools, the authors concluded that Jupyter Notebook is more powerful because of a huge list of supported libraries, including more libraries for visualizing data (Project Jupyter, 2019; Zeppelin, 2019). Zeppelin has a better integration with Apache Hadoop because it is a native tool – it has interpreters for many libraries that are supported in the Apache Hadoop Ecosystem. Both tools can run scheduled tasks, but only Jupyter has options to export a developed notebook as a Python code. It will be very useful for the prototype component 'Data Analysis' to be able to integrate already existing data processing procedures at the end of the development process, thereby automatizing data analysis. There are several ways to connect Jupyter Notebook and get data from the BD platform – run alongside the existing Apache Hadoop platform and access data from Spark, install standalone and use additional tools/extensions like Apache Toree, SparkMagic and Apache Livy, etc. Thereby for creating the prototype component 'Data Analysis', the open source web application tool Jupyter Notebook should be used. It: (1) supports more Python libraries, (2) has better data visualization opportunities, (3) can process both data types – traditional data and MPD, (4) data analyses code can be exported as Python scripts which will be very useful for the automating of the data analyses process.

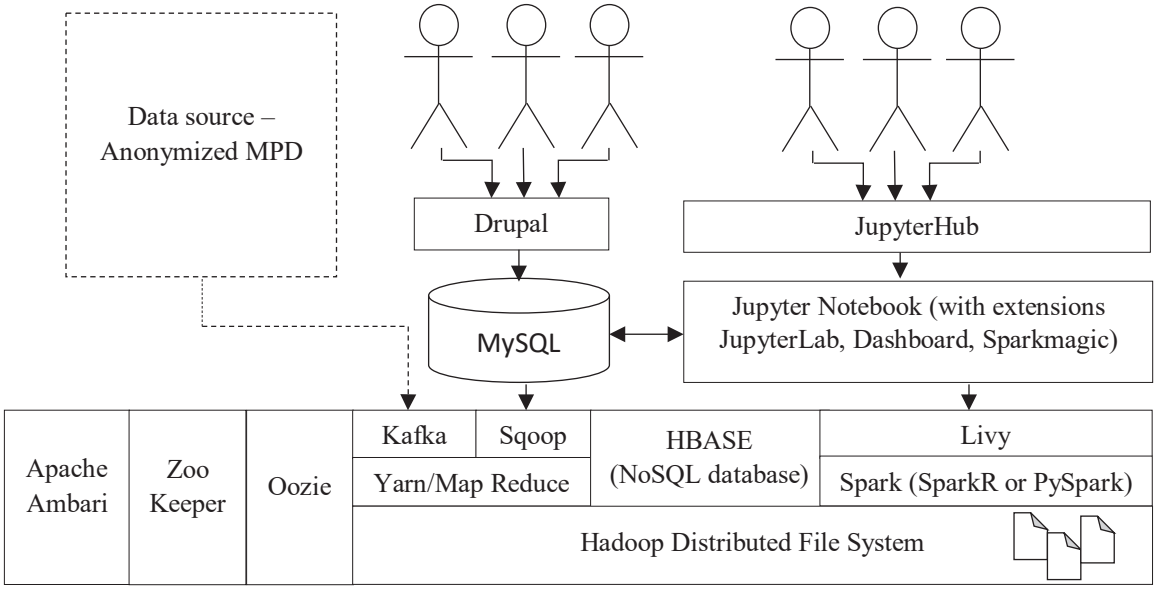


Figure 1. The tactical model for the construction of the prototype of the automatized assessment of tourism economic impact (created by the authors).

*Interaction of technologies investigated for the prototype development*

Following the examination of the platforms and their support tools, the authors compiled and explained the interconnected technologies and the technologies to be combined that are going to be used in the prototype development. Kafka is a general purpose data collection and streaming tool. For security reasons, Kafka has the encryption of data in-flight using SSL / TLS: This allows data to be encrypted between endpoints (Maarek, 2018). Kafka may be one of the solutions for automatically receiving MPD provided by MNO towers or the LR CSB. Whereas ZooKeeper is like a coordinator that maintains and synchronizes configuration information for distributed applications, Oozie is a workflow scheduler system to manage Apache Hadoop jobs. Yarn and Map Reduce are resource managers for data processing, but HBase is a NoSQL database for MPD storage and data query. Sqoop is like a connector between databases – it can import and export data from MySQL databases. Spark is an analytical framework with programming libraries like SparkR (R on Spark) and PySpark (Python API for Spark). Tool Apache Livy is a connector of Jupyter and Spark (The Apache Software Foundation, 2019). Apache Ambari – a web-based monitoring and managing software for the Apache Hadoop Ecosystems clusters. Jupyther Notebook includes the following extensions: (1) JupyterHub – for multi-user management support, (2) Jupyter Dashboard – layout extensions that allow managing and displaying data analysis results, (3) JupyterLab – enables arranging work area with notebooks and text files in one window, (4) Sparkmagic used for the Jupyter integration with the BD framework Spark. Drupal is a CMS that in conjunction with the Jupyter Notebook platform and extensions, and the code developed in the Python and/or the R languages can be very powerful for Data Science, because Drupal has the ability to collect information, and Jupyter Notebook – to process and analyse from both data stores – traditional data and MPD.

Based on the investigation results, the authors created the tactical model for the construction of the prototype of the automated assessment of tourism economic impact in specific regions (Figure 1).

Creating a theoretical tactical (technological action) model that is essentially a combination of technological solutions used in the prototype construction, the authors see both its strengths, weaknesses, and future perspectives. The following can be considered as the theoretical values of the model:

1. The ability of the model to be flexible – the wide range of the available library modules in the ‘Data Bank’ and ‘Data Analysis’ structure will allow the solution to be used for other research in future;
2. Using the ‘Data Bank’ content management system, authorized users will be able to easily create new multi-language survey forms, sort the data submitted there, and create new data views;
3. The ‘Data analysis’ interactive interface will allow easy and fast data analysis and visualization;
4. The standalone system eliminates the risk that a platform manager stops working or makes significant technological changes that threaten the sustainability of the model;

5. After the development and validation of the 'Data Analysis' component of the prototype, it will be possible to export the data analysis stages as executable scripts for further integration into the system as automatic background data processing processes;
6. A model based on open source technologies ensures that there is no need to buy/subscribe to licenses, and the technologies selected provide a possibility for it to be 'transferred' to one of the cloud computing platforms in the future;
7. The technologies support distributed computing.

Risky technological features of the model:

1. The technological combination consists of a set of components, libraries, and it can complicate the technological installation, configuration and administration of the practically implemented prototype.
2. The limitations of the mutual collaboration of libraries are not fully known. Thus, there is a risk of being forced to change the libraries.

Future prospects for the practical implementation and maintenance of the model:

1. To evaluate the integration possibilities of the applications' interfaces, including a unified authentication mechanism, taking into account data security aspects;
2. To assess available resources to separate the externally available information systems from the internal at the network level;
3. To migrate the model to one of the cloud computing platforms.

**Conclusions**

1. The tactical (technological action) model of the construction of both prototype components – 'Data Bank' and 'Data Analysis' consists of a combination and joint operation of 4 platforms (servers) – Apache Ambari, Apache Hadoop Ecosystem, Drupal and Jupyter Notebook;
2. The model includes promising open source technologies that are combined to produce a powerful framework that can process, analyse and visualize both traditional data and MPD;
3. The tactical model complies with the conditions of the SRS – using free open source solutions that must be able to operate with traditional and MPD, perform simple and more complex calculations, and the statistical analysis and visualization of results. Taking into account that the methodology for evaluating tourism EI is a set of mathematically static (fixed) actions, the requirement for ensuring a higher statisticality of the model is also met – considering the peculiarities of cooperation of all involved technologies, it is possible to transfer the model to one of the cloud computing platforms;
4. In the course of the research, the values of the model, possible risky features and future perspectives for the implementation of the model have been identified. This proves that there is a basis for the continuation of the research, but already in parallel with the technical development of the prototype.

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# LEGAL ASPECTS AND SUPPORT INSTRUMENTS FOR SOCIAL ENTREPRENEURSHIP IN THE BALTIC STATES

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**Abstract**
Social entrepreneurship plays an increasing role in society. It is evidenced not only by the inclusion of a section on social entrepreneurship in the Europe 2020 strategy but also by the engagement of European countries in making legal documents on social entrepreneurship as well as designing support programmes in order to help entrepreneurs to start up a social entrepreneurship business. The research aim is to characterise the legal aspects of social entrepreneurship and support instruments for the promotion of social entrepreneurship in the Baltic States. In order to achieve the aim, the research analysed legal acts and strategic policy documents regulating social entrepreneurship in Latvia as well as analysed the legal framework for social entrepreneurship in Lithuania. To do the analysis, the research examined the kinds of support for starting up a social entrepreneurship business in the Baltic States. The research has found that no uniform definition of social entrepreneurship is available in Europe, which does not result in a unanimous opinion on what a social enterprise should be. In the Baltic States, the Social Enterprise Law has been passed in Latvia and Lithuania; besides, the laws mainly focus on the integration of target groups into society, addressing no other essential problems that could be solved by means of social entrepreneurship, e.g. environmental protection.
**Key words**: social entrepreneurship, social enterprise, legal aspects, Baltic States.

## Introduction

The term social entrepreneurship has emerged in the world quite recently. According to various research investigations (Nicholls, 2006; Trivedi, 2010), the term for the first time was used in the book 'The Sociology of Social Movements' by J.Banks in 1972. The book stresses that social problems are tackled by applying a management approach (Banks, 1972). M. Yunus is considered to be the founder of social entrepreneurship; he is a social entrepreneur from Bangladesh, the founder of Grameen Bank and a Nobel Peace Prize winner. M. Yunus defined seven principles of social entrepreneurship that make the basis for the definition of social entrepreneurship (Hoogendoorn, Pennings, & Thurik, 2010). However, viewing the evolution of social entrepreneurship from the legal perspective, one can conclude that the very first country that made legal acts pertaining to social entrepreneurship was Italy with the New Italian Law on Social Enterprise adopted in 1991, which was complemented in 2006 (Fici, 2006). Italy was followed by the United Kingdom and Lithuania (Nyssens, 2006; Law on Social..., 2007).

In pursuit of economic development and solutions to employment problems and environmental challenges at national level, social entrepreneurship developed fast in recent years; consequently, relevant legal documents have been drafted and enhanced, various projects aimed at contributing to social entrepreneurship were implemented and various kinds of tax relief were introduced for social entrepreneurs. The research aim is to characterise the legal aspects of social entrepreneurship and support instruments for the promotion of social entrepreneurship in the Baltic States. In order to achieve the aim, the following specific research tasks are set: 1) to examine the legal frameworks for social entrepreneurship in Latvia and Lithuania; 2) to analyse support instruments for social entrepreneurship in the Baltic States.

In the world, social entrepreneurship has been researched by D. Bornstein (2010) who mainly focused on social innovation, A. Nicholls (2006) who stressed the role of social entrepreneurship in social development as well G. Dees (2002) who researched the practical application of social entrepreneurship. In the Baltic States, social entrepreneurship has been researched by a number of scientists, including L. Licite (2013), E. Butkeviciene (2008), Jolita Greblikaite (2012) *et al*.

## Materials and Methods

To achieve the aim and perform the tasks, the research employed several methods. The monographic and descriptive methods were used to make a theoretical discussion on legal aspects and interpret the research results based on scientific findings and theories on social entrepreneurship. Analysis and synthesis were employed to examine problem elements in legal aspects across the Baltic States and identify regularities. Induction was used to make scientific assumptions from individual elements or facts and identify causal associations. Deduction was used for logically systemising and explaining empirical data.

## Results and Discussion

*Legal framework for social entrepreneurship in Latvia.* No uniform definition of social entrepreneurship has been given in the European Union. Instead, Paragraph 3.1 of the Opinion of the European Economic and Social Committee on 'Social Entrepreneurship and Social Enterprise'

suggests giving characteristics of a social enterprise based on certain indications of it in accordance with Subparagraph 3.1.1 'Diverse linguistic and cultural traditions have led to differing meanings of the concepts of social enterprise' (European Economic and..., 2012). By giving characteristics of a social enterprise instead of a uniform definition, the concept of social entrepreneurship is very broad, thereby creating a similar understanding of it in all the EU Member States while also allowing each Member State to adapt the legal form and other aspects of social entrepreneurship to the particular situation.

The Constitution of the Republic of Latvia stipulates that Latvia is a socially responsible state that protects the fundamental rights and respect of individuals as stated in Section 106 – 'everyone has the right to freely choose their employment and workplace according to their abilities and qualifications'. However, Section 115 states that 'the State shall protect the right of everyone to live in a benevolent environment by providing information about environmental conditions and by promoting the preservation and improvement of the environment'. On the basis of the Constitution, it can be concluded that the mentioned sections directly pertain to the substance of social entrepreneurship, and this legal act is the most important one in the hierarchy of legal documents in Latvia (Figure 1) (Constitution of the Republic of Latvia, 1922). It has to be noted that a socially responsible state involves not only the responsibilities set by the state in the legislation but also the self-engagement of individuals in social responsibility. One of the ways how to be socially responsible is to contribute to social entrepreneurship. It has to be mentioned that 'human rights, the rights to favourable working conditions, protection against unemployment and discrimination' represent the basis of Article 23 of the UN Universal Declaration of Human Rights stipulating that 'everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection' (UN Universal Declaration of Human Rights, 1948).

Since one of key goals of social entrepreneurship is the involvement of target groups in business and employment, it is essential to refer to the UN Convention on the Rights of Persons with Disabilities. Article 27 of the Convention stipulates that in the UN member states, discrimination on the basis of disability is prohibited and persons with disabilities have the rights to work and favourable conditions of work as well as the member states have to contribute to the integration of persons with disabilities into the labour market, which is also stated in the European Social Charter (Par Pārskatīto Eiropas..., 2013). It has to be also noted that most of the social enterprises registered in Latvia (Social Enterprise Register, 2019) employ persons with disabilities, even though the Cabinet Regulation 'Regulations regarding Population Groups at Risk of Social Exclusion and the Procedure of Granting, Registering and Controlling the Status of Social Enterprise' prescribes that the following social groups are at risk of social exclusion:

- persons with disabilities;
- persons with mental impairments;
- persons having the status of poor family (person);
- unemployed persons having dependents, unemployed persons aged 54 and older and long-term unemployed persons;
- ethnic minority – the Roma;
- imprisoned persons or those released from imprisonment;
- persons addicted to alcohol, drugs, psychotropic or toxic substances, gambling or computer games;
- persons whose place of residence is a night shelter;
- human trade victims;
- persons whom the status of refugees, an alternative status or the status of stateless persons have been granted in the Republic of Latvia;
- orphans and children without parental care aged 15 and more as well as adults up to the age of 24 who belong to this social group (Regulations regarding Population…, 2018).

The Opinion of the European Economic and Social Committee on 'Social Entrepreneurship and Social Enterprise' stresses the role of a social enterprise and the benefits it gives to the society (European Economic and..., 2012). The opinion states that social entrepreneurship is the basis for establishing a European social model, and it is strongly associated with the strategy Europe 2020 whose three priorities are as follows: developing an economy based on knowledge and innovation; promoting a more resource efficient, greener and more competitive economy; fostering a high-employment economy delivering social and territorial cohesion (Europe 2020). However, it has to be stressed that the development of social entrepreneurship is strongly associated not only with tackling human resource and employment problems but also with the other two priorities. Social entrepreneurship requires innovative solutions and knowledge management, and the founder of the social enterprise TOMS, Blake Mycoskie, could be mentioned as an example. In 2006, he established a footwear enterprise with the aim of donating a pair of footwear to those in need for every pair of shoes sold (Dubois, 2011). One of the most important areas to be considerably affected by the development of social entrepreneurship is environmental protection and environmental safety. One of the most popular social enterprises in the world, Seventh Generation, Inc., is

engaged in producing environment-friendly cleaning and personal care products, thereby contributing to reducing the ecological footprint in the world (Seventh Generation, [s.a.]).

In Latvia, social entrepreneurship is regulated by the Social Enterprise Law (2018); its purpose is to 'facilitate improvement in the quality of life of the society and to foster employment of population groups at risk of social exclusion, creating an economic activity environment favourable to social enterprises'. The Social Enterprise Law has been in force in Latvia since April1, 2018, and the key shortcoming of it is the focus on target groups, even though social entrepreneurship encompasses environmental and other aspects (Social Enterprise Law, 2018). The Social Enterprise Law is based on the 2014 conception 'On Opportunities for Introducing Social Entrepreneurship in Latvia', the action plan of which prescribes making the Social Enterprise Law (Koncepcija 'Par sociālās...', 2014) as well as the Commercial Law (Commercial Law, 2002). Besides, the Sustainable Development Strategy of Latvia until 2030 prescribes the establishment of social enterprises and support for social entrepreneurship (Section 97) as one of the priorities of the government, while Section 157 of the strategy refers to the need for new social services and support networks stimulating social enterprises and the integration of individuals into them (Sustainable Development Strategy…, 2010). Since the Social Enterprise Law was passed as late as in 2018, the law 'On the Enterprise Register of the Republic of Latvia' has no section on the procedure of registering social enterprises (On the Enterprise Register…, 1990), and the procedure is prescribed by the Cabinet Regulation 'Regulations regarding Population Groups at Risk of Social Exclusion and the Procedure of Granting, Registering and Controlling the Status of Social Enterprise'. However, as mentioned above, the Cabinet Regulation focuses on the target groups, which is in contradiction to the opinion of the European Economic and Social Committee and the strategy Europe 2020 (Regulations regarding Population…, 2018).

In Latvia, the Social Enterprise Register is administrated by the Ministry of Welfare, and, according to the data, 43 entrepreneurs were granted the status of social enterprise (Social Enterprise Register, 2019).

The Labour Law is also applicable to social enterprises just like any other enterprises, and Section 7 of it defines the principles of equal rights and non-discrimination (Labour Law, 2002). Stressing that in Latvia, unlike in Europe and the world, social entrepreneurship is mainly associated with the integration of target groups into the labour market, the Environmental Protection Law has to be also mentioned, as its purpose is to 'ensure the preservation and recovery of the quality of the environment, as well as the sustainable utilisation of natural resources'. Furthermore, it has to be noted that the Environmental Protection Law mainly refers to sustainable development and biodiversity preservation, which is closely associated with the priorities of Europe 2020 and the basic principles of social entrepreneurship (Environmental Protection Law, 2006).

Figures 1 and 2 show the hierarchy of legal and strategic documents in Latvia.


Figure 1. Basis for the strategic documents of social enterprises in the Republic of Latvia.

Source: authors' construction.

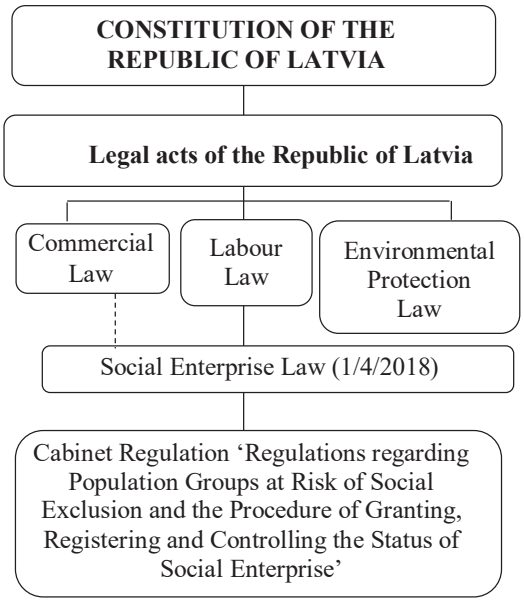


Figure 2. Hierarchy of legal documents on social entrepreneurship in Latvia.

Source: authors' construction.

Table 1

**Characteristics of social entrepreneurship in Latvia and Lithuania**

| Indicator | Latvia | Lithuania |
|---|---|---|
| Social Enterprise Law adoption (entry into force) | 2018 | 2004 |
| Number of social enterprises in 2019 | 43 | 176 |
| Key legislative shortcomings | • Law is general, there is a lack of detailed characteristics;<br>• Social Enterprise Register is not transparent;<br>• Law focuses on target groups. | • Social Enterprise Law aims to contribute to the integration of target groups into the labour market; no legal framework for other aspects of social entrepreneurship;<br>• Social Enterprise Register is available only in Lithuania. |
| Key kinds of tax relief | • Enterprise income tax relief;<br>• Local government has the right to grant immovable property tax relief. | • Salaries and state social insurance contributions are partly covered;<br>• Subsidies for new jobs, adaptation of workplaces to persons with disabilities and purchase or adaptation of equipment for such persons and transport costs;<br>• 15% corporate income tax rebate. |

Source: authors' construction based on the Social Enterprise Law, 2018; Law on Social..., 2007.

*Legal framework and support programmes for starting up a social entrepreneurship business in the Baltic States.* Social entrepreneurship is developed unevenly in Europe. In the Baltic States, the legal frameworks for social entrepreneurship are at different stages of development. Even though the strategies of the EU Member States have been affected by the strategy Europe 2020, which contains important points about social entrepreneurship and how to foster it, the Social Enterprise Law has not been adopted in Estonia. In Latvia, the law became effective in 2018, while in Lithuania, which was one of the first countries to adopt the law, it has been in force since 2004 (Law on Social..., 2007). Since the Social Enterprise Law has been adopted only in Latvia and Lithuania, Table 1 gives the legal characteristics of social entrepreneurship in Latvia and Lithuania.

It has to be mentioned that in the Sustainable Development Strategy of Latvia until 2030 and the National Progress Strategy 'Lithuania 2030', innovations in entrepreneurship and the promotion of development of social enterprises is one of the priorities (Lithuania 2030, 2010). According to the Social Enterprise Register of Lithuania, the last

Table 2

**Support programmes for promoting social entrepreneurship in the Baltic States**

| Country | Support programme | Kind of support | Form of support | Shortcomings |
|---|---|---|---|---|
| Latvia | International social entrepreneurship development programme 'New Door' | Training programme | Support for mentors, start-ups, consultations on social entrepreneurship, forums, experience exchange programmes | Support only for social start-ups working with the target groups |
| | Shop chain 'Otrā Elpa' scholarship programme | Financial support for social projects | Profits are allocated for implementing social ideas; in a 9-year period, EUR 115 thou. were invested to co-fund social projects | No information is available on the website on the procedure of applying for projects supported and the way they are carried out |
| | Foundation for an open society 'DOTS' | Popularisation of the idea of social entrepreneurship among the public | Social entrepreneurs have an opportunity to participate in the foundation's events, share their experience and get advice | No uniform criteria for engagement in the foundation and getting support are defined |
| | Programme 'Reach for Change' | Business incubator | Development of business ideas of social entrepreneurs, training, financial support and establishment of contacts | Range of project activities is limited – social entrepreneurs have to develop their ideas related to children life enhancement |

Table 2 Continued

| | | | | |
|---|---|---|---|---|
| Estonia | European Social Fund | Financial support | Within the Europe 2020 strategy, support is provided to social entrepreneurs in European countries to the extent of 50 – 95% of the project budget | Support only for projects in which the target groups are involved |
| | National Foundation of Civil Society | Financial support for NGOs | Financial support up to EUR 2000 for projects related to the integration of target groups into society and creation of new jobs | Support for particular projects with a certain goal rather than for social entrepreneurship |
| | Estonian Civil Society Development Conception | Social entrepreneurship support measures | Strategy designed by the Estonian Ministry of the Interior is based on civic society development measures and the integration of target groups into society | No particular measures or target audience are defined, just a strategy |
| | Good Deed Foundation | Financial support for social entrepreneurship ideas | Total support EUR 500 000 (3 years) for 4 – 6 projects aimed at tackling social problems; support for 10 – 15 initiatives in the amount of EUR 1 million aimed at education of the target groups | No criteria to be met by an organisation or enterprise to participate in a competition are defined |
| Lithuania | Kazimiras Simonavičius University | Education services in the area of social entrepreneurship | Courses in social entrepreneurship and innovation under the Bachelor programme Business and Management | No information on whether the courses in social entrepreneurship could be taken as a listener |
| | National Social Integration Institute | Support for the integration of target groups into society and the working environment | Support for social innovation projects, maintenance of contacts with target group representatives and establishment of contacts between the target group representatives and entrepreneurs | No information on the website about the projects implemented and an opportunity to take part in the programme |
| | Association of Social Enterprises for the Disabled | Assistance for the disabled to get integrated into the labour market | Project management and organisation of activities, assistance in finding jobs for persons with disabilities, education for entrepreneurs | Website is active, yet the last time the news was updated was in 2015; therefore, it is impossible to find out whether the initiative is active and if there is an opportunity to take part in the projects |
| | NGO ‘Socialinis verslas’ | Source of information on the latest developments in social entrepreneurship | Organisation of an annual summit on social entrepreneurship, assistance in finding contacts and establishing cooperation between social entrepreneurs and business supporters | Website provides general information; no information about particular projects or success stories |

Source: authors’ construction.

social enterprise was registered on June 1, 2018, and their total number was 176 (Lithuanian Labour Exchange, [s.a.]). Just like the Social Enterprise Law of Latvia, the Social Enterprise Law of Lithuania focuses on the integration of target groups into the labour market, disregarding the other aspects of social entrepreneurship, e.g. environmental protection (Law on Social..., 2007).

It is important to note that even though Estonia lacks legal acts on social entrepreneurship, the number of social enterprises increased fast owing to the Strategy of Estonia 2030, as well as the Estonian Social Enterprise Network, the strategy of which encompasses social entrepreneurship promotion measures until 2020, which was established (Estonian Social Enterprise, [s.a.]).

Both in Latvia and Lithuania, various support programmes for social entrepreneurship are available (Table 2).

After examining the support programmes for social entrepreneurship, one can conclude that the key shortcoming is the fact that the support is given to the initiatives that engage human resources – the target groups – in projects. Out of all the organisations examined, only Good Deed Foundation in Estonia noted on its website that the projects and initiatives submitted could relate to environmental problems. However, the Latvian enterprise ‘Otrā elpa’ is a good example of how not only to develop social entrepreneurship and contribute to charity but also to support other entrepreneurs, thereby making feedback. An analysis of Lithuanian experience in social entrepreneurship

revealed that Kazimiras Simonavičius University provides considerable support to social entrepreneurs through educating them, giving them an opportunity to take courses, develop innovations and popularise social entrepreneurship.

**Conclusions**

1. The key challenge to the legal framework for social entrepreneurship is that each Baltic State interprets the criteria set in the Opinion of the European Economic and Social Committee on 'Social Entrepreneurship and Social Enterprise' differently, which leads to the lack of a single concept, as there is no single definition and clear criteria.
2. In Latvia and Lithuania, the Social Enterprise Laws focus on the target groups, yet social entrepreneurship is associated with also other factors – education and environmental protection, yet the laws do not refer to the factors, which creates an impression that social entrepreneurship pertains only to human resources.
3. In Latvia, the Social Enterprise Law entered into force as late as 2018, and its support for social entrepreneurs is considerably smaller than that available in Lithuania where social entrepreneurship has been developing since 2004.
4. In Estonia, the social entrepreneurship movement expands fast, yet there is no single law regulating social entrepreneurship. For this reason, entrepreneurs themselves interpret the concept of social entrepreneurship in Estonia, which means that those claiming to be social entrepreneurs might not be such entrepreneurs.

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# THE CONTRIBUTION OF UNIVERSITIES TO REGIONAL DEVELOPMENT

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**Abstract**
It is neccessary for the Regional Universities (RU) to strengthen their regional role. The reason behind such trend is the increased economic and regional differences between regions which applies also to Latvia. The aim of this research is to define the contribution of the RU to the regional development. The research included analysis of scientific sources, correlation and analysis of variance. It was determined that there is a positive correlation 0.979 between the number of students of RU and corresponding regional Gross domestic product (GDP) per capita; thus the RU have a positive impact on the regional development while other drawbacks and problems exist.
**Key words**: regional development, higher education institutions, contribution.

## Introduction

In previous periods the state policies and Regional Universities (RU) have been emphasising the reaching of specific national goals or knowledge acquir. At the same time, a research by the Organisation for Economic Co-operation and Development (OECD) (2007) has indicated the necessity to help the area in the vicinities around the RU, to cooperate with the aim of strengthening the regional role. The research results have showed that this is a tactic used by the wealthiest states – to develop regions 'by nurturing the unique assets and circumstances of each region' (OECD, 2007).

However, the global tendencies indicate that the overal economic and social disparity between the regions and cities is increasing (Beeson, 2010; Glaeser, Giacomo, & Ponzetto, 2014; Chadwick, 2016). The regional development goal in Latvia, as well as in many other countries, is to ensure and enhance balanced regional development, while taking into consideration the unique aspects and opportunities of its separate regions (NAP, 2012).

The regional research in the United States (US) (over a period of almost 200 years) has indicated that the education increases the level of entrepreneurship, while ensuring positive impact on the unemployment and, as a result on the level of wealth (Glaeser, Giacomo, & Ponzetto, 2014).

The priority of the National Development Plan of Latvia 2014-2020 (NAP) 'Development enhancing territories' was aimed on creation at the conditions for longterm, balanced economic development in the regions of Latvia with the aim of reaching sustainable development, strengthening regional capacity and using regions resources and advantages with the greatest effect (NAP, 2012).

Region Gross domestic product (GDP) per capita is an indicator portraying the regional disparities at the economic development level (it is estimated by summing the national and region GDP Nomenclature of Territorial Units for Statistics 3 (NUTS 3) differences per one inhabitant, while evaluating the proportion of regions population and expressed as percentage of GDP per capita). The reduction of regional GDP variance per capita indicate the differences in the economic development, while RU investment is the result of interaction of human capital and economics.

The interaction of human capital and economic development was analysed at both the micoeconomic (Odit, Dookhan & Fauzel, 2010), as well as macroeconomic level (Bouaissa, 2009). The OECD (2007) report explicitly indicates the importance of the higher education in the development of the human capital. According to Bashir, Iqbal & Zaman (2011), the education allows creating the elements necessary for the creation of human capital – competency, knowledge, etc., but most importantly it is directed towards work to creat the economic value. The analysis of scientifical literature proves the interrelation of human capital and the GDP, thus indicating a possibility to use eduation indicators as indicators of human capital (Mankiw, Romer, & Weil, 1992; McMahon, 1998).

In Latvia, the research on the interrelation of education and economic parameters has been carried out by multiple researchers – Baumanis (2004), Ekmanis (2005), Grizane, Sannikova & Jasaitis (2017). Nonetheless, the authors underline that the overall number of research on the RU impact on the regional development is not sufficient and further studies are necessary.

Research object: the contribution of Regional Universities.

Research aim: define the contribution of the RU to the regional development.

Research tasks:

(1) To examine theory on the contribution of RU on the regional development;
(2) To investigate the regions and the RU;
(3) To evaluate the employment of the graduates, entrepreneurship activity, and loyalty to the region;

(4) To determine the correlation between the GDP per person in the regions of Latvia and the corresponding number of RU students.

The research of scientific literature has allowed to determine that the impact of RU in the regional development can materialise as (1) economic and social impact spheres of a person; (2) economic and social spheres of the society (O'Carroll, Harmon, & Farrell, 2006; Universities UK, 2015).

Investments in education might lead to increased personal income, however, according to Dr. Simon McGrath from Notingham University, specialising in international education and development, 'when taking into account the real world occurences, it is a way too simplified model' (Kruss *et al.*, 2015).

On the one hand, the impact of RU can lead to an increase in labour effectiveness, knowledge and technology transfer, as well as facilitation of entrepreneurship and use of scientific research. On the other hand – in social sphere – it can lead to an increase in social protection, non-commercial knowledge transfer, and an increase of cultural and social consumptionand the use of results of scientific research.

Another important consideration is the territoriality which can affect their institutional independence. The state financed higher education institutions are autonomous with independent study and research control. However, on a regional level the RU should be more integrated in the regional planning system, in order to create a more coherent organizational and financial management in both the study and research areas. The author of this research emphasize that such mechanisms can be generated to overcome institutional problems in the RU authonomy.

The second point of attention is that the RU are functioning within the scope of multiple territorial entities, i.e. – they are not limited to one region. The existence of a higher education institution within a certain area is an advantage factor over other regions and is an important resource for the specific community. It is challenging to manage different RU in different territorial areas of regions, in such a way that they would magnify each institution's performance and allow creating mechanism for fulfilling important tasks for the benefit of the region as well as help building national and international interinstitutional relations.

At the some time, the goals of the regions are to increase the well-being of the citizens and to reduce inequality, as noted by Sinkiene & Grumadaite (2014). Knight (2012) has referred to RU target which is to practically use higher education as an instrument for regional development (Knight, 2012).

**Materials and Methods**

The research design is concentrated on the large scale and multilevel research methodology, while ensuring research limitations set based on the available information on comparable data on GDP in regions (NUTS 3) of Latvia in the period from 2010 to 2013.

Research methods: analysis of scientific research sources, comparison, systematization, generalization, descriptive statistic, correlation, and co-variation analysis.

Research limitations: the comparable GDP NUTS 3 regional data of Latvia is available only for the period of 2010–2013; therefore, further comparison and analysis was based on the data from this period, while only the RU of the particular country and their impact on the regional development of the particular regions were analyzed. Due to the limitations of this paper, the impact of RU on the regional development was evaluated from a limited perspective: the impact on the economic activity, impact on employment and unemployment, number of vacancies, salary of RHEI graduates, distribution of labour force according to the higher education in regions, according to the RU, graduate loyalty to the region and the base costs of RU programmes.

Authors chose the following methodology for determining the RU investments in the regional development on three levels:

(1) The first research level included research on regional understanding and regional problems related to the division of regions and the RU of Latvia. The latter is based on the Overview of the Higher Education System of Latvia in 2017. The territory of the European Union (EU), according to the European Parliament and Council Regulation of 26th May 2013, can be divided in NUTS 1, NUTS 2, and NUTS 3 regions. Each territorial unit has its own unique code and name: (EUROSTAT, EC, 2011). In Latvia, the following territorial units are present: Kurzeme (LV003), Latgale (LV005), Riga (LV006), Pieriga (LV007), Vidzeme (LV008), Zemgale (LV009) un Latgale (LV009) (CSB, 2015). Within these territorial units currently six RU are present: Latvia University of Life Sciences and Technologies, (LLU); Daugavpils University (DU); Liepaja University (LiepU); Rezekne Academy of Technologies (RTA); Ventspils University of Applied Sciences (VeA); Vidzeme University of Applied Sciences (ViA) (LR IZM, 2016).
(2) The second research level included evaluation of employment and business activity in Latvia as well as the loyalty of graduates to each region. This research based by statistics of the Central Statistical Bureau of Latvia (LR CSB) and scientists' research.
(3) The third and fourth level of research help determine the impact of RU on the regional development, which the authors of the research

carried out by performing correlation between the GDP and number of students active in Latvia. The results were further correlated with the average GDP per capita of the particular region's population, in order to evaluate the impact of RU on the regional development. Dispersion analysis was carried out to further examine this tendency, based on the Eurostat, LR CSB, Higher Education Monitoring and Analysis Centre of Lithuania (MOSTA) statistical data, Vidzeme University of Applied Sciences and the results of authors' researches.

To affirm the newly calculated results, the situation analysis was performed based on the theory, economic activity, increase of number of jobs, overall employment, unemployment, open job vacancies, salary, and analysis of the breakdown of labour force.

**Results and Discussion**

Multiple RU accept regionalism rhetoric with the term 'region' as an opposite to metropolitanism and cosmopolitanism. Undoubtedly, the term region can be attributed to a territory of substantially different space of area (Encyclopedia Britannica, 2017). It can be applied to the inner parts of the state, or greater national territories, while it span over state borders, thus accompanying multiple national territories. For instance the regions of Baltic, Scandinavia countries include statistical territorial classification units (NUTS). Thus, as a result, the regional role of RU can be interpreted differently. For instance, the RU can define itself as (1) regional, using the name of the area; (2) working on a regional level with the aim of fulfilling the labour market demands; (3) cooperating with regional research institutes and employer representative organizations; or (4) offer the regional society services and support centre. RU have many reasons to name themselves 'regional' universities according to the extent to which one of the priorities is their relations with the region and the interested parties. Thereby, it is clear that the question about the territoriality of RU is not flawless. It is important that everyone who is in contact with the RU would acknowledge the questions related to territoriality.

It should be noted that from all national universities of Latvia, the proportion of RU compromises around 21% of the total number of students in Latvia i.e. 5945 students which is by 5645 less than in 2015 (LR IZM, 2018).

The theory analysis indicated that education can cause positive impact on the unemployment (Glaeser, Giacomo & Ponzetto, 2014); therefore it was necessary to examine the unemployment level in the regions of Latvia.

In the labour market of Latvia, the authors identified significant regional disparity between the capital city Riga, Pieriga and, most significantly, in comparison with Latgale region in both the aspects of employment and unemployment level, which is around 19% (2010/13) (Latviete, Pilvere, 2010). When comparing the working age population with tertiary education, it can be seen that Riga and Pieriga regions attract ever larger number of enrollees (2015/18), by about 14.6 thousand. At the some time, in regions this increase (2015/18) is minimal, only by 2 – 3 thousand. In Latgale region there is the highest number of the employed people with higher education (CSB, 2018b). Despite this fact, in Latgale the economic activity is the lowest (56.3%) and there is the highest level of registered unemployment (7.6%), while in Riga and Pieriga regions the combined economic activity is (68.6%) and unemployment – 3.3%, which is a significant difference (CSB, 2018c).

The indications on the positive impact on education can be found in a research on regions of the US (Glaeser, Giacomo, & Ponzetto, 2014), therefore authors chose to analyse the economic activity structure of regions of Latvia (Figure 1).

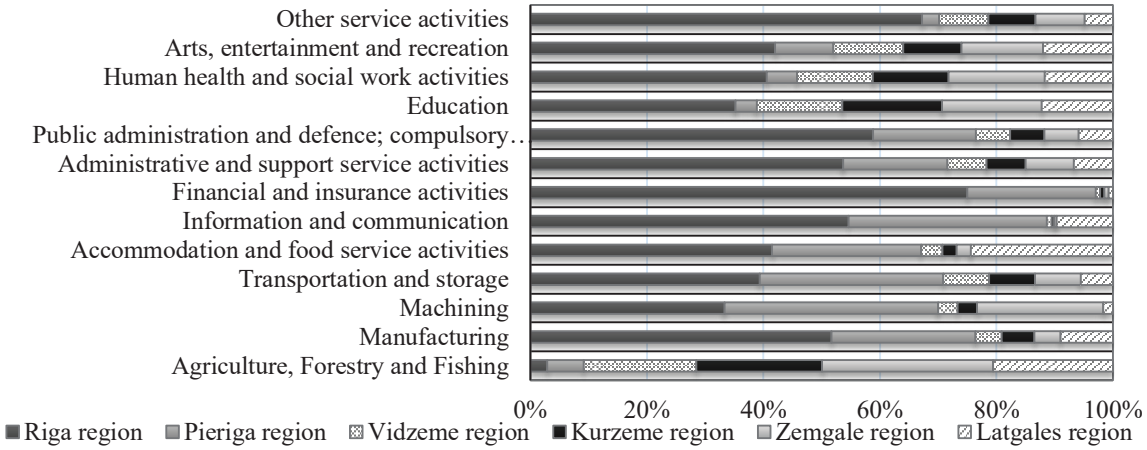


Figure 1. Distribution of economic activity in NUTS – 3 regions of Latvia by sectors, 2018, % (CSP, 2018c; 2018d).

In comparison with Riga and Pieriga, the activity in regions is dominated by financial and insurance services, information and communication, administrative and support services and other services. In comparison to the capital city and the neighbouring Jurmala, in the regions the existence of a significant proportion of secondary manufactory industry, metal working, machinery and logistics and other economic sectors (Figure 1) is relatively less likely to be observed.

In other regions the leading industries are agriculture, arts, entertainment and recreation, human health and social work activities, machining, and other services. In Riga and Pieriga regions there is the lowest unemployment level and the highest overall employability level nationwide due to the developing trade, transport, manufacturing, services and tourism sectors, which are further emphasized by the existence of the sea harbour (Pavlyuk, 2011; CSB, 2015).

The specialization goal of RU is to provide the necessary specialists to the particular region and its economic sectors. The theory has proved that education can cause economic activity, which is an investment in the development of the regional economics (Glaeser, Giacomo, & Ponzetto, 2014).Among the entrepreneurs 48.6% have the bachelor's degree, while 22% – master's degree (SSE Riga, 2011).

Nonetheless, the entrepreneurs are facing employee shortages. When comparing the ratio of vacancies in Riga and Pieriga with regions, it is 10: 1, while the largest deficit of workers can be seen in Latgale region. The lack of qualified workers can be observed not only in the large companies (69%), but also in the medium (67%) and small (59%) enterprises and even in the microenterprises (39%) (Zvirgzdina & Jekabsone, 2016).

After studies, part of the graduates settle in the respective region where their RU is located, thus 'indicating loyalty´ to its region: in Latgale – 74%, Kurzeme – 66%, in Zemgale – 49.4% of Latvian University of Agriculture, Vidzeme – 47.8%, in Vidzeme region – 59.3% (Vidzemes augstskola, 2016). Overall this is not a positive trend during the period of time with a labour deficit.

On the one hand, the graduates (incl. those of RU) lack job opportunities (youth unemployment is 30 – 30.7%), they are not satisfied with the salaries offered in the regions and they tend to find opportunities in the capital city or to emigrate. On the other hand, while in 2010 almost 27.1% of all employed of youth cohort received 150 – 300 euros has salary, then in 2013 there were only 19.2% in the same category. At the same time, the number of youth who received 700 – 1000 euros has increased from 10.9 to 15.5%, which indicates an overall increase of the number of highly qualified young people, whose impact on the regional economy increases proportionally, thus contributing to regional development (CSB, 2016a).

Taking into consideration that a higher salary in the regions can be received by the managers, senior specialists, and other highly qualified workers, the influence potential of the RU on the regional development is obvious. The distribution of labour force according to the education (bachelor's level) and sex (female/male %) in regions is as follows: Latgale – 17.5/11.5%; Kurzeme – 14.8/10.4%; Zemgale – 14.3/9.7% and Vidzeme – 13.4/9.5%, which indicates a balanced distribution, while in Riga and Pieriga – 25.5/71.5%. Labour force distribution with masters degree in regions by gender (female/male %) is: Kurzeme 2.2/4.7% and Latgale – 2.0/4.9%, while significantly less in Vidzeme – 1.1/3.3%, meanwhile in Riga and Pieriga 25.5/63.4%, which significantly influences the overall salary level (CSB, 2016b). The number of unemployed people with the higher education decreased in all regions, most significantly in Kurzeme region by 35% (2012/13) (Zvirgzdina *&* Jekabsone*,* 2016).

Research authors have conclude dthat not only the overall professional abilities of RU graduates increase, but also their compliance with the regional labour market needs; Nonetheless more progress is needed, which is evident by the surveys indicating the lack of highly qualified labour force. The distribution

Table 1

**Distribution of graduates in total and by gender at universities in the regions of Latvia (LR IZM, 2018)**

| Regional University | Total graduates | Number of female graduates |
|---|---|---|
| Latvia University of Life Sciences and Technologies (LLU) | 629 | 332 |
| Daugavpils University (DU) | 412 | 307 |
| Liepaja University (LiepU) | 234 | 186 |
| Rezekne Academy of Technologies (RTA) | 287 | 175 |
| Ventspils University of Applied Sciences (VeA) | 160 | 96 |
| Vidzeme University of Applied Sciences (ViA) | 175 | 97 |

Table 2

**Estimation of homogeneity of GDP per capita in the NUTS 3 regions of Latvia by location of regional universities (n=4) ****

| NUTS_3 | Subgroup Configurations* | |
|---|---|---|
| | 1 | 2 |
| Vidzeme | 1171.2850 | x |
| Latgale | 1490.4475 | x |
| Zemgale | 1498.0750 | x |
| Kurzeme | x | 1913.5400 |
| Sig. | 0.0620 | 1.000 |

* Subset for alpha = 0.05

** Means for groups in homogeneous subsets are displayed.

of highly qualified (bachelor and master's degrees) labour force is in favour of Riga and Pieriga regions, most significantly in female cohort. Overall, there are more women with received qualification and degree also in regional universities (Table 1). This indicates the impact of the existing problems in the RU on the regional development.

In Latvia University of Life Sciences and Tehnologies and Vidzeme University of Applied Sciences (Table 1) the gender ratio is even, meanwhile the most unequal situation can be observed in Liepaja University and Daugavpils University, where the share of female graduates reaches 79.5% and 74.5%, respectively.

The base costs of a single study place in the 2013 prices for bachelor's (academic and professional) education level on average were 1 810.02 EUR, while for masters level – 2 715.03 EUR per year (LR IZM, 2014), which can be considered to be an investment in the regional development. In Latvia similar to Lithuania, women more often have higher education (on average by 7%) than men, thus they have predominance in the regions. Higher return is from RU graduates with engineering-technical degree, lower from arts and humanitarian degree owners; and while higher from individuals with master's degree in comparison with those with bachelor degree (MOSTA, 2015).

The dispersion analysis of the RU impact on regional development accounts to p-value = 0.553, thus with a 95% probability the zero hypothesis; that GDP per capita of the four NUTS 3 groups is similar can not be rejected.

Since the p-value = 0.01<0.05, then with 95% probability the hypothesis, that GDP of all the NUTS groups are similar; can be rejected. At the same time it can be seen (Table 2) that there are homogenous sub-groups in which the average values do not differ.

The correlation between the regional (NUTS 3) GDP per person in regions of Latvia with the number of RU students (2010/13) correlation r=0.979, p=0.01, $R^2$=0.9593, but t=6.450>0.679, then with significance level α=0.001 or probability P=1- α=0.979 it can be assumed that there is a greater possibility of a significant positive linear connection between the GDP and the number of RU students. Statistically significant direct relations can be observed. Analysis of covariance indicated that the number of students of RU influence the GDP, [F (2.34) = 245.585, p<0.00].

In order to confirm the interrelations, the authors carried out analysis of changes in the number of students. Due to economic and demographic aspects, migration as well as RU competition the overall shrinkage in the number of students at the RU – in 2014/15. academic year was by 5 to 12%, while the overall number of enrolled students has shrunk by 20% (LR IZM, 2016).

Authors conclude that the impact of RU on the regional development has a tendency to decriase, mainly to the reason that the general population is decreasing, incl. of students. Theory explaines it through personal and social socioeconomic spheres and their interactions (IHEP, 1998; Knight, 2012; Universities UK, 2015).

**Conclusions**

1. The contribution of RU to the regional development was proved in the following instances: (1) by encouraging entrepreneurship, preparing the necessary specialists and entrepreneurs for regions; (2) reducing unemployment level; (3) the loyalty of RU students towards their region's national average – 59.3%; (4) the qualification of RU graduates is increasing along with salary; (5) increased conformity of the RU graduates skills with the regional labour demand according to the economic sectors; (6) in Latvia, the same as in Lithuania, the return of education is higher for women (by average 7%) than for the men.
2. Significant problems can be observed in the process of RU impact on the regional development: (1) theoretical problems: terminological inaccuracies

in the use of word 'region' when attributing it to a certain territory in relation to RU zones of impact; (2) problems with RU autonomy and cohesion of needs of the region; (3) reducing number of RU students; (4) around 40.7% RU students are not loyal to the region of their university and move to Riga, Pieriga or migrate abroad; (5) the region lacks specialists; (6) analysing the labourforce distribution by according to education (with bachelor's degree), the lowest number is in Vidzeme; (6) in the regions of Latvia more women than men have a degree (procentage-wise) while in Riga and Pieriga 71.5% men have the bachelor's degree, the opposite situation is with the master's degree – out of 3.3% of labour force with the master's degree, 63.4% are men, which affects the salary depending on the gender; (7) the overall return of investment from the possession of a higher education degree in the regions for men is reduced due to fact that there are fewer men, although the return for RU graduates with engineering degrees is higher.

3. The analysis of RU investment in to the regional development indicated that there is a close positive correlation 0.979 between the number of RU students and GDP per inhabitant from regions of Latvia (four NUTS 3). Due to economic and, demographic reasons, as well as migration and RU competition, a significant reducation of overall number of enrolling students can be seen, consequently, the impact of RU on the regional development has been reduced and, as a result, the decrease in the number of students negatively affects the business activity.

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# PEDAGOGICAL APPROACHES TO PROBLEM SOLVING IN HIGHER EDUCATION

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**Abstract**
One of the most often mentioned competence in the surveyed literature is problem solving. It is also one of the key skills for the sustainable development of society. The article includes analysis of pedagogical approaches like project-based, problem-based learning and enquiry-based learning, as well as describes the use of design thinking as one of the problem solving approaches in higher education. As mathematics studies at universities play an important role in developing problem solving skills, an empirical study was carried out to identify the pedagogical approaches used by mathematics teachers and to illustrate the development of problem solving skills in mathematics studies at universities in Latvia. It includes a survey of mathematics teachers in Latvia aimed at identifying their experience in implementing different pedagogical approaches to mathematics and assessing the extent to which these methods help develop problem solving skills. The answers of mathematics teachers show that problem solving skills are developed at the middle level, which means only for the use in a certain situation (that is slightly different from previously known). The most effective approach to promoting problem-solving skills is the so-called context approach, which means focusing on the practical task related to a specialty. In the empirical study self-assessment method is used and the results are based only on respondents' opinion.
**Key words**: case study, design thinking, pedagogical approaches, problem-solving skills, survey.

## Introduction

The scientific literature contains a number of studies on knowledge, skills and competences as key elements of sustainable development. The concept of competence is seen as an essential guide to orientate teaching and learning to sustainable public development. The European Commission (EC) documents also deal with the issue of competence by identifying different key competences, each of which contributes to a successful life in society (EC, 2006, 2018). Key competences include skills such as critical thinking, problem solving, teamwork, communication and negotiation skills, analytical skills, creativity and intercultural skills (EC, 2018).

One of the most frequently above-mentioned competencies in literature is problem solving. In the World Economic Forum (2016), this skill was identified as one of the ten skills needed for future employment (World Economic Forum, 2016). Also, a study conducted by employers in the United States highlighted problem-solving skills and critical thinking as some of the important skills needed by young people entering the labour market (The Conference Board, 2006).

At the World Economic Forum in 2018, it was noted that 'skills continuing to grow in prominence by 2022 include analytical thinking and innovation, as well as active learning and learning strategies. ... 'human' skills such as creativity, originality and initiative, critical thinking, persuasion, and negotiation will likewise retain or increase their value, as will attention to detail, resilience, flexibility and complex problem-solving' (World Economic Forum, 2018). This document also emphasizes the importance of problem-solving skills both in the economy as a whole and in jobs that require flexibility and innovation.

Higher education has to fulfil requirements of modern trends in the development of society. For that reason, the aim of university study programs is to develop analytical ability and skills, and provide students with the knowledge and skills necessary to be work-ready and competitive specialists in the labour market. According to the European Qualifications Framework (EQF), the results of studies is 'advanced knowledge of a field of work or study, involving a critical understanding of theories and principles; advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study' (Descriptors defining..., 2016). For this reason, the aim of this study is to identify pedagogical approaches to foster problem-solving skills during university studies, as well as to carry out comparative analysis of the identified approaches.

Mathematics is one of the disciplines that develops problem-solving skills. When problems arise in mathematics and other contexts, students should apply and adapt various appropriate strategies to solve problems, monitor and analyse the problems of mathematical processes (Zeidmane & Rubina, 2018). According to Serve (1957), mathematics develops logical thinking that includes the ability to think deductively, ability to abstract, generalize, classify, ability to think, analyse, criticize. For this reason, an empirical study was carried out to identify the pedagogical approaches used by mathematics teachers and to illustrate the development of problem solving skills in mathematics studies at universities in Latvia.

## Materials and Methods

The study includes two parts. The first part of this paper is the result of scientific analysis and

assessment of scientific literature as well as a number of information sources taking into consideration the author's reflection of experience and observations in connection with approaches allowing the development of university students' problem-solving skills.

Problem-solving skills here are understood as 'goal-directed thinking and action in situations for which no routine solution procedure is available. The problem solver has a more or less well-defined goal, but does not immediately know how to reach it. The incongruence of goals and admissible operators constitutes a problem. The understanding of the problem situation and its step-by-step transformation, based on planning and reasoning, constitute the process of problem solving' (Finegold & Notabartolo, 2016). The scientific literature shows that students need to develop different skills, including problem solving using holistic and systemic approaches, making critical judgements on real life issues, applying theory to practice and vice versa, and working collaboratively and in interdisciplinary teams (Parkin *et al*., 2004; Dawe, 2005).

The aim of the empirical part of the research is to illustrate the use of pedagogical approaches in higher education. In the framework of this study, a case study has been conducted. It was based on a survey of mathematics teachers in Latvia, aimed at identifying their experience in implementing different pedagogical approaches in mathematics and assessing the extent to which these methods help develop problem solving skills.

In the survey the participants were asked to evaluate their mathematics study course on the scale from 0 to 3, which contributes to lower problem solving skills, where:

a) 3 – can be used in different life situations and in a new context,
b) 2 – can be used in a particular situation that is somewhat different from previously known,
c) 1 – developed only at reproductive level,
d) 0 – this competence is not required for students of this specialty.

Teachers were also asked to indicate which of the given teaching methods (project based, problem-based, enquiry-based) they use and to rank them by priority numbering 1, 2, 3, ..., as well as open question – to indicate one method that they find the most effective in promoting the development of the problem solving skills.

The empirical study was conducted in late 2018. The sample of this study – 56 mathematics teachers from different universities in Latvia, but only 12 questionnaires, which have been taken as the basis for this study, were completely filled. It should, therefore, be noted that this was a case study, and the study uses the self-assessment method. The questionnaire (in Latvian) is available at: http://www.iipc.lv/surv/index.php/survey/index/sid/895516/newtest/Y/lang/en.

**Results and Discussion**

One of the most often mentioned competences in the surveyed literature is problem solving. It is also one of the key skills for the sustainable development of society. Different methods and pedagogical approaches are discussed in the scientific literature as the effective development of problem solving skills. The author has selected four of the most common approaches to developing problem solving skills: problem-based, project-based and inquiry learning, as well as design thinking.

'Problem-based learning emphasizes learning by doing. It also provides a motivating context for learning. Students are given a real-world problem similar to those they face as professionals' (Steinemann, 2003). The benefits of problem-based learning are the development of professional skills, independence and cooperation, the activation of learning through a variety of resources, solving a complex problem, etc.

The second most often mentioned approach is project-based learning. According to Helle (2006), the main feature of project-based learning is that the problem itself serves to organize and manage student activities, and these activities end with the final product. Project-based learning includes different activities (Helle, 2006):

1) the solution of the problem, set by a student himself,
2) initiative by a student group and a variety of educational activities,
3) commonly results in an end product (e.g., thesis, report, design plans, computer program and model,
4) 'work goes on for a considerable length of time',
5) teachers involved as advisors.

Inquiry-based learning is one of the approaches of constructivist theory. Inquiry learning is a social process in which individuals learn through collaboration with others, continue to acquire new knowledge and understanding based on existing experience, choosing and transforming information.

Design thinking is a relatively new pedagogical approach. Although there are many examples in the scientific literature that characterize this approach as an effective learning strategy, in Latvia it is not yet sufficiently integrated in the education process. The design thinking focuses on creative problem solving, innovation and also practical skills, as well as the ability to see the link between the things we know. The more we know, the more interconnection we can create (Krūmiņa, 2018).

Design thinking involves changing attitudes towards traditional things by combining analytical and creative

Table 1

**Comparative analysis of pedagogical approaches**

| Pedagogical approach | Approach characteristics |
|---|---|
| Project-based learning | Approach includes a measure or activity that has a specific purpose and result, and is implemented over a specified period of time (with certain resources) |
| Problem-based learning | The goal of the approach is to find a solution to the problem. This is usually done by the so-called 'three-step technique: problem analysis, solution search, idea evaluation and implementation |
| Inquiry learning | Not so much attention is paid to solving the problem as to the issues that arise from this problem |
| Design thinking | A new, innovative approach focused on solving the problem and creating the desired outcome, focused on the human being, his needs and desires |

thinking, making manageable and understandable creation of a wide range of innovations, and contains case and event studies, idea creation, solution development, and thinking management techniques in a specific order to achieve problem solving with maximum efficiency (Razzouk & Shute, 2012).

'The Design thinking process begins with a problem finding process that engages with the world around to discover needs and insights that might drive the innovation of products, services or systems of various scales and complexities' (Melles *et al*., 2015).

Several studies show that the use of design thinking is also effective in education, especially in social and business studies (Matthews & Wrigley, 2017). The method is successfully used for the development of the so- called soft skills: communication, negotiation, understanding of the needs of other people, working in teams, decision making etc. By participating in the Baltic University program, the author has also become familiar with the use of this method for curriculum development and improvement of the educational process, successfully implemented by Kaunas University of Technology.

Table 1 gives the comparative analysis of pedagogical approaches depending on the nature of the approach and the contribution to the problem.

The results of the empirical study showed that the average rating of the development of problem solving skills in the mathematics study course is 1.5, but median and mode – 2 on a three-point scale.

Of the proposed teaching methods, the lead is a lecture, which has been marked as the first priority by 9 mathematics teachers surveyed, but as the second priority – by 3. In mathematics studies, project-based learning is not popular because it is mentioned only once, in addition as a third priority.

The respondents were asked to indicate whether the mathematics course they led was using the pedagogical approaches given in the questionnaire. In turn, the answer 'yes' and 'no' to the questions about the use of the problem-based and inquiry-based learning approaches were distributed evenly – 6 to 6.

The questionnaire also included an open question where teachers had to write one learning method which they thought was most effective in promoting problem-solving skills. The most frequently mentioned answer was the creation and solving of practical tasks. Here, with practical tasks, are understood the tasks in connection with specialty and also the real-world situations. Problem-based learning highlighted the importance of working on complex, real problems that students experience in developing knowledge, skills and competences, which is an important part of problem-based learning (Lozano *et al.*, 2017).

Three other pedagogical approaches are often mentioned: project work, work in groups and case studies. As mentioned above, the project work and project-based learning are not often used in mathematics teaching. Case studies are also not often used. This method is mentioned only twice as a method used in mathematics studies, with the fourth and seventh priority. The results of the survey showed that work in groups is used by a quarter of the surveyed teachers, giving it the fourth or fifth priority.

**Conclusions**

1. There are four approaches to problem solving skills: project-based (result-oriented), inquiry learning (focused on identification of questions related to the problem), problem-based (finding the solution of the problem), and design thinking (search for new alternatives rather than choosing from existing ones where the decision is empathetic to the person).
2. The results of the empirical study show that the average rating of the development of problem solving skills in the mathematics study course is 1.5, but median and mode – 2 on a three-point scale. Case studies and project work in mathematics studies are rarely used. The most

effective approach in promoting problem-solving skills is the so-called contextual approach, which means focusing on the solving of practical tasks.

3. The empirical part of the research uses a self-assessment method, therefore the results are based on the respondents' opinion. It was a case study and it only reflected the views of the teachers involved. So the results cannot be generalized. The study identified problems / directions for an in-depth research.

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# CONFLICT MANAGEMENT MODELS IN THE CONTEXT OF CONSTRUCTIVISM IN MEDIATION

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**Abstract**
Mediation process promotes conflict solving, contributes to a higher level of positive solutions and decreases the number of litigation cases. The aim of the study is to outline the usage of constructive approach in mediation process, analyse conflict and its solving models and to find out the opinions of secondary school students on dialogue and conflict, as well as parties' assessments after the mediation process. The theoretical method of the study is the analysis of conflict, conflict resolution, mediation process and long-standing mediator practice. The investigation of constructivist approach, conflict elements and strategies are outlined in the study. Conflict solving models are analysed in the Methodology part of the study. Empirical methods were a structured group interview of secondary school students and questioning of conflicting parties. The results of the study confirm that knowledge on conflict and mediation should be developed at school and mediation models should be improved on the basis of constructive approach.
**Key words**: conflict, relationships, constructivism, mediation, skills transformation.

## Introduction

Conflicting visions, assumptions, prejudices, beliefs, feelings are rooted in a variety of experiences, knowledge, awareness, and abilities. A person is a unique phenomenon who accumulates in their consciousness and subconsciousness all the information that they have gone through, learned, watched and accepted as their own. This information forms a human personality, their character, desires, interests and needs that allow having a very individual look at events, things, circumstances. The person has imagined that they need this information as a protection for their existence and growth; they can protect themselves through the accumulated experience and develop. Nevertheless, at the same time, that experience limits the person. If a person is not open enough to anything new, if they are unnecessary cautious, then the first reaction to the unknown may be negative because it does not suit them, it threatens them. This can often lead to a conflict both in social relations with others and in individual – inner conflict of the person. In such a situation, there is often a lack of knowledge and skills to help the person, easily and thoroughly explore the new circumstances or information, approbate it and analyse the consequences. It is often hindered by the emotional condition created by the feelings that have already arisen, like fear or anger. The conflict is truly resolved when all the involved parties agree that they have attained the desirable result, when no one feels a loser. When there is a loser and a winner in the conflict, the conflict can resume or move to the inner conflict of a person. After the unjust victory, there may be concerns about its fairness and the justification of the loser's suffering and feeling remorse. The losers, in turn, may plot a plan of revenge, form a coalition, or castigate themselves for the loss. This is usually the case when the victory is determined by the third party's decision. The decision of the third party is guided by the law and by the circumstances, which can be seen from their point of view, in a purely subjective manner. It leads to the necessity of developing the mediation process where a mediator helps both sides to come to the solution and exclude the necessity for legal proceedings.

Mediation is an alternative way of dealing with conflict, which is used in many countries. G. Amoh has defined the mediation process as follows: 'Mediation simply refers to the process of resolving conflict in which a third neutral party (mediator), assists the disputants to resolve their own conflict. The process is voluntary, and the mediator does not participate in the outcome of the mediation process (agreement). The disputing parties themselves have control over the agreements to be reached' (Amoh, 2007). G. Amoh concisely named four mediator skills: '1)The mediator acts to build, maintain, and improve communication between the disputants, 2) The mediator facilitates information to and between the disputants, 3)The mediator must 'befriend' the disputants in the mediation process to enhance trust and confidence, 4) To encourage what he refers to as 'active mediation'. By active mediation Curle refers to the ability to cultivate a willingness to engage in cooperative negotiation' (Amoh, 2007).

In Latvia the mediation process has officially begun since May 2014, when Mediation Law (2014) came into force.

Until now, certain areas have been studied, such as conflict, constructiveness as a model for acquiring and accumulating knowledge, constructivism in international and social relations, the mediation process and its forms. The contribution of this study is to demonstrate how the constructivism theory and

constructive approach work in the mediation process for conflict resolution, what methods are used in the mediation process to find out the nature of the conflict, and what results can be achieved if, during mediation, the parties acquire additional abilities and skills in partnership with a professional mediator, how the mediator performs the role of the teacher while simultaneously managing the mediation process and teaching the disputants the skills that can further help them to deal with the conflicts themselves. That is why the aim of the study is to outline the usage of constructive approach in mediation process, analyse conflict and its solving models and to find out the opinions of secondary school students on dialogue and conflict, as well as parties' assessments after the mediation process.

**Materials and Methods**

The methods of the study were the theoretical analysis of conflict, conflict resolution, mediation process and long-standing mediator practice. The empirical methods were group interview and questioning the parties on the mediation process and conflict.

The first one was an oral survey conducted among the students of forms nine, ten and eleven (137 respondents in total), 2/3 girls and 1/3 boys from secondary schools in Latvian towns Ogre, Ikskile and Salaspils, with an aim to identifying the skills they have acquired for conflict resolution and dialogue. The study was carried out in November 2018. The results of the oral survey are presented in Table 1.

The second empirical study covered the investigation of three mediation cases (three pairs of conflicting parties). The study was carried out in January – March 2019. Conflicting parties were questioned before and after the mediation, in the phase when they had arrived at a complete or partial conflict solution, to clarify their first opinions and feelings. The second objective was to find out what dialogue skills disputants have obtained during mediation that helped to assess the situation and recognise the other party's views. The assessment was in the gradation from one to three (one – weak; two – average; three – strong). They also ticked what dialogue skills they have obtained in the process of mediation.

The first case was family relations mediation and it lasted for eight sessions, 12 hours in total (1.5 hours each), in the model of facilitative mediation. The objective was to solve the problem of family communication. The mediator promoted the usage of eye contact, listening and hearing, emphatic listening, asking open and circular questions, rephrasing, summarising, verbalising, confronting, identifying non-verbal communication, dropping, blocking, recognising and naming emotions.

The second case also was family relations mediation during the divorcing process, and it lasted for five sessions, 7.5 hours in total (1.5 hours each), in the model of mediation for finding solutions. The parties tried to come to a solution regarding the fathers' further relations with children and the amount of maintenance. The parties considered all mediation phases. The mediator promoted the usage of eye contact, listening and hearing, emphatic listening, asking open, circular and hypothetic questions, rephrasing, summarising, verbalising, confronting, identifying non-verbal communication, dropping and blocking.

The third case was a work conflict mediation and it lasted only for one session (1.5 hours). The disputing parties tried to find a solution in the case when one person had taken material values of the employer. The mediator used the dialogue technique with the purpose to assess the situation, its causes and consequences. The disputing parties appreciated the skills of the mediator because the problem was resolved in a short period of time.

**Results and Discussion**

Conflict as a clash of different opinions and efforts of its solving is the main cause of introduction of mediation.

The conflict is based on two needs. The first is to protect oneself and the second – to be correct, to fit in. A person has a dual nature – he/she wants to be special with their own special beliefs, interests and needs and at the same time, they want to be a part of a family or a group. If it leads to a conflict situation, people usually want to remain accepted by the group as equals. This phenomenon 'is generally known today as a relational account of human nature and society, recognizing this dual consciousness, of simultaneous separateness and connection, as inherent in human beings' (Bush & Folger, 2005).

It is essential for a person to find the solution to a conflict because 'of this dual quality of human nature' (Bush & Folger, 2005).

*Conflict elements*

A mediation process is promoted considering the following conflict elements: degrees of conflict escalation and behavioural strategies.

A mediator has to know the degree of conflict escalation to join in more effectively. F Glasl's (2009) nine degrees are used in mediation. They are as follows: tension, debate and polemic, actions instead of words, coalitions, loss of moral credibility/complete loss of trust, threat strategies, limited destructions, fragmentation of the enemy, and together into the abyss.

Thomas-Kilmann conflict mode instrument is widely used in conflict solving practice to overcome escalation. It includes five strategies: avoiding,

competing, accommodating, collaborating and compromising. The strategies show an individual's behaviour choice during the conflict 'along two basic dimensions: (1) assertiveness, the extent to which the individual attempts to satisfy his or her own concerns, and (2) cooperativeness, the extent to which the individual attempts to satisfy the other person's concerns' (Thomas & Kilmann, 2010).

When the conflict turns towards understanding, 'parties can recapture their sense of competence and connection, reverse the negative conflict cycle, re-establish a constructive (or at least neutral) interaction, and move forward on a positive footing' (Bush & Folger, 2005).

A. M. Gordon and S. Chen, following an in-depth study, have pointed out that conflict can be destructive, but by acquiring additional skills, it can be transformed into constructive and transforming relationships: 'From a conflict management perspective, conflicts are indeed thought of as damaging and destructive, but only when they are characterized by negative behaviours such as aggression, hostility, or withdrawal. When they involve positive behaviours such as affection, affiliative humour, or effective problem-solving, conflicts can instead be constructive. In line with this perspective, research shows that teaching premarital couples how to manage conflict constructively can minimize distress in the relationships' (Gordon & Chen, 2016).

The most effective way to resolve conflicts is to analyse the circumstances of the situation, the views of the partners, the emotions, the meaning of the words used. Parties involved in the conflict must be objective in evaluating the details of the conflict, which usually is not possible because of the emotions, ambition and personalities of the parties involved. In addition, the parties of the conflict can simply lack knowledge and skills for understanding and resolving the conflict situation. In such cases, it is advisable to assess the conflict situation with the presence of a mediator, in a mediation process. The participation of a skilled mediator can highlight the true circumstances of the conflict and contribute to its resolution.

Mediation is a method of conflict resolution in which the mediator organizes the conversation in such a way that the feelings, interests and needs of each party are heard, the circumstances of the situation and future prospects, as well as the consequences of the solutions are assessed. The mediator is a specifically trained expert, who remains objective and neutral in the conflict settlement process, while emphatically understanding both parties, knows the boundaries of the legal conflict and has sufficient experience in resolving disputes and a broad view of life to help the conflicting parties to assess the causes and consequences of the conflict in question. The mediator is a skilled dialogue maker and leader. The mediator in the conflict is not only a mediator, a magistrate or a moderator, but also a teacher who, by his example and explanations, can teach the conflicting parties. Usually, if the parties do not cope with the resolution of the conflict, they are vitally affected and, therefore, the parties are motivated to find solutions to a specific conflict and also to acquire knowledge, skills and experience for future cases. That is why the mediator's role is to help and demonstrate appropriate humanistic approach in looking for solutions. Nowadays theory and practice recognise a constructivism approach because it allows to implement all the elements and functions of dialogue fostering humanistic and optimal way of conflict solution.

*Constructive approach in a mediation process*

Constructive approach promotes a situation when people actively construct their ideas and interpret them, and the dialogue is the main means of how to get to conclusions and results. N. Onuf (1998) stresses that 'Constructivism is a way of studying social relations – any kind of social relation'.

In mediation, with the support and knowledge of the mediator, the parties acquire a new view of themselves, the partner, and the situation, which makes it possible to see the options for solution of the conflict and to choose the best for both parties, the most suitable for an existing situation in life. As a result, both parties have won and perfected their personality, abilities and skills. Mediation is an active process in which both the mediator and the parties are actively involved, and this is the only way, in which conflict resolution may be found. Neutrality is the basic principle of the mediator, but the basic rule of the parties is self-determination. The mediator is not entitled to decide how the parties should deal with the conflict, the parties themselves have come to a solution that they consider acceptable in this situation and with which they can live. The mediation process is essentially a workout and practice that tries to identify common interests and achieve mutually beneficial results. Thus, it is practical work, practicing, in which new skills are acquired, which the parties of the conflict have lacked, to avoid escalation of the conflict. 'Practices are competent performances. More precisely, practices are socially meaningful patterns of action, which, in being performed more or less competently, simultaneously embody, act out, and possibly reify background knowledge and discourse in and on the material world' (Adler & Pouliot, 2011).

Of course, we can say that people come into conflict because of their nature. The human character comes from experiences that are not determined by the person himself or herself and cannot be controlled. The experience just comes from life situations. You can search someone's fault for being in conflict

or search for the cause of the conflict situation. If you question whether it is correct to analyse your behaviour and qualities when you are involved in a conflict – the answer is yes, it is important. However, if the question is, what is more important – to analyse your behaviour or to acquire skills for constructive behaviour, learning new successful skills is definitely the right answer.

When relationship of persons come to an impasse with arguments and conflicts arise, this means that the parties lack the knowledge, understanding of vision, existing in their experience and skills, and they fixate on it. Constructive approach pays attention to the widest range of social phenomena as learning peculiarities, psychology, interpersonal relations, traditions and everyday life habits. Constructivism is a learning approach traditionally but due to its humanistic ideas including support of dialogical relations it is prospective in the mediator's work. Constructivism is the adoption and approbation of other experience; it is opening oneself for something unknown.

In the mediation process the following constructivism principles are recommended: learning with meaning, finding of learning by a person himself/herself, finding coherences and understanding entity of phenomena, active involvement in acquiring knowledge (instead of passive receiving of knowledge), active usage of contexts and the person's experience in acquiring knowledge, active involvement in self-evaluation of one's knowledge and behaviours and preserving positive atmosphere.

Usage of constructive approach in a mediation process reflects two dimensions. The first is promotion of dialogues between two conflicting parties. The second is the learning dimension when a mediator understands, controls and fosters clients' learning and transformations through dialogue.

Research of the constructive approach is still ongoing. T. Alexeyeva (Алексеева, 2014) points out 'that modern constructivists believe that in the past researchers have not assessed the effect of linguistics on relationships, and that insufficient attention has been paid to behaviour of habit and, in general, to expanding, non-reflexive behaviour'.

A person's individual system consists of needs, expectations, values, cognitive intelligence, temperament, emotional intelligence, and world view. When a person with his/her individual system meets the individual system of the other person and they start to contradict, a conflict arises. In general, the conflict is maintained if the parties cannot define and express their real interests and needs, are unable to look into the consequences of the change.

A mediator reveals the true interests and needs of the conflicting parties, helps to discuss the needs, fears, and expectations of the parties. The mediator can help to assess the actual situation and conditions more objectively, to discuss the consequences of the best solution to the situation and the consequences of the worst solution.

Using the negotiating technique, a mediator tries to get a new view of the parties to a situation where personalities are separated from the problematic situation. The mediator attracts the parties' attention to the interests and needs of the parties, but not to positions. The mediator motivates the parties to develop options that resolve the conflict situation. This usually takes place in four phases of the mediation process: clarifying the problem arising from the positions of the parties and their arguments; clarifying the facts, circumstances, interests, and needs; clarifying the desired outcome and finding possible solutions.

Mediators-practitioners A. Trosens, R. Hofmans, D.B. Rotfishere (2007) in the book 'Mediation. Fundaments of mediation in theory and practice' list and describe the most commonly used techniques, which the parties, involved in the conflict, learn by participating: active listening, reading, copying, accepting the body language, communication at metacommunication level, asking open questions, asking circular questions, encouraging, doubling, restraining, anchoring, focusing, confronting, gathering, paraphrasing, empathic listening (repeating content, paraphrasing, reflecting and naming feelings), blocking, chunking, normalizing, rephraming, mirroring, building a triad bridge, transforming, not listening, translating, verbalising, clarifying, presuming, paradoxical intervention, changing the perspective, positive rewording, distinguishing individuals and objects, modelling the situation, moderation, expanding the room for negotiation and solutions, management of brain storming.

Dialogue techniques are used in the mediation models.

*Mediation models*

In each of the phases, the mediator carries out successive statement activities in order to achieve the necessary mediation result. The necessary mediation result is determined by the disputant. It should be noted that conflict resolution is not always the most important and demanding destination of the mediation process that the parties want and carry out with the mediator. The mediator's services can just be used to come out of the impasse which the parties are not able to accomplish on their own. There may be a conflict between the disputants at the applied level, where parties cannot find common visions at the level of cases and activities, at the level of interests and needs, and at the level of values. Various processual models emerge from the entity of statements and activities: evaluative, transformative and facilitative mediation (Zumeta, 2018), understanding-based mediation

(Friedman & Himmelstein, 2006), narrative mediation (Hansen, 2003), mediation of finding solutions and e-mediation (Shonk, 2018).

*Facilitative mediation*. In this model of mediation a professional mediator facilitates negotiations between conflicting parties by applying the broadest spectrum of methods and techniques of dialogue: 'asks questions; validates and normalizes parties' points of view; searches for interests behind the positions taken by the parties; and assists the parties in finding and analysing options for resolution' (Zumeta, 2018), so that the parties can explore the deepest interests and needs, fears and assumptions, causes and consequences of events, the best solutions and the worst consequences if the conflict is not resolved. The model covers all phases of mediation in depth and comprehensively:

- familiarising with the nature of the mediation process and the agreements of its arrangements, rules and boundaries;
- the parties expose their vision on a situation and express their positions and the best possible conflict solutions;
- a mediator together with the disputing parties assesses the circumstances, causes and consequences of the situation;
- true emotions, feelings, interests, needs, rights and intentions of each party touched or not respected are assessed and solution options proposed;
- each party's life and cultural values and their compatibility for coexistence are clarified;
- defining of the most appropriate solution and describing its implementation process, determining each party's rights and duties, activities and terms.

A mediator keeps neutrality during the whole mediation process and parties keep self-determination. The mediator explains the nature of dialogue, necessity of its usage and consequences, and how to use the dialogue in a particular case with the purpose to find the solution.

*Transformative mediation*. The disputants make a dialogue, and the choice of themes and organisation of the dialogue are left to themselves. A mediator supports them and helps them to discuss the theme completely. The emphasis is placed on cognition of personalities and mutual understanding, respecting views, interests and needs, as well as gaining self-respect and improving mutual relations. 'The potential for transformative mediation is that any or all parties or their relationships may be transformed during the mediation' (Zumeta, 2018). Conflict solving lies in the background. Deeper knowledge about the other conflicting side is at the centre of this model. The main dialogue skills are asking questions, listening and empathy. Improvement of these skills highlights understanding of each person.

*Narrative mediation*. This model is based on the concept that every person has his or her own story of how to get to the vison/perspective of the situation, and what is the basis of conflict solution ideas. Exchange of experience is in the centre of the model because parties share their narrations and 'build on the storytelling metaphor' (Hansen, 2003), therefore it is a way how to find out new ways for conflict solution. The phases of mediation are identified but it is not necessary to consider them strictly. Usage of versatile dialogue techniques is important in the model because they serve as the main tool of giving and receiving information.

*Understanding-based mediation*. Conflict solving by understanding the situation is in the centre of the model and 'the deeper understanding by the parties of their own and each other's perspectives, priorities, and concerns enables them to work through their conflict together' (Friedman & Himmelstein, 2006). The mediator gets involved actively by using dialogue techniques and it helps both parties to understand better their own interests, priorities and prospects, and provides an opportunity to solve the conflict together. The parties are responsible for their decisions. This model is based on the assumption that both parties understand the situation and the nature of conflict and they can better decide on a solution than the mediator. The role of the mediator is to help highlight the unknown in the situation which both parties were not able to comprehend by themselves.

*Evaluative mediation*. The mediator manages the mediation process and takes a neutral position in assessing the situation. The mediator substantiates his or her own activities and opinions, and thus the conflicting parties learn to look at the situation from metaposition, disregarding their emotions and former experience, 'in reaching resolution by pointing out the weaknesses of their cases' (Zumeta, 2018). Dialogue techniques are used quite minimally in this model. They are used only to highlight real conditions of the case.

*Mediation of finding solutions*. The emphasis is placed on finding the solution in this model. Needs, interests, positions, persons, conditions of the situation are assessed as far it is necessary to come to the solution and no more. Finding mutually advantageous conflict solution as soon as possible determines the way of dialogue management and the choice of dialogue techniques. The phases of mediation under the guidance of the mediator are considered only with the purpose of finding the solution. There is an economy of time and energy. However, the effectiveness of keeping good relations between the disputants and solution could be the lowest one.

Table 1

**Secondary school student statements on dialogue and conflict**

| Statement | Agree | Disagree | Rather agree than disagree | Rather disagree than agree |
|---|---|---|---|---|
| I have an understanding of dialogue | 20 | 7 | 73 | 0 |
| I have enough knowledge about dialogue to solve conflict at school or at home | 15 | 15 | 12 | 58 |
| I have enough knowledge about dialogue to teach others | 0 | 0 | 36 | 64 |
| Teachers and students use dialogue | 0 | 27 | 36 | 37 |
| I would like to get to know more about elements of dialogue and how to make it | 100 | 0 | 0 | 0 |
| There is enough information in school programme to foster students' understanding of dialogue | 0 | 0 | 0 | 100 |

*The first empirical study*

When compiling the results, it appears that students have not obtained sufficient understanding of the nature of the dialogue and are unable to distinguish it among other forms of communication. Students have not acquired skills to deal with conflicts sufficiently. The answers showed that it is necessary to learn about dialogue and conflict at school to improve their mutual relationships. Respondents agree that they have an understanding of dialogue – 20% agree fully and 73% agree partly (Table 1). At the same time, 100% of the students recognise that there is not enough information in the school programme to foster their understanding of dialogue. They (100%) also would like to get to know more about the elements of dialogue and how to make it, and 58% of the respondents recognise that in general they do not have enough knowledge about dialogue to solve conflicts at school or at home. Nobody agrees fully that there is a real usage of dialogue either by teachers or students and only 36% rather agree that teachers and students use the dialogue.

The results show the necessity for promotion of dialogue in everyday life, and schools have to foster learning of dialogue, understanding its role in democracy and maintaining a positive social environment.

*The second empirical study*

In the first case, the mediator observed that disputing parties use offered dialogue skills and they helped to come to a positive solution. The parties appreciated the new dialogue skills.

In the second and third cases, the mediator observed that disputants tried to practise dialogue techniques which allowed them to come to a solution in a quite brief period of time. They recognised that they were not able to agree without the help of the mediator because of emotional tensions and they did not use dialogue techniques.

In all three cases, when compiling the results, it can be seen that before the mediation process nearly 80% experienced insecurity and confusion, while 60% had a sense of fear and anger. On the other hand, the creators of the mediation process have changed and there was a sense of peace and security in 90% of cases.

And also in all three cases the picture was the same – among the important skills acquired during mediation, which the parties did not know before, the ability to recognise the non-verbal language of the speaker was mentioned, to predict the consequences of his/her words, to express views without imposing, to ask for other people's support and assistance, to seek common interests, to speak about emotions and to recognize them, to speak and accept the feelings and opinions of others, without fear of accepting the views and vision of the situation of others.

The mediator managed to improve communication of the parties because they acquired and practised dialogue techniques successfully.

As can be seen from the study, conflict situations frequently escalated if the parties did not possess the skills and knowledge simultaneously with emotions of how to ask questions to identify their and partner's real needs and interests, of how to analyse the consequences of conflict situations and solutions that need to be directly addressed in the event of a conflict. Once you go through the conflict with a specialist who has these skills, you gain these skills and experience. This person will definitely use this experience, skills and knowledge in future conflict situations.

*Views on the development of mediation*

B. Hommel analysing the need for knowledge, both in the experience and operation has indicated that 'there are reasons to assume that the main function of consciousness in action control is actually for communication with both others and oneself. Having conscious insight into aspects of action control allows us to verbalise what we are doing, how we are doing, and why we are doing it, which provides the opportunity to share tasks and strategies how to implement and control a task with others, and to use this information for self-control' (Hommel, 2017).

Several forms of mediation are distinguished and, often, several types may be applied sequentially within the framework of a single mediation or change in the timing of the mediation process. This depends on the purpose of the participants in the mediation process. The mediator guides the parties involved in the conflict: their wishes, their capabilities and their possibilities to deal with the current conflict situation.

A mediator may operate in the mediation process, ranging from the simple negotiating moderator, who only moderates the information of the conversation, to the facilitator, who forms the negotiating area and facilitates the dialogue and transformation of the parties with a view. 'The facilitator's job is to support everyone to do their best thinking. To do this, the facilitator encourages full participation, promotes mutual understanding and cultivates shared responsibility. By supporting everyone to do their best thinking, a facilitator enables group members to search for inclusive solutions and build sustainable agreements' (Kaner *et al.*, 2014).

In all these mediation processes, the conflicting parties participating in the settlement of the conflict with the help of the mediator are looking at new possibilities for the resolution of the conflict, acquire specific dialogue methods and practise them during the mediation process. The mediator works as a real teacher and model, and thus the parties can supplement and expand their conflict-solving skills.

**Conclusions**

Constructive approach is a philosophical and pedagogical basis of mediation process and determines a mediator's behaviour in conflict phases. It means that the mediator fosters relations between both conflict solving and learning of dialogue.

The usage of the principles of constructivism with the focus on the dialogue method reveals versatile opportunities for parties: learning with meaning, finding of learning by a person himself/herself, finding coherences and understanding entity of phenomena, active involvement in acquiring knowledge (instead of passive knowledge receiving), active usage of contexts and the person's experience in acquiring knowledge, active involvement in self-evaluation of one's knowledge and behaviour, and preserving positive atmosphere; looking at a situation from various angles, improving communication skills and solving a conflict.

Mediation models is a tool how to structure and manage the mediation process. To make the mediation process more successful, it is necessary to improve the models by highlighting their structure and process basing on constructivism approach and conflict theory in further research.

The choice of the model depends on the nature of conflict, time limit, dialogue scope and depth for getting solution. Disputants usually choose the model considering also the mediator's experience and view on the situation. Dialogue techniques are a relevant part of each model and, in spite of the length of the mediation process, they help to improve communication, diminish conflict and find the solution.

Dialogue skills belong to soft skills because they fit into the frame of co-operation, problem solving and decision taking. As the secondary school students think that information about dialogue skills is not included at all in their school subjects, it has to be one of the objectives in the competence-based education programmes with the purpose to explain the importance and application of soft skills. Dialogue training practice should be included in the secondary school interdisciplinary subject modules.

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# INFORMATION TECHNOLOGY COMPETENCY MANAGEMENT IN FINANCIAL SECTOR: LITERATURE REVIEW

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**Abstract**
Rapid technology development has had an evident impact on the financial sector during the last eight years. The financial sector experiences changes and it is important for the contemporary financial organizations to set a sustainable business perspective through competency management to ensure competitiveness. The current paper additionally focusses on fintech. Information technology development and competency management are the basis of the research. Authors of this research performed literature review to clarify the technology management competency model proposed by Doggett, McGee and Scott (2013) with the purpose of customizing the model for finance and technology knowledge-intensive fintech companies.
**Key words**: Information Technology; Competency, Competency Management; Financial Sector.

## Introduction

During the past decade, competency management has come to the foreground driven by an increasing scientific interest in the topic (Wickramasinghe & De Zoyza, 2011; Kansal & Singhal, 2018). Competency is extensively defined as a performance aspect representing a combination of skills, knowledge, expertise, values, social and methodical abilities, ambitions and attitudes that are used by individuals for personal growth to perform specific tasks in an effective manner and in line with values and goals of the organization (Kansal & Singhal, 2018; Colomo *et al.*, 2013; Bohlouli *et al*., 2017). The authors of this research specify that the term '*competence*' describes a performance aspect for the required set of skills so that necessary tasks may be performed effectively, but '*competency*' is related to the behavioral characteristics of an individual.

Wickramasinghe and De Zoyza (2011) point out that competencies contain individual level and organizational level aspects; therefore, both levels will be discussed separately, although individual level competencies are linked to organizational level competency. The authors define organizational level competency as a set of assets, processes, routines and a combination of competencies from multiple individuals that provide effective process performance, competitive capabilities and sustainable advantage in comparison to other organizations. Wickramasinghe and De Zoyza (2011) state that individual level competencies can be split into input and output competencies. Knowledge, attitudes, skills and technical knowledge are considered to be inputs, but competency presentation with the purpose of sharing results of exceeded work standards is regarded as outputs. Bohlouli, Mittas, Kakarontzas, Theodosiou, Angelis and Fathi (2017) agree with Wickramasinghe and De Zoyza (2011) and supplement the above mentioned individual level competencies aspect by a statement that self-direction is a crucial component in the individual set of competencies, especially when an individual is facing specific challenges, previously imperceptible situations, job roles or goals. Based on the definitions collected from literature sources, the authors of this research propose to define individual competency and organizational level competency. Individual competency is a set of ambitions, skills, knowledge and characteristics that a self-driven individual uses and is able to train to achieve personal effectiveness. Organizational level competence is a set of ambitions, skills, knowledge and characteristics owned by a company through employees, which measures and predicts employee effectiveness to achieve organizational goals.

Technology has an extensive variety of definitions in academic literature. Krawczyk-Dembicka (2017) offers numerous technology definitions. In the opinion of the authors, knowledge and skills used to produce products or services to meet customer needs by applying specific types of methods, techniques and structures represent key elements of definitions formulated by academic researchers. Schuh and Kramer (2016) emphasize that technology management consists of two dimensions. Science and engineering are recognized to be the hard dimension of the technology management, but all other technology management aspects are assumed to be the soft dimension of the technology management. The paper focuses on literature review concerning the soft dimension of the technology management to analyze technology management competencies.

Technology management competencies have been extensively researched by Doggett, McGee and Scott (2013). The authors propose a core technology management competency model linking process, project, systems and operations through the management context that refers to self-management, people management, quality management and risk management. In this paper, the authors aim to clarify the technology management competency model

proposed by Doggett, McGee and Scott (2013) with the purpose of customizing the model for finance and technology knowledge-intensive fintech companies.

To reach the aim, an extensive, systematic literature review has been applied. More detailed description is given in section II.

**Materials and Methods**

During the research, a systematic literature search was performed based on scientific database search and cross-reference snowballing, using the following three main keywords: 'digital transformation, 'fintech' and 'competencies'. The key words in the combination with the secondary key words, such as 'digital', 'electronic markets', 'technology', were used to search only for editorial materials in English on the Web of Science platform, EBSCO and Elsevier Scopus, Springer and other databases listed in Figure 1. The period defined for the literature review was from 2011 to 2018 because during the past decade competency management has come to the foreground driven by an increasing scientific interest in the topic (Kansal & Singhal, 2018; Wickramasinghe & De Zoyza, 2011).

After the first scan of keywords, abstracts and titles were scanned to understand the relevance of publications. Relevant publications were added to the literature review sample, and, analogously, publications for cross-references were searched and added to the publication list. The authors coded the final sample by assigning codes, such as, main definition and competencies to have a transparent cross-reference management. The final sample was integrated into the literature review. Table 1 shows publications since 2011 by the key words. The interest in competencies in the digital and technology context have been moderate since 2011 and increased in 2018. Authors have found relevant publications about 'fintech' starting from 2016 and 2017.

**Results and Discussion**

Baran and Clos (2014) propose three competency management models. The traditional model is described by Baran and Clos (2014) who state that employee recruitment, training, development and evaluation are focused on specific positions and tasks assigned. The authors argue that the traditional model does not assess talent and competencies of an individual, but strives to achieve specific goals defined for specific positions through a specific set of skills and knowledge. According to Baran and Clos (2014), the qualifications-based model foresees that employee recruitment ignores personality traits and is focused fully on education and qualification. The employee-oriented model, as stated by the authors, encourages focusing of employee recruitment on personality traits, in addition to education and qualification, with the result that a variety of competencies lead to an organization's functional effectiveness. The authors argue that technology and knowledge-intensive companies often require competencies that are not available in the market, such as, advanced descriptive

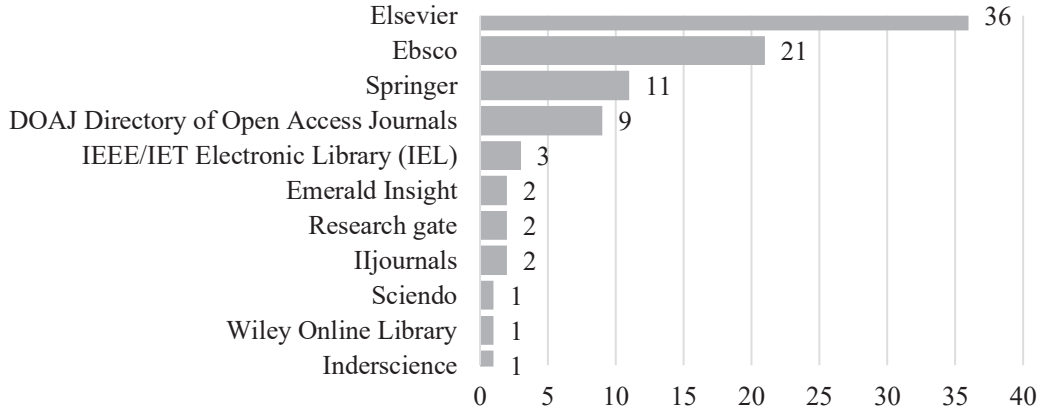


Figure 1. Number of publications examined during the literature review.

Source: Created by the authors based on literature review (December 2018).

Table 1

**Number of publications examined during the literature review by publication year**

| Key words | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Competencies | 8 | 5 | 8 | 10 | 8 | 7 | 6 | 13 | 65 |
| Fintech | - | - | - | - | - | 1 | 4 | 8 | 13 |

Source: Created by the authors based on literature review (December 2018).

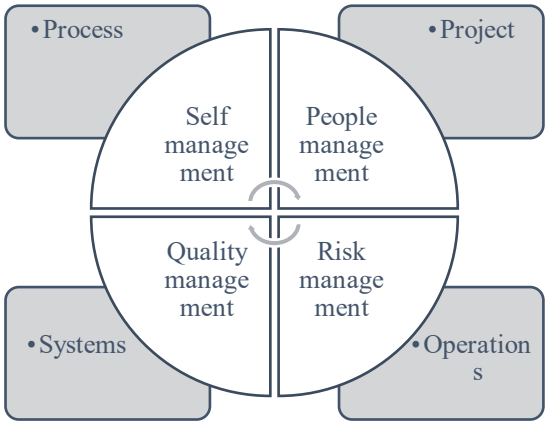


Figure 2. Technology management competencies model.

Source: created by authors based on Doggett, McGee and Scott (2013).

and predictive data analytics, or digital marketing; therefore, contemporary companies are forced to move away from traditional and qualifications-based models and apply employee-oriented models to recruit employees with personality traits to fit the position.

The authors of this research performed a literature review to clarify the technology management competency model proposed by Doggett, McGee and Scott (2013) with the purpose of customizing the model for finance and technology knowledge-intensive fintech companies.

*Process*

Doggett, McGee and Scott (2013) describe the process within the context of technology management as '*the transformation of input elements into output elements with specific properties, within defined parameters or constraints*' and point out that a specific product or service is the result of the process. Within the context of digital transformation, academic researchers widely discuss process enhancements and changes in the financial industry with a special focus on fintech companies (Li, Spigt, & Swinkels, 2017; Schulte & Liu, 2017). Academic literature widely researches the importance of self-management and emphasizes the ability to be self-directive in previously unexperienced situations (Bohlouli *et al*., 2017; Forster, Parrer, & Woss, 2013; Wickramasinghe & De Zoyza, 2011).

Character. Forster, Parrer and Woss (2013) in their research discuss the character as a key competency to be able to adapt to changing circumstances. The authors point out that efficient working behavior highly correlates with the character and integrity. Polancic, Hericko and Pavlic (2011) discuss the integrity aspect for individuals when acquiring new technologies and state that companies have to leverage carefully the existing technology and competencies. In their research, Wickramasinghe and De Zoyza (2011) start a discussion on the integrity aspect, stressing the individual's capability of adapting to the rapidly developing technology.

Relationships. Liu et al. (2011) discuss in their research extensively the synergy between the technical management competencies and finance management competencies, applying relationship dimension between stakeholders. The authors of the paper point out that the development environment is constantly changing and business teams are forced to apply constant changes to certain projects, while technical teams would prefer to lock in the project requirements. Forster, Parrer and Woss (2013) argue that self-dispositive competencies like stress tolerance, time management, flexibility and teamwork positively influence self-management and are the central factor influencing people positively, which is critical for companies to succeed. Personal Productivity. Junglas and Harris (2013) state that the correlation of personal productivity with technology development is more recognized in emerging-market economies than in developed economies. See competencies in Table 2.

Table 2

**Process and self-management competencies**

| Category | Detailed competencies |
|---|---|
| Self-Management | Ability to adapt to changing circumstances; openness to new experiences, integrity, capability; communication between technical and business teams; enthusiasm; ability to use and evaluate technologies critically; entrepreneurial creativity; methodological competency |

Source: created by authors based on Doggett, McGee and Scott (2013)

Table 3

**Project and people management competencies**

| Category | Detailed competencies (AGILE) | Traditional |
|---|---|---|
| Supervision | Leadership and collaboration | Command and control |
| Planning, organizing | Spread across the entire project cycle, project transparency | Occur in an up-front in the one-off manner |
| Staffing, leading | Tacit | Explicit; |
| Control and reporting | Continuous control of requirements | Heavy and well-planned project-based controls |
| Resource allocation | Same team can work on multiple projects | Same team work only on one project |
| Decision making | Informal | Formal |
| Coaching | Ongoing frequent feedback loops, iterative reviews | Planned feedback sessions |
| Team building | Organic | Mechanistic |
| Conflict and negotiation | Directly between technical personnel and process owners | Communication through planned project sessions |
| Change | Part of the overall process, can be easily incorporated | Hard to be incorporated, usually cause a new project |

Source: created by authors based on Doggett, McGee and Scott (2013).

Knowledge has been extensively mentioned in various academic researches and used to describe the technical aspect of competencies; it can be related to traditional and qualifications-based competencies models and is mostly connected to hard skills, qualifications and experience in a specific domain (Gray & Rumpe, 2017). Passion is reviewed in academic researches mainly from an entrepreneurial perspective (Baumann *et al*., 2018; Mamonov & Malaga, 2018).

*Project*

Doggett, McGee and Scott (2013) describe 'project' within the context of this research as '*the one-time application of a process to produce a unique product or service*'. The authors of the paper point out that the difference between process and project is that a unique product or service is produced during the project, but, as regards process, an input element is transformed into an output element within the frame of an existing product or service. Jemala (2013) argues that companies can achieve outstanding results by appointing a specific team for consistent monitoring and analysis of new market opportunities, trends and technological infrastructures and points out the importance of people management to innovate and optimize technology strategies and related processes.

The authors point out that a constantly changing environment leads to the development of new project management methods and facilitates an individual's ability to adjust to the rapidly changing environment, where the main focus for companies is to provide only necessary rules and guidelines for project delivery and overcome old paradigms with standardized procedures, comprehensive guidelines and project planning templates aiming to address the whole project lifecycle. According to the results of the research by Dingsoyr and Balijepally (2012), the change in project and people management from traditional approaches to the AGILE approach requires a new set of competencies. More competencies are shown in Table 3.

*Systems*

Systems in the context of technology management can be defined as '*management of technology across disciplines and companies in an integrated fashion for the purpose of business venture and development*' (Doggett, McGee & Scott, 2013).

Quality Management. Doggett, McGee and Scott (2013) assert that quality management is the managerial context in the systems aspect. Deshmukh, Thampi and Kalamkar (2015) state in their research that quality management strongly correlates with the technology, training and project management, while skills or employees have negligible influence on the quality management.

Strategy. Gomber et al. (2018) point out in their research that the financial industry has been fundamentally disrupted by digital transformation and that it is time for financial industry incumbents to '*embrace disruption*' and focus on the strategy change. The authors of the paper argue that synergy of quality management with systems and continuous product delivery project management are factors that help fintech companies build completely new business models, and incumbents change their existing business models. Kotabe et al. (2011) discuss that companies with the pressure to perform exceptionally well to maintain competitiveness strategically choose to outsource the missing competencies.

Methods and tools. To handle the dynamics and complexity of technology management, there are a

number of methods and tools available to respond to the changing environment. Fitzgerald and Stol (2017) mention in their research that AGILE principles help organizations scale and link organizational functions, products and development processes. According to the authors, the ability to sense a change and respond appropriately is the key AGILE characteristic. Fitzgerald and Stol (2017) discuss the DevOps concept, whereby development and operation teams are aligned into one function for a scalable technology approach to assure fully automated and measurable processes based on the software-as-a-service approach.

Customer focus. Bons et al. (2012) assert that future financial sector solutions are customer-oriented and all developed innovations are customer-focused. Kotarba (2017) argues that under customer-focused business models customers use technology not only to satisfy their needs, but also to evaluate the quality of services and relationships among financial service providers. The authors of the paper agree with Kotarba (2017) that digital transformation has influenced changes in the financial sector process and the main driver of the change is the availability of data owing to technology development in combination with advanced big data analytics resources that are addressing customer requirements and delivering high-quality processes and products.

Value stream management. It is discussed in academic publications that rapid technology development encourages companies to become more flexible to meet the constantly changing customer demands. In their research, Lugert, Volker and Winkler (2018) discuss a concept that, according to the classical definition, value stream management has a static project-oriented nature and inability to accommodate all the dynamics required by the contemporary organizations within rapid technology changes; therefore, the authors propose to evolve classical value stream management from an analysis of current value stream and creation of future value stream design to a dynamic value stream management concept, where synergy between technology and corresponding management approach through lean management is needed to address dynamic business environment requirements to increase flexibility and productivity.

Training and development. The authors of the paper have noted that a great variety of modern technical tools, frameworks and solutions are available owing to continuous technology development and technical and business managers are striving to get familiar with as many tools and technologies as possible, but in many cases technologies are quickly replaced with new solutions due to the rapidly changing environment and continuous learning needs to be applied. Bontis (2012) has pointed out in his research that most of the activities of the financial sector companies are regarded as an intellectual work; accordingly, financial sector companies qualify as knowledge-intensive with most of their workforce well qualified and trained continuously. More competencies can be seen in Table 4.

*Operations*

According to Doggett, McGee and Scott (2013), the term 'operations' in the context of technology management is defined as '*management of technology within a specific industrial specialty*'. Gomber, Kauffman, Parker, Weber (2018) argue about the changes in financial services, including online services and branchless banking, real-time credit scoring, transaction and credit monitoring.

Risk Management. Doggett, McGee and Scott (2013) assert that from the operational viewpoint within the management context the risk management is '*the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control their probability and/or impact*.' Based on the main definitions provided in academic researches, the risk is an uncertainty of the outcome of activity and severity of the consequence and, if an uncertain event occurs, it can have a positive or negative effect. The authors of the paper review risk management competencies based on the classification of technology management competency proposed by Doggett, McGee and Scott (2013). Philosophy, identification, assessment, response and control, compliance and reporting are identified as competencies related to operations and risk management. Paper authors point out that digital transformation and information technology bring in new types of risk which traditional risk management fails to recognize, mitigate and control.

Table 4

**Systems and quality management competencies**

| Category | Detailed competencies |
|---|---|
| Quality Management | Continuous delivery project management; scalable, fully automated and measurable processes and products; overproduction reduction; open-ended dynamic business plan management; dynamic value stream management; data centers, data analytics, data simulations and data model management |

Source: created by authors based on Doggett, McGee and Scott (2013).

Table 5

**Operations and risk management competencies**

| Category | Detailed competencies |
|---|---|
| Risk Management | Risk appetite definition; technology risk identification and monitoring; risk-based quality testing; data driven risk assessment model (using R or Phyton) |

Source: created by authors based on Doggett, McGee and Scott (2013).

Philosophy. Digital transformation challenges the established organizational risk management practices. Risks related to technology are well researched in academic literature, but a research gap still exists as to when and why technology risks emerge. Most of the technology risk management researches deal with organizational philosophy, culture, objectives and risk appetite. As previously mentioned in the research, Jemala (2013) argues that the best technology companies systematically analyze market and trends and innovate technology strategies and programs to be up to date with the market and maintain competitiveness. This is a risk-adverse philosophy of contemporary companies to mitigate the risk of becoming suddenly obsolete among competing companies. Aven (2013) argues that risk appetite is strongly connected to physiology adopted by the company and describes it as '*willingness to take on risky activities in pursuit of values*', pointing out that the risk appetite concept is especially important for technology-based companies, where the decision-making process regarding the use of existing technologies or shift to new solutions is strongly correlated with the risk appetite concept.

Identification. Poth and Sunyaev (2014) argue that the identification of product or service quality risk is a key step after product or service functions and values are defined. The authors extensively discuss risk-based quality testing and suggest defining appropriate measures for quality risk reduction. Gomber et al. (2018) argue that digital transformation encourages contemporary organizations to apply radical and disruptive innovation approach.

Assessment and strategy. Traditional and commonly used risk assessment practices can be applied for most of the technology-based business processes using standards published on information technology risk assessment and management by the Information Systems Audit and Control Association, the National Institute of Standards and Technology, the International Electrotechnical Commission, the International Organization for Standardization and the Information Technology Governance Institute. The authors argue that based on an aspect of the research of Obrand, Holmstrom and Newman (2018), which has been discussed earlier, rapidly growing technologies give rise to new risks and, due to this trend, companies are forced to apply risk assessment approaches to the emerged technology-based solutions, which can result in a deviation from the established risk assessment and management standards. In their research, Cayirci et al. (2016) identify 35 different incident scenarios, such as, lock-in, compliance challenges, cloud provider acquisition, and insecure or ineffective deletion of data, which are classified under four business-related categories (technical, legal, policy and organizational, and other).

Response and control. Schuh and Kramer (2016) argue that exhaustive management of technologies requires a comprehensive, transparent, structural and systematic control system to respond to diverse technology activities. Authors point out that the control is necessary to maintain a sustainable and resource effective technology management through the ongoing analysis of technology projects.

Compliance and reporting. The authors have discussed the financial sector change due to the development of technology and regulatory environments earlier in this research. Arner, Barberis and Buckley (2017) argue that the current process of regulatory compliance and reporting is obsolete and, with the development of technology, regulatory compliance and reporting will be technology based very soon and RegTech will be part of regulatory ecosystem, where regulators will be capable of real-time monitoring and underpin a more efficient financial system. Detailed competences are shown in Table 5.

## Conclusions

Authors argue that fintech and competency management haveincreased academic research interest because of information technology development. Technology domain is the most active in the publications and researches, but interest evolves to business domain through fintech concept researches, having rapidly increased in 2018. In this research, the authors have clarified the main technological competencies in the financial sector: Process and self-management competencies – ability to adapt to changing circumstances, openness to new experiences, integrity, capability, communication between technical and business teams, enthusiasm, ability to use and evaluate technologies critically, entrepreneurial creativity, methodological competency.

Project and people management competencies categories – supervision, planning, organizing,

staffing, leading, control and reporting, resource allocation, decision making, coaching, team building, conflict and negotiation, change. System and quality management competencies – continuous delivery project management, scalable, fully automated and measurable processes and products, overproduction reduction, open-ended dynamic business plan management, dynamic value stream management, data centers, data analytics, data simulations and data model management. Operations and risk management competencies – risk appetite definition, technology risk identification and monitoring, risk-based quality testing, data driven risk assessment model (using R or Phyton). Future research direction according to the research – to explore IT competencies management model.

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# PRACTICAL EVIDENCE OF WEB-BASED IDEA MANAGEMENT SYSTEMS: CLASSIFICATION AND APPLICATION

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**Abstract**
Multiple information systems have been developed during the last decade to gain more from collaboration, knowledge management and ideas. One type of such tools is the idea management systems (IMS) – a manageable systematic tool to generate and evaluate ideas. However, there is a lack of research which explores what web-based IMS are, and how they materialize practically. To fill the gap, the paper aims to create classification and application description of web-based IMS by adapting the theoretical and empirical research approaches. To achieve this aim, first, scientific papers, book chapters, and proceedings focused on the idea management and IMS were analyzed using a systematic literature review method and content analysis technique. Based on the analyses, several possible classifications of IMS criteria were found. Second, commercially available web-based IMS evaluation was conducted to verify the criteria and to add data-based classification criteria. Analysis of IMS has helped to characterize parities and disparities of web-based IMS. Results prove that IMS could be classified by their application focus – as 'active' and 'passive'. Dominant type is the active IMS. IMS could also be classified by the sources involved in the idea management - internal, external or mixed IMS. The main structural features of the web-based IMS are idea generation, idea evaluation, and idea retention. Results prove that there are no important differences between theoretical and empirical research results.
**Key words**: Idea Management Systems; Classification, Web-based; Application, Information Technology.

## Introduction

Polaris, Rolls-Royce and Pfizer have reached up to 80% improvements in time to market, creating new patents and service propositions with real revenue realization in excess of $50million thanks to IMS Spigit (Juma, 2018). The idea management system Crowdcity is trusted by clients, such as Intuit, P&G, the NHS, and others to engage employees, partners and customers in order to address the unique challenges they face (Crowdcity, 2018). Many organizations all over the world apply web-based IMS to solve their or their client problems. But even as these systems become more frequently applied in the organization, there is a research gap found in literature – that there is no common view on these systems. In previously conducted research (Mikelsone & Liela, 2015), the authors have developed a definition of IMS based on more than 70 literature sources. Definition developed during the research is that IMS are systematic, manageable tools, tool kits that help users to generate, evaluate and continue this process (that is, repeated idea generation and evaluation). The authors in that research have concluded that there is a great need to research web-based IMS empirically, enriching theoretical findings.

There is a literature base for this research. First, IMS literature gives wide theoretical insights into the idea management and IMS concept, both from systematic (e.g. Bailey & Horvitz, 2010; Vandenbosch *et al*., 2006) and structural (e.g. Bassiti & Ajhoun, 2013; Bergendahl & Magnusson, 2014; Divakaran, 2016; Narvaez & Gardoni, 2015) viewpoints. Literature sources regarding systematic IMS perspective focus on the social capital, creativity, cognition etc., but structural IMS perspective focus on the systems, design and the process (Jensen, 2012).

In their previous research, the authors have found that there are multiple pieces of research with a structural perspective that provide a theoretical base for further IMS concept exploration. Most researches that explore the existing IMS look into one or a few systems, while this research studies 108 web-based IMS based on the systematic approach. As a result, this will be the largest web-based IMS study. Previously, Summa (2004) has researched and compared 24 IMS, however, without a systematic approach. Classifications as a topic of IMS literature have been undervalued because there has been no scientific effort to do that up to now.

Focusing on IMS concept exploration, there are 2 main research gaps found in the literature: (1) there is no common view on IMS concept; (2) there are no IMS classifications based on theoretical or empirical research. It is very important to fill these gaps for the following reasons. First, common understanding will help researchers and IMS applicators to understand the basic concept of IMS and what could be reached with their application. Second, the exploration of different IMS classes could benefit future researches and advise end-users practically by providing main disparities of different IMS. The parity (provided by IMS basic concept exploration) and disparity (provided by the classification development) descriptions will help to build an understanding of IMS full potential and highlight different system classes that could provide different benefits.

There is also a personal motivation of the authors for this research. Although there is a great variety of

web-based IMS and, as previously shown, many well-known organizations have used them, the situation that was described in the legendary publication 'Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory' by DeSanctis and Poole (1994) is still topical: developers and users of the information management systems see potential of these systems but positive outcomes often do not occur consistently and that is one of the reasons why organizations do not use them commonly. That is the reason why it is vitally important to research web-based IMS and their application that could be one of the steps to explore how to apply these systems to increase organizational effectiveness. This paper is one of the steps on the authors' way of exploring web-based IMS application to increase organizational performance and effectiveness within adaptive structuration theory context. And in this way, it is vitally important to characterize web-based IMS practically, not only theoretically.

To fill the gap, the authors apply theoretical and empirical approach with the main aim of developing web-based IMS parity description by creating web-based basic concept explanation and disparity descriptions by creating classifications of web-based IMS. The paper aims to answer the research questions: (RQ1) what is meant by IMS at a conceptual level – main elements; (RQ2) what are the main IMS application approaches found in the literature – possible classification criteria; (RQ3) what is web-based IMS empirically? The answer to these questions implies an answer to the underlying composite question: what are web-based IMS parities and disparities?

This paper proposes that both terms – the idea management (IM) and IMS – are connected terms, which means that the literature about both terms should be researched. But as IM is a wider and more uncertain term and IMS is more determined subterm of IM, both of these terms should be divided. In this paper, IM is understood as a process, but IMS as a tool kit which provides IM. This paper fulfills an identified need to clarify IMS concept by applying theoretical and empirical approaches. The paper creates academic contribution: (1) it is the widest web-based IMS empirical research based on 108 studies and, based on the theoretical and empirical approaches, IMS concept has been clarified; (2) developed the classification of web-based IMS.

**Materials and Methods**

Research development is based on a theoretical research method - a literature review and empirical method of web-based IMS research. First, a literature review data collection was conducted in 3 stages: (1) research of scientific databases to explore literature where terms 'idea management' and 'idea management systems' are mentioned, – every term was researched in 7 databases; (2) selection of literature directly about IM, IMS; (3) exclusion of duplicates. The detailed literature source count in different stages is reflected in Table 1.

All the sources that passed stage 3 were used in content analysis to analyze the main elements of IM and IMS. Systematic literature analysis was conducted in 3 step process. First, to make the research process more effective, before the content analysis a review protocol was developed. The development of the protocol is essential to codify as precisely as possible the way studies have been collected to answer specific research questions, namely: (RQ1) what is meant by IMS at a conceptual level – main elements; (RQ2) what are the main IMS application approaches found in literature – possible classification criteria. Second step – data extraction. Third step – information synthesis with the help of thematic analysis. Content analysis instead of thematic analysis was selected because this technique provides not only qualitative but also quantitative insights, which in this case are important to explore the most frequently applied IMS approaches.

Table 1

**Count of the literature sources in stages**

| | Stage 1 – in the article title or/and keywords mentioned terms: | Stage 2 – directly about (full text available): | Stage 3 – unique sources: |
|---|---|---|---|
| Scopus | 39702 | 15 | 82 |
| ScienceDirect | 364611 | 2 | |
| Google Scholar | 3980000 | 33 | |
| Sage Journals | 152934 | 8 | |
| Ebsco | 5129835 | 9 | |
| Emerald | 107825 | 3 | |
| Web of Science | 269 | 52 | |
| Sum | 4645341 | 122 | |

Source: created by the authors.

Table 2

**The web-based IMS selection by stages**

| | Stage 1: keyword 'idea management system' | Stage 2: web-based IMS selection | Stage 3: unique IMS selection |
|---|---|---|---|
| Capaterra | 116 | 98 | 108 |
| Google | 129 | 104 | |
| SUM | 245 | 202 | |

Source: created by the authors.

Based on the analyses, several possible classification criteria have been found by answering to RQ1 and RQ2. Then commercially available web-based IMS evaluation was conducted to verify criteria found in the literature and improved with data-based classification criteria. This method helped to answer RQ3 – what is web-based IMS empirically? It was divided into 2 steps: (1) summary of web-based IMS systems that are commercially available and its content analysis to explore web-based IMS trends and main characteristics; (2) comparative analysis of theoretical and empirical study results. Analysis of systems helped to characterize structural features of web-based IMS that are important for future research to explore web-based IMS relations with organizational effectiveness in adaptive structuration theory context. Data for commercially available web-based evaluation have been selected from product descriptions available on websites of IMS, but information is processed through content analysis. The first step of data selection was to search in the Capaterra database. This database was chosen because it is one of the most comprehensive corporate IT solution databases that are publicly available. In November 2017, the database was searched by entering the keyword 'idea management system'; 116 systems were selected. Additional research was conducted in Google Search by entering the same keywords and looking through the first 100 search pages. In the second stage, only web-based systems were selected and the installed systems were excluded. In the third step, all unique systems that were later analyzed in the research were selected. The web-based IMS selection helped to find 108 web-based IMS (Table 2).

The data analysis was conducted using the content analysis method, which is essential to reach the aim of identifying the main parities and disparities of IMS and creating the methodology. In this paper, one of the most commonly used content analysis models consisting of 3 steps was used (based on Vaismoradi *et al*., 2013). 1. Preparation – sources are prepared for analysis (selected web-based IMS descriptions in the web-pages of the products) and an analysis protocol is created, based on the inductive and deductive found elements. 2. Organization – completed protocols, nonlinear coding (inductive, deductive). Codes are grouped into categories, selected for relevance to this study. Category network map was created with a global, organizational, and basic category. Repeated category mapping was conducted for disparities to create possible classification criteria. Table 3 shows the category map that helped to systemize protocols.

3. Results – report development, proposing empirically based IMS description and classification proposition. Niknazar and Borgault (2017) have concluded that unification is necessary to better understand the phenomenon under study and improve the common understanding in the research field. That shows that not only classification based on the disparities should be created but also clarified the object itself. The classification is intended to enhance understanding of phenomena related to organizations,

Table 3

**Category map of web-based IMS analysis**

| Global Category | Organizational Category | Basic Category |
|---|---|---|
| IMS Characteristics | Basic characteristics (deductive) | Product; Main functions; Main benefits; Price; Clients; Main fields of uses |
| | IMS characteristics based on the literature review (deductive) | Idea generation; Idea evaluation; Idea maintenance/continuation; Parallelism; Anonymity; Internal IM/ External IM; Transparency; Active/Passive IM |
| | Data-driven characteristics (inductive) | Inductive characteristics from IMS descriptions (e.g. dashboards, collaboration, status tracking, idea creator tracking, idea ranking, task formats, discussion, feedback, game mechanics, rewards, process control, involvement monitoring) |

Source: created by the authors.

management and different objects (Niknazar & Bourgault, 2017). There are several definitions of the classification. McKelvey (1978) explained that 'classification is identification and assignment of organization forms to formally recognized classes', but Hjorland and Nissen-Pedersen (2005) that it is 'the sorting of objects based on the criteria selected among the properties of classification objects'. These are not conflicting but complementary explanations because classification is identification and assignment of object different classes based on the classification criteria. A single entity could be classified by different classification criteria can be applied. But the value of classification criteria is determined by its alignment with classifier's purpose and there is no universal classification (Hjorland & Nicolaisen, 2005). In this paper, as the classification possible elements will be applied elements retrieved from the literature review and empirical web-based IMS research using inductive approach - the main separates of the systems are used as classification elements, divided in one phenomena characterized category (classification criteria).

**Results and Discussion**

Based on the previous studies, web-based IMS are systematic, manageable tools, toolkits that help users to generate, evaluate, as well as provide continuation of this process (that is, repeated idea generation and evaluation). The main elements of web-based IMS determined by content analysis are: idea generation (including preparation, capture/gathering of ideas, enhancement), idea evaluation (screening, selection), idea maintenance (it is included in the idea generation and evaluation process) and continuation of IM (that includes concept development, distribution of ideas, support during implementation with repeated IM, rewarding and retention). The main application characteristics are transparency, parallelism, anonymity, but approaches – internal IM/ external IM, active/passive IM. Table 4 shows the description of these characteristics, while these elements were evaluated as existing or not existing.

The systems were analyzed based on elements found in the literature, pre-defined categories that described product overall and in data-driven categories. Pre-defined IMS basic research elements based on the research aim were: the product name, main functions, main benefits, price, clients, main fields of uses. Data-driven or inductive characteristics from IMS descriptions, for example, are: dashboards, collaboration, status tracking, idea creator tracking, idea ranking, task formats, discussion, feedback, game mechanics, rewards, process control, involvement monitoring.

Table 4

**IMS main characteristics based on the literature review**

| Element | Explanation |
|---|---|
| Idea generation | Idea generation sessions (hybrid brainstorming) including preparation, capture/gathering of ideas, enhancement (e.g. Korde & Paulus, 2016; Wooten & Ulrich, 2015) |
| Idea evaluation | Ability to filter, compare and evaluate ideas submitted into an IMS (screening; selection) (e.g. Westerski, 2013; Summa, 2004) |
| Idea retention and continuity of IM | Ability to store ideas, concept development, distribution of ideas, support during implementation with repeated IM and rewarding, retention (e.g. Dennis & Garfield, 2003; Summa, 2004) |
| Parallelism | The ability for members to exchange information simultaneously (e.g. Dennis & Garfield, 2003) |
| Anonymity | Enables members to make contributions without attaching their names, which is not possible when contributions are made verbally (e.g. Dennis & Garfield, 2003) |
| External IM | External idea generation and evaluation (main IM sources – experts, partners, customers and other stakeholders (out of an organization) (e.g. Bothos *et al*., 2012; Tung *et al*., 2009; Westerski *et al*., 2011) |
| Internal IM | Internal idea generation and evaluation in an organization (main IM source – employees) (e.g. Bassiti & Ajhoun, 2013; Deichmann, 2012) |
| Mixed IM | Idea generation and evaluation involving internal and external sources (e.g. Sandstrom & Bjork, 2010; Westerski & Iglesias, 2012) |
| Transparency | Transparent evaluation process (e.g. Summa, 2004) |
| Active IM/IMS | Ability to submit ideas that are focused on special needs (focused) (e.g. Gamlin *et al*., 2007) |
| Passive IM/IMS | Ability to submit all ideas that come to mind (unfocused). Not providing all IM process elements (e.g. Gamlin *et al*., 2007) |

Source: created by the authors.

Table 5

**Parities and disparities of web-based IMS**

| Element | Parity/ disparity | Group |
|---|---|---|
| Idea generation; Idea evaluation; Idea retention; Parallelism; Anonymity; Transparency; Fields of uses; Benefits; Clients | Parities | 1 – parities |
| External IM; Internal IM; Mixed IM | Disparities | 2 – disparities related to idea sources |
| Active IM; Passive IM | | 3 – disparities related to IMS focus |
| Functions; Dashboards; Status tracking; Idea creator tracking; Collaboration; Idea ranking; Task formats; Discussion; Feedback; Game mechanics; Rewards; Process control; Involvement monitoring | | 4 – disparities based on the functions |

Source: created by the authors.

Based on the research results, it could be concluded that there are no conflicting insights of pre-defined web-based IMS as systematic, manageable tools, tool kits that help users to generate, evaluate and continue this process (that is, a repeated idea generation and evaluation). This research also proves that the main characteristic elements or structural features of web-based IMS are: idea generation, idea evaluation, idea retention (that is involved in idea generation and evaluation phases). Additional parities are that these systems provide parallelism, anonymity, transparency and are applicable for different kind of idea generation and evaluation. See the list of all parities and disparities in Table 5.

Parities are the elements that were observed in more than 80% of the web-based IMS. Main disparities highlight the potential elements for classification criteria development. Main disparities were divided into 3 groups: source related elements, application focus related elements, and process function related elements. Based on these 3 groups of elements, the classification criteria were defined. The created classifications: (1) based on the involved IM source (internal, external or mixed IMS); (2) based on the application focus – as 'active' and 'passive'; (3) based on the provided process functions (limited IMS, full IMS, extra IMS. Table 6 shows the disparities and parities, and the description of the classification classes.

Based on the involved IM, the source (internal, external or mixed IMS) provides the insight in the classes of IMS based on the possible idea generators and evaluators. Internal IMS provides an opportunity to involve in IM employees or some departments, external IMS provides an opportunity to involve external sources, for example, crowds, clients etc. (mostly these systems have public platform), mixed IMS provides an opportunity to involve internal and external IM sources, for example, external IM sources create ideas, but internal ones evaluate them or vice versa. Mixed IMS provides a large scale of opportunities on how to manage IM sources.

Based on the application focus, all systems could be classified as 'active' and 'passive'. This classification shows that there are systems that passively collect all ideas not focused, but active IMS provides functions to collect ideas more focused and mostly also includes idea evaluation possibilities.

Based on the provided process functions all systems could be classified as limited IMS, full IMS, extra IMS. Empirical research explored that not all web-based IMS are fully consistent with IMS definition (based on the process functions), but in reality IMS frequently are classified as systems that provide only idea generation (limited IMS) or systems that provide not only IMS process functions, but also some innovation management functions, such as, idea implementation, project management etc. (extra IMS). But the majority of the systems empirically called IMS has IMS process functions described in the theoretical definition- that is idea generation, evaluation, and continuation of IM (full IMS). These are only some of the classifications that could be created for IMS. The authors of the paper hope that this research will embrace a discussion of these classifications with other researchers to create classifications of IMS because there is a lack of research-based classifications that could explain differences between IMS, and consequently have a practical and academical contribution.

**Conclusions**

Research results prove that there are no important differences between theoretical and empirical research results. Additionally, researching IMS potential application, it was concluded that these systems are universally applicable for different use specifics and by different users. Main structural features of web-based IMS are idea generation, idea evaluation, idea retention. This paper provides several ways how web-based IMS could be classified by their application focus – as 'active' and 'passive', however, the dominant type of web-based IMS are 'active' IMS that, according to the literature, are more effective (Gamlin *et al*., 2007). It would be interesting to do

Table 6

**Disparities and parities of systems**

<table>
<tr><td colspan="6">IMS – tool, tool kit or complex system which provides systematic, manageable process of:</td></tr>
<tr><td colspan="2">Idea generation (preparation, capture/gathering of ideas, retention, enhancement)</td><td colspan="2">Idea evaluation (screening, selection, retention)</td><td colspan="2">Continuation of IM (concept development, distribution of ideas, support during implementation with repeated IM and rewarding, retention)</td></tr>
<tr><td colspan="6">Additional characteristics: these systems provide parallelism, anonymity, transparency and are applicable for different kind of idea generation and evaluation aims</td></tr>
<tr><td colspan="6">Classifications</td></tr>
<tr><td colspan="6">Classification criteria: based on the application focus</td></tr>
<tr><td colspan="3">Passive IMS</td><td colspan="3">Active IMS</td></tr>
<tr><td>Functions<br>Focus on idea generation</td><td colspan="2">Type of focus<br>Unfocused process</td><td>Functions<br>Focus on all IM dimensions</td><td colspan="2">Type of focus<br>Focused process</td></tr>
<tr><td colspan="6">Classification criteria: based on the involved IM source</td></tr>
<tr><td colspan="2">Internal IMS</td><td colspan="2">External IMS</td><td colspan="2">Mixed IMS</td></tr>
<tr><td>Description<br>IMS that allows involving only internal IM sources</td><td>Main IM source<br>Employees</td><td>Description<br>IMS that allows involving only external IM sources</td><td>Main IM source<br>Crowds, experts, clients etc.</td><td>Description<br>IMS that allows involving internal and external IM sources</td><td>Main IM source<br>Employees; clients, experts, crowds, etc.</td></tr>
<tr><td colspan="6">Classification criteria: based on the provided IM process functions</td></tr>
<tr><td colspan="2">Limited IMS</td><td colspan="2">Full IMS</td><td colspan="2">Extra IMS</td></tr>
<tr><td>Description<br>IMS with limited process elements that support only some IM process elements</td><td>Main functions supported<br>Idea generation</td><td>Description<br>IMS which supports all process elements of IM</td><td>Main functions supported<br>Idea generation, idea evaluation, continuation</td><td>Description<br>IMS that supports all IM process elements with additional innovation functions</td><td>Main functions supported<br>Idea generation, idea evaluation, continuation, idea implementation</td></tr>
</table>

Source: created by the authors.

research on experience of the companies that apply 'passive' IMS and main application benefits, and aims to compare with 'active' IMS. Van den Ende et al. (2015) have observed that in practice there are two main problems in with the idea generation: (1) low quality of ideas; (2) usefulness for organizational strategy. Both problems theoretically could be solved by choosing 'active' IMS with a possibility of creating focused IM processes.

This paper fulfills an identified need to clarify IMS concept applying theoretical and empirical approaches. It creates academical contribution: (1) it is the widest web-based IMS empirical research based on 108 studies; and based on the theoretical and empirical approaches IMS concept has been clarified; (2) developed the classification of web-based IMS. This paper makes an important novel contribution to the literature by characterizing parities and disparities of web-based IMS. It is also the widest research which summarizes the benefits of web-based IMS application. Practical contribution: (1) theoretically and empirically based insight into parities and disparities of web-based IMS that could help to review the potential application of these systems in different other systems; (2) classifications will help to understand some classification criteria that could also be used as criteria for these systems when choosing in practice; (3) classifications highlight benefits/implications of adopting different types of IMS for organizations. These contributions also give managers a richer set of theoretical tools, making them easier to select IMS that are the best for their situation. In the research process and paper development, many future research directions have been identified. First, research could focus on how organizations adapt/customize systems to their own use and implement them in their operations. That would be a great element for case studies that authors are conducting next and is also connected to the adaptive structuration theory. Case studies could provide more comprehensive characteristics of web-based IMS application. This paper concentrated only on commercially available and web-based IMS, but future research could include insights from non-commercial/ private IMS and installed IMS. Additional research should be done on how commercially available systems could be customized and why some organizations create their own IMS. Future research should provide evidence on how different classes of IMS impact organizational results. That also resonates with van den Ende et al. (2015) ideas. The authors hope that this paper will stir up the researchers' interest in classification of IMS, which has been neglected for too long.

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# CONTENT MARKETING DECISIONS FOR CUSTOMERS' DESIRED VALUE IN THE TOURISM SECTOR

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**Abstract**
In a landscape of increasing customer/firm interactions in digital space, content marketing, which aims to generate prospects and sales to foster customers' brand engagement, brand awareness and trust, is on the rise. Notwithstanding, despite significant marketing specialist interest, scientific content marketing research is not widely developed. Therefore, it encourages the need for new studies in the content marketing field.
This paper introduces theoretical and practical aspects of content marketing decisions for the creation of desired customer value in the tourism sector. The aim of the presented research is to determine which combinations of content marketing decisions could create the desired value for the customer in the tourism sector. Understanding the content marketing decisions that create the desired value for customers could lead to a proper implementation of content marketing in the tourism sector.
The presented results of q-sort study indicate twelve different combinations of content marketing decisions which could be used by tourism organizations in order to create desired value for their customer. Thus, it means that increasement of desired customer value can be made in the light of content marketing usage. The paper ends with insights, conclusions, limitations and future research possibilities.
**Key words**: content marketing, desired customers' value, tourism.

## Introduction

Content marketing is a relatively new marketing concept which is focused on customers attraction and retention by creating and distributing relevant, unique, valuable, well produced and entertaining content. Need for this type of marketing emerged due to popularity of digital activities, information overload, increased competition, unconcerned internet users and willingness to attract and to keep customer interest on company or brand (Kidane & Sharma, 2016; Kose & Sert, 2017; Hollebeek & Macky, 2019). As A. Karkar (2016) stated, companies that adapted content marketing perceive this is an effective technique in terms of guiding customers who are knowledgeable about the product and know how to choose the brand, and leading them to be loyal customers. Researchers (Kose & Sert, 2017; Kaitosalmi, 2017; Bruhn & Schnebelen, 2017) admit that content strategy is a view based on business strategy and customer insights, of what value to create for the customers, how to concretise the value in content, for whom to create it and in which channels to distribute it. Accordingly, there are several types of content marketing decisions in content creation stage: the idea of content decision, content distribution decision, content format decision and content element decision.

It is noticeable that content marketing concept is indirectly linked to the value for customer, which is always the goal of all companies (Danciu, 2016; Kumar & Reinartz, 2016). For instance, content marketing and customer value are actualized by digitalization (Hollebeek & Macky, 2019), and content marketing concept is based on valuable content (Jiao, Jo, & Sarigöllü, 2017), thus content could be used as a value creation tool (Dvir, & Gafni, 2018). Customer value is a construct which includes different value types related to different buying stages. Desired customer value is related to the purchase decision and possible actions before it. This type of value refers to what customer desire in a product or service (Shanker, 2012) is and is not limited to the direct benefits of the product. Furthermore, it reflects customer expectations and dominates in customer decision making process (McMurrian & Matulich, 2016; Ntimane & Tichaawa, 2017).

Accordingly, it is important to look for new decisions that could create desired customer value. A tourism sector is not an exception as the search for information online is an important part of the purchasing decision process (Wu, 2018). However, despite the connection between customer value and content marketing, or supposed positive effect of this implementation, there is a lack of research in this particular field.

Considering the discussed connections, the object of this research is content marketing decisions directed towards the desired customer value in the tourism sector. The scientific problem solved by the research is formulated by the question: what type of content marketing decisions could create the desired value for customer in the tourism sector? Accordingly, the aim is to determine content marketing decisions that could create desired value for customer in the tourism sector.

## Materials and Methods

Q-sort methodology was used to identify and classify marketing experts' viewpoint towards content marketing decisions for desired customer value creation in the tourism sector. Various researchers (Shinebourne, 2009; Zabala, 2014; Lobinger & Brantner, 2015) describe a card sorting as a method by

Table 1

**The sample of cards**

| | | | THE IDEA OF CONTENT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | A. Informative | B. Reliable | C. Relevant | D. Emotional | E. Unique | F. Valuable | G. Intelligent |
| CONTENT DISTRIBUTION | Owned media | 1. Website | 1A | 1B | 1C | 1D | 1E | 1F | 1G |
| | | 2. Email | 2A | 2B | 2C | 2D | 2E | 2F | 2G |
| | | 3. Catalouges | 3A | 3B | 3C | 3D | 3E | 3F | 3G |
| | Paid media | 4. Web portals | 4A | 4B | 4C | 4D | 4E | 4F | 4G |
| | | 5. Social networks | 5A | 5B | 5C | 5D | 5E | 5F | 5G |
| | | 6. Google | 6A | 6B | 6C | 6D | 6E | 6F | 6G |
| | Earned media | 7. Social networks | 7A | 7B | 7C | 7D | 7E | 7F | 7G |
| | | 8. Review sites | 8A | 8B | 8C | 8D | 8E | 8F | 8G |
| | | 9. Users blogs/ vlogs | 9A | 9B | 9C | 9D | 9E | 9F | 9G |

which it is possible to explore the different ways cards can be organized in particular categories. Application of the card sorting includes cards design, cards selection, method choice, participant determination, preparation of instructions, sorting process and given data analysis.

At the beginning, the authors prepared a sample of cards (Table 1) and selected cards for the next step of study. Two main types of content marketing decisions, the idea of content (5 ideas) and content distribution (9 channels), were chosen. Particular ideas were selected based on authors' previous research (Pažėraitė & Repovienė, 2016). Due to the big amount of available channels for content marketing, particular 9 channels were chosen based on a structure of content marketing distribution, channel suitability for content marketing, channel usage in the tourism sector and channel popularity among customers.

This 63 cards collection was reduced to a final representative of 30 cards selection based on q-sort instructions (Shinebourne, 2009). Thus, illogical, duplicating or previously studied combinations were eliminated.

In the method choice stage, online card sorting platform from 'Optimal Workshop' was chosen. The main advantage is that sorting happens simultaneously and can be completely unmoderated. Besides that the chosen tool allows to provide instructions and guidelines for participants throughout the activity.

Based on the set aim and authors' ambitions to develop a foundation for further research involving a big number of consumers, 12 marketing experts from the tourism industry were selected to be first round respondents to provide data for this particular research. As it is marked in scientific literature (Shinebourne, 2009; Zabala, 2014), card sorting method requires a relatively small sample of respondents, especially in pilot researches. Participants were approached by e-mail, inviting them to online survey and providing detailed instructions for sorting.

During card sorting session, every participant was asked to sort 30 cards in random order over a

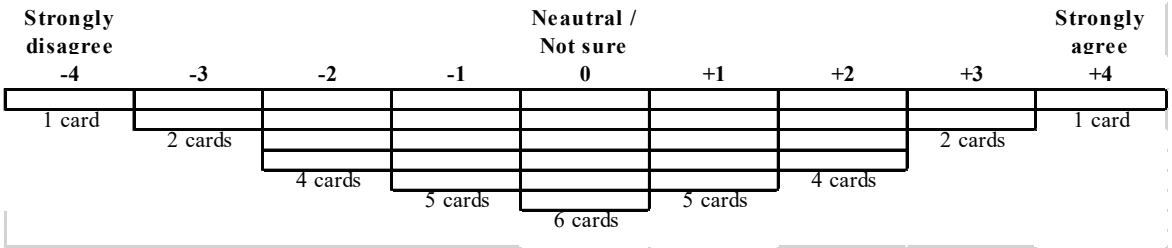



Figure 1. Card sorting grid.

grid (Figure 1), from strong disagreement to strong agreement in a response to one question 'Which of these content marketing decisions could create a desired value for customers who are choosing services from tourism sector?'.

Results and insights were obtained through the analysis of card sorting arrangements. There are several ways to use card sorting method: problem/ insight identification, knowledge acquisition, participatory design activities, and evaluation/ optimization of a prototype. In this study, attention was given to knowledge acquisition and evaluation of particular content marketing decisions by analysing the physical distribution of sorted cards.

**Results and Discussion**

During the card sorting sessions, marketing experts from the tourism sector used all of the 30 combinations of content marketing decisions, distributing the cards across 9 different categories. The analysis of the research results starts with the review of popular card placements (Table 2). Popular placements matrix reveals the number of participants who sorted a particular card into the corresponding category. Furthermore, it attempts to propose the most popular groups based on each individual's highest placement score.

First of all, all negative categories should be reviewed. As shown in Table 2. 6 different cards were assigned to the category 'Strongly disagree (-4)' which has 1 card limit. Despite that, this category has one leading card which was selected by five participants (6E: Unique content in Google search platform). This category also contained several cards covering emotional content (in total 4 times) and content sent by email (in total 4 times). To the category 'Disagree

Table 2

**Popular placements matrix**

| | -4 | -3 | -2 | -1 | 0 | +1 | +2 | +3 | +4 | CATEGORIES PER CARD | σ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6E.** | 5 | 5 | 2 | | | | | | | 3 | 0.8 |
| **2D.** | 3 | 4 | 4 | 1 | | | | | | 4 | 1.0 |
| **4D.** | 1 | 5 | 3 | 3 | | | | | | 4 | 1.0 |
| **1B.** | | 3 | 5 | 3 | | 1 | | | | 4 | 1.1 |
| **2B.** | 1 | | 6 | 3 | 1 | 1 | | | | 5 | 1.2 |
| **6C.** | | | 6 | 4 | 1 | 1 | | | | 4 | 1.0 |
| **5A.** | 1 | | 3 | 6 | 1 | | 1 | | | 5 | 1.4 |
| **8D.** | | 1 | 3 | 7 | 1 | | | | | 4 | 0.8 |
| **9E.** | | 1 | 2 | 7 | 1 | 1 | | | | 5 | 1.0 |
| **8E.** | | 2 | 3 | 3 | 3 | | 1 | | | 5 | 1.4 |
| **3A.** | 1 | | 3 | 4 | 3 | 1 | | | | 5 | 1.3 |
| **2E.** | | | 1 | 4 | 4 | 3 | | | | 4 | 1.0 |
| **1D.** | | | 1 | 4 | 5 | 2 | | | | 4 | 0.9 |
| **4A.** | | 1 | 3 | 1 | 5 | 2 | | | | 5 | 1.3 |
| **9D.** | | 1 | 1 | 4 | 6 | | | | | 4 | 1.0 |
| **3E.** | | | 1 | 2 | 6 | 2 | 1 | | | 5 | 1.0 |
| **4E.** | | 1 | | 2 | 6 | 3 | | | | 4 | 1.1 |
| **9A.** | | | | | 7 | 3 | 2 | | | 3 | 0.8 |
| **5D.** | | | | | 5 | 5 | 1 | 1 | | 4 | 0.9 |
| **1E.** | | | | | 4 | 6 | 1 | | 1 | 4 | 1.1 |
| **4C.** | | | | | | 8 | 3 | 1 | | 3 | 0.7 |
| **2A.** | | | | 2 | 2 | 4 | 3 | 1 | | 5 | 1.2 |
| **9C.** | | | | | 4 | 4 | 2 | 1 | 1 | 5 | 1.3 |
| **8C.** | | | | | 2 | 3 | 5 | 2 | | 4 | 1.0 |
| **8A.** | | | | | 1 | 3 | 4 | 2 | 2 | 5 | 1.2 |
| **1A.** | | | | | | 1 | 6 | 3 | 2 | 4 | 0.9 |
| **1C.** | | | | | 1 | 1 | 5 | 3 | 2 | 5 | 1.2 |
| **2C.** | | | | | 2 | 1 | 6 | 3 | | 4 | 1.0 |
| **5E.** | | | 1 | | 1 | 2 | 4 | 4 | | 5 | 1.5 |
| **5C.** | | | | | | 2 | 3 | 3 | 4 | 4 | 1.1 |
| **CARDS PER CATEGORY** | 6 | 10 | 17 | 17 | 23 | 23 | 16 | 11 | 6 | | |

(-3)' 10 different cards were assigned and 2 cards dominate (each assigned 5 times): 4D (Emotional content published in web portals) and 6E, which was the most popular card in category 'Strongly disagree (-4)', too. It could also be observed that category 'Disagree (-3)' often comes along with other cards that include emotional content (in total selected 11 times), content published in web portals (in total selected 7 times) and content published in review sites (in total selected 3 times). More than half - 17different cards - were allocated to the category 'Partly disagree (-2)', which hold 4 card positions. 6C (Relevant content in Google search platform) and 2B (Reliable content sent by email) were most frequently designated as a combination of content marketing decisions that are partly unable to create desired value for customers. Despite the wide distribution of cards and its variety, different content marketing decisions that include emotional content (emotional content in web portals; emotional content sent by email; emotional content on review pages; emotional content in other users' blogs/vlogs; emotional content on website) were sorted into 'Partly disagree (-2)' category 12 times (half of all selections in this category). Category 'More disagree, than agree (-1)' has a 5 cards limit and collected 17 different cards in total, the same as category 'Partly disagree (-2)'. This category was mostly attributed to two types of cards: 8D (Emotional content on review sites) and 9E (Unique content in other users' blogs/vlogs).

However, the review of negative categories shows that there are only 3 different cards which were not assigned to any positive category and 2 different cards whose highest placement was in the category 'Neutral / Not sure (0)': 6E, 2D (Emotional content sent by email), 4D, 8D and 9D (Emotional content in other users' blogs/vlogs).

Analysis of category 'Neutral / Not sure (0)', which holds 6 cards positions, revealed that even 23 different cards were associated with a particular category. It could be explained by the fact that this category is the most widespread and the most acceptable for tourism marketing experts who are hesitant about a specific combination of content marketing decisions. 9A (Informative content in other users' blogs/vlogs) was the most common in this category. Because of the fact that this category collected more than two-thirds of the entire card pile, there are a few cards which were selected by 6 respondents each: 9D, 3E (Unique content in tourism catalogues) and 4E (Unique content published in web portals).

Reviewing the positive categories shows that the first category 'More agree than disagree (+1)' attracts as many cards as the neutral category (in total 23 cards) and 6 cards more than the category 'More disagree than agree (-1)'. It means that tourism marketing experts appreciate the potential of content marketing decisions for the creation of desired customer value more positively than negatively. In addition, this category was attributed to a card that was the most frequently rated (selected 8 by participants): 4C (Relevant content published in web portals). 1E (Unique content on a website) was assigned into this category by half of participants, as well. As presented, popular placement matrix (Table 2) shows that 16 different cards were assigned to the category 'Partly agree (+2)' which has 4 card limit – fewer card spread as in the category 'Partly disagree (-2)'. Accordingly, the category 'Partly agree (+2)" has two leading cards (as well as category 'Partly disagree (-2)'), which was selected by 6 participants each (1A (Informative content on website) and 2C (Relevant content sent by email)). This category also came with several cards covering relevant content (in total 22 times), content published on a company website (in total 12 times), content in review sites (in total 9 times) and content in social networks (in total 8 times). In the category 'Agree (+3)', it appears that it has collected one card more (in total 11 cards) than analogous category on the negative side of the card sorting grid. 5E (Unique content in social networks) was most frequently designated as a combination of content marketing decisions, which are able to create desired value for customers. Considering the wide distribution of cards, 6 from 7 different content marketing decisions, which include relevant content (relevant content in social networks; relevant content on review sites; relevant content sent by email; relevant content on website; relevant content published in web portals; relevant content in other users' blogs/vlogs), were sorted into 'Agree (+3)' category 13 times (more than half of all selections in this category). Category 'Strongly agree (+4)' has 1 card limit and collected 6 different cards in total, the same as the category 'Strongly disagree (-4)'. Category 'Strongly agree (+4)' was mostly attributed to one type of card: 5C (Relevant content in social networks) and came with a few cards covering the content on a website (in total 5 times and informative content (in total 4 times).

Finally, by completing the review of card placements, it could be noted that there are 11 different cards which were not assigned to any negative category: 9A, 5D (Emotional content on social networks), 1E, 4C, 9C (Relevant content in other users' blogs/vlogs), 8C (Relevant content on review websites), 8A (Informative content on review websites), 1A, 1C (Relevant content on a website), 2C and 5C. Analysis reveals that a much larger part of the content marketing solutions is considered to constitute a positive value for the consumers in the tourism services sector. Therefore, the analysis of card display results also showed that a much bigger proportion of

content marketing decisions (i.e. different types of cards) were considered to be positive than negative in order to create the desired customer value in the tourism sector.

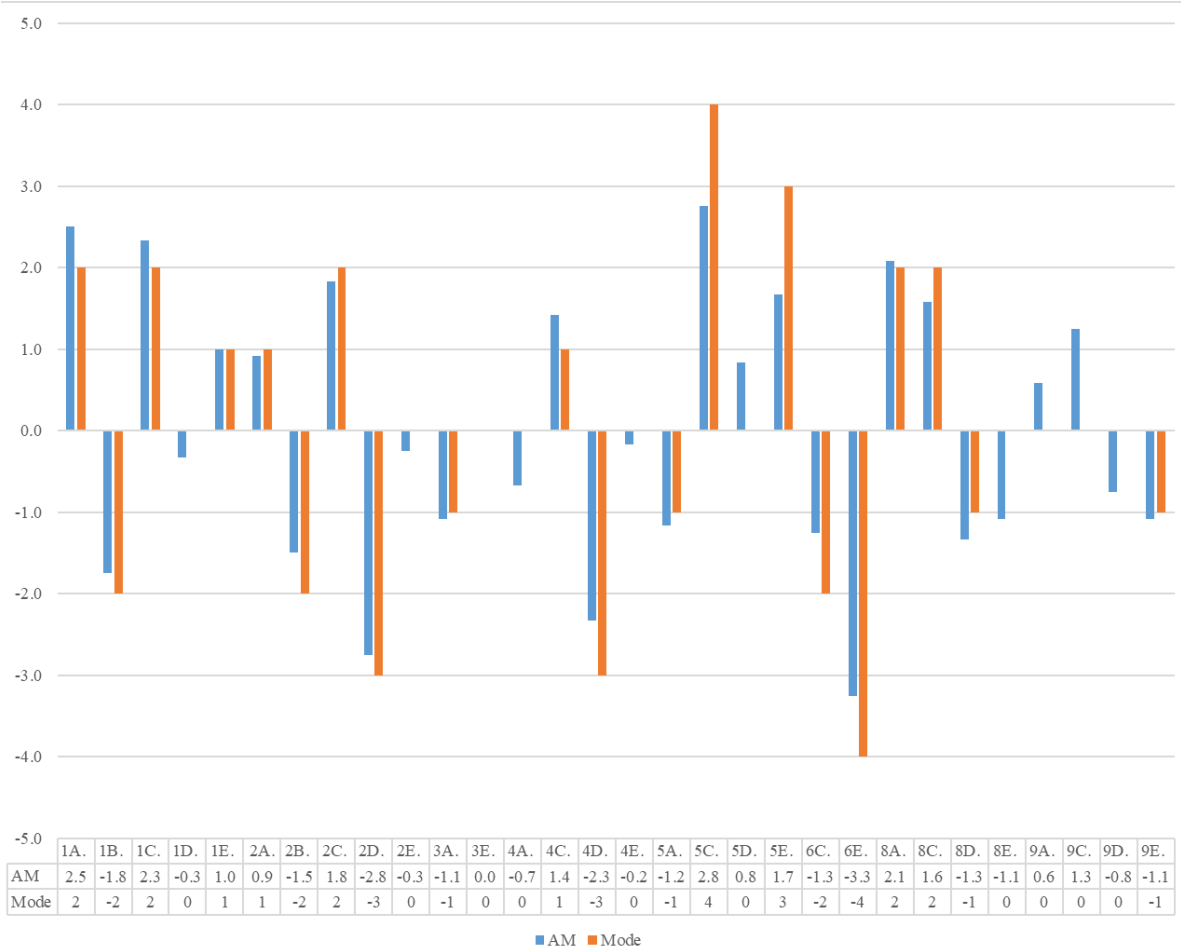
When assessing the distribution of individual card in different categories, it was revealed that all cards spread between 3 and 5 categories per card (in total 9 categories). Consequently, the average is 4.3 positions per card. This means that a single card evaluation made by a separate marketing expert is partly different and might vary across evaluation scales. Accordingly, only three cards were limited by three categories: 6E, 9A, 4C.

Although the card sorting method includes many attributes from qualitative research, it is worth to take a look at the trends in the deviation of values in order to understand the level of homogeneity of participants evaluation. Deviation of the larger part of the cards does not exceed more than one category position, so a common attitude between the different participants can be noticed. The biggest diversion between separate card evaluation is in 5E case (σ=1.5). 8E (Unique content in review sites), and 5A (Informative content in social networks) was also assessed differently (σ=1.4). On the other hand, analysis of the deviation showed that 4C (σ=0.7), 6E (σ=0.7) and 8D (σ=0.7) have the most homogeneous assessments.

Focusing on individual content marketing decisions, it can be seen that the number of data variation is different as well. Participants' opinions were more diverged on 'content in social networks' and 'informative content' cards. In contrast, possibilities of 'content in Google platform' and 'emotional content' to create desired value for customers in the tourism sector were assessed in a quite similar way.

The analysis of the research results continues with the review of card arrangements (Figure 2). In order to determine, which combinations of content marketing decisions create desired value for customers in the tourism sector and which do not, the focus was on average (AM) and the most often value (Mode) of individual card evaluation.

As one may see (Figure 2), the range of card evaluation varies between -3.3 and +2.8. This means that none card, in the overall result, reaches a total agreement (+4) or total disagreement (-4) from marketing experts who work in the tourism sector. The most unfavourable combination of content marketing decision is 6E (AM=-3.3; Mode=-4).




| | 1A. | 1B. | 1C. | 1D. | 1E. | 2A. | 2B. | 2C. | 2D. | 2E. | 3A. | 3E. | 4A. | 4C. | 4D. | 4E. | 5A. | 5C. | 5D. | 5E. | 6C. | 6E. | 8A. | 8C. | 8D. | 8E. | 9A. | 9C. | 9D. | 9E. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AM | 2.5 | -1.8 | 2.3 | -0.3 | 1.0 | 0.9 | -1.5 | 1.8 | -2.8 | -0.3 | -1.1 | 0.0 | -0.7 | 1.4 | -2.3 | -0.2 | -1.2 | 2.8 | 0.8 | 1.7 | -1.3 | -3.3 | 2.1 | 1.6 | -1.3 | -1.1 | 0.6 | 1.3 | -0.8 | -1.1 |
| Mode | 2 | -2 | 2 | 0 | 1 | 1 | -2 | 2 | -3 | 0 | -1 | 0 | 0 | 1 | -3 | 0 | -1 | 4 | 0 | 3 | -2 | -4 | 2 | 2 | -1 | 0 | 0 | 0 | 0 | -1 |

Figure 2. Card arrangements.

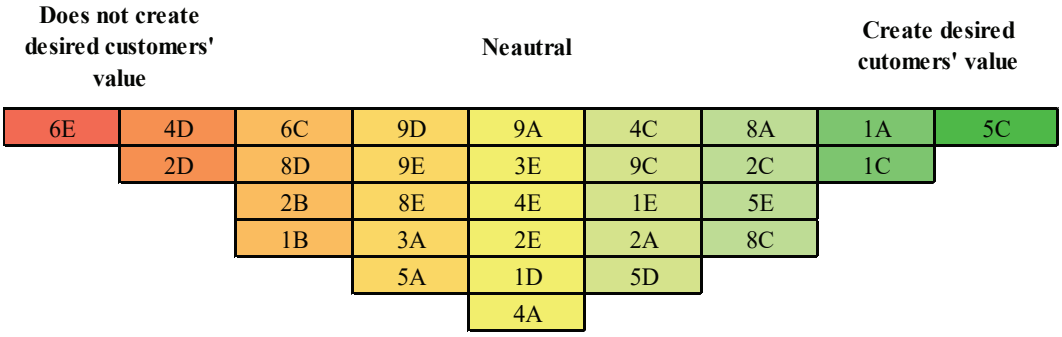



Figure 3. Combinations of content marketing decision for desired customer value in the tourism sector.

Other unfavourable (-2 and less) cards appeared in the following order: 2D (AM=-2.8; Mode=-3) and 4D (AM=-2.3; Mode=-3).

Hence, only 3 combinations of content marketing decisions (two of them include emotional content) are seen as really incapable of creating desired value for the consumer. The most disliked content marketing decisions are reliable content (AM=-1.63) and content in Google platform (AM=-2.3). Results of 4 cards show these cards as the most neutral (AM is between -0.5 and +0.5) combinations of content marketing decisions in a perspective of desired customer value creation: 3E (AM=0.0; Mode=0), 4E (AM=-0.2; Mode=0), 2E (Unique content sent by email (AM=-0.3; Mode=0)) and 1D (Emotional content on website (AM=-0.3; Mode=-0)). As it can be seen, three-quarters of these cards are related to content uniqueness. The most favourable combination of content marketing decision is 5C (AM=+2.8; Mode=4). Next favourable (+2 and more) cards ranked as follows: 1A (AM=+2.5; Mode=2), 1C (AM=+2.3; Mode=2) and 8A (AM=+2.1; Mode=2). The most favourite content marketing decisions are relevant to content (AM=1.43) and content in social networks (AM=1). Accordingly, combinations of content marketing decisions have more possibilities to create desired value for a customer.

Despite that the most unfavourable combinations (6E, 2D, 4D) get stronger disagreement (average AM= -2.8, Mode=-3) than the most favourable combinations (5C, 1A, 1C, 8A) gets an agreement (average AM= +2.4. average Mode=2). However, it can be noticed that the difference between AM values of 4 favourable cards is less (AM from +2.1 to +2.8) than between the values of 3 the most unfavourable cards (from -3.3 to -2.3). Thus, the research participants are more likely to appreciate the equal potential of favourite combinations.

Finally, corresponding to the aim of the study, content marketing decisions, which create desired customer value, can be determined. It can be seen in the figure above (Figure 3), that if a tourism organisation wants to create more desired value for a customer, it should use one of following combinations of content marketing decisions: relevant, unique or emotional content in social networks (paid media); informative, unique or relevant content on organization website (owned media); informative or relevant content on review sites (earned media); relevant or informative content sent by email (owned media); relevant content published on web portals (paid media); and relevant content in other users' blogs/vlogs (earned media).

Importance of unique content, which is relevant for a user and gives him or her a desired information about the possible benefits, is revealed. Thus, it is clear that marketing experts and content marketing theorists (Karkar, 2016; Pažėraitė & Repovienė, 2016; Kaitosalmi, 2017) have the same understanding about what the content should be. Interpretations of the results provide some insights as well. It is noticeable that reliability, one of the most important attributes of content marketing (Pažėraitė & Repovienė, 2016), was not so favourably assessed as a part of particular combinations. Perhaps this could be explained by the fact that all content published by an organisation should be reliable, and it is more a necessity than an opportunity, sspecially so, when it comes to the desired customer value, which is associated with consumer's expectations and all risks related to it. We see that even emotional content is not the most suggestive for the organisation seeking to create desired customer value. Its ability to create desired value depends on a distribution channel and its suitability for such content.

From a content distribution perspective, various distribution channels can be used for the creation of desired customer value in the tourism sector and there is not one leading distribution decision. It is worth paying attention to several of the following ones: to owned, paid and earned media. According to the results, the Google search platform is only one content distribution channel, which is strictly not recommended for the creation of the desired customer value. It can be explained by the nature of this platform – it is a shortstop for the customer between a search performed and a website, i.e. main content location. Social networks, the most favourable distribution channel according to the research results, provide opportunities not only for various types of

content marketing decisions but for various initiatives as well. It can be used in a range from simple boosting to collaboration with influencers or user-generated content decisions. Searching for new ways to create and distribute content in tourism review sites and other users' blogs/vlogs is worth paying attention as well. Content marketing decisions in tourism catalogues, email and web portals were treated differently. Therefore, their usage or not usage for the desired value creation should be determined by the idea of the content. At the end, no tourism organisation shoul forget the importance of their websites.

Taking into account the research results, it could be stated that there are several combinations of content marketing decisions that could be used for desired customer value creation in the tourism sector. These combinations can help to attract customers' attention, educate them and reveal all values that could be obtained by choosing a particular tourism product or services. All this leads to a growing desired customer value and possible value from the customers.

**Conclusions**

1. This study provides novel insights into the possible interconnections among content marketing, new marketing paradigm and customer value, as the main goal of all companies. Therefore, the application of content marketing decisions in the tourism sector for creation of desired customer value, which dominate in customer decision making process, can provide positive results for companies and require a deeper examination.
2. Conducted q-sort research contributes to the knowledge advancement in the marketing theory and the tourism industry. The results obtained in the current study show that there are twelve different combinations of content marketing decisions which can create desired value for customers. The main focus of a company, which would like to adopt content marketing for customer value creation, should be dedicated to relevant, informative and unique content distributed in social networks, company website or review sites.
3. The present study is the first step of continuing research in developing proper content marketing decisions for improved customers' perceived value. The study could be continued in various ways: with expanded research sample, expanded number of decisions to be tested, selection of another sector, selection of other customer value types or obtaining results by applying other qualitative and quantitative research methods.

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