Latvia University of Agriculture

RESEARCH
FOR
RURAL DEVELOPMENT 2017

Annual 23rd International Scientific Conference Proceedings

Volume 2

Jelgava 2017

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FOREWORD

The four independent reviewers estimated each paper and recommended 81 articles for publishing at the proceedings consisted of 2 volumes, which started life as presentations at the Annual 23rd International Scientific Conference "Research for Rural Development 2017" held at the Latvia University of Agriculture, in Jelgava, on 17 to 19 May 2017.

In the retrospect of four months later, we can count the Conference as a great success. The theme – Research for Rural Development - attracted participation more than 155 researchers with very different backgrounds. There were 124 presentations from different universities of Poland, Kazakhstan, France, Czech Republic, Lithuania, Estonia, India, Russia and Latvia.
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 cross disciplinary proceedings of the Annual 23rd International Scientific Conference "Research for Rural Development 2017" (two volumes since 2010) are intended for academics, students and professionals. The subjects covered by those issues are crop production, animal breeding, agricultural engineering, agrarian and regional economics, food sciences, veterinary medicine, forestry, wood processing, water management, environmental engineering, landscape architecture, 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 and the sponsors for their great support to the conference and proceedings.

On behalf of the Organizing Committee
of Annual 23rd International Scientific Conference
"Research for Rural Development 2017"

Ausma Markevica
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THE ENVIRONMENTAL ASPECTS OF ENERGY CROPS GROWING IN THE CONDITION OF THE CZECH REPUBLIC

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Abstract
Renewable energy resources have been developing very fast due to negative effects and finite reserves of the fossil fuels. Biomass is ranked among the most promising renewable energy resources within the Central Europe. Corn (*Zea mays* L.) is currently the most widely grown crop in the Czech Republic; nevertheless, the cultivation of corn provokes soil erosion by water. Perennial energy grass called tall wheatgrass (*Elymus elongatus* subsp. Ponticus cv. Szarvasi-1) is supposed to be a good and environment-friendly alternative to corn. Field trials including these two crops were established in the experimental locality of South Bohemia. Their yield potential was monitored during spring harvest periods (use for combustion). Dry phytomass was fundamentally analysed (N, C, H, S) and higher heating value was determined too. Universal Soil Loss Equation was calculated for both crop species. Corn provided much higher average yield in a three-year interval; corn phytomass reached higher heating value as well. The area of *Elymus elongatus* should enlarge considerably, if we wanted to get the identical amount of energy from corn and *Elymus elongatus*. However, we found that, compared to *Zea mays* L., water erosion theoretical land losses would be several times less serious for *Elymus elongatus*.
Key words: energy crops, erosion, yield.

Introduction

Fast world population growth (Schau & Fet, 2008) provokes a higher demand for energy (Ho & Show, 2015). A considerable demand for energy is met by fossil fuels (Sakuragi, Kuroda, & Ueda, 2011). Burning of fossil fuels pollutes the environment (Nicoletti *et al*., 2015) and produces greenhouse gas emissions (Moutinho, Madaleno, & Silva, 2016). Global reserves of fossil fuels are strictly limited. Therefore, renewable energy resources (RER) have become a key issue to be raised (Bernas *et al*., 2014). RER may help change the climate (Cherubini & Strømman, 2011).

Biomass is one of the most significant RER (Bernas *et al*., 2016b). It is used for direct combustion or biogas production (Jasinskas, Zaltauskas, & Kryzeviciene, 2008). Demirbas (2004) considers the near future promising – biomass can be burnt. Low water content in biomass is crucial. Therefore, the right harvest time is necessary and important there. It also determines a proportion and composition of chemical elements in phytomass. If we harvest plants later, the proportion of unwanted chemical elements decreases (N, S, K, Na and Cl are not good for burning, they slow it down) (Hadders & Olsson, 1996). The amount of ash which is produced by biomass burning is important. Csete *et al*. (2011) state that there is about 5% of ash in tall wheatgrass (*Elymus elongatus* subsp. ponticus cv. Szarvasi-1). Almost the same percentage of ash is indicated in corn (*Zea mays* L.) straw (Durda *et al*., 2016).

Energy crops have become more popular and the area of energy crops has been extending in the Czech Republic (Kopecky *et al*., 2015). Nowadays, corn is very popular there (Mast *et al*., 2014). It is, nevertheless, considered an environmentally unfriendly crop (Vogel, Deumlich, & Kaupenjohann, 2016). It contaminates ground water with nitrates (Glavan, Zorcic, & Pintar, 2016). There is a competition between energy crops and food production as well (Emmann, Schaper, & Theuvsen, 2012). A high risk of water erosion is another negative aspect of corn growing (Vogel, Deumlich, & Kaupenjohann, 2016). Soil erosion is a common problem that complicates watershed management around the world (Karas, 2016).

As the erosion damages the upper and most fertile soil layer the most, it causes the production and non-production potential of the soil to decrease (Blanco-Canqui & Lal, 2008). There are specific conditions for water erosion in the Czech Republic – because of the area of land blocs; they are the largest land blocs amongst all the European countries. Former land management system caused many hydrographical or landscape features to be removed from the countryside; such features, nevertheless, protected the soil against erosion very well. Nowadays, more than one half of arable land is endangered by water erosion in the Czech Republic (Novotny *et al*., 2014).

Grasslands and grass growing seem to be environment-friendly measures; they provide a sufficient amount of phytomass which is used in the eco energy sector (Kopecky *et al*., 2017). Compared to an annual crop, perennial grass protects the land against torrential rains and wind more and all year long (Mrkvicka, Vesela, & Ninaj, 2007). Therefore, it is highly recommended to grow grass in regions and localities facing water erosion (Dumbrovsky *et al*., 2014). Growth is the only arable land management factor we can influence directly – it is important to adopt anti-erosion measures at the same time in order

Table 1

Annual and seasonal climate of the years 2013 – 2015 at the experimental site of České Budejovice

Year	Average temperature (°C)		Precipitation (mm)	
	year	season	year	season
2013	9.1	15.3	685.4	469.5
2014	10.2	15.1	595.9	428.7
2015	10.5	16.9	487.7	233.8
Long-term average (1961 – 1990)	8.3	14.2	520.0	366.2

Table 2

Habitat characteristics

Altitude (MSL)	400
Agricultural production region	grain-growing
Soil texture class	medium heavy-textured soil
Soil type	pseudogley cambisoil
pH H_2O	6.1
pH KCl	5.6
GPS coordinates	48°97'44.13'' N, 14°44'88.37'' E

to protect the land against erosion (Novotny *et al*., 2014). Grasslands play an important ecological and environmental role in the landscape (Nitsch *et al*., 2012). Compared to annual crops, they require fewer fertilizers (Lewandowski *et al*., 2003).

Bernas *et al*. (2016a) also consider *Phalaris arundinacea* L. and *Elymus elongatus* to be suitable energy grass species. Csete *et al*. (2011) recommend *Elymus elongatus* subsp. ponticus cv. Szarvasi-1 too; they highly appreciate its yield potential and drought-resistance properties. Water deficiency is supposed to be the major agricultural threat (Konvalina *et al*., 2014).

This article intends to compare the conventionally grown corn and the alternative tall wheatgrass from the point of view of their yield potential and energy gain. It also intends to determine water erosion threat the soil faces – crop stands of these energy crops were monitored at the experimental locality of the University of South Bohemia in *České* Budějovice. The trial was conducted between 2013 and 2016.

Materials and Methods

Small-plot trials with *Elymus elongatus* subsp. ponticus (cv. Szarvasi-1) and *Zea mays* L. (hybrid Simao) were established in South Bohemia, at an experimental station of the University of South Bohemia in *České* Budějovice. Characteristics of the test habitats are described in Tables 1 and 2.

The experimental plot had been fertilized with mineral fertilizers before perennial grass of *Elymus elongatus* was seeded there. The following amounts of fertilizer were used: 200 kg of ammonium sulphate per hectare, 100 kg of ammonium nitrate with dolomite per hectare, 300 kg of triple superphosphate per hectare and 60 kg of potassium chloride per hectare. Grass was seeded on the experimental plot on 17 April 2013. Four small experimental plots were established there – each of them having an area of 10 square metres (8 times 1.25 m). The phytomass was harvested every spring of 2014, 2015 and 2016 (on 1 April 2014, on 17 March 2015 and on 21 March 2016) – the phytomass plants contained little water then. The harvest of 2014 represents the yield for 2013 growing season, and so on. The crop stands were cut with a grass mower having a mowing bar. They were left 6 cm long. After mowing the crop stand, mineral fertilizers were applied – 300 kg of ammonium sulphate per hectare, 150 kg of ammonium nitrate with dolomite per hectare, 60 kg of triple superphosphate per hectare and 60 kg of potassium chloride per hectare.

Corn crop stand (an area of 100 square meters) was established every spring of 2013, 2014 and 2015 (17 May 2013, 15 May 2014 and 17 April 2015). After the crop stand was seeded, fertilizers were applied there – 220 kg of ureastabil per hectare, 190 kg of triple superphosphate per hectare and 100 kg of potassium chloride. Another 115 kg of ureastabil per hectare were added into the crop stand during the stage of growth. *Zea mays* L. was harvested in the same period of time as *Elymus elongatus*.

Afterwards, the harvested fresh matter yield was determined and processed for drying. Dry matter (DM) content was determined by drying the biomass at 60 °C until constant weight. Based on water content,

the yield of the fresh matter was converted to the dry matter hectare yield.

Dried samples of both plants were homogenized and they were subjected to the elementary analysis in the Central Laboratories of the Czech Technical University in Prague. Elementary elements (N, C, H, and S) were detected in the phytomass with the Vario EL CUBE equipment, which is based on a purge&trap chromatography and separates gasses emerging from a sample burning; it provides the maximum working extent possible – greater extent than the other analyzers provide. Then percentage of oxygen was calculated (O = 100 - N - C - H - S - ash); in this equation, ash was replaced by a common figure of 5% which is very often mentioned in special literature sources. Higher heating value (HHV) was calculated afterwards. A pattern recommended by Sheng & Azvedo (2005) was used there (Sheng & Azvedo considered the pattern the most exact):

$$HHV = -1.3675 + 0.3137 \times C + 0.7009 \times H + 0.0318 \times O \ (MJ \cdot kg^{-1}) \quad (1)$$

HHV… higher heating value
C, O, H… weight percentage of elements in a dry sample

Based on the data acquired, energy gain was calculated for both crops afterwards.

$$E = HHV \times Y \ (GJ \cdot ha^{-1}) \quad (2)$$

E… energy gain
HHV… higher heating value
Y… average yield of DM

A long-time loss of the soil caused by water erosion was also calculated via Universal Soil Loss Equation (Wischmeier & Smith, 1978):

$$G = R \times K \times L \times S \times C \times P \ (t \cdot ha^{-1} \cdot year^{-1}) \quad (3)$$

G… the computed soil loss per unit area, expressed in the units selected for K and for the period selected for R
R… the rainfall and runoff factor
K… the soil erodibility factor
L… the slope-length factor
S… the slope-steepness factor
C… the cover and management factor
P… the support practice factor

We used a substitution and substituted R-factor with 40 which was recommended for the region of the Czech Republic. Other factors were derived from relevant plants and calculated for every single experimental plot (local geographical and land conditions). K-factor of 0.38 and S-factor of 0.47 were the same for both crops. *Zea mays* L. reached the L-factor of 1.62 and C-factor of 0.32. *Elymus elongates* reached the L-factor of 1.35 and C-factor of 0.005. We used another substitution and substituted P-factor with 1 in the equation (no anti-erosion measures). Figures of the factors had been derived from Janecek *et al.* (2012) and their methodology. Multiplying G-value by an area generating 1 TJ of energy, we got the total amount of soil theoretically washed away by the water erosion (if we grow the above-mentioned and assessed energy crops).

Results and Discussion

Yield produced by grass and corn between 2014 and 2016 is shown in Figure 1. As far as *Elymus elongatus* is concerned, there is an average of four micro plots. In 2014, *Elymus elongatus* produced a low yield which was caused by slow growth in the initial stage of growth. On the other hand, in 2015 (harvest in 2016), its great potential for growth and yield potential showed. In spite of the extreme weather conditions – long dry periods that could even reduce yield to its one half (Csete *et al*., 2011), this grass species produced the yield of 9.6 t·ha⁻¹ DM. On the other hand, *Zea mays* L. could not cope with the atypical weather conditions and it produced very low yield.

Zea mays L. reached the 2014/2016 average yield of 12.7 t·ha⁻¹ of DM and *Elymus elongatus* reached the 2014/2016 average yield of 7.1 t·ha⁻¹ of DM. Compared to available data, corn and grass reached yield figures are relatively low. For example, Mast *et al.* (2014) show *Elymus elongatus* yield of 8.9 t·ha⁻¹ – 13.4 t·ha⁻¹ DM (they largely depend on harvest time). Other authors show *Elymus elongatus* yield of up to 20 t·ha⁻¹ DM. *Zea mays* L. did not produce any high

Table 3

Elementary analysis

Plant species	% N	C %	H %	S %
Zea mays L.	1.238	43.37	7.04	0.07
Elymus elongatus	0.64	43.73	6.29	0.07
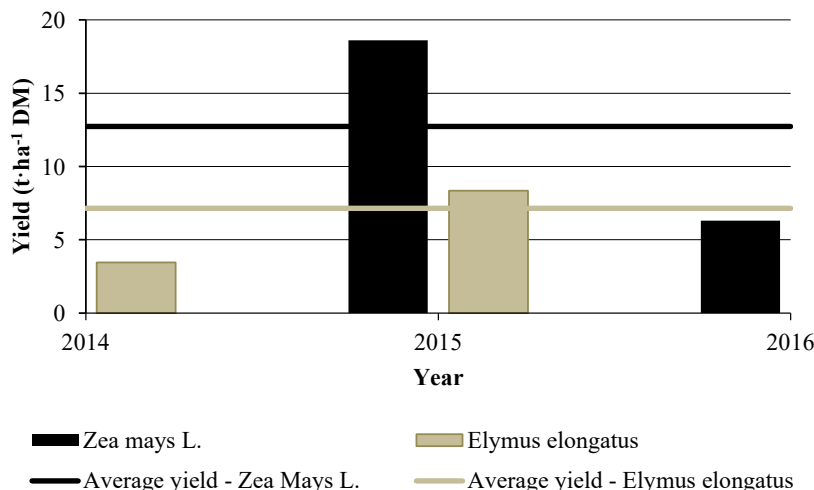
Figure 1. Yield of energy crops.

yield at the same station either (12.7 t·ha⁻¹ DM). For example, Badalikova, & Bartlova (2011) showed the yield of 20.26 t·ha⁻¹ DM (usual farming technology, ploughing).

Based on the elementary analysis results (Table 3), HHV was calculated for both crops. *Zea mays* L. reached the figure of 18.6 MJ·kg⁻¹ and *Elymus elongatus* reached the figure of 18.2 MJ·kg⁻¹. Such figures correspond to commonly accepted figures. For example, Demirbas (2001) states the figure of 18.27 MJ·kg⁻¹ for corn straw.

Zea mays L. crop stand reached the average energy gain figure of 236.2 GJ·ha⁻¹ and *Elymus elongates* crop stand reached the average energy gain figure of 129.8 GJ ha⁻¹. Re-calculating the above-mentioned figures, we found that we need 4.23 ha of *Zea mays* L. or 7.70 ha of *Elymus elongates,* so that we get 1 TJ of energy from the phytomass. The amount of soil theoretically washed away due to water erosion is very different – it is 29.8 t in the case of *Zea mays* L. cultivation and 0.4 t in the case of *Elymus elongatus* cultivation. According to Vogel, Deumlich & Kaupenjohann (2016), crop stands do not effectively protect land or the soil against water erosion. According to a lot of authors (e.g. Prochnow *et al.*, 2009), grassland successfully protects land and soil against water erosion (much better than wide-row crops).

Conclusions

Corn produced the average yield of 12.7 t·ha⁻¹ DM. Tall wheatgrass produced the average yield of 7.1 t·ha⁻¹ DM. Pursuant the results of elementary analysis of phytomass samples, corn HHV attained 18.6 MJ·kg⁻¹ and tall wheatgrass HHV attained 18.2 MJ·kg⁻¹. Corn produced twice as high hectare energy (236.2 GJ·ha⁻¹) yield as tall wheatgrass (129.8 GJ·ha⁻¹). Corn area needed for 1 TJ of energy was much larger than tall wheatgrass area. On the other hand, tall wheatgrass is an efficient method of land and soil protection against water erosion. It perfectly protects land and soil. Universal Soil Loss Equation calculation confirmed this fact as well. If we produced the amount of phytomass needed for 1 TJ of energy on a certain parcel, only 0.4 tons of the soil would be washed away by water erosion for tall wheatgrass and 29.8 tons for corn. Perennial energy grass species are good alternatives to corn; they effectively protect land and soil against water erosion and they also provide us with other services and are ecosystem-friendly.

Acknowledgements

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THE INCIDENCE OF WHEAT CROWN ROT DEPENDING ON AGRONOMIC PRACTICES

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Abstract
Wheat crown rot is a harmful disease that can be caused by different pathogens. The control of this disease is complicated because of the diversity of pathogens and an insufficient efficacy of fungicides; therefore, the agronomic practices of wheat production are an important tool for reducing the disease development. The aim of this study was to estimate the incidence of wheat crown rot depending on soil tillage system and on the pre-crop of wheat in the year 2016. The field experiment was carried out at the Research and Study farm 'Peterlauki' of the Latvia University of Agriculture in the autumn of 2008. The data obtained in 2016 are analyzed in this study: A – soil tillage system: 1 – traditional soil tillage with ploughing at the depth of 22 – 24 cm, 2 – reduced soil tillage with disc harrowing up to the depth of 10 cm; B – pre-crop of winter wheat: 1 – wheat, 2 – oilseed rape, 3 – faba beans. The incidence of crown rot was not influenced by soil tillage system, but the impact of pre-crop was significant (p = 0.006). The level of disease was essentially higher in continuous wheat sowings. The experiments showed that the main causal agents of the disease were *Fusarium* spp. and *Oculimacula* spp. The spectrum of pathogens was not dependent on a particular agronomic practice.
Key words: soil tillage, crop rotation, *Fusarium*, *Oculimacula*, *Microdochium*, *Phaerosphaeria pontiformis*.

Introduction

Winter wheat (*Triticum aestivum* L.) is one of the most cultivated and economically beneficial crops in Latvia. In 2015, wheat sowings occupied 38% out of the total field crop area (CSP, 2016). The increasing proportion of wheat in the cropping systems may increase the pressure of diseases, including stem base and root rot (Jenkyn *et al*., 2010; Winter, Mol, & Tiedemann, 2014).

Wheat stem base (crown) rot is a widespread and harmful disease, which can cause significant yield losses, especially under the conditions of intensive wheat production. The efficacy of fungicide application does not provide a sufficient control because the disease can be caused by different causal agents with different sensitivities to fungicides; therefore, it is important to understand the impact of a particular agronomic practice on the development of this disease. Several names for this disease can be found in the literature depending on the disease symptoms and its causal agent. The most frequently used names of the disease are: eyespot caused by *Oculimacula* spp., Fusarium foot rot caused by *Fusarium* spp., brown foot rot caused by *Microdochium nivale*, take-all disease caused by *Gaeumannomyces graminis*, and sharp eyespot caused by *Rhizoctonia cerealis* (Crous, Groenewald, & Gams, 2003; Bateman *et al*., 2007; Jenkyn, Gutteridge, & White, 2014; Winter, Mol, & Tiedemann, 2014; Matušinsky *et al*., 2016; Weber *et al*., 2016). Precise identification of the disease is complicated under field conditions (Polley & Turner, 1995). Complex infection of the same stem base by two or three pathogens has been proved by Matusinsky

(Matusinsky *et al*., 2008). For these reasons, the general name 'crown rot' is used in this study.

The impact of different soil tillage systems and crop rotations on the development of crown rot has been investigated for many years worldwide, but the results obtained are still contradictory – they depend on the meteorological and climatic conditions in a particular region and, at the same time, can also be influenced by the spectrum of wheat crown rot pathogens.

Three-year studies in Poland revealed a distinctive impact of soil tillage systems depending on the pathogens; conventional ploughing did not decrease the level of *Oculimacula* spp. and *Fusarium* spp., but essentially reduced the level of *G. graminis* (Majchrzak *et al*., 2016). Conservation tillage systems promote the increase in *Fusarium* infection in general; however, this effectiveness was dependent on *Fusarium* species because the survival of chlamydospores that are produced by *F. culmorum* was not influenced by the soil tillage method (Moya-Elizondo, 2013).

Crop rotation has been described as the most effective agrotechnical method to reduce the severity of crown rot, including the diseases caused by *Fusarium* spp. The disease can be caused by different *Fusarium* species with different abilities to survive without hosts, and a number of species can infect other grass species (Moya-Elizondo, 2013). The pre-crop significantly influences the development of wheat crown rot; however, this impact depends on a particular pathogen. The level of take-all has been essentially higher in continuous wheat sowings compared to other crops; maize as the pre-crop has not influenced the occurrence of *Fusarium* spp., but the

results related to eyespot have not been clear (Wenda *et al.*, 2016).

Previous studies in Latvia (Bankina *et al.*, 2013) showed that agrometeorological conditions of year are the most important factor influencing the incidence of crown rot; however, also agronomic methods are important. The incidence of crown rot in continuous wheat sowings was 10% higher than in the wheat fields following winter or spring oilseed rape. The impact of soil tillage system is not so clear – ploughing only slightly decreased the level of disease compared to reduced tillage.

The aim of this study was to estimate the incidence of wheat crown rot depending on soil tillage system and on the pre-crop of wheat in the year 2016 and to identify causal agents of disease.

Materials and Methods
Sites and experimental design

The field experiment was carried out at the Research and Study farm 'Peterlauki' of the Latvia University of Agriculture (central part of Latvia – 56° 30.658′ N and 23° 41.580′ E) in the autumn of 2008. The total area of the experimental field was 6 ha, the size of each plot – 0.25 ha. Different aspects related to soil properties and plant growth were investigated in this trial, and the evaluation of the development of wheat crown rot depending on agronomic practices was only one part of the observations.

Field trials were designed as a two-factorial experiment: soil tillage methods, and crop rotation. The data obtained in 2016 were analyzed: A – soil tillage system: 1 – traditional soil tillage with ploughing at the depth of 22 – 24 cm (TT), 2 – reduced soil tillage with disc harrowing up to the depth of 10 cm (RT); B – pre-crop of winter wheat: 1 – wheat (W), 2 – oilseed rape (OR), 3 – faba beans (FB).

The soil type was Cambic Calcisol, silty clay loam, neutral (pH 7.3), with high content of phosphorus and potassium (148 and 295 mg kg^{-1} respectively) – consequently, the soil was suitable to winter wheat production. All agronomic measures were applied uniformly, according to the requirements of agronomic practices under the conditions of intensive wheat production. Seeds were treated (fludioxonil, 75 g L^{-1}, cyproconazole, 25 g L^{-1}, dose 1.5 L t^{-1}), but fungicides against stem base diseases were not applied.

The assessment of crown rot and the identification of causal agents

The incidence of wheat crown rot was evaluated shortly before harvesting. Plants were collected from two adjacent rows (each 10 cm long) in five randomly chosen places of each plot (altogether 12 wheat plots), approximately 300 stems. Crown rot was determined visually, and the incidence of disease was calculated.

From each plot, a total of 100 randomly chosen stems with the symptoms of wheat crown rot were prepared for identification of the disease causal agents. Small parts of infected wheat stems (approximately 2 mm long) were superficially sterilized with 1% sodium hypochlorite for 3 min, rinsed three times in sterile distilled water, and placed onto potato-dextrose agar (PDA) enriched with streptomycin and penicillin to avoid bacterial infection. Plates were incubated at + 20 °C for 7 – 10 days. Fungi were preliminary
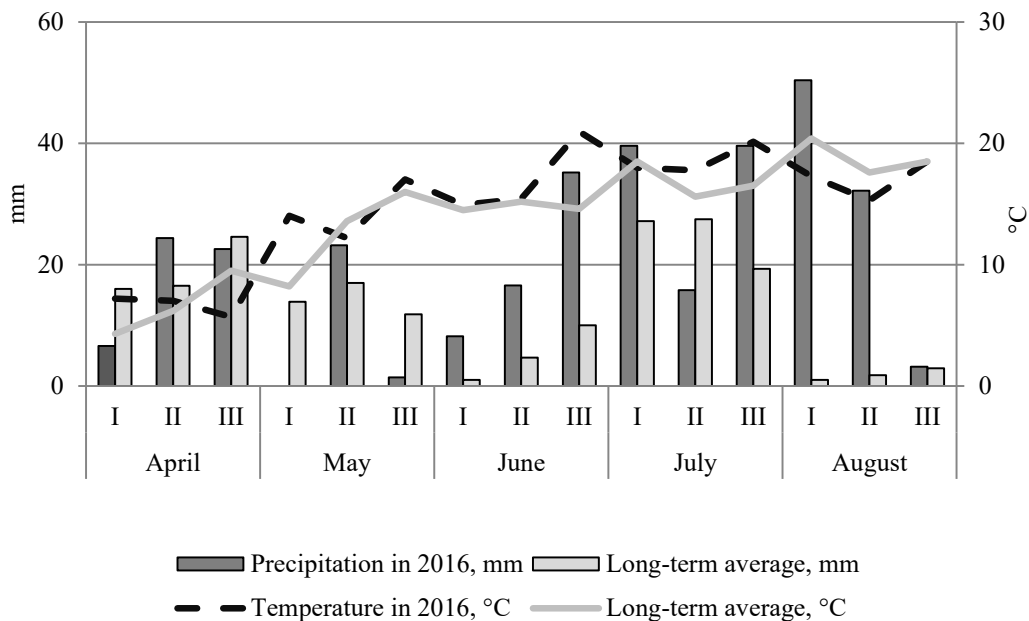
Figure 1. The average temperature and the amount of precipitation in 2016, and the long-term average data.

identified both directly on the isolation plates (by the colour and texture of mycelium and the pigmentation of media) and microscopically (by morphological characteristics of conidia and conidiophores).

The results of identification were confirmed by the molecular genetic analyses. All obtained isolates were grouped according to the similarity of morphological peculiarities, and two examples of each group were prepared for molecular genetic analyses. The identification of fungal isolates on genus level was performed through isolation of genomic DNA from ~ 10 µg of fungal material, sequencing of the ribosomal RNA gene Internal transcribed spacer (ITS) region and subsequent BLAST analysis of acquired sequences against NCBI nucleotide database. All molecular biology related activities were carried out at 'Genome center'– a genetic analysis core facility of Latvian Biomedical Research and Study center.

Meteorological conditions

The meteorological data in 2016 were collected from a meteorological station closely located to the trial site. The long-term meteorological data were collected from the nearest hydro-meteorological station (HMS) 'Latvian Environment, Geology and Meteorology Centre', Dobele HMS (Fig. 1).

The meteorological conditions in 2016 were suitable for wheat production, and temperature during the period of vegetation was similar to the long-term average. Higher amounts of precipitation during wheat stem elongation and ripening may have promoted the development of wheat crown rot.

Data analysis

The data of wheat crown rot incidence were statistically processed by the computer program 'R Studio'. The analysis of variance ANOVA was used to analyze the effects of the variables of wheat crown rot incidence. The general linear model was used to evaluate the impact of the factors that had influenced the incidence of wheat crown rot. The general linear model included the soil tillage (traditional or reduced) and the pre-crop (wheat, oilseed rape, faba been). Pairwise comparisons between factor levels were done using the Bonferroni test; the level of significance was α = 0.05.

Results and Discussion

The level of wheat crown rot in 2016 was relatively high – the average incidence was 68%, which is in accordance with the findings of other scientists, for example, Moya-Elizondo *et al*. (2015) reported that incidence of crown rot achieved 72%. Meteorological conditions in 2016 were similar to long-term average data and were favourable for the development of diseases, including crown rot.

Soil tillage method did not influence the level of wheat crown rot in our experiments, which is contrary to other investigations. Several papers have reported on the possibility of reducing the disease by ploughing, which interrupts the life cycles of pathogens; however, most of the researchers have noted that it depends on the biological peculiarities of pathogens, for example, ploughing decreased the level of eyespot on triticale in Lithuania (Janusauskaite & Ciuberkis, 2010), but in other investigations, the efficacy of ploughing was dependent on the causal agents of the disease (Majchrzak *et al*., 2016). Váňová *et al*. (2011) suggest that conventional ploughing does not decrease the level of eyespot because of the undecomposed infected plant residues that could be brought on the topsoil level. Previous investigations in
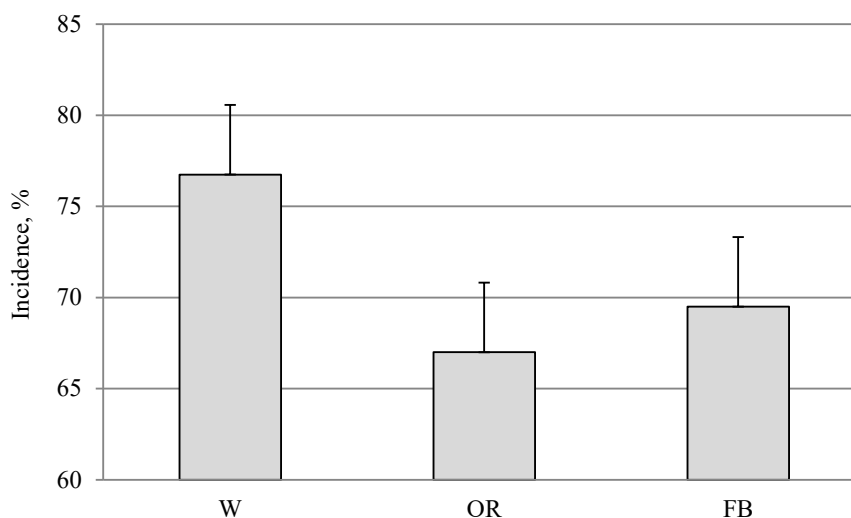
Figure 2. The incidence of the wheat crown rot depending on pre-crop:
W – wheat; OR – oilseed rape; FB – faba beans.
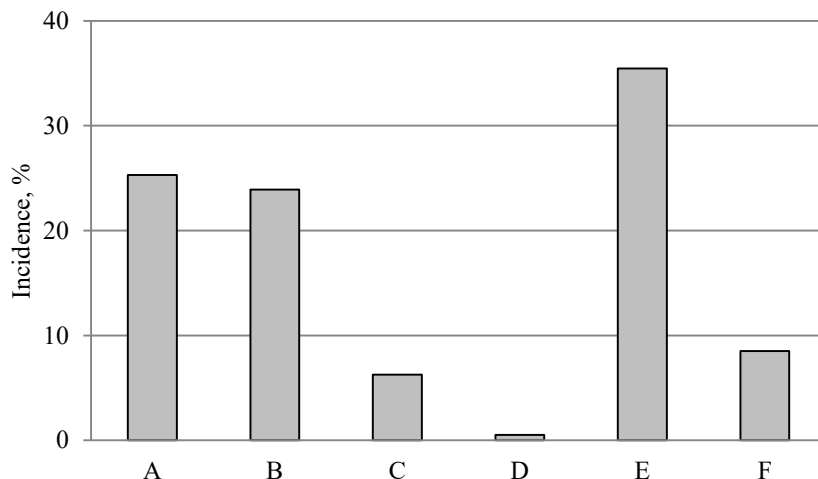
Figure 3. The incidence of pathogens isolated from symptomatic wheat stem bases:
A – *Oculimacula* spp; B – *Fusarium* spp.; C – *Microdochium nivale/majus*;
D – *Microdochium bolleyi*; E – *Phaeosphaeria*; and F – others.

Latvia have not recognized ploughing as an important tool to reduce the risk of this disease (Bankina *et al*., 2013).

Crop rotation has been described as the most effective agrotechnical method to reduce the severity of crown rot. The findings of this study confirm the importance of the pre-crop of wheat to the development of crown rot (Fig. 2).

The incidence of crown rot was significantly higher in continuous wheat sowings (p = 0.006), whereas oilseed rape and faba beans decreased the level of this disease; however, an essential difference between these two pre-crops was not determined. Precise identification of pathogens is essentially necessary to explain the obtained results, because influence of pre-crop is depending on pathogens' spectrum.

Of the 1150 isolates obtained from the infected wheat stems in 2016, 56% were the causal agents of wheat crown rot (*Oculimacula* spp., *Fusarium* spp. and *Microdochium* spp. together), 9% were different saprotrophic fungi, and 35% were identified as *Phaeosphaeria pontiformis* (Fig. 3). Agronomic practices did not influence the proportions of different fungal species isolated from the wheat steams.

Stem crown rot was caused mainly by *Oculimacula* spp. (45%) and *Fusarium* spp. (43%). *Microdochium* spp. was found in 11% of isolates, of which 1% of isolates were identified as *Microdochium bolleyi*. These are unexpected results, because during previous investigations pathogens form *Microdochium* spp. were not found in this trial site (Bankina *et al*., 2013). Such widespread pathogens as *Gaeumannomyces graminis* and *Bipolaris sorokiniana* were not found, although these pathogens were found only occasionally in previous investigations. Such spectrum of pathogens could be explained by soil

characteristics, for example, *G. graminis* prefers light, poorer soils than those on the experimental site. The spectrum of pathogens detected in one year, of course, does not allow drawing complete conclusions, but it is possible to make a hypothesis that *Fusarium* spp. and *Oculimacula* spp. are the main pathogens involved in the development of crown rot. These results confirm the other data obtained by several scientists (Gala *et al*., 2014; Matušinsky *et al*., 2016; Wenda-Piesik *et al*., 2016).

The importance of *Microdochium* spp. has been detected by several authors in the last ten years (Matusinsky *et al*., 2008, 2016; Ren *et al*., 2015). Although this pathogen is usually described as the causal agent of snow mould (Bankina *et al*., 2012) and seedling blight, our results highlight the significance of this pathogen on the fungal complex associated with crown rot. *M. nivale* and *M. majus* have been found with similar frequency in the seeds and seedlings in Lithuania (Jonavičiene *et al*., 2016), but in our experiments, these two species have not been identified yet. *M. bolleyi* has been rarely recognized as a wheat pathogen (Vujanovic, Mavragani, & Hamel, 2012); this fungus is usually considered as a saprotroph, and further studies are needed to clarify its life cycle and impact on wheat.

P. pontiformis is an endophyte in wheat, but the role of this fungus is unclear. Similar results have been obtained in Chile, where the isolation frequency of *P. pontiformis* made 62.5% (Moya-Elizondo *et al*., 2011). E. Moya-Elizondo with a group of scientists has expressed a hypothesis that this fungus might be one of the reasons for the darkening of stem base (Moya-Elizondo *et al*., 2015). On the other hand, the infection of switchgrass (*Panicum virgatum*) from *Poaceae* family with *P. pontiformis*

has significantly increased the biomass of plants (Kleczewski *et al.*, 2012). This suggests that the relationship between *P. pontiformis* and wheat should be studied in future.

The investigations have revealed the complexity of the problem of wheat crown rot, as this disease can be caused by different pathogens. Precise identification of it is necessary to understand the impact of agronomic practise. *O. yallundae* and *O. acuformis* have been found in Latvia (Bankina *et al.*, 2016), but the percentage of these species is not known yet. *F. culmorum* and *F. avenaceum* were determined as the main *Fusarium* species in our previous investigations (Bankina *et al.*, 2013); however, research must be continued because the conditions favourable for the development of particular species of *Fusarium* are still unclear.

Conclusions

1. The average incidence of stem crown rot was high (68%), but the method of soil tillage did not influence the level of this disease in 2016.

2. The pre-crop of wheat significantly influenced the development of stem crown rot; continuous wheat sowings promoted development of this disease.
3. Different groups of fungi were isolated from wheat stem bases with disease symptoms. Overall, 56% of fungi were causal agents of wheat crown rot, 9% were different saprotrophic fungi, but 35% were identified as *Phaeosphaeria pontiformis* – an endophyte of wheat.
4. *Oculimacula* spp. and *Fusarium* spp. were found as the most important causal agents of crown rot, high occurrence of *Microdochium* spp. was recognized.
5. Further investigations are needed to identify the species of pathogens and to understand the ecological niches of other fungi.

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ESTIMATION OF YIELD AND YIELD STABILITY OF SPRING BARLEY GENOTYPE MIXTURES

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Abstract
Organic farmers need varieties adapted to variable growing conditions, because in organic farms environmental conditions significantly vary in soil nutrient status, weed and disease pressure not only between years, but also among farms within a season. Modern varieties developed under high input agricultural systems do not always perform well under organic growing conditions. Therefore, farmers need such varieties of cereals that can adapt to variable growing conditions and maintain productivity. One of the ways to promote adaptation to environment is growing of variety mixtures. Field trials were conducted during 2014 – 2016 under organic and conventional farming systems in two locations with an aim to estimate the advantages of barley mixtures in respect of yield and its stability. The trial consisted of eight mixtures of barley varieties and breeding lines, components of mixtures in pure stand and three check varieties. The mixtures were combined by using two, three and five components. Three mixtures, each in one out of 11 environments significantly out–yielded, but one mixture had significantly lower yield than the average value of their components. Some mixtures showed a tendency to out–yield the average of components in both farming systems. All mixtures insignificantly out–yielded check varieties in 2015, but in 2016, yield was within the range between varieties with lowest and highest yield. The results of yield stability analysis showed that mixtures could be used as one of the approaches to stabilize yield – only one of eight mixtures had a lower yield than the average over all environments.
Key words: variety mixtures, yield, yield stability.

Introduction

Modern high yielding varieties are usually grown under high input agricultural systems, but they generally do not perform well under low–input situations (Fess, Kotchon, & Beneditto, 2011). Plant breeders have achieved high yield through hybridization and selection of superior plants. In hybridization often are included only new and most productive varieties. The result of this approach is reduction of genetic diversity and the loss of ability to adapt to variable environments. Due to development of organic agriculture in the last decades, the importance of appropriate varietal choice is increasing (Wolfe *et al*., 2008). In organic farms, the growing conditions significantly vary in soil nutrient status and weed, pest and disease pressure not only between years, but within seasons among farms, too. Therefore, such varieties of cereals are necessary that can adapt to variable growing conditions and maintain productivity. This can be achieved via extended genetic diversity of plants within the varieties. Increasing genetic diversity in crops could ensure yield stability and adaptability, reduce disease distribution and improve competitive ability with weeds and nutrient uptake efficiency (Döring *et al*., 2011). Development of crop varieties requires large inputs of material, financial and time resources, therefore one of the ways to add genetic diversity at the shortest time and cheaper is by growing variety mixtures (Lopez & Mundt, 2000). It is not possible to predict which mixture component will provide advantage in the respective year and environment while sowing mixtures, but compensation mechanism can provide stability (Kaut *et al*., 2009).

Mixtures of varieties with different characteristics have proved to be means of increasing, as well as stabilizing the yield in terms of various aspects: morphological and phenological differences of plants (Jedel, Hekm, & Burnett, 1998) and ratio effects (Juskiw, Helm, & Burnett, 2001), manner of seed mixing (Newton & Guy, 2009), phenotypic contrasts (Essah & Stoskop, 2002), soil tillage effects (Newton *et al*., 2012)*,* manure application, root development, and growth rate (Askegaard *et al*., 2011). The effect of number of components in mixtures has been evaluated in several studies (Mille *et al*., 2006; Newton, Hacket, & Swanson, 2008; Kaut *et al*., 2009), as well as possibilities to reduce levels of fungal disease by growing mixtures (Tratwal, Law, & Philpott, 2007; Muchova & Faekašova, 2010; Newton & Guy, 2009; Newton *et al*., 2012). In some studies, the yield of mixtures has been about the same, or slightly higher or lower than the mean of their components, and positive effect of variety mixtures is seen on the yield stability. Further studies about the possibilities to increase yield and yield stability of the crop by increasing the genetic diversity are needed. It is essential to understand what plant traits are most important in the mixtures (Mille *et al*., 2006).

The aim of the research was to find out the efficiency of spring barley genotype mixtures in improving certain traits: yield and yield stability, competitive ability with weeds and infection severity with leaf diseases. The aim of the present paper is

to estimate advantages of eight, two, three and five–component spring barley mixtures in comparison to average value of the respective components in pure stand, and three check varieties.

Materials and Methods

The investigation was carried out at Institute of Agricultural Resources and Economics Priekuli Research Centre (latitude 57.3148 ° N, longitude 25.3388 ° E) and Stende Research Centre (latitude 57.1412 ° N, longitude 22.5367 ° E). Field trials were carried out during 2014 – 2016 in Priekuli and Stende under both conventional (C) and organic (O) growing conditions. The experimental design in 2014 was a randomized complete block, but in 2015 and 2016 – lattice design (Petersen, 1994) with four replications. 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. Field trial in Stende under O growing conditions in 2015 was significantly damaged by heavy rainfall after sowing. Therefore, the results of 11 instead of planned 12 environments were obtained. Eight mixtures of barley (*Hordeum vulgare* L.) varieties and breeding lines were used in the study. The mixtures consisted of two, three and five components. Seed of mixtures was prepared every year by mixing components

in equal proportions according to the germination ability. The genotypes used to compose mixtures – varieties 'Rubiola', 'Vienna', 'Anni' and 13 local breeding lines – have characteristics which are highly important in organic farming (Table 1). One of the criteria of choosing components for mixtures was yield. Genotypes with a higher yield than the average level of previous field trials were selected. The yield of mixtures was compared to the average value of the respective components in pure stands in 11 testing sites (2014 – 2016) and to three commercially used check varieties: 'Rubiola' – released for growing under organic conditions, 'Rasa' – check variety in official trials for testing of value for cultivation and use (VCU) under organic growing conditions, and 'Abava' – characterized as a variety with good adaptability to various environments in seven environments (2015 – 2016).

The soil in all locations was sod–podzolic sand loam (Kārkliņš, 2008). Other soil properties are summarized in Table 2.

Pre–crop in all C environments was potatoes, except in Stende in 2014 it was annual ryegrass; in O locations pre–crop in Priekuli was green manure in 2014 and grain legumes in 2015 and 2016; in Stende – legumes, spring wheat and buckwheat,

Table 1

Characteristics of genotype mixtures

Mixture	Number of components	Criteria for the selection of components for mixtures*
M 1, M 2	3	Different adaptability to growing conditions
M 3	3	Different plant growth habit – erect, intermediate and planophyle
M 4	5	Combination of rapid plant development, good soil covering ability, good tillering, early heading, leaf bending
M 5	2	Different weed competitiveness
M 6, M 8	3	Different level of infection with foliar diseases caused by *Pyrenophora teres* and *Blumeria graminis*
M 7	2	

*According to the results of ESF co–financed project "Development, improvement and implementation of environmentally friendly and sustainable crop breeding technologies"

Table 2

Soil agrochemical properties during 2014 – 2016

Properties	Priekuli						Stende				
	conventional			organic			conventional			organic	
	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2016
pH KCL	5.5	5.8	5.5	5.8	5.7	5.7	6.6	5.9	6.1	5.9	6.0
Organic matter content, %	2.1	2.1	2.3	2.3	2.2	2.4	3.5	1.9	1.9	2.3	1.9
K$_2$O mg kg^{-1}	149	176	136	128	135	175	116	176	168	180	115
P$_2$O$_5$ mg kg^{-1}	172	125	143	182	169	163	246	219	219	265	151

respectively. Before sowing, in C sites complex mineral fertilizer was applied ensuring the following amounts of pure elements: in Priekuli N 95–97, P_2O_5 50–62, 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 environments herbicide was applied.

The obtained data was analyzed by using single and two–factor analysis of variance. Regression of yield on environmental index (the difference between the average yield of all tested genotypes in a given environment and the average yield of all genotypes of all environments) was done to evaluate the yield stability. One of the indicators used to characterize yield stability was coefficient of regression (b). Genotypes with b larger than 1 were considered as responsive to high yielding environments; genotypes with b close to 1 – stable and with wide adaptability, and the ones with b lower than 1 – with adaptability to low yielding environments. A variety was considered stable if its yield was at least at the level of average productivity, coefficient of regression was not significantly different from 1, and deviation from regression (s^2dj) was as close as possible to zero (Eberhart & Russel, 1966). Ranking method was used to obtain additional information about adaptability of mixtures to specific growing conditions – mixtures and its components in pure stand were ranked within sites, and scores given for top, middle and low level in the range for individual genotypes across sites were summarized (Fox et al., 1990).

Meteorological conditions during the investigation differed not only between the years, but also between the field trial locations. There was no precipitation in both growing locations in 2014 during sowing and the average air temperature exceeded the long–term data (hereinafter – norm). May and July was hit by a warmer and drier weather than the long–term data, except in Priekuli in May, where the precipitation exceeded the long–term data by 73%. In June, there was heavy precipitation in both growing locations, going beyond the long–term data, while the air temperature during the third and second decade of the month was below the norm, which slightly delayed the development of the plants. There was increased rainfall and the air temperature was close to the norm in both locations in the third decade of April 2015. During the following growing season the average air temperature was below the long–term data in both locations, but precipitation exceeding the norm was observed only in May in Stende. The weather differed drastically in 2016, when in Priekuli, after experiencing an increased rainfall in the last decade of April, which delayed the sowing, in May fell 18% of the norm. There was increased rainfall starting with the second decade of June up to

the end of August in Priekuli, peaking during the third decade of June, when it rained by 309% more than in the long–term data. During this decade, the weather was warmer than usual – air temperature was higher than the norm by 4.5 °C in Priekuli and by 3.1 °C in Stende. In 2016, annual precipitation resembled the long–term data in Stende, exceeding the norm only in June by 62%. In general, meteorological conditions were more favorable for barley development in 2015 and in 2016 at both growing environments in Stende. Heavy precipitation in June 2014 and temperature below norm and dry conditions in May 2016 in Priekuli slightly delayed the development of the plants.

Results and Discussion
Yield of mixtures in comparison to average of the respective components

In all years of the study, the mixtures' yield was significantly affected both by the growing environment and genotype; as well as interaction between environment and genotype was significant (p < 0.01).

No significant differences between yield of variety mixtures and average value of respective components were observed in 2014. A significantly higher yield of mixtures in comparison to average of the respective mixture components was observed only under C growing conditions in 2015 for mixture M1 in Priekuli, and M7 and M8 in Stende (p < 0.05) (Table 3). However, in 2016 under O conditions in Stende, mixture M6 produced a significantly lower yield than the average of components. It should be noted that the yield of mixture M7 increased in comparison with the average (at confidence level 95% significant differences were not found) in eight (four O and four C) out of eleven testing environments, which ranged 1 – 12% in O environments and 5 – 12% in C environments. In seven (four O and three C) out of eleven testing environments, the yield increase was observed in mixtures M5 and M6. For mixture M5, it was 1 – 10% under O growing conditions and 2 – 6% under C conditions, while for M6 the increase was 5 – 9% and 1 – 3%, respectively. Yet, as mentioned above, in one case the yield of M6 was observed to be significantly lower than the average of components.

Mixture M7, which showed the largest yield increase in the most environments if compared to the average of respective components, was composed of two genotypes (Table 1). Another comparatively successful mixture M5 was also produced by using two genotypes. Possibly, this tendency shows that in two–component mixtures there is a lower competition between different plants, as it was also mentioned by Döring et al., (2011). In theory, under O growing conditions, where plants have to compete with weeds, less competition between different plants should

Table 3

Differences between yield of mixtures and average of its components, t ha⁻¹

	2014				2015			2016			
	P**O***	S**O	PC***	SC	PO	PC	SC	PO	SO	PC	SC
M1	-0.06	0.11	0.36	-0.19	-0.14	0.61*	0.43	-0.20	-0.29	0.33	0.37
M2	-0.30	0.01	0.11	0.09	0.26	0.17	-0.23	-0.17	0.86	0.06	-0.03
M3	-0.12	-0.11	0.25	0.31	-0.11	-0.03	0.01	0.41	-0.04	0.13	-0.41
M4	0.09	0.08	0.19	-0.42	0.01	-0.09	0.02	-0.14	-0.13	-0.09	0.37
M5	0.07	0.29	0.08	0.17	0.09	0.00	-0.15	-0.16	0.05	-0.01	0.43
M6	0.26	0.14	-0.10	-0.01	0.33	0.04	0.22	0.20	-0.56*	0.10	-0.31
M7	0.04	0.27	-0.11	0.24	0.45	0.49	0.77*	0.31	-0.12	-0.07	0.72
M8	-0.12	-0.10	0.06	-0.39	0.00	0.49	0.91*	0.27	-0.01	0.07	0.27

*significantly different from the average of respective components (p < 0.05); **location of field trials: P – Priekuli, S – Stende; ***growing conditions: O – organic, C – conventional.

prove to be more significant. However, this theory is not supported by findings of another research, which tested two and three–component mixtures in eight locations (five O and three C), and only in one O location two–component mixtures out–yielded the three–component ones (Kaut *et al.*, 2009). Mille *et al.* (2006) also reported that under C growing conditions a larger yield increase was observed in three to five–component mixtures, but not in two–component mixtures. Similarly, in the present research three–component mixtures M1 and M8 showed a tendency to produce more yield, particularly under C conditions, where in five out of six environments they out–yielded the component average by 5 – 11% and 2 – 13%, respectively, while other three–component mixtures M2 and M3 out–yielded the average in four out of six C environments. In contrast to what Mille *et al.* (2006) found about five–component mixtures, in the present study five–component mixture M4 did not perform better than the average of components in most of the environments. However, the number of components is a secondary factor after the yield potential of component genotypes.

Yield of mixtures in comparison to check varieties

Reports differ on the matter of comparing yields produced by mixtures and pure stand variety. There are results of investigation showing yield increase in mixtures by 13 – 14% if compared to varieties in pure stand (Essah & Stoskop, 2002), as well as results of testing the same mixtures in different environments, showing a yield increase in some of the environments and no increase in others (Tratwal *et al.*, 2007; Kiær, Skovgaard, & Østergård, 2012). In the present research, the yield of mixtures did not significantly differ if compared to the check varieties in 2015, however, in most cases, in O and C farming systems, mixtures slightly out–yielded the check varieties, by 3 – 29% and 1 – 19%, respectively (Figure 1). The largest increase of yield in 2015 was observed for mixture M7 (15 – 29% and 11 – 19% under O and C growing conditions, respectively). In 2016 under O growing conditions, mixtures had insignificantly more yield than check varieties 'Abava' and 'Rasa' (by 1 – 20%), but slightly lower yield than 'Rubiola', while under C growing conditions the mixture yield was significantly (p<0.05) higher than check varieties with the lowest yield, but slightly lower (2 – 12%) than that of the check with the highest yield 'Rubiola' (Figure 1). Juskiw *et al.* (2001) reported similar results: mixtures gave significantly higher yields than the lowest yielding pure stand variety, while no mixture had a higher yield than the highest yielding pure stand.

Figure 1. Average yield over organic (O) and conventional (C) environments of mixtures and check varieties, t ha⁻¹, 2015 – 2016.

Table 4

Average yield of mixtures and its components over 11 environments and yield stability indicators

Mixture	Average yield, t ha⁻¹	Coefficient of regression (b)	Deviation from regression (s^2 dj)	Components of mixtures	Average yield, t ha⁻¹	Coefficient of regression (b)	Deviation from regression (s^2 dj)
M 1	4.75	1.13*	0.05	Rubiola	4.73	1.15*	0.16
				BZ14-12	4.35	0.80*	0.14
				PR-3605	4.80	1.07	0.06
M 2	4.75	1.02	0.05	Vienna	4.93**	1.12	0.14
				PR-5105	4.49	0.94	0.16
				PR-4814	4.61	1.02	0.10
M 3	4.79	1.07	0.09	Rubiola	4.73	1.15	0.16
				Anni	4.70	1.03	0.04
				PR-4181	4.88	1.19*	0.07
M 4	4.59	1.03	0.04	Vienna	4.93**	1.12	0.14
				KZ14-52	4.13**	0.76*	0.08
				PR-3605	4.80	1.07	0.06
				PR-4812	4.41	1.05	0.13
				PR-5135	4.71	0.98	0.06
M 5	4.72	1.03	0.05	PR-3605	4.80	1.07	0.06
				PR-5105	4.49	0.94	0.16
M 6	4.45	0.82*	0.07	PR-5330	4.55	1.02	0.10
				PR-4311	4.48	0.92	0.14
				PR-5279	4.24**	0.77*	0.09
M 7	4.79	1.03	0.06	PR-5279	4.24	0.77*	0.09
				PR-5602	4.69	1.13*	0.09
M 8	4.60	1.02	0.12	PR-5279	4.24**	0.77*	0.09
				PR-5602	4.69	1.13*	0.09
				PR-6246	4.40	0.87	0.12

*significantly different from 1 (p < 0.05); ** significantly distinctive from average yield over 11 environments (p < 0.05)
(LSD$_{0.05}$ = 0.29)

Yield stability of variety mixtures

Kiær *et al.* (2012) reports that spring barley variety mixtures were observed to have a better adaptability to environment than components of mixtures in pure stand. Similar results were reported in studies conducted with other species, such as winter wheat (Cowager & Weisz, 2008) and spring wheat (Kaut *et al.*, 2009; Zhou *et al.*, 2014). Six out of eight mixtures tested in the present study can be characterized as suitable to different growing conditions or with wide adaptability to environments since their coefficient of regression does not significantly differ from 1, including mixtures M2, M3, M5 and M7 with an average yield over 11 environments above the average of all genotypes (4.61 t ha⁻¹), and M4 and M8 with equal yield to the average (Table 4). The mixture M1 can be described as suitable to high yielding environments with b significantly above, and its average yield was also higher than the average of

the trial, but M6 showed adaptability to low yielding environments, however, its yield was lower than average yield of the trial.

Mixtures M1 and M2 were composed with the aim to test whether it is possible to stabilize the yield by combining genotypes with different adaptability (Table 1). The characterization of mixture M1 components in regard to yield stability was confirmed also in this research (Table 4). As a result, by combining genotypes with different adaptability to growing conditions, a mixture suitable to high yielding environments was derived with a yield that was above the average. Characteristics of M2 components according to results of this study slightly differ from the information available during composing the mixture. The component, which was characterized as suitable to low yielding environments, now is described as having a wide adaptability and maintaining a tendency to adaptability to low yielding environments (b = 0.94).

But the component which was characterized as suitable to high yielding environments, following present study, can be characterized to have wide adaptability, with a tendency towards adaptability to high yielding environments (b = 1.12). As a result, similarly to its components, the mixture M2 is characterized by wide adaptability with b closest to 1. The genotypes included in the other mixtures were selected without taking into account the component yield stability. Mixture M7 should be highlighted while comparing the yield of mixtures to the component average. Having evaluated the yield stability, we concluded that one of the components of this mixture has a weak suitability to any environment and yield significantly lower than average, while the other is suitable to high yielding environments (Table 4). The mixture M7 composed from these different genotypes can be described as suitable to various growing conditions and its yield was above the average. Our observation confirmed conclusions of another research, that some genotypes have better yield performance growing in mixtures than in pure stand (Juskiw, Helm, & Salmon, 2000). Similar effect has been observed in the M8 consisting of the same two genotypes used in M7 and the third one, yield of which was slightly above the average. This mixture had been able to provide yield of average level. Mille *et al.* (2006) reports that the best yielding genotype in pure stand was not the best contributor to the mixtures and inclusion of it in a mixture may not have led to overall yield advantage. In our study, the mixtures, which include the best yielding genotype 'Vienna', were M2 and M4. As mentioned above, M2 was characterized by wide adaptability and yield above the average, whereas five–component mixture M4 consisted of three genotypes which out–yielded average and two components which had lower yield than average. The yield of this mixture was just at the average level, which in this case may support the findings that better yielding genotypes are not the best contributors in mixture.

Assessing mixture yield stability with the rank evaluation method in both C and O growing environments M7 ranked either in the top of the list or in the middle (data are not shown in this paper), which corresponds to the previous findings regarding this mixture's adaptability to different growing conditions and yield level above the average. Method of ranking confirmed also the characterization of M1: in C environments in most cases it was ranked in the top third of the genotype list, which complies with

the previously mentioned regarding this mixture's adaptability to favourable growing conditions.

The check varieties used in the study can be characterized as diverse regarding their adaptability: 'Rubiola' – with adaptability to high yielding environments (b = 1.11), 'Rasa' – with wide adaptability (b=0.92) and 'Abava' – with adaptability to low yielding environments (b = 0.78) according to data from seven environments; in addition, two of them – 'Rasa' and 'Abava' – had lower yield than average (4.87 t ha[1]). All of the tested mixtures showed better yield performance than 'Rasa' and 'Abava' (data in seven environments are not shown). The third check variety 'Rubiola' out–yielded average over the trial. Three out of eight mixtures – M1, M2 and M7 out–yielded this variety, M3 yielded the same as 'Rubiola' and other mixtures had slightly lower yield.

Conclusions

1. Three mixtures, each in one out of 11 environments significantly out–yielded, but one mixture had significantly lower yield than the average value of their components in pure stand. Two–component mixture M7 out–yielded the component average in eight out of eleven testing environments by 1 – 15%.

2. To evaluate performance of genotype mixtures in comparison to check varieties in 2015 under both growing conditions and 2016 under organic conditions, yield increase by 1 – 29% was observed, but in 2016 under conventional growing conditions mixtures significantly out–yielded check varieties with the lowest yield 'Abava' and 'Rasa', but had a slightly lower yield than highest yielding variety 'Rubiola'.

3. The results of yield stability showed that genotype mixtures could be used as one of approaches to stabilize yield: six out eight mixtures can be characterized as suitable to different growing conditions; all mixtures were more stable with higher average yield than check varieties 'Rasa' and 'Abava'; three mixtures were more stable and with a higher average yield than 'Rubiola'.

Acknowledgements

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INFLUENCE OF LEGUMES ON SOIL FERTILITY IN STRAWBERRY – LEGUME INTERCROPPING

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Abstract

Legumes are becoming more popular in food and feed consumption. They are promoted by EU policy related to healthy lifestyle and environmental policy. Legumes can be grown in crop rotation as monocrop or in different kind of intercropping systems. It is a well known fact that legumes play an important role in fixation of the atmospheric N, whereas their influence on other biological and chemical aspects of the soil ecosystem is only explored partially. The experimental trial was established at the Pūre Horticultural Research Centre with the aim of studying the influence of legumes on the soil properties in the intercrop with strawberries (*Fragaria × ananassa* Duch.). Different genotypes were included in the trial as intercrops: two local broad bean (*Vicia faba* var. *major* L.) genotypes, two pea (*Pissum sativum* L.) cultivars and clover (*Trifolium hybridum* L.). Two control treatments were included in the trial: with and without nitrogen fertilizer usage. Strawberries were planted in May of 2014 and maintained in the field for three years. Results showed that there were significant differences between treatments in soil respiration rate (SRR) and SRR dynamic throughout the experiment time. Dehydrogenase activity had similar results, though no significant differences between treatments were observed in the third year. No significant difference between treatments was found in the soil organic matter. Obtained data shows that legumes have a significant influence on the soil biological properties but not on biochemical properties. Further research needs to be carried out to determine legume influence on soil environment in more detail.

Key words: *Vicia faba*, *Pissum sativum*, *Trifolium hybridum*, soil biological activity, soil chemical properties.

Introduction

More and more farmers in EU are looking for possibilities to reduce chemical fertilizer usage with the aim to improve the sustainability of their farming systems and to reduce environmental load, to reduce growing costs and to supply customers with products grown in natural environment. Legume growing is being promoted to reduce the necessity for nitrogen fertilizer applications. Their ability to fix atmospheric nitrogen is well known, while their influence on environment, especially on soil properties, is not yet thoroughly studied. It is known that plants with deep and broad root system improve soil structure (Bardgett, Mamer, & De Vries, 2014). Leguminous plants increase nitrogen content in soil. At the same time, some studies suggest that legumes do not increase nitrogen content in the soil but more likely keep it at the same level if plant leftovers are incorporated in the soil (Herdina & Silsbury, 1990; Hayens, Martin, & Goh, 1993). Plants used for green manure or plant residues incorporated in the soil increase soil organic matter (Brennan & Acosta- Martinez, 2017).

Strawberries are one of the most popular berries in the human diet. Their consumption increases every year (FAO, 2017). There are many different technological solutions used in their growing. Strawberries are mainly grown in the soil under open field condition. Significant area is left bare between strawberry rows in such production systems. Sustainable agriculture approach could promote using that space for food/feed growing. Strawberries are in need of nitrogen not only during active growing but also in formation of inflorescence in autumn (Sønsteby *et al.*, 2009). Including legumes in strawberry growing can give the necessary amount of nitrogen during formation of inflorescence if legume plant leftovers are incorporated in soil after the harvest of legume green pods (Jensen, Peoples & Hauggaard- Nielsen, 2010). This research was performed to get a better knowledge of how legumes included in the intercropping influence the biological and biochemical soil properties. Three-year data of strawberry–legume intercropping system`s influence on soil fertility are presented in this paper.

Materials and Methods

The experiment was performed for three consecutive seasons from 2014 to 2016 at the Pūre Horticultural Research Centre, Latvia, in 57°02'17.8" north latitude, 22°55'00.3" east longitude. Strawberry (*Fragaria × ananassa* Duch.) cultivar `Polka` was planted as mine crop in the spring of 2014. Before plowing, the field was used as perennial meadow for harvesting hay. Strawberries were planted in rows with distance 1.0 m between rows and 0.3 m between plants in the row. Interplants were sown between strawberry rows as shown in Figure 1. Two local genotypes of broad beans (*Vicia faba* var. *major* L.) VF_01 and VF_02, two peas (*Pissum sativum* L.) sugar pea 'Ambrosia' and green pea 'Capella', alsike clover (*Trifolium hybridum* L.) 'Namejs' were used as intercrops. Two controls: with and without application of nitrogen fertilizer were included in the trial. Broad beans were sown in three rows with 0.25 m distance between rows and 0.20 m between plants in row.
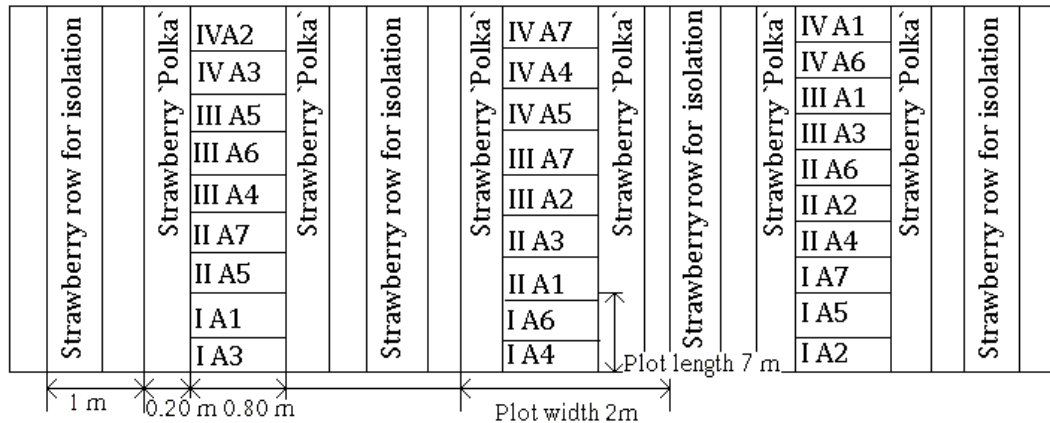
Figure 1. Experimental field layout: A1 – Broad bean genotype VF_02, A2 – Broad bean genotype VF_01, A3 – Pea 'Ambrosia', A4 – Pea 'Capella', A5 – alsike clover 'Namejs', A6 – control without N fertilizer, A7 – control with N fertilizer, I – IV replications.

Peas were sown in three rows with 0.25 m distance between rows and 0.1 m between plants in row. Alsike clover was sown in three rows with a seed rate of 6.4 g m^{-2}. In the control treatment with nitrogen fertilizer application, $Ca(NO_3)_2$ was used in a rate of 9.64 g m^{-2}. In other treatments no nitrogen fertilizers were used. The plot size was 2 × 7 m with isolation 2 × 1 m from both plot ends, where the size of evaluation plot was 2 × 5 m. Alsike clover was mowed with lawn mower after reaching 0.15 – 0.20 m height, residues were left on spot.

Peas and beans were grown for obtaining immature pod yield. Immature bean pods were harvested once and peas three times per vegetation season when reached fresh consumption stage (BBCH 80 – beans, 79 – peas).

Soil samples for soil organic matter content determination were collected two times per season – at the beginning and at the end of vegetation season. To determine soil biological activity, the soil samples were collected every 10 days during the vegetation season. To evaluate soil biological activity, soil respiration (SR), activity of dehydrogenase (DHA) and the content of soil organic matter were measured. Soil respiration was evaluated by the method of closed container method, where soil sample (50 g) was placed in a jar where low container with 5 mL of 0.1 M KOH was placed inside. After exposing it for 24 hours at 28 °C in dark, the liquid was titrated with 0.1 M HCl. The amount of CO_2 (mg) was calculated by using the (1) formula:

$$CO_2(mg) = \frac{(K - A) \times 2.2 \times 60}{m \times t} \qquad (1)$$

where K – amount of titrated 0.1 M HCl (mL) in the control jar; A – amount of titrated 0.1 M HCl (mL)

in the sample jar; m – soil sample weight (g); t – incubation time (min).

DHA activity was detected according to Kumar *et al.* (2013) method (modified by Dane (2016)). One gram of soil sample was exposed to 0.2 mL of 0.4% INT (2-p-iodophenyl-3-p-nitrophenyl-5-phenyltetrazolium chloride) and 0.05 mL of 1% glucose in 1 mL distilled water for at least 6 hours. The formed INTF is extracted by adding 10 mL methanol and actively shaking for 1 min. INTF is measured spectrophotometrically at wave length 485 nm. DHA activity was calculated by (2) formula:

$$Amount\ of\ INTF\ (DHA\ activity)\left(\mu L \times L^{-1} \times h\right) =$$

$$= \frac{(-3a^2 + 4a) \times 86400}{(60 \times h) + min}, \qquad (2)$$

where a – reading from spectrophotometer, h – incubation time in full hours, min – minutes over full hour.

Soil mineral analysis were performed in the Institute of Agroresources and Economics, Stende, where organic matter was determined using oxidation with $K_2Cr_2O_7$.

Meteorological data were collected in the local meteorological station LUFFT, meteorological data registered every 10 min (Figure 2). Soil moisture was determined with HH2 WET-2 sensor. Temperature in the vegetation season of 2015 was registered lower than long-term observed temperature. Temperature conditions in 2014 and 2016 were similar, fluctuating in average around long-term observed. More expressed variations were observed for the amount
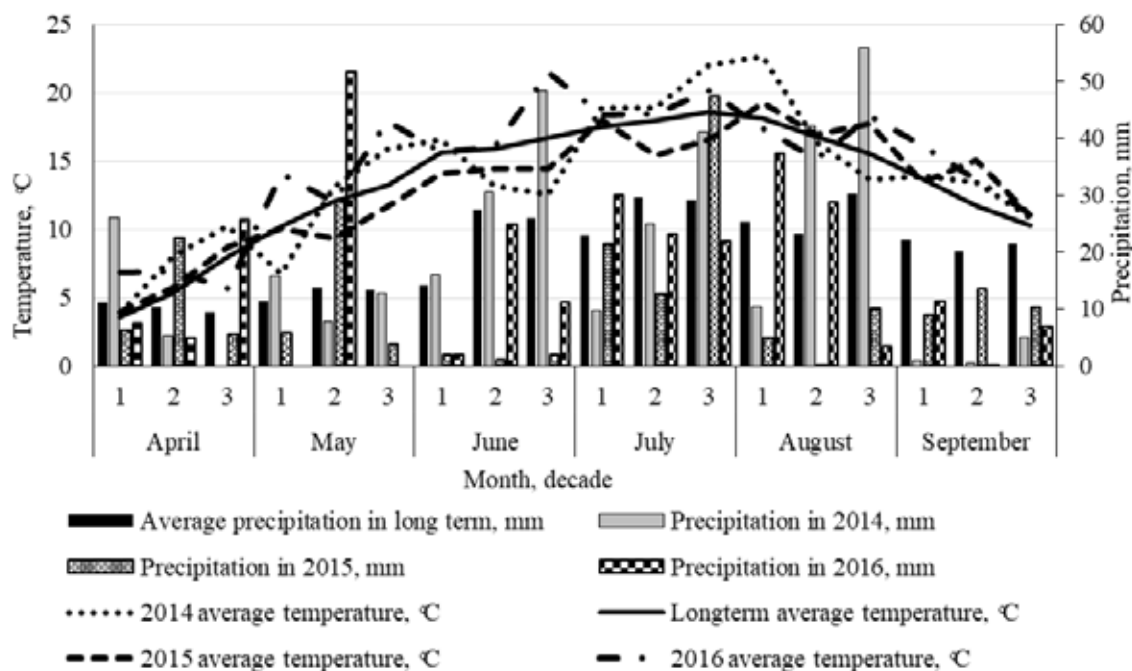
Figure 2. Long term meteorological data and meteorological data during experiment at Pūre

of precipitation. In 2014 the amount of precipitation was close to long-term data. During 2015 and 2016, the amount of precipitation was less in comparison to long-term data, especially at the end of May, beginning of July and the end of August, through all of September. These are critical periods for strawberry and legume development and yield formation. Reduced moisture can strongly influence the activity of soil microorganisms.

All data were subjected to analyses of variance (ANOVA) using STATISTICA (Dell Software, Round Rock, TX, USA) and the level of significance was set at $p < 0.05$.

Results and Discussion

Dehydrogenase activity was stated significantly different between the tested variants during almost all trial time (second year data shown in Figure 3). Only at the end of the third year there were no significant differences between treatments (data not shown). During the first and second growing year at the beginning of the vegetation season differences were minor, however, in the middle of the vegetation season differences became more significant ($p < 0.001$). Significant differences were observed between control without N fertilizer usage (Control -N) and other treatments. There were small but significant differences between control with N fertilizer usage (Control +N) and treatments with legumes. Treatments with legumes not always showed higher DHA activity than in Control +N. Mostly treatments with clover and pea `Ambrosia` showed significantly lower DHA activity ($p < 0.001$) in the first growing year. Significant

differences between treatments were observed also in the second growing year. Rapid decrease of DHA activity in August in the second growing year was due to dry period, when soil moisture capacity was stated below 8%. Treatments with clover and pea recovered significantly faster when drought periods passed. During the third growing year no significant differences were observed between treatments ($p = 0.07$). There is high probability that it was caused by dry period started at the beginning of the vegetation season and persisting until the end of June when trial ended. No significant differences in DHA activity were found between treatments with different legume genotypes ($p > 0.05$).

Trial data shows significant decrease in DHA activity over the years in the treatments of intercropping strawberries with legumes. In the first growing year, the amount of INTF was from 80 to 100 $\mu LL^{-1}h^{-1}$, in the second and in third growing year it was only between 60 to 95 $\mu LL^{-1}h^{-1}$. That matches the findings of other research on microorganism activity where results show a significantly higher microorganism activity in soils with minimum tillage compared to conventional soil management (Dubova, Ruža, & Alsiņa, 2016). It contradicts other research where microorganism activity and their biomass increased not only during the first years after the change of land use (Nautiyal, Chauha, & Bhatia, 2010) but also later in soil management (Filser *et al*., 2002; Bischoff *et al*., 2016).

Soil respiration rate (SRR) significantly ($p < 0.001$) differed between treatments (Figure 4). Control +N showed the lowest respiration rate during the first and
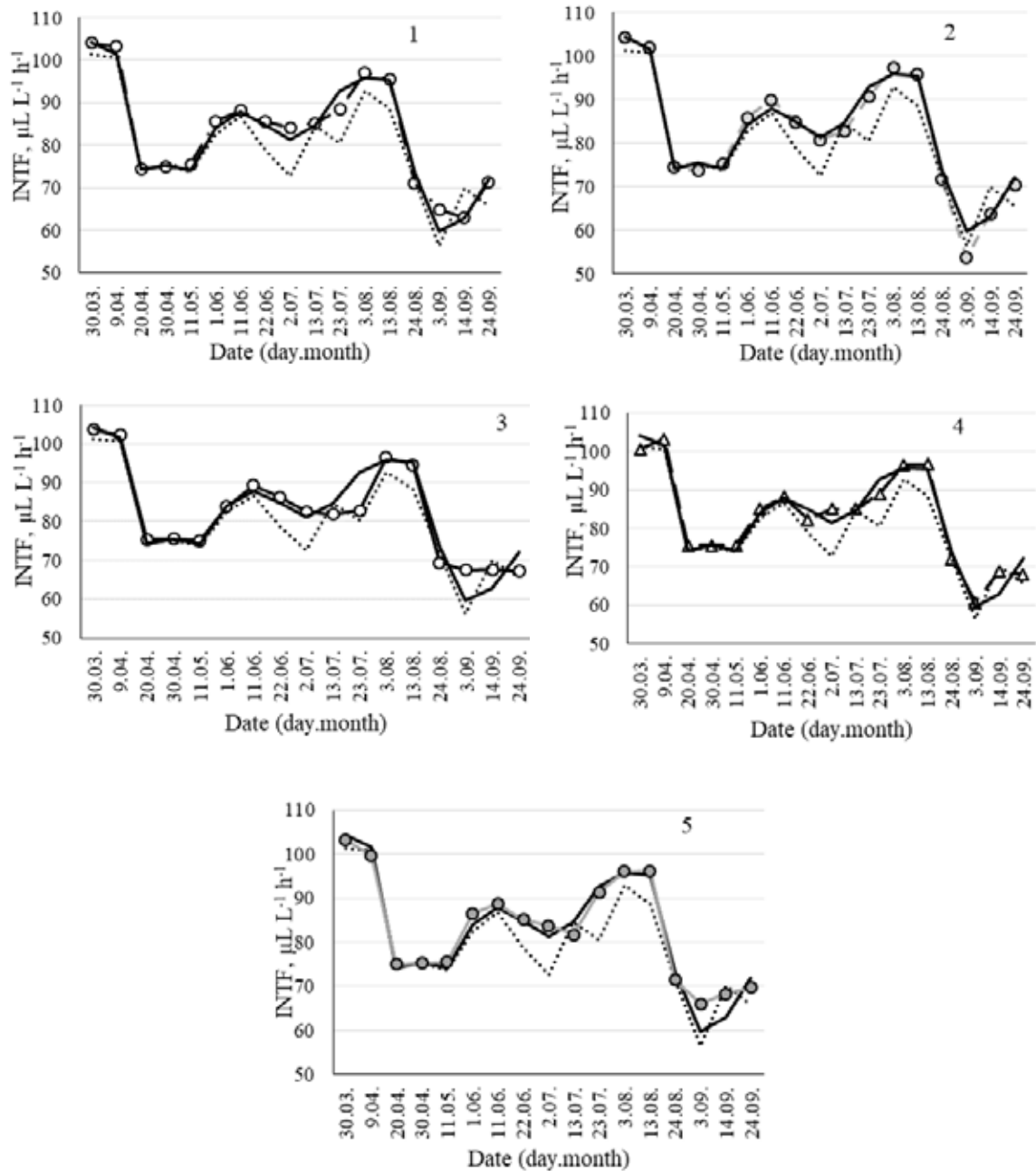
–◦– Bean VF_02   ◦ Bean VF_01   –●–Pea Ambrosia   –△–Pea Capella   ◦ Clover ······Control -N ——Control +N

Figure 3. DHA activity in the two-year old strawberry – legume intercropping system (LSD0.05 = 1.23).
1 – Bean VF_01 compared to both controls, 2 – Bean VF_02 compared to both controls, 3 – Pea `Capella`
compared to both controls, 4 – Pea `Ambrosia` compared to both controls, 5 – Clover compared to both
controls.

the second growing year. Combining results of soil respiration rate with DHA activity, it is clearly visible that in the Control +N treatment conditions were favourable for microorganism development, while not favourable for decomposition processes in soil done by chemical reactions as it was in the treatments with legumes and Control – N. In the third year, there were no significant differences in SRR between treatments (data not shown). The highest SRR was observed in the treatment with clover in the second growing year. It could be explained by regular clover mowing that increased dead root mass in the soil and green manure from regular clover mowing which served as C source for soil microorganisms. Data shows significant differences between growing years in SRR (data not shown), where SRR in the first year was significantly

−◦− Bean VF_02   ◦   Bean VF_01 −•−Pea Ambrosia −△−Pea Capella   ◦   Clover ······ Control -N ——Control +N
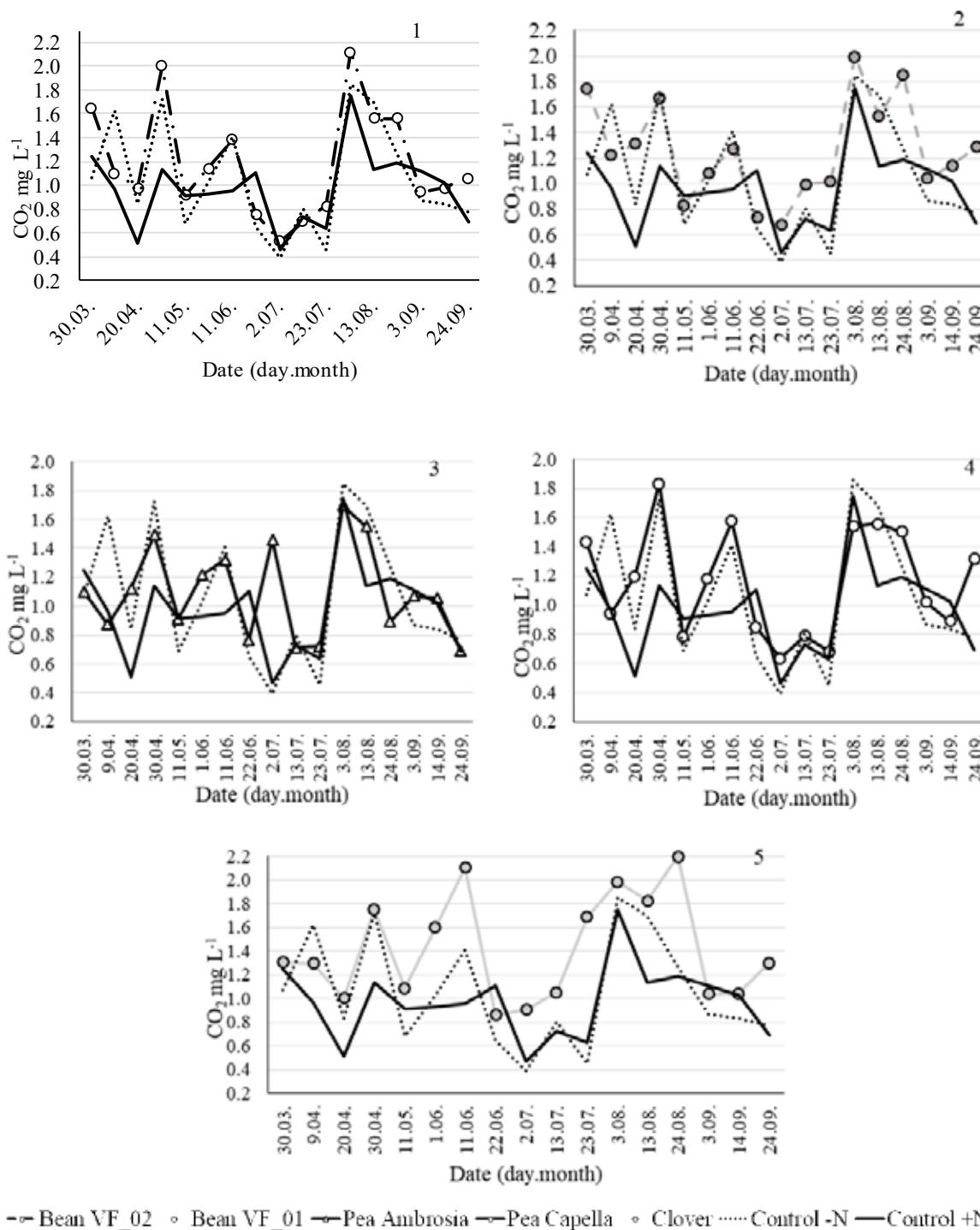
Figure 4. Soil respiration rate in the second year of strawberry–legume intercropping system ($LSD_{0.05}$ = 0.12).
1 – Bean VF_01 compared to both controls, 2 – Bean VF_02 compared to both controls, 3 – Pea `Capella`
compared to both controls, 4 – Pea `Ambrosia` compared to both controls, 5 – Clover compared to both
controls.

lower than in the second and the third growing year.
It is in line with findings of other research that soil
cultivation increases CO_2 emission (Schwen, Jetler, &
Böttcher, 2015).

To clarify the influence of the growing
technologies on the soil, multiple soil parameters must

be monitored. As one of the most important is soil
organic matter (SOM) (Figure 5). During monitoring
of SOM no significant differences were observed
between treatments (p = 0.054). Comparing SOM
content at the beginning of the experiment to SOM at
the end of experiment, only treatment with pea variety
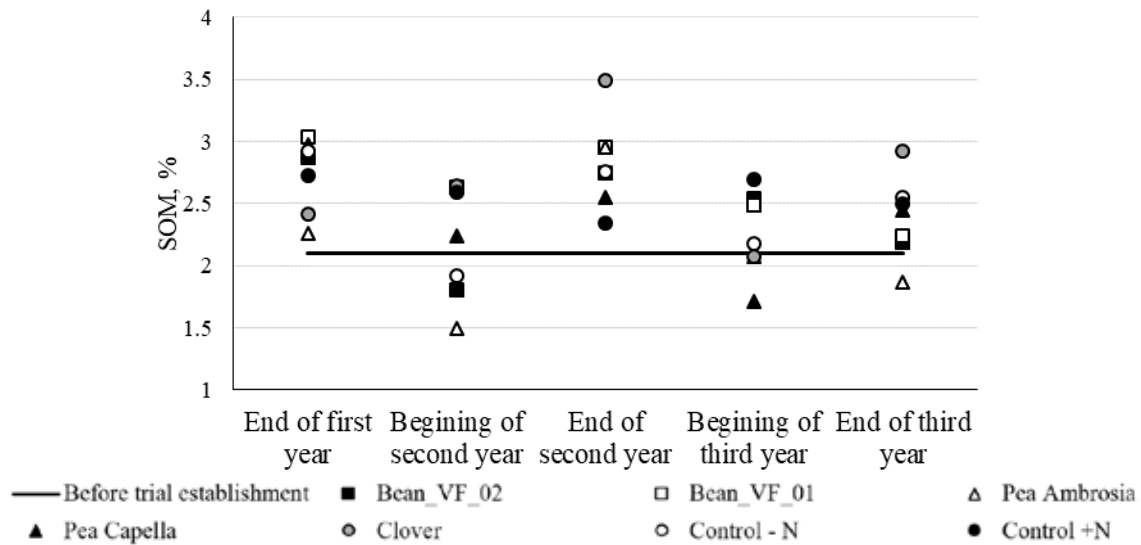
Figure 5. Soil organic matter`s changes during strawberry–legume intercropping trial ($LSD_{0.05}$ = 0.43).

`Ambrosia` had decreased SOM content. It can be due to its small amount of leaf canopy incorporated in the soil. Small increase in SOM was in treatments with beans and in pea `Capella` treatment. It can be explained with strawberry mulching. To get clean berries straw mulch was used, and in treatments with beans and peas straws were applied only from the side of unused interrows. That can lead to lower input of organic matter in these treatments. It thus evens organic matter input between treatments by straw mulch and incorporated legume leftovers.

significant differences between treatments, however, no significant differences were found between treatments in the third year. No significant difference was found between treatments in soil organic matter. Obtained data shows that legumes have a significant influence on the soil biological properties but not on biochemical properties. It gives a starting point in research field for strawberry–legume intercropping influence on soil fertility. Further research needs to be carried out to determine legume influence on the soil environment in more detail.

Conclusions

Trial results show that there were found significant differences between treatments in soil respiration rate and soil respiration rate dynamic all through the experiment time. Dehydrogenase activity also had

Acknowledgements

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INOCULATED BROAD BEANS (*VICIA FABA*) AS A PRECROP FOR SPRING ONIONS (*ALLIUM CEPA*)

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Abstract
The agronomic role of legumes in cropping systems is well understood with the respect to N_2 fixation, mechanisms of precrop effects, and environmental impacts. The combined inoculation and tripartite symbiosis between leguminous plants, *Rhizobium* spp. and vesicular-arbuscular mycorrhizal fungi has been the subject of intensive research. Less attention has been paid to their effects on subsequent crops. Pot experiments were carried out in the greenhouse of Latvia University of Agriculture in 2015 and 2016. Soil used for this experiment was taken from the previous trial, where broad beans (*Vicia faba* var. major Harz.) were grown. Bean seeds, depending on the variant, were inoculated with rhizobia bacteria or mycorrhiza fungi, or the mixture of both microorganisms. Onions were grown as a subsequent crop. During the experiment, fresh and dry weight of onion leaves was determined. Onion root mycorrhizal colonization frequency and arbuscule abundance in the onion root system were determined. The activity of soil microorganisms was determined by soil respiration intensity. Results showed that the use of microsymbionts increased the subsequent onion leaf harvest in 2014 by 2.3% and in 2015 by 9.5%. In 2015 the highest increase of onion leaf yield was detected in variants were rhizobia strain RP023 was used. Rhizobia strain RV407 gave a positive effect only in combination with mycorrhiza fungi. Precrop treatment with mineral nitrogen fertilizer increased the onion yield in both years – by 12.4 and 14.3%, respectively. In all treatments, a decrease in dry matter content was observed. The highest incidence of mycorrhiza fungi structures was detected under mycorrhiza treatment. Tripartite symbiosis promoted the soil respiration rate.
Key words: legumes, crop rotation, *Rhizobium sp.*, mycorrhiza fungi, soil respiration.

Introduction

Beans, as an important part of a sustainable agriculture, should be included in crop rotations in intensive agriculture to diversify now simplified crop rotations (Köpke & Nemecek, 2010). The agronomic precrop benefits of legumes can be divided into a 'nitrogen effect' component and 'break crop effect' component (Stagnari *et al*., 2017). The 'nitrogen effect' component is a result of acquiring nitrogen via symbiotic nitrogen fixation. The second one ('break crop effect') includes diverse benefits, such as improvements of soil organic matter and structure. The symbiotic root-fungal association increases the uptake of less mobile nutrients (Ortas *et al*., 2001), essentially phosphorus (P), but also micronutrients like zinc (Zn) and copper (Cu). In addition, the symbiosis has also been reported to influence water uptake as well as reduced pressure from diseases and weeds (Nuruzzaman *et al*., 2005; Köpke & Nemecek, 2010; Preissel *et al*., 2015; Stagnari *et al*., 2017).

Faba beans are mostly grown as a field crop, with cereals as the subsequent crop. But broad beans are mostly grown as horticulture crop, hence the subsequent crop can be any vegetables. To promote symbiotic nitrogen fixation, legumes are mostly inoculated with *Rhizobium* bacteria. Mycorrhizal fungi are obligate symbionts that form mutualistic relationships with plant roots known as a mycorrhiza. Mycorrhizal fungi receive carbon from their host plants in exchange for nutrient transfer to the roots, which benefits plant growth. Therefore arbuscular mycorrhizal fungi (AMF) can be integrated in the

soil management to achieve low-cost sustainable agricultural systems (Hooker & Black, 1995). The combined inoculation and tripartite symbiosis between leguminous plants, *Rhizobium* spp. and vesicular-arbuscular mycorrhizal (VAM) fungi has been the subject of intensive research (Ames & Bethlenfalvay, 1987; Abd-Alla *et al*., 2014).

The microorganism, introduced in the soil as an inoculum, affects not only the inoculated plants but it remains in the soil for the next growing season and can also affect the subsequent crops. While rhizobia are forming symbiosis exclusively with legumes, the mycorrhizal fungi have a broader host range. More and more are revealed VAM fungi host specialization than previously stated (Heijden van der & Scheublin 2007). Although the presence of mycorrhizal fungi are detectable in roots of majority of the plants, the impact on crop growth and yield may vary. Specific and non-specific relationships between symbionts have been found. This means that the VAM genotypes have a different impact on plant biomass formation and nutrient uptake. Biotic and abiotic factor interaction (eg., plant density, photosynthetic rate, the available mineral elements) significantly influence benefits obtained by host plants. These crops can potentially increase yields of subsequent cereal crops (Munkvold *et al*., 2004; Koch *et al*., 2006). Plant-microbe interactions influence soil microbiological activity. Plants are able to influence the composition and activity of microbial community around their root systems through the selective exudation of specific carbohydrates, carboxylic and amino acids, and

Table 1

Bean seeds inoculation variants

Label of variants	Treatment
K	control without any treatment
RP023	*Rhizobium sp.* strain RP0233
RV407	*Rh. sp.* strain RV407
M	mycorrhiza fungi
RP023M	*Rh. sp.* strain RP023 and mycorrhiza fungi
RV407M	*Rh. sp.* strain RV407Mand mycorrhiza fungi
KN	added mineral nitrogen fertilizers, without microorganism treatment

these microbial communities can be cultivar-specific. Microorganisms in the rhizosphere can themselves induce root exudation responses in plants or initiate changes in root biochemistry (Sturz & Christie, 2003; Verbruggen & Kiers, 2010).

The mycorrhiza can influence onion growth beneficially. Onions have an insufficient, mostly unbranched, shallow root system, almost without root hairs. Therefore, mycorrhiza are important for such plants to improve uptake of nutrients and growth (Shuab *et al.*, 2014).

The aim of the experiment was to compare the effect of different broad bean seed inoculation variants on the subsequent crop.

Materials and Methods

Pot experiments with onions were carried out in the greenhouse at the Institute of Soil and Plant Sciences, Latvia University of Agriculture in 2015 and 2016. The onion sets were planted in pots where broad beans (*Vicia faba* var. major Harz.) were grown in 2014 and 2015. For pot experiments, loamy sand soil was used. Soil analyses were conducted at the Institute of Biology, Latvia University before experiments with broad beans and characterized by pH KCl 7.6, Ec 0.73 mS cm^{-1} and mineral element content in $1M$ HCl solution (mg L^{-1}): N-78, P-523, K-170, Ca-161450, Mg-3850, S-65, Fe-1920, Mn-170, Zn-10.5, Cu-6.5, Mo-0.08, B-0.4.

Broad bean seeds, depending on the variant, were inoculated with Rhizobia bacteria or mycorrhiza fungi, or the mixture of both microorganisms (Table 1). At the end of vegetation period, the plant shoots were harvested but roots left in the soil as postharvest residues.

Onions were grown as a subsequent crop after broad beans. Five onions were planted in 5 L pots. Experiment was carried out in four replications.

Onions were fertilized only once to adjust the nutrients taken out by the precrop. They were fertilized with Kristalon™13+05+26+3+micro- dose 0.8 g per vegetation pot (respectively 20 g m^{-2}) a week after onion planting.

In the first year (2015) experiment started at the beginning of February. In the second year (2016) experiment started later – in April (Table 2). Additional illumination (286.5 µmol m^{-2} s^{-1}) with 12 hours photoperiod was used in 2015. Air temperature during greenhouse experiment during the day was between 15 – 25 °C, but in the night 8 – 15 °C.

The first leaf yield samples were collected 20 days after planting, further samples were collected once per week. In total, onion leaves were collected 5 times every year. Each time 5 leaves from one pot were collected (in total 20 leaves from each variant) to determine fresh and dry (dried 2 days at 60 °C) weight.

Onion root mycorrhizal colonization frequency and arbuscule abundance in the onion root system was determined at the end of experiment. The activity of soil microorganisms was determined by soil respiration intensity. For determination of soil basal respiration intensity, modified method described by Pell, Stenström, & Granhall, (2005) was used. Briefly – soil respiration was determined by placing 50 g of field-moist soil and a beaker containing 5 mL of $0.1M$ KOH solution into a 500 mL jar; the jar was sealed and placed in the dark at 30 °C for 24 hours. Afterwards, the KOH solution was removed and titrated with 0.1 M HCl to determine the amount of CO_2 evolved with the soil microbial respiration. The soil moisture was determined by drying the sample for 24 hours at 105 °C.

For assessment of onion root mycorrhizal colonization, 30 root fragments from each pot were randomly collected. The roots were stained according to Vierheilig *et al.*, (1998). The sampled roots were cleared by soaking in 10% KOH for 24 h (room temperature) and then rinsed several times with tap water. Cleared roots were boiled for 3 min in a 5% ink-vinegar solution. Roots were destained by rinsing with tap water (acidified with a few drops of vinegar). After staining, the roots were cut into 1 cm sections, mounted onto slides and analysed. Absolute mycorrhizal colonization and arbuscule/ vesicle richness were assessed. Onion root mycorrhizal colonization frequency and arbuscule abundance in

<div align="right">Table 2</div>

Design of experiments

Sequence of experiments	2014	2015	2016
1st experiment	Broad beans (vegetation pots in outdoor conditions)	Onions (vegetation pots in the greenhouse)	-
2nd experiment	-	Broad beans (vegetation pots in outdoor conditions)	Onions (vegetation pots in the greenhouse)
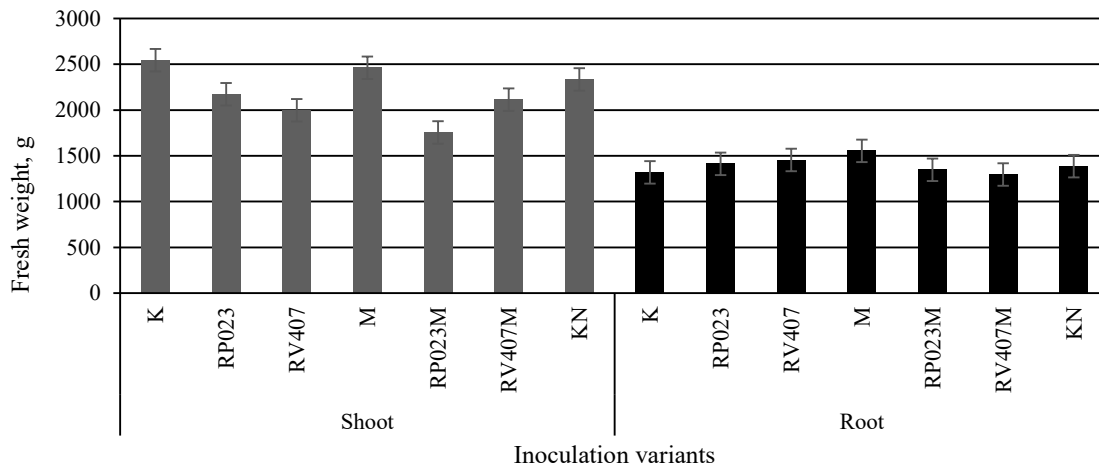
Figure 1. Shoot and root fresh weight from $1m^2$ at the beginning of broad bean flowering
(BBCH 60-61) in 2014.

the onion root system were calculated according to Brundrett *et al.* (1996).

The data were processed using ANOVA test and correlation analyses. The parameters were considered as significant at $p < 0.05$.

Results and Discussion

Shoot and root weight of the precrop. Broad beans is an important component for crop rotation. Therefore, in our experiment broad beans were used as the precrop for onions. Since beans were inoculated before sowing, used microorganisms could influence the following plants. Beans as the precrop affected mineral element quantity in soil – not only by symbiotically fixed nitrogen, but by post-harvest residue too. The differences between variants in shoot and root amount were found (Fig. 1).

The results showed that in year 2014 no significant differences between variants were detected ($p = 0.2$ and $p = 0.9$), but a tendency was found that inoculation with mycorrhiza preparation stimulated root growth. As a result, soil could reach more plant residue at the end of vegetation period. In year 2015 measurement of fresh weight of beans showed similar results with no statistically significant differences detected between variants (Fig. 2). However, a tendency remains that inoculated plants formed wider root system. This year

plants inoculated with *Rhizobium* strain RP023 had more stimulated root system.

Yield of the subsequent crop. Influence of symbiotic microorganisms on plant depends on different environmental conditions, too. Therefore, the amount of plant residue, especially of roots, and amount and activity of symbiotic microorganisms are not similar every year. Survival and activity of microorganisms in the soil can affect not only nutrient availability, but can influence plant growth through activity of rhizosphere microorganisms. Comparison of onion leaf yield in 2015 and 2016 with control variant where precrop was not inoculated with microorganisms or fertilized with addition mineral nitrogen is shown in Figure 3.

In all variants, except variant where precrop was inoculated with *Rhizobium* strain RV407, the yield was higher than in the control variant. Moderate correlation between precrop root weight and subsequent crop yield was observed in 2015 when the correlation coefficient was 0.61, but in 2016 it was 0.78. Variant with additional nitrogen showed 12.4% and 14.3% higher yield than control variant, respectively.

Results showed that in both years leaves of onions grown in the control variant contained the highest dry matter content in comparison with treated ones (Table 3). The lowest dry matter content was detected
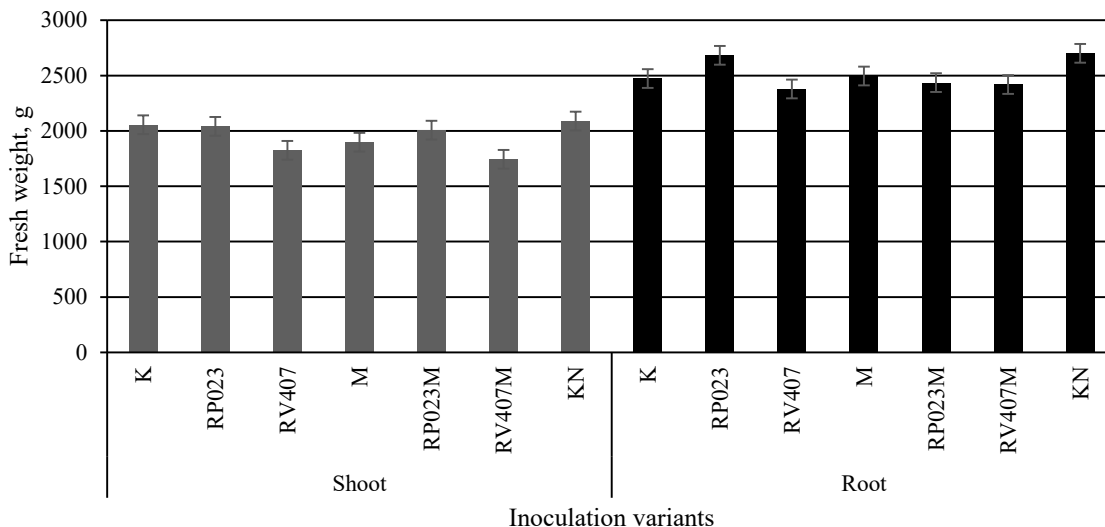
Figure 2. Shoot and root fresh weight from 1m^2 at the beginning of broad bean flowering
(BBCH 60-61) in 2015.
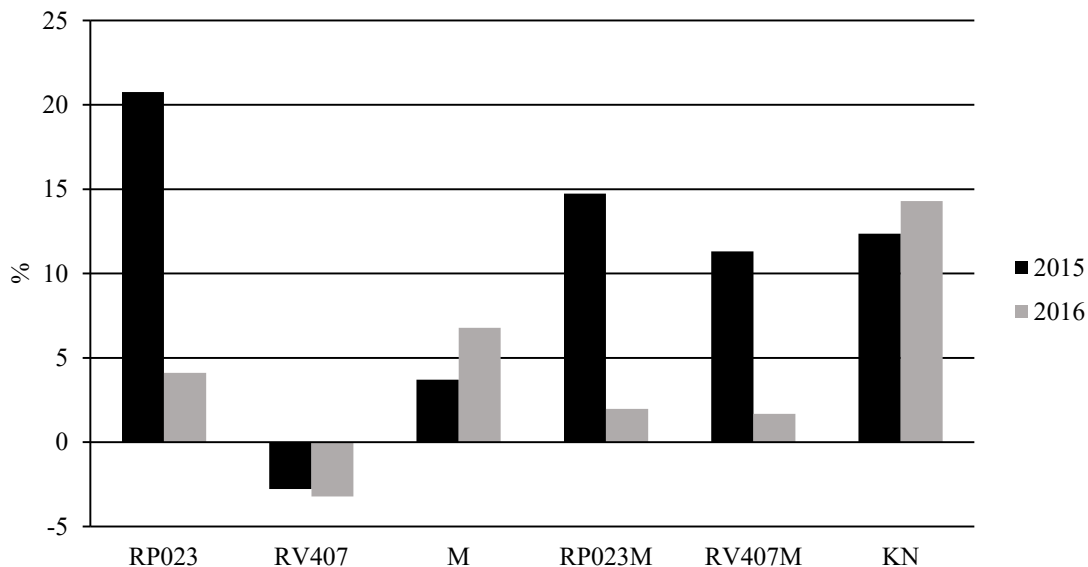
Figure 3. Onions leaf yield in experimental variants in comparison with control.

Table 3

Average dry matter of onions leaves

Inoculation variants	Year 2015		Year 2016	
	mg g^{-1}	% from control	mg g^{-1}	% from control
K	73.2	100.0	101.6	100.0
RP023	69.3	94.7	98.4	96.9
RV407	70.3	96.0	100.1	98.5
M	68.0	92.9	93.8	92.3
RP023M	70.9	96.8	98.9	97.3
RV407M	71.9	98.2	99.1	97.5
KN	71.9	98.2	97.9	96.3

Table 4

Mycorrhizal colonization of onions roots

Mycorrhyzation parameters	Precrop inoculation variants				
	K	M	RP023M	RV407M	KN
Root fragments with mycorrhiza fungi	152	180	166	180	176
Frequency of mycorrhiza in the root system, %	84.4	100	92.2	100	97.7
Abundance of arbuscules/ vesicules in root system, %	1.0	3.7	6.1	5.8	4.3

in plants grown under mycorrhiza treatment. Variants treated with rhizobia strain RP023 in all cases had less dry matter in comparison with rhizobia strain RV407. Date elaboration approves significance of year's influence (p = 5.22×10^{-9}), as well as treatments influence (p = 0.018).

At the end of the second year experiment, the onion root mycorrhiza colonization intensity was analysed. In all of the analysed root fragments from variants (n = 180) where precrop was inoculated, mycorrhiza fungi structures (fungal hyphae and arbuscules) were identified. Mycorrhiza fungi hyphae were detected also in the control variant, because soil contains indigenous fungi spores, however, in this variant the arbuscule abundance was low (Tab. 4). Higher abundance of arbuscules was detected in variants RP023M and RV407M – 6.1% and 5.8%, respectively, suggesting that the plant establishes a functional symbiosis with the fungi. However, higher onion leaf yield in these variants was determined only in 2015. As pointed out by Rozpadek *et al*., (2016), arbuscule formation and colonization intensity differences often do not appear into phenotypic characteristics. At the same time Cavagnaro *et al*., (2015) stresses the importance of mycorrhiza fungi hyphae to limit mineral loss

from the soil. This can explain the positive effect of mycorrhiza on plant growth.

Results of soil respiration intensity at the end of the experiment are summarized in Figure 4. The highest soil respiration intensity was determined in variants where more significant abundance of arbuscules/vesicules in onion roots was identified. It is an evidence of interaction between the plant and soil microorganisms. Similar results were shown by Zhang *et al*., (2016). They indicated that soil respiration intensity in the presence of mycorrhizal fungi is more intensive, but at the same time it is significantly influenced by environmental factors, especially soil moisture. Shi, Wang, & Liu (2012) indicated that, in addition to abiotic factors, biotic factors are important as well, because the presence of AMF could enhance plant productivity and thus promote soil respiration. Soil respiration, which results from soil organic carbon decomposition, was determined by both soil microbial activity and substrate availability. However, it depends not only on the presence of VAM, but also on the interaction between different soil microorganisms (Shi, Wang, & Liu, 2012). This is consistent with our results, where higher soil respiration was obtained in variants where
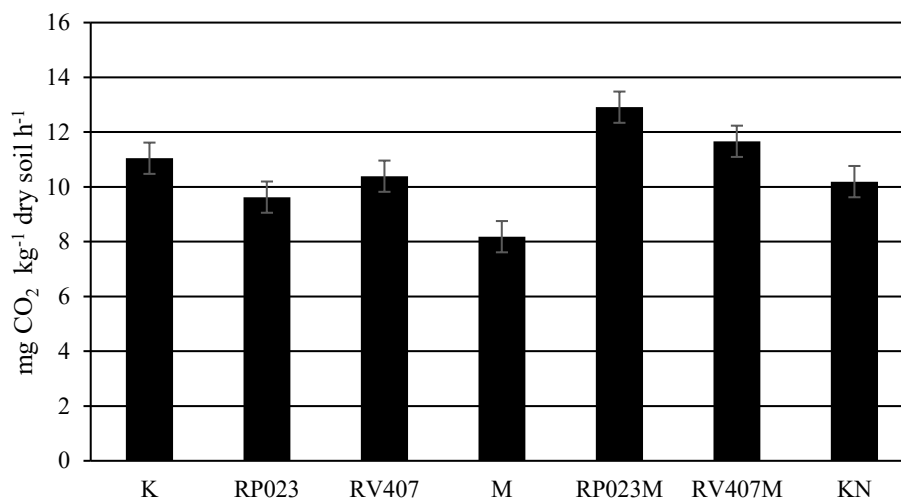
Figure 4. Soil respiration intensity at the end of experiment.

double precrop inoculation was used. Cavagnaro *et al.*, (2015) results show that AMF hyphae can promote the formation of soil macro-aggregates and reduce soil organic matter decomposition which affects growth conditions.

It can be summarized that crop rotation is recommended for onion cultivation. It was observed that precrop treatment with mineral nitrogen resulted in higher and more stable onion leaf yield. The effectiveness of microsymbiont treatment depended on the growing season. Better results with onion were obtained in 2015. It can be explained with the result of higher bean shoot yield in 2014 – on average 11% higher than in 2015. In both years a small yield increase was observed also in variants with mycorrhiza. As pointed out by Cavagnaro *et al.* (2015), it could be explained by the enhanced precrop supply with water and mineral nutrition (mainly phosphorus). Variants with rhizobia treatment were variable and do not allow for any clear conclusions.

Conclusions

The use of microsymbionts for bean inoculation increased the subsequent crop (onion leaf) harvest by 9.5% in 2015, and by 2.3% in 2016. The impact of microsymbionts on the onion yield is variable, the highest yield increase was reached in 2015 under rhizobia strain RP023 treatment. Rhizobia strain RV407 gave a positive effect on the yield only in combination with mycorrhiza fungi. Precrop treatment with mineral nitrogen fertilizer increased the yield in both years – by 12.4 and 14.3% in 2015 and 2016, respectively. Under all treatments, dry matter content decreased in comparison with control. The highest incidence of mycorrhiza fungi structures was detected under mycorrhiza treatment, leading to a potentially improved subsequent plant yield. Tripartite symbiosis promoted soil respiration rate, which indicates a higher microorganism activity.

Acknowledgement

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INSIGHT IN EDAMAME YIELD AND QUALITY PARAMETERS: A REVIEW

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Abstract
Environmental conditions and climate change on a global scale affect the overall agriculture and food supply. Edamame, also called vegetable soybean is an import vegetable in the world, especially in the East Asia. China is the world's centre for vegetable soybean production. Edamame beans are harvested before full maturity when bean pods are green and just before turning to yellow colour. Most cultivated varieties in the world are of Japanese origin. The aim of this literature survey is to give a review on history and consumption facts of edamame, as well as on the yield and quality parameters of this fresh commodity. Monographic method has been used for this review. Edamame has a high nutritional and medical value. Composition of biologically active compounds in edamame plants is dependent on climate conditions, seasonal changes, cultivar properties and maturity stage. Vegetable soybean has a long cultivation history in the world. In Europe edamame is grown, but in Latvia edamame has not been grown until now, but there is some experience in soya grain growing. Pod colour is the main external quality factor of edamame. It can be influenced by light, moisture, fertilization, variety properties, planting density and harvesting procedures. Vegetation period for edamame in most cases is reported to be between 75 and 100 days.
Key words: *Glycine max* (L.) Merr, pods, quality, protein.

Introduction

Edamame belongs to the same species as the traditional grain soybean (*Glycine max* (L.) Merr.). Vegetable soybean has a long history. *Glycine soja* Sieb & Zucc in eastern China is the ancestor of *Glycine max* (L.) Merr.). For the first time edamame were recorded in China, as early as the second century BC (Mentreddy *et al*., 2002). Edamame is a traditional component in diet also in Japan, where it has been known for more than 400 years. It is generally sold in the pods as fresh or frozen beans. For consumption, edamame is boiled for 5 to 7 minutes in highly salted water (Johnson, Wang, & Suzuki, 1999). Edamame, boiled with or without pods, is consumed as snacks, soups, salads or vegetable dishes (Mentredy *et al*., 2002; Stevenson, Jane, & Inglet, 2007). In Brazil, edamame packaging is canning; if sucrose is added, it helps to save the desirable colour (Czaikoski *et al*., 2013).

Soybean is an annual self-pollinated diploid legume (Gurdip, Thomas, & Carter, 1993). It is a popular crop that is widely consumed worldwide (Song *et al*., 2013). Soybean can be used as oil bean and as food bean. Soybean varieties with a larger seed size than traditional varieties, harvested at immature stage, also are called edamame (Saldivar *et al*., 2011). The consumption difference between soybeans and edamame is in the stage of maturity when the beans are harvested. Edamame beans are harvested before full maturity when bean pods are green and just before turning to yellow (Basavaraja, Naidu, & Salimath, 2005; Hu *et al*., 2006; Pao *et al*., 2008). Similarly to dried soybeans, the seeds of edamame are characterized by high nutritional and medicinal value (Konovsky, Lumpkin, & MeClary, 1994). It is valuable due to high protein, fat, phospholipids, phosphorus, calcium, iron, thiamin, riboflavin, vitamin E, diet fibre and isoflavone content (Basavaraja, Naidu, & Salimath, 2004; Hu *et al*., 2006). There are also reports on high level of essential amino acids in the beans (Maruthi & Paramesh, 2016). Soybean is a good source of several natural isoflavones (78 to 220 µg g^{-1} dried seed) (Mentredy *et al*., 2002). Isoflavones have a preventive effect on vascular diseases, osteoporosis, menopausal symptoms, and cognitive function (Sirisomboon, Pornchaloempong, & Romphophak, 2007). Soybean also has potential for cancer prevention and suppression due to its high genistein content (Huang *et al*., 2014). Clinical studies show that isoflavones in soybean proteins have a positive influence on blood substance and reduce the risk of cardiovascular diseases (Mentredy *et al*., 2002). Edamame is a valuable food for vegetarians and vegans due to its high nutritional value, especially as a source of proteins and amino acids. Vegetable soybeans are also used in the preparation of innovative products such as green milk, green tofu and green noodles (Basavaraja, Naidu, & Salimath, 2005).

According to literature, the vegetation period for edamame in most cases is between 75 and 100 days. Such length of vegetation period is common for majority of agricultural crops in Latvia. Taking into account this fact, assumption of too short vegetation period in Latvia is deniable. Nonetheless, the shorter the vegetation period, the more secure is a high quality production outcome. This fact is taken into consideration also by edamame breeders worldwide – the most important breeding objectives are early maturity, high quality (Fig. 1.) and disease and insect resistance (Shanmgasundaram, 1991). Edamame tradability is characterized by physical and organoleptic properties. Quality characteristics depend
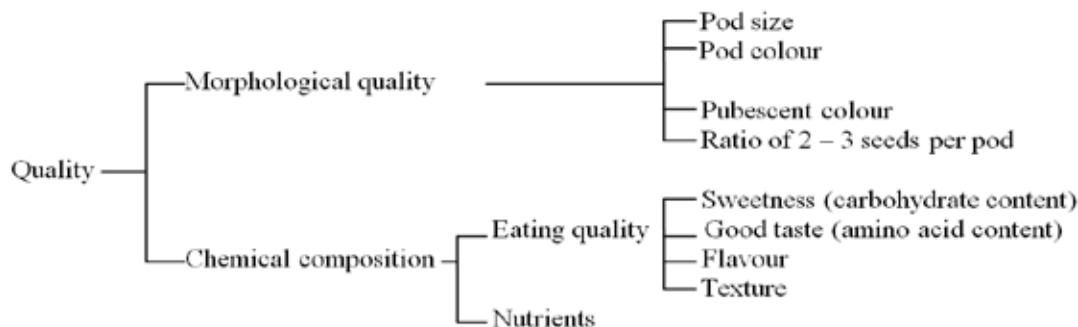
Figure1. Quality components of vegetable soybean (Shanmgasundaram, 1991).

on genotype, harvest time, growth and environmental conditions (Mentreddy *et al*., 2002).

Quality parameters of vegetable soybean are scaled into five categories, including visual aspects, taste, flavour, texture and nutritional value. The pod colour is crucial and bright-green is the most suitable. Yellowing of the pods shows freshness decrease and debasement of ascorbic acid. At harvest, edamame has more vitamins than field-dried soybeans. Taste is determined by sucrose, glutamic acid and alanine. Sucrose promotes sweetness, while saponin, isoflavonoids, and L-arginine add bitterness to edamame seeds. The blanched beans are mostly used in the human diet. It is found that shortly boiled/blanched edamame beans are a good source of ascorbic acid, vitamin E and dietary fibre (Shanmgasundaram, 1991; Johnson, Wang, & Suzuki, 1999). Analysis of vegetable soybean performed in Japan showed energy value 2435 kJ per 100 g, as well as 71 g water, 11 g protein, 7 g lipids, 7 g carbohydrates, 2 g fiber, 16 g dietary fiber, 2 g ash and 70 mg calcium, 140 mg phosphorus, 140 mg potassium, 27 mg ascorbic acid and also other vitamins and microelements (Johnson, Wang, & Suzuki, 1999; Wszelaki *et al*., 2005).

The aim of this literature survey is to give a review on history and consumption facts of edamame, as well as on the yield and quality parameters of this fresh commodity.

Materials and Methods
Monographic method has been used for this review. Literature from different scientific journals all around the world has been used in its development. It includes information from research conducted in Japan, India, Thailand, Georgia, Pakistan, Canada, Brazil, Dakota, Mississippi and Colorado.

Results and Discussion
Growing conditions
Until harvest, the edamame growing system is similar to that of traditional grain soybeans. However, the edamame seeds are larger and it can be necessary to organize a different sowing system if the sowing machines are used. Seeds have to be sown in 2.5 – 5.0 cm depth, in well-drained, warm, moist fertile soils. Plantlets may be started in a greenhouse and later transplanted in the field. If edamame is sown for the first time in a particular field, the seed should be inoculated with the *Rhizobium* strain, *Bradyrhizobium japonicum* bacterium (Konovsky, Lumpkin, & MeClary, 1994; Kaiser & Ernst, 2013; Zhang *et al*., 2013). As planting depth increases, soybean seedling emergence declines (Zhang *et al*., 2013). Soybean germination will be better if seeds are planted into moist soil (Mentredy *et al*., 2002). In Japan, base fertilizer rates used for soybean are approximately 50 – 80 kg nitrogen ha⁻¹, 70 – 100 kg phosphorus, and 100 – 140 kg potassium ha⁻¹. Immoderate nitrogen fertilizer can influence pod number and increase the number of empty or one-seeded pods. One of the significant factors influencing yield is the planting density. The distance between rows influences plant development more than distance between plants in a row. Lower plant densities provide darker pods (Kanovsky, Lumpkin, & MeClary, 1994). Low phosphorus availability can negatively influence edamame growing and development. The biotechnological tool can be used to improve phosphorus using efficiency in vegetable soybean – a rice phosphate transporter gene has to be transferred into the vegetable soybean genome (Yan *et al*., 2014).

Plant growing and development conditions can influence properties of a particular variety. A major factor for vegetable soybean production is seed quality. In India research was performed with the aim to determine the best nutrient management system for higher seed quality. From 12 different tested treatment combinations the best results showed variants with treatment combination of recommended rates of NPK (30:80:37.5 kg ha⁻¹) + Recommended dose of FYM (farmyard manure), (10 t ha⁻¹) + *Bradyrhizobium* inoculant (250 g ha⁻¹) + PSB (phosphate solubilizing bacteria), (250 g ha⁻¹) can be used for obtaning good quality seeds of vegetable soybean. In all variants, the mean germination rate was 85.4% (Maruthi & Paramesh, 2016). There is a high variation found between genotypes according to plant height, yield,

seed size, seed flavour, and time to maturity (Kaiser & Ernst, 2013). In India, an investigation was performed with 10 vegetable soybean genotypes, where plants were grown with a spacing of 30 cm between rows and 10 cm between plants in a row. In all vegetable soybean genotypes a significant difference was observed between measurements, except pod width. Plant height ranged from 26.7 to 62.73 cm, number of branches 2 – 3, period of 35 – 46 days to 50% flowering and 79 – 84 days to harvest, pod number on plant was ranged from 22 to 31, pod length 3.3 – 4.6 and pod width 0.9 – 1.1 cm, the fresh pod yield varied between 6.2 and 11.4 t ha^{-1} and, accordingly, the seed yield was 2.0 – 4.9 t ha^{-1}, but hundred seed weight was found to be 16.7 – 35.8 grams. Basavaraja with colleagues observed a positive correlation between seed yield, pod length, and hundred seed weight (Basavaraja, Naidu, & Salimath, 2005). In Pakistan, an investigation was performed on evaluation of different soybean genotypes, where plants were grown in a spacing of 30 cm between rows and 5 cm between plants in a row. The average number of pods per plant was recorded as 21 and average plant height – 71 cm (Rehman et al., 2014).

In China, 30 edamame genotypes were analyzed. Seeds were sown in a row with 65 cm spacing. Plant height was varying from 32 to 119 cm and growing period between 101 – 130 days (Li et al., 2012). Investigation in two different places in Colorado during 1994 – 1998 year showed significant differences in yield, depending on location. The yield of five edible bean cultivars ranged between 2.2 – 8.1 in one location and 4.1 – 10.2 t ha^{-1} in another, but marketable yield between 1.0 – 4.8 in one location and 2.1 – 6.8 th^{-1} in another (Johnson, Wang, & Suzuki, 1999). Another investigation was performed in Georgia, US with six edamame cultivars from Japan, two from China and two US elite soybean cultivars during 1995 – 1998. The average fresh green pod yield ranged between 16.3 and 19.7 t ha^{-1}, but seed yield ranged between 7.3 and 11.6 t ha^{-1} (Mentreddy et al., 2002).

In Brazil, four vegetable soybean genotypes were compared. The number of pods per plant during two vegetation seasons on average fluctuated between 17 and 29. Fresh bean yield was stated to be from 3.3 to 6.6 t ha^{-1} (Santos et al., 2013).

Five vegetable soybean cultivars were evaluated during 2003 and 2004 in Dakota. Marketable yield in the trial ranged between 6.5 and 11.3 t ha^{-1} and pod number per plant was 27 – 81 (Duppong & Hatterman-Valenti, 2005). During 2004 and 2005 in Mississippi Zhang and Kyei-Boahen (2007) observed that plant growth and development were faster in 2004 than 2005 because in 2004 there were warmer temperatures at planting (average 25 °C). The late-maturing variety plants in the trial were taller, had more pods per plant and total fresh pod weight was higher than for the early-maturing varieties. In 2004, the plant height ranged between 21 – 74 cm and in 2005 from 17 to 144 cm; accordingly, pods per plant ranged between 14 – 57 and 27 – 98, and yield ranged between 1.6 – 21.4 and 8.5 – 39.2 t ha^{-1} respectively in both years.

Harvesting

In small farms edamame yield is usually harvested by hands. Pods are ready for harvest when they are close to full size and are bright green (between R6 and R7 growth stage), and pods have filled up to 80 – 90% of the pod width (Konovsky, Lumpkin, & MeClary, 1994; Mentreddy et al., 2002; Basavaraja, Naidu, & Salimath, 2005). It is highly recommended to perform pod cooling during post-harvest to save the product freshness as long as possible (Kaiser, & Ernst, 2013). Edamame pods at harvest should have white pubescence; the hilum should be light brown or gray. Two or three seeds must be developed in the pod and pod length must be at least 5 cm and width 1.4 cm (Metredy et al., 2002). Pods are sorted in two grades. Level A, – at least 90% pods with two or three seeds. The pods have a good shape, are completely green, and without injury or blots. Level B edamame pods can be a little bit lighter green, and a few pods can be slightly spotted, injured. In both levels, pods cannot be completely mature or unripe, with disease, or insect-damaged. Pod colour is the most seeable quality parameter of edamame (Konovsky, Lumpkin, & MeClary, 1994; Sirisomboon, Pornchaloempong, & Romphophak, 2007; Sirisomboon, Hashimato, & Tanaka, 2009). Ensuring of high quality is quite a challenging task in edamame production. In Thailand, green soybean pods were analyzed with NIR scanning system, all samples were classified into 10 groups of pods. From total pod number (802) only 98 were of good quality. Most of pods had downy mildew (*Peronospora manshurica*) (167) and brown spots (*Septoria glycines*) (193) (Sirisomboon, Hashimato, & Tanaka, 2009).

Yield quality

Different factors such as cultivar, growing conditions, climate, soil type, and plant maturity can influence the biochemical quality of crop. Not only environmental factors, but also genetic factors can strongly affect the seed biochemical composition. Soybean is an important source of vegetable proteins and lipids, especially of essential fatty acids (Zarkadas et al., 2007). In Japan and Canada, different methods are used for protein quality determination. These methods are used by breeders to select high quality soybean varieties. In Canada, 14 soybean cultivar seeds were analyzed, where average protein content values among these varieties ranged from 29.8 to

36.1% (Zarkadas *et al*., 2007; Lee *et al*., 2012). Starch content in immature soybean seeds was found to be 4 – 5%, but it decreased to almost zero at maturity. Level of oil increased rapidly to 20% at 40 days after flowering, and stayed constant until maturity, but protein was accumulated at later stages. 60 soybean genotypes were analyzed and it was observed that sucrose and raffinose contents were positively correlated with oil content, but negatively correlated with protein content (Saldivar *et al*., 2011). From trials performed in Pakistan data shows that protein concentration of soybean seeds was significantly affected by planting time. Early planted soybean produced seeds with lower protein (Rehman *et al*., 2014). Protein content increased by 7 – 8% in the period of 20 days before harvest (Stevenson, Jane, & Inglett, 2007). In Georgia, protein and oil content in dry seeds for different genotypes ranged between 33.3 and 38.6%, and from 5.0 to 6.9% in fresh seeds. The content of sugar ranged from 6.0% to 7.4%. The content of total soluble sugar of the fresh green beans is a significant factor that directly affects the organoleptic attribute of seeds (Mentreddy *et al*., 2002). In China, eight vegetable soybean genotypes were analyzed on biochemical composition. It was found that sucrose concentration ranged between 9.4 and 31.8 mg g^{-1}, which is 78.9 to 93.7% of the total sugar content; free amino acids ranged between 4.6 and 10.2 mg g^{-1} dry matter. Vegetable soybean contains 23 free amino acids (Song *et al*., 2013). In India, biochemical evaluation of 16 edamame genotypes of Taiwan origin was performed. Results of investigation indicate significant genotypic variation for content of vitamin C, from 34.8 to 88.7 mg 100 g^{-1} dry seeds. Total phenol content in green seeds ranged from 0.68 to 1.39 mg gallic acid equivalent g^{-1}. Antiradical activity varied from 10 to 25% (Kumar *et al*., 2014). In another investigation in India, ten different vegetable soybean genotypes were compared. It was determined that protein content in seeds ranged from 11.6 to 15.3 g 100 g^{-1} of fresh sample. It should be stressed that regarding protein content, the vegetable soybean has the highest ranking among other legumes. Vitamin C content of vegetable soybean genotypes ranged from 15.90 to 20.85 mg 100 g^{-1} (Salmani, Vijayalakshmi, & Sajjan, 2012).

Researchers observed that 10 – 14 day storage in a fridge at 3 – 5 °C temperature did not show significant loss in edamame seed quality (Johnson, Wang, & Suzuki, 1999). On the contrary, others observed that when stored at 5 °C for 10 days, green colour, content of sucrose, and seed weight gradually decreased. Combination of blanching in boiling water and following freezing is found to be a good way to save the quality of vegetables. However, blanching negatively influences the vegetable quality, texture – they become soft, their colour changes to brown, and the content of nutrients is lower. Steam blanching is better than water blanching because more soluble matters have been lost during water blanching (Saldivar *et al*., 2010).

Conclusions

Edamame is becoming more and more popular all over the world, particularly in countries from the United States to Asia. Vegetable soybean is of similar growth and development peculiaries as traditional soybean. Fresh green soybeans have a low oil and high protein content (10 – 15 g 100 g^{-1}). Vegetable soybean yield and its quality can vary depending on genotype, weather conditions and other environmental and agrotechnological factors.

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TECHNOLOGICAL AND SENSORY QUALITY OF GRAIN AND BAKING PRODUCTS FROM SPELT WHEAT

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Abstract
This work deals with the baking quality of the spelt wheat grain (*Triticum spelta* L.) compared with bread wheat (*Triticum aestivum* L.). Mixed flours were made of different share of spelt wheat and bread wheat (in total 11 mixtures) in 2016 in the Česke Budejovice in the laboratories of the Faculty of Agriculture. The technological quality of these mixtures was analyzed, focusing on standard evaluation methods (protein content, characteristic of gluten or swellability of protein). The analysis was supplemented by complete rheological analysis made by Mixolab II. Bread was used as a model product. Subsequently, sensory evaluation of baked bread from the previously prepared mixtures was done. Part of the analysis was to estimate the economic basic bread recipe with different proportions of bread wheat and spelt wheat. The results were statistically analyzed via STATISTICA 9.1 (StatSoft, Inc., USA). It was proved that the flour made of spelt can give cereal products with a higher nutritional value. The results have shown that the spelt grain is much more suitable for baking. Its advantage is the higher protein content and higher resistance of kneading of the dough and starch gelatinization rate, which was statistically confirmed. The main disadvantage is the higher price of spelt. According to the results, the ideal utilization of spelt wheat based on sensory analysis and economic calculations seems to be the mixture of spelt wheat and bread wheat, which results in an undeniable decrease of the product cost, and hence effects the common customer choice and taste preferences.
Key words: spelt wheat; bread wheat; technological quality; baking test; sensory evaluation.

Introduction

Cereals are the most widespread of all the crops. They are grown worldwide. Wheat is ranked among four most significant crops from the human caloric intake point of view (Moudry *et al.*, 2013a; Moudry *et al.*, 2013b; Jelinkova *et al.*, 2016). Apart from their nutritional, health and technological parameters, impact of cereals of the environmental sustainability was also evaluated in our research, pursuant to our attempt to evaluate farming and food products from broader point of view (Dalgaard *et al.*, 2006). Food consumption patterns were counted and assessed in particular (Wallgren & Hojer, 2009). As far as alternative wheat cultivars are concerned, spelt wheat is the most widespread alternative wheat species in the organic farming; spelt wheat growing areas have been extending (Korczyk – Szabo & Lacko – Bartosova, 2013; Konvalina *et al.*, 2014). In 2014, spelt wheat was grown on the area of 2,000 ha and the average yield amounted to 2.11 t ha^{-1} in the Czech Republic (Hrabalova, 2015). In Austria, for instance, the growing area is larger than in the Czech Republic nowadays; spelt wheat is grown on the area of almost 10,000 ha there. Any statistics mapping spelt wheat growing areas worldwide do not exist. However, spelt wheat is supposed to be grown on the area of hundreds of thousands of hectares in total. A wide range of products are made from spelt wheat grains – bakery products, various semi-products, pasta or coffee (Konvalina *et al.*, 2011; Stehno *et al.*, 2010).

Spelt wheat is often said to contain more nutrients in its grains. Its grains are supposed to be more easily digestible than bread wheat ones. There is not, nevertheless, any unequivocal evidence for that claim.

High grain protein content (13 – 20%) has already been described in details. Compared to bread wheat, spelt wheat contains much more proteins. Spelt wheat composition of amino acids is very similar to bread wheat one, if related to the same grain protein content (Ranhotra *et al.*, 1995). In spite of high grain protein content, spelt wheat grain is suitable for malt and beer production (Krieger, 2004). Grela, Baranowska & Krusinski (1993) noticed some differences in E-vitamin content between spelt wheat and bread wheat. Compared to bread wheat grains, spelt wheat grains contain more zinc (Ranhotra *et al.*, 1995). Cubadda and Marconi (1996) described a high baking quality of spelt wheat in their study, despite spelt wheat gluten being less tough or firm and provoking worse rheological properties of dough than bread wheat one (Schmitz, 2006). Therefore, it is highly advisable to use a mixture of spelt wheat and bread wheat flour for the production of bakery products. Considering that spelt wheat is sold at a higher price than bread wheat, such a mixture of flours allows us to produce bakery products at lower prices. Gluten stability and rheological properties of dough have improved thanks to hybridizing spelt and bread wheat cultivars. Such species are not, nevertheless, accepted by consumers in Austria or Switzerland. They are highly sensitive to wheat gluten. Some grains might even contain more carotenoids that cause darker colour of spelt wheat bakery products, compared to bread wheat ones (Grausgruber *et al.*, 2004; Schmitz, 2006). The Italian research showed (Marconi *et al.*, 2002) that pasta could be made from spelt wheat grains containing more proteins (Lacko-Bartosova & Lacko-Bartosova, 2016). In order to make good-quality

pasta, temperature has to be increased when pasta is being dried. A study showed (Ruibal-Mendieta *et al*., 2005) that wholegrain spelt wheat flour was richer in fats than bread wheat one, and unsaturated fatty acids in particular. High ash, copper, iron, zinc, magnesium or phosphorus contents were detected in some spelt wheat samples (and in the aleuronic layer of caryopsis in particular). On the other hand, there was 40% less leaf acid in spelt wheat than in bread wheat. Digestible fibre content was also lower in hulled wheat grains than in naked wheat ones (Grausgruber *et al*., 2004).

This article aims at evaluating primary parameters of the milling and baking quality. Such evaluation is accompanied with a complex rheological evaluation (carried out with Mixolab II) and sensory analysis as well. Optimizing technological and economic parameters of the mixtures of spelt and bread wheat is another partial objective.

Materials and Methods

Wheat samples: The samples were purchased from a commercial shop, products were from Bioharmonie bio baking flour. The study was done in 2016 in the Česke Budejovice in the laboratories of the Faculty of Agriculture. Evaluation of parameters of the milling and baking quality: Standardized methods were used to determine Gluten index, falling number (ICC 107/1), wet gluten content (ICC 137/1), Zeleny test (ICC 116/1) and moisture (ČSN ISO 712). The nitrogen content was determined according to the Kjeldahl method (ICC 105/2); we used conversion factors, known as N factors, 5.70 for all flours. Advanced evaluation of the baking quality was made by rheological system Mixolab II (ICC 173). Sensory analysis and economic cost analysis: The bread-making test was done using the standard procedure: 300 mLwater, 500 g flour, 16 g salt, 16 g sugar, 3 g cumin and 3 g dried yeast in the home breadmaker Moulinex Home Bread Inox on the 4 h program. The sensory analysis of various bread types was performed (those types of bread differed in the spelt wheat share). Twenty-five participants participated in the evaluation of 5 different breads. They were asked to fill in a questionnaire which included the following questions: taste, smell, visual aspects of bread crust and bread crumb, touch and hearing impressions. Statistical data analysis: The data were statistically analysed (at level p < 0.05) by analysis of variance to determine significant differences among samples using program STATISTICA 9.1 (StatSoft, Inc., USA).

Results and Discussion
Evaluation of primary parameters of the milling and baking quality

Table 1 shows the summary of all baking quality parameters that were monitored and evaluated in our research. Measured values corresponded to long-time figures. High falling number values were measured for both wheat species; they indicated a minor damage to grain starch as a consequence of pre-harvest lodging. We measured very high values of falling number; they exceeded the limit and were several times higher. Such high values could have a negative effect on volume and sensory properties of bakery products and bread crumb (Every *et al*., 2002). Gluten index (GI) indicates the stability and flexibility of gluten. Higher values of GI are better for mechanical dough processing. Bread wheat or stronger bread wheat mixtures attained higher values than spelt wheat or any stronger spelt wheat mixture in our research. There was a statistically significant difference between spelt and bread wheat values. On the other hand, there was a minimum difference in Zeleny test values between spelt and bread wheat. Spelt and bread wheat were similar in protein swelling capacity; pursuant to Tukey HSD test, it was a statistically significant trend.

Wet gluten content is closely linked to grain protein content (Famera *et al*., 2015). Spelt wheat usually attains higher values of grain protein content than bread wheat. It is similar to cereal mixtures. 100% pure spelt flour contained higher amount of proteins in our research. It is a general trend nowadays – spelt wheat grains contain more nutritionally valuable proteins than bread wheat ones, in the organic farming in particular. There was a statistically significant difference between 100% bread wheat sample and spelt wheat one in our research; however, there were statistically non-significant differences in every single mixture and they mingled. Dvoracek & Curn (2003) described the following trend – there are more protoplasmic protein fractions, and nutritionally valuable albumins and globulins in particular, in spelt wheat grains. Bread wheat grains usually contain more spectra of prolamins which have a positive effect on their technological quality - e. g. they attain higher values of Gluten Index (see Table 1). On the other hand, these are proteinous fractions that might cause wheat to be toxic to people suffering from celiac disease (Petr *et al*., 2003).

Advanced evaluation of the baking quality – rheological properties of dough

We analysed it with Mixolab II that allowed us to assess the complex rheology of dough during the baking process (Papouskova *et al*., 2011). In fact, we studied and evaluated the stability of dough – an ability and capacity of dough to rise and to keep leavening gas or a product of rising activity (produced by yeast cells activity) – carbon dioxide. The analysis carried out with Mixolab II also involved an evaluation of starch quality (Kahraman *et al*., 2008). The impact of starch on the baking quality was detected and

Table 1

Basic parameters of baking quality (average of two repetitions)

Sample	Spelt wheat (%)	Bread wheat (%)	Falling number (s)	GI	Wet gluten	Zeleny test (mL)	Protein content (%)
1	100	0	585[h]	52.3[a]	43.8[k]	11.0[a]	14.84[e]
2	90	10	528[ac]	58.1[b]	42.2[j]	11.5[ab]	14.78[e]
3	80	20	516[b]	59.8[c]	41.8[i]	11.5[ab]	14.59[de]
4	70	30	537[d]	60.0[d]	40.5[h]	11.0[a]	14.41[de]
5	60	40	533[cd]	60.9[e]	39.8[g]	12.0[bcd]	14.07[ce]
6	50	50	562[g]	66.6[f]	37.3[f]	11.0[a]	13.77[bc]
7	40	60	527[a]	68.0[h]	36.7[e]	11.8[bc]	13.53[abc]
8	30	70	506[f]	69.7[i]	36.1[d]	12.3[cd]	13.28[ab]
9	20	80	471[e]	67.4[g]	33.7[b]	12.3[cd]	13.20[ab]
10	10	90	524[a]	70.0[j]	35.3[c]	12.5[d]	12.95[a]
11	0	100	514[b]	72.4[k]	33.1[a]	12.0[bcd]	12.55[a]

Note: Values marked with the same letter did not show statistically significant differences at a significance level of $p < 0.05$ (Tukey HSD test).

evaluated in our research. We mostly detected and evaluated starch gelatinization and degradation, which meant a stability of hot gel (Mixolab applications handbook, 2008).

As the detailed figures in Diagram 1 and Table 2, Table 3 show, spelt wheat flour is more stable, and spelt wheat dough leavens longer. It is also obvious that high values of C1 are kept if a spelt wheat share decreases to 50%. A positive effect of top-quality spelt wheat persists. From the Amplitude point of view (the Amplitude reflects and expresses the flexibility of dough), there are not any significant differences. It has been 95% confirmed by the statistics as well. Lower value of the 50% mixture was provoked by a measurement deviation in our research.

The most stable dough was made from 100% spelt wheat flour in our research. Such trend showed that spelt wheat dough needed to be worked and processed intensively. Less stable dough was made from a mixture of spelt wheat and bread wheat; the stability of mixed dough reduced considerably. Such dough should be worked and processed with care and did not need to be kneaded too much. However, Kohajdova & Karovicova (2007) showed the contrary trend. Therefore, we will have to deal with this aspect more in the future. Rheological properties of dough deteriorated (in all C2-C5 parameters) if bread wheat share increased in a flour mixture in our research. Proportion of proteins decreased and they got weaker. Starch got less gelatinized and it was less stable. Retrogradation values were also lower. From the sensory point of view, spelt wheat bread should be more attractive to consumers (spelt wheat attains higher values of all the parameters we have

been measuring); it stays fresh longer and it does not crumble. We detected very small differences as both kinds of flour were quite good-quality in our research. There were also small differences from the statistical point of view.

As far as α direction (C1-C2) was concerned, minimum differences in protein weakening speed (when proteins are heated, they weaken) were noticed in our research. Such result showed that the baking technology and temperature should be similar to spelt wheat. There was a noticeable difference in starch gelatinization speed (β direction, C3-C4) between spelt wheat and bread wheat. Spelt wheat starch got gelatinized later (more slowly) than bread wheat one. Therefore, spelt wheat dough requires longer time of baking and lower temperature in general. Enzymatic degradation speed of spelt wheat is lower, as γ direction (C5-C4) shows (see Diagram 1).

Correlations shown in Table 4 demonstrate a relation between parameters. C1 parameter and amplitude had a statistically non-significant correlation in our research. No statistically significant correlation emerged between these parameters and the other ones. Zeleny test and protein content had an interesting negative correlation. A negative correlation also existed between gluten index and protein content. Both negative correlations were statistically significant (99.9%). Such a negative correlation confirmed that spelt wheat contained more proteins and attained lower values of Zeleny test and gluten index. Schober, Clarke & Kuhn (2002) state that spelt wheat dough has got worse rheological properties than bread wheat one. They also noticed that rheological properties of dough improved if the share

of spelt wheat decreased in flour mixture. Stiegert and Blanc (2000) confirmed that protein weakening had a negative effect on dough and it made it less stable. Generally said, we have come to the same conclusions as the above-mentioned authors. We, nevertheless, recorded the contrary trend in the dough stability in our research. Spelt bread leavened less, and it had got lower bread volume – which complied with Kohajdova & Karovicova (2007). Bread volume is not the only and deciding factor; sensory properties of bread are also important. Therefore, the sensory analysis was made.

Sensory analysis and economic cost analysis

Results of the sensory analysis showed that pure bread wheat was found the best of all types of bread in our research (it got 2.22 points on average). It is not so difficult to interpret it – bread wheat bread resembles those sold in shops and supermarkets. Mixed bread wheat/spelt wheat bread (there is 30% of spelt wheat in it) was found the second best one (it got 2.44 points in the sensory analysis). It is also available in shops and supermarkets. Mixed bread wheat/spelt wheat bread (there is 70% of spelt wheat in it) was found the third best one (it got 2.49 points in the test). The last two mixtures were very similar to each other in

Table 2

Detailed results of the analyzes on Mixolabu II (parameters dough rheology)

Sample	Spelt wheat (%)	Bread wheat (%)	C1	Amplitude	Stability	C2
			min	Nm	min	Nm
1	100	0	2.72[a]	0.07[a]	6.99[d]	0.40[b]
2	90	10	2.71[a]	0.06[a]	5.59[c]	0.39[ab]
3	80	20	2.81[a]	0.06[a]	5.07[bc]	0.37[ab]
4	70	30	2.60[a]	0.06[a]	4.79[abc]	0.36[ab]
5	60	40	2.89[a]	0.05[a]	4.61[abc]	0.37[ab]
6	50	50	2.84[a]	0.05[a]	4.20[ab]	0.38[ab]
7	40	60	2.85[a]	0.08[a]	4.54[abc]	0.36[ab]
8	30	70	2.94[a]	0.06[a]	4.39[ab]	0.37[ab]
9	20	80	2.85[a]	0.065[a]	3.87[a]	0.38[ab]
10	10	90	2.58[a]	0.065[a]	3.90[a]	0.35[a]
11	0	100	3.07[a]	0.055[a]	4.05[ab]	0.37[ab]

Note: Note: Values marked with the same letter did not show statistically significant differences at a significance level of $p < 0.05$ (Tukey HSD test). C1 = Dough hydratation and mixing, C2 = The protein weaking.

Table 3

Detailed results of the analyzes on Mixolabu II (parameters dough rheology)

Sample	C3	C4	C5	α	β	γ
	Nm	Nm	Nm	Nm	Nm	Nm
1	1.660[a]	1.523[a]	2.471[ab]	-0.076[ab]	0.652[b]	0.001[bc]
2	1.633[a]	1.501[a]	2.4355[ab]	-0.087[a]	0.538[ab]	-0.005[abc]
3	1.628[a]	1.518[a]	2.5025[b]	-0.081[ab]	0.267[a]	-0.01[abc]
4	1.5635[a]	1.4595[a]	2.3375[abc]	-0.09[a]	0.431[ab]	-0.012[abc]
5	1.5985[a]	1.494[a]	2.358[abc]	-0.073[ab]	0.411[ab]	0.016[c]
6	1.597[a]	1.492[a]	2.355[abc]	-0.069[ab]	0.344[ab]	-0.013[abc]
7	1.571[a]	1.441[a]	2.274[abc]	-0.072[ab]	0.405[ab]	-0.027[ab]
8	1.56[a]	1.457[a]	2.316[abc]	-0.069[ab]	0.31[ab]	-0.005[abc]
9	1.587[a]	1.477[a]	2.3135[abc]	-0.049[b]	0.295[ab]	-0.024[abc]
10	1.554[a]	1.4365[a]	2.231[ac]	-0.065[ab]	0.317[ab]	-0.04[a]
11	1.5585[a]	1.427[a]	2.1585[c]	-0.069[ab]	0.3[ab]	-0.024[a]

Note: Values marked with the same letter did not show statistically significant differences at a significance level of $p < 0.05$ (Tukey HSD test). C3 = Starch gelatization, C4 = Starch breakdown, C5 = Starch retrogradation, α = protein weakening speed under heating effect, β = speed of starch gelatinization, γ = speed of enzyme degradation.
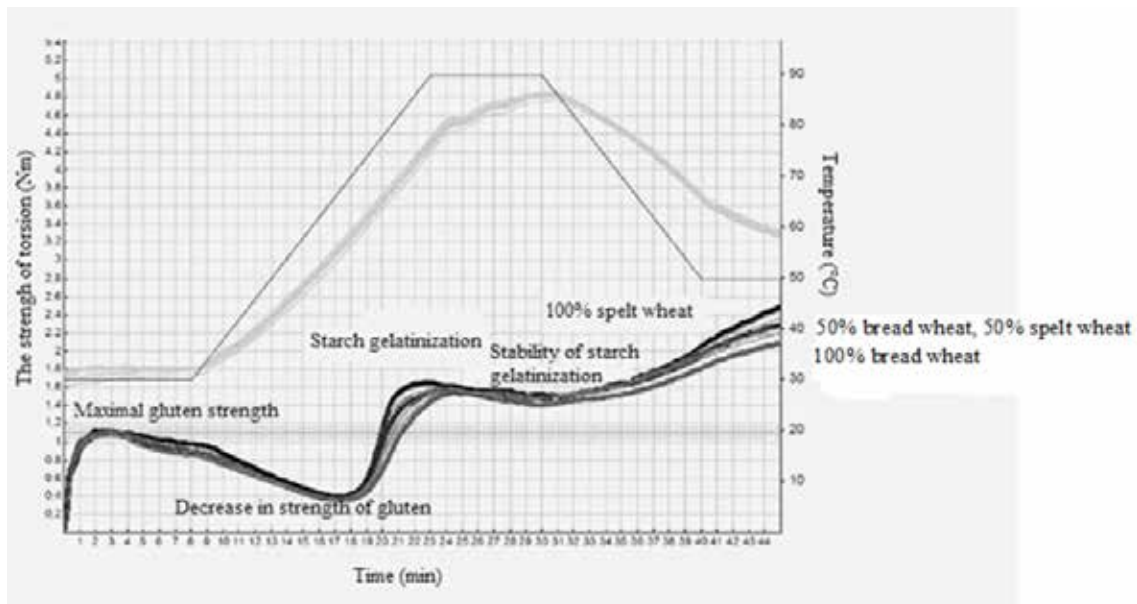
Figure 1. Comparison of the 11 mixtures with different proportions of spelled flour and flour of bread wheat.

Table 4

Results of correlation analys

	Mean±SD	S	C2	C3	C5	α	β	PC	FN	GI	WG
S	4.73 ± 0.91	1									
C2	0.37 ± 0.01	0.57**	1								
C3	1.59 ± 0.04	0.62**	0.85***	1							
C4	1.48 ± 0.04	0.43*	0.81***	0.91***							
C5	2.34 ± 0.11	0.63**	0.68***	0.81***	1						
α	-0.07 ± 0.01	-0.48*	-0.09ns	-0.22ns	-0.28ns	1					
β	0.39 ± 0.13	0.74***	0.33ns	0.24ns	0.26ns	-0.35ns	1				
γ	-0.01 ± 0.02	0.47*	0.45*	0.47*	0.59**	-0.34ns	0.34ns				
PC	13.81 ± 0.77	0.78***	0.56**	0.71***	0.84***	-0.62**	0.56**	1			
FN	527 ± 28	0.65**	0.42ns	0.41ns	0.35ns	-0.43*	0.59**	0.53*	1		
GI	64 ± 6	-0.87***	-0.58**	-0.69***	-0.76***	0.53*	-0.69***	-0.94***	-0.59**	1	
WG	38 ± 4	0.84***	0.5*	0.66***	079***	-0.65***	0.62**	0.97***	0.62**	-0.95***	1
ZT	11.70 ± 0.55	0.56**	-0.52*	-0.45*	-0.46*	0.56**	-0.47*	-0.69***	-0.7***	0.66***	-0.66***

Note:S = Stability, C1 = Dough hydratation and mixing, C2 = The protein weaking, C3 = Starch gelatization, C4 = Starch breakdown, C5 = Starch retrogradation, α = protein weakening speed under heating effect, β = speed of starch gelatinization, γ = speed of enzyme degradation, PC = protein content, FN = falling number, GI = gluten index, WG = wet gluten content, ZT = Zelny test.

the analysis. Pure spelt wheat bread got 2.61 points and was found worse in general. It is understandable as it is not widely spread or available in shops or supermarkets. Consumers are not used to it. According to the results of the sensory analysis, bread made from a mixture of bread wheat and spelt wheat is supposed to be the best and is highly recommended. It is more attractive to consumers and is sold for a reasonable price. Results of the sensory analysis are shown in Table 5. It confirmed the finding a lot of authors had

revealed – bread made from a mixture of spelt wheat flour and any other kind of flour was supposed to be the best (Kohajdová & Karovičová, 2007).

Cost analysis – bread made from a flour mixture, various spelt wheat shares

Spelt wheat is mostly bought by consumers who use it in order to bake home-made bread. Nowadays, there is a lack of flour on the market. It leads to an important consequence – a high price of spelt wheat

Table 5

The results of sensory evaluation of bread prepared from various mixtures

Order	Mixture	Point evaluation
1	Bread wheat (100%)	2.22
2	70% bread wheat, 30% spelt wheat	2.44
3	30 % bread wheat, 70% spelt wheat	2.49
4	50% bread wheat, 50% spelt wheat	2.59
5	Spelt wheat (100%)	2.61

Table 6

Assessment of the costs of bread baked from a mixture of different proportions of spelt and bread wheat

Proportion of spelt wheat (%)	Proportion of bread wheat (%)	Price for 0.75 kg of bread (EUR)
100	0	1.74
90	10	1.67
80	20	1.56
70	30	1.48
60	40	1.37
50	50	1.30
40	60	1.22
30	70	1.11
20	80	1.04
10	90	0.93
0	100	0.78

flour. A simple economic cost analysis was made: costs of home-made bread were calculated. Bread wheat flour's price was 1.35 EUR per kg^{-1}, whereas spelt wheat flour's price was 3.13 EUR per kg^{-1}. Other ingredients cost 0.18 EUR per one baking cycle.

As Table 6 shows, pure (100%) spelt wheat bread costs 1.74 EUR, whereas pure (100%) bread wheat bread costs 0.78 EUR. Pure spelt wheat bread is twice as expensive. Its price is not accepted by a lot of consumers. Therefore, it is better to bake bread from a mixture of spelt wheat e.g. (50% of spelt wheat). The price of one baking cycle drops to 1.30 EUR.

Conclusions

Cereal products made from spelt wheat have got a higher added value. Bread was used as a model product in our research. The results of our research showed that spelt wheat grains were suitable for baking (from the technological point of view). It was confirmed by usual baking quality methods and a complex rheological analysis carried out with Mixolab II. Spelt wheat is also more suitable, as its grains have got much higher nutritional value than bread wheat grains. Results of the sensory analysis and economic cost analysis showed that spelt wheat should be mixed with bread wheat and used for baking. This is the optimal solution for spelt wheat. If we use such a mixture, we come to a provable baking cost reduction and the sensory properties of such bakery products are closer to consumer preferences of taste.

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NITROGEN FERTILIZER INFLUENCE ON WINTER WHEAT YIELD AND YIELD COMPONENTS DEPENDING ON SOIL TILLAGE AND FORECROP

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Abstract

Wheat (*Triticum aestivum*) is one of the main crops grown in Latvia. Nitrogen fertilizer is one of the most important factors affecting the acquired yield and its quality. The aim of this paper is to describe the nitrogen fertilization impact on winter wheat yield and yield components under two soil tillage systems and after two forecrops. Field trials were carried out at Research and Study farm 'Peterlauki' of Latvia University of Agriculture (56° 30.658°C N and 23° 41.580°C E) in 2014/2015 and 2015/2016. Researched factors were (1) crop rotation (continuous wheat and wheat/oilseed rape (*Brassica napus* ssp. *oleifera*), (2) soil tillage (traditional soil tillage with mould-board ploughing at a depth of 22 – 24 cm and reduced soil tillage with disc harrowing at a depth below 10 cm), and (3) nitrogen fertilizer rate (N0 or control, N60, N90, N120(90+30), N150(90+60), N180(90+60+30), N210(90+70+50), and N240(120+60+60). Results showed that the nitrogen fertilization significantly increased winter wheat grain yield after both forecrops and in both soil tillage variants. Grain yield significantly increased until the nitrogen fertilizer rate N180. Nitrogen fertilizer significantly affected all tested yield components. Values of yield components increased enhancing N-rate of N150 – N180. The forecrop had a significant impact on wheat yield and 1000 grain weight (both increased when wheat was sown after oilseed rape). Yield and grain number per ear were significantly higher when conventional tillage was used, but number of ears per m^2 – when the reduced tillage was used.

Key words: forecrop, soil tillage, nitrogen fertilizer, wheat yield, yield components.

Introduction

Wheat (*Triticum aestivum*) is one of the most important cereal crops in Latvia. In this country, the average statistical grain yield is around 4 t ha^{-1}, therefore it is important to study production increase possibilities. High yield of good quality is based on the used agro-technical measures. One of the most important agro-technical measures is optimal nutrient provision. Nitrogen is a nutrient of high importance for plant growth, development, and grain quality assurance, but it is also one of the most mobile plant nutrients in the soil. Unsuitable nitrogen doses lead to increased nitrate leaching, which contributes to eutrophication of surface waters (Myrbeck, 2014).

A variety of methods are available to reduce the use of nitrogen fertilizer. One approach is to adopt a fertilizer-reducing farming practices. One of such measures can be crop rotation, for example, it is possible to include legumes in the crop rotation. Legumes are used to fix nitrogen as a substitute for artificial nitrogen fertilizer (Huang & Uri, 1993). Nowadays farmers use a very short crop rotation with high proportion of cereals. They often sow cereals after cereals, in better case, cereals after oil crops. But re-sowings of cereals can lead to a grain yield decrease. The reasons of grain yield decrease are the increase of fungal diseases and weeds, and the degradation of soil structure, as well as negative impacts on water and air regime (Babulicová, 2014).

Frequently wheat growing in a short crop rotation or even without any rotation is combined with a reduced tillage. Soil tillage is an important operation of agricultural production technology. Researchers found that soil tillage can affect nitrogen leaching (Stenberg, 1998) and it can also affect crop yields. In literature, the results regarding the tillage effect on wheat yield are contrary: some authors (e.g., Lyon, Stroup, & Brown, 1998) have concluded that a higher yield can be achieved by using conventional tillage (mould-board ploughing) in comparison to non-conventional tillage systems, but others (e.g., Kosutic *et al.*, 2005) indicate that a higher winter wheat yield is obtained using reduced soil tillage (chisel plough, multitiller) if compared with a traditional one, however, differences are not significant.

In Latvia, nitrogen influence on wheat yields has been much studied. For example, the latest previous studies on the effect of N-fertilization rate with older winter wheat cultivars 'Bussard' and 'Zentos' showed that the grain yield increased until the N-rate of 120 – 150 kg ha^{-1}, but grain quality increased until the N-rate 180 kg ha^{-1} (Ruža, Maļecka, & Kreita, 2012). However, newer cultivars can react differently to such fertilizer rates. At the same time, Ministry of Agriculture depending on the planned size of grain yields, has developed rules determining the maximum allowable N-rate for winter wheat (until N 220 kg ha^{-1}) (Cabinet Regulations No. 834 (2014), retrieved from https://m.likumi.lv/doc.php?id=271376). Nowadays, reduced soil tillage is used more and more widely also in Latvia. Therefore, in Latvia, researchers and farmers are looking for cost-effective and environmentally friendly rates of N-fertilizers in different tillage systems with different forecrops for winter wheat. The objective of this experiment was to clarify the nitrogen fertilization impact on winter wheat yield and

yield components under two soil tillage systems and after two forecrops.

The research has been carried out within the framework of 'State and European Union investment for encouragement in agriculture' theme 'Determination of maximal fertiliser norms for crops'.

Materials and Methods

Three-factor field trials were conducted at Research and Study farm 'Peterlauki' of Latvia University of Agriculture (56° 30.658°C N and 23° 41.580°C E) in the growing seasons of 2014/2015 and 2015/2016. Trials were arranged using split plot design in four replications. Researched factors were (1) crop rotation (wheat/wheat and wheat/oilseed rape (*Brassica napus* ssp. *oleifera*), (2) soil tillage (traditional soil tillage with mould-board ploughing at a depth of 22 – 24 cm and reduced soil tillage with disc harrowing at a depth below 10 cm), and (3) nitrogen fertilizer rate (altogether eight rates: N0 or control, N60, N90, N120(90+30), N150(90+60), N180(90+60+30), N210(90+70+50), and N240(120+60+60)). One of the most widely grown cultivars in Latvia 'Skagen' was used in the trial. It is characterized by a good winterhardiness which is combined with disease resistance and baking quality. Wheat was sown at the rate of 450 germinable seeds m^{-2} in the second half of September after both forecrops in 2015/2016 and after oilseed rape in 2014/2015. Due to adverse weather conditions, wheat sowing after wheat was delayed to the beginning of October in 2014/2015, and consequently, in this case, sowing rate was a little increased (500 germinable seed m^{-2}). Soil at the site was loam, *Endocalcaric Abruptic Luvisol* (Cutanic, Hypereutric, Ruptic, Siltic, Protostagnic, Epiprotovertic). Soil is characterized by the following indicators depending on the year: pH KCL = 6.3 – 6.9, organic matter content 2.3 – 2.5 g kg^{-1}, P content 30.1 – 107.7 mg kg^{-1} and K content 131.1 – 272.24 mg kg^{-1} of the soil. Before sowing, fertilizer was applied: P 17.44 - 19.18 kg ha^{-1} and K 46.48– 51.13 kg ha^{-1}. Weeds were controlled using herbicides in both years, but wheat diseases were controlled by fungicide application once per season (GS 51).

In spring, when the vegetation had renewed, nitrogen fertilizer (NH_4NO_3; N 34%) was applied for all variants, except the control variant N0. The whole rate of fertilizer was applied in one time for variants N60 and N90, it was divided into two applications for variants N120 and N150, but into three applications – for variants N180 – N240. Second top-dressing was done at GS 29 – 31 of winter wheat, but the third – at GS 47 – 51.

Plant sample sheets were taken before the yield harvesting at GS 89 for analysis of crop yield components from 0.12 m^2 in each plot. The following

yield components were detected: number of ears per m^2, grain number per ear, 1000 grain weight (g), grain weight per ear (g). After harvesting the whole plots, yields' data was calculated to standard moisture (14%) and 100% purity.

Meteorological conditions in trial years 2014/2015 and 2015/2016 were different from the long-term average data. The autumn of 2014 was long and cool, but in 2015, it was relatively warm and dry. Both winters were mild and favorable for wheat wintering. The vegetation renewed in mid-March in both years. Both springs were warm and favorable for the development of crop. Summer in 2015 was characterized by high rainfall only in July, but that of 2016 was overall very rainy. In general, weather conditions promoted growth and development, and high yield formation of wheat in both years, but 2014/2015 can be characterized as slightly more optimal.

For data statistical processing analysis of variance was used. Bonferroni test was used for comparison of means; the differences were considered statistically significant when $p < 0.05$. Significantly different means were labeled with different letters ([a,b,c,d,e,f,g,h] or [A, B]) in superscript. Data processing was done using R-studio.

Results and Discussion

Wheat yield

Winter wheat grain yield was very high on average per two years (8.12 t ha^{-1}). Without any nitrogen top-dressing it was 4.84 t ha^{-1}, but in variants where nitrogen was applied it, depending on rate, was 6.85 – 9.71 t ha^{-1} (Table 1). Year as a factor did not significantly affect wheat yield (Table 2). The effect of the nitrogen fertilization on the wheat grain yield was the same in both years of study. Results show that nitrogen fertilization significantly increased the average grain yield per both years ($p < 0.001$, Table 2) if compared to control. N-fertilization had the most impact on yield among all researched factors (Table 2). It coincides with another studies which demonstrated that nitrogen application significantly enhanced the grain yield (Ruža, Maļecka, & Kreita, 2012; Skudra, Ruža, 2014; Maadi *et al.*, 2012). In our trial, even lower nitrogen fertilizer rates gave a significant yield increase if compared with N0 (control). A significant yield increase was observed until the nitrogen fertilizer rate N180 (Table 1).

Results show that the forecrop had a significant impact on the grain yield ($p < 0.001$; Table 2), and oilseed rape was a better forecrop for high winter wheat yield production. The average grain yield was higher (+0.49 t ha^{-1}) in variant where the forecrop was oilseed rape (4.83 – 9.98 t ha^{-1}), despite the fact that in the control variant (N0) winter wheat grain yields were similar after both forecrops (Table 1). Similar results

Table 1

Winter wheat yield depending on nitrogen fertilizer rate, forecrop and soil tillage, t ha^{-1}

N-rate	Forecrop		Soil tillage		Average
	Oilseed rape	Wheat	Traditional	Reduced	
N0	4.83^a	4.85^a	5.11^a	4.55^a	4.84^a
N60	6.87^b	6.82^b	7.22^b	6.46^b	6.85^b
N90	7.63^c	7.23^{bc}	7.63^b	7.23^b	7.44^c
N120	8.71^d	7.92^{cd}	8.55^c	8.10^c	8.34^d
N150	9.11^{de}	8.58^{de}	8.92^{cd}	8.79^{cd}	8.86^{de}
N180	9.66^{ef}	8.97^{ef}	9.50^{de}	9.19^d	9.36^{ef}
N210	9.93^f	9.21^{eg}	9.73^e	9.49^d	9.62^f
N240	9.98^f	9.37^{fg}	9.86^e	9.54^d	9.71^f
Average	8.34^A	7.85^B	8.34^A	7.87^B	×

a,b,c,d,e,f,g – yields labeled with different letters are significantly different in columns depending on N-rate
A,B – yields labeled with different letters are significantly different depending on forecrop or soil tillage.

were obtained in Germany, where it was found that a higher wheat yield was obtained growing wheat after oilseed rape if compared with variant when wheat was grown after wheat (Sieling *et al.*, 2005). Such a result could be confirmed also by the results of other studies, where oilseed crop in cereal-based cropping systems has shown to have a positive agronomic and economic impacts (Maadi *et al.*, 2012). Study in Southern Italy showed that the continuous wheat cropping provided the lowest yield if compared with crop rotation (Montemurro & Maiorana, 2014). Wheat growing in monoculture in three-year period reduced the yield by 20% (Sieling *et al.*, 2005).

Soil tillage also had a significant (p < 0.001; Table 2) impact on the grain yield increase (+ 0.47 t ha^{-1} in conventional tillage variant). Under reduced tillage system, the grain yield of winter wheat was lower (4.55 – 9.54 t ha^{-1} depending on N-rate) than under conventional tillage (5.11 – 9.86 t ha^{-1} depending on N-rate). This result does not conform to the findings from Lithuania, where it was found that the wheat grain yield was not significantly affected by different soil tillage methods (Seibutis, Deveikytė, & Feiza, 2009). Winter wheat produced a higher grain yield in all fertilization variants when the traditional soil tillage was used (Table 1).

Considering the average grain yields in both years, nitrogen fertilization increased the grain yield after both forecrops and in both soil tillage systems. Similar results were obtained by Sieling *et al.* (2005), who found that nitrogen fertilization increased the grain yield after all forecrops.

Yield components

As wheat yield components, the number of ears per 1 m^2, number and weight of grain per ear, 1000 grain weight were detected.

The number of ears per 1 m^2. Results show that nitrogen fertilizer significantly affected the number of ears per m^2 (Table 2), and the increase of nitrogen

Table 2

**Sums of squares showing the impact of researched factors on
winter wheat yield and values of its components**

Influencing factor	Sums of squares				
	Yield	Number of ears per 1 m^2	Grain number per ear	Grain weight per ear	1000 grain weight
N-fertilization rate	570.39***	189499***	597.28***	2.93151***	134.160***
Soil tillage	8.99***	13269*	65.71*	0.06558	0.014
Forecrop	14.48***	0.00	18.16	0.06412	60.086***
Year	0.00	1406	440.38***	2.47749***	76.973***
Residuals	74.05	250240	1044.88	2.15487	289.035

*p < 0.05; **p < 0.01; ***p < 0.001

Table 3

The number of ears m^{-2} depending on nitrogen fertilizer rate, forecrop and soil tillage

N-rate	Forecrop		Soil tillage		Average
	Oilseed rape	Wheat	Conventional	Reduced	
N0	370[a]	402[a]	394[a]	378[a]	386[a]
N60	436[ab]	426[a]	428[ab]	434[ab]	431[ab]
N90	463[bc]	463[a]	464[ac]	462[ac]	463[bc]
N120	495[bd]	475[a]	449[ad]	522[bc]	485[bd]
N150	521[be]	523[a]	512[bcde]	532[bc]	522[cde]
N180	493[bf]	505[a]	500[bcdf]	497[bc]	499[bef]
N210	530[cdefg]	492[a]	492[aef]	538[bc]	512[cdf]
N240	509[bg]	523[a]	484[aef]	498[c]	516[cdf]
Average	477[A]	475[A]	465[A]	488[B]	×

a,b,c,d,e,f,g – yields labeled with different letters are significantly different in columns depending on N-rate
A,B – yields labeled with different letters are significantly different depending on forecrop or soil tillage.

fertilizer rate also increased the number of ears per 1 m^2 (Table 3). It is logical, as wheat tillering can continue also in spring, and N promotes it. The average number of winter wheat ears m^{-2} varied between 386 – 522 per 1 m^2 depending on the nitrogen fertilizer rate, and increase of it was observed up to the nitrogen fertilizer rate N150 (522 ears m^{-2}; Table 3).

Forecrop in the trial did not significantly impact (Table 2) the average winter wheat number of ears m^{-2}. At both forecrop variants, the average number of ears m^{-2} was similar (477 and 475; Table 3). This coincides with results of Lithuanian study which showed that crop rotation did not significantly affect the ear number per 1 m^2 of winter wheat (Seibutis, Deveikyte, & Feiza, 2009). Number of ears m^{-2} was similar in all the nitrogen fertilization variants when wheat after wheat was grown. Number of ears m^{-2} depended significantly on N-rate when wheat was grown after oilseed rape, and a significant increase, if compared with unfertilized control, was observed starting with N-rate 90 kg ha^{-1}. Further changes of ear number were slightly irregular.

Results showed a significant impact of soil tillage on the number of ears per 1 m^2 (p < 0.05; Table 2). It differs from results of Seibutis, Deveikyte, & Feiza (2009) who found that soil tillage did not significantly affect the number of winter wheat ears m^{-2}. Significantly higher (p < 0.05) average number of ears m^{-2} was found using reduced soil tillage (488 ears) if compared to conventional soil tillage (465 ears). The number of ears m^{-2} gradually increased until nitrogen fertilizer rate N150 in both soil tillage variants. Using higher nitrogen fertilizer rates the number of ears m^{-2} decreased with only one exception – in the reduced soil tillage variant with N-rate of 210 kg ha^{-1} (Table 3).

Grain number per ear. Results show that nitrogen fertilizer rate had a significant impact on grain number per ear (p < 0.001; Table 2). Grain number per ear ranged from 26.4 to 34.8 depending on the nitrogen fertilizer rate (Table 4). The results revealed that the lowest grain number per ear (26.4) was in the control variant where no nitrogen was applied, but the highest grain number per ear was observed in variants N180 (34.8) and N240 (34.6). The grain number per ear increased with each increment of nitrogen rate until N180 kg ha^{-1}. Similar results, where nitrogen significantly increased the number of grain per ear, were also obtained in the study of Usman *et al.* (2013). In literature it is mentioned that number of grain per ear is in direct connection with productivity of wheat. This component depends on genetics, environmental factors, and nutrition (Knežević *et al.*, 2008). Change in the number of grain per ear can drastically influence the final yield (Protich, Todorovich, & Protich, 2012).

Forecrop did not significantly influence the average grain number per ear of winter wheat. A slightly higher grain number per ear was observed when wheat was grown after wheat (32.2; Table 4), but significant differences at the 95% level were not found. Number of grain per ear increased up to the nitrogen fertilization rate of N180 under both forecrops.

Soil tillage showed a significant impact on grain number per ear (p < 0.05; Table 2). Conventional soil tillage promoted a significantly higher (p < 0.05) grain number per ear if compared to reduced soil tillage. Difference of average grain number per ear depending on tillage variant is 1.7 (Table 4).

Grain number per ear was significantly dependent on the trial year (p < 0.001; Table 2). In the growing season 2014/2015 (35), the average grain number per ear was higher if compared with the growing season 2015/2016 (30.3).

Table 4

Grain number per ear depending on nitrogen fertilizer rate, forecrop and soil tillage

N-rate	Forecrop		Soil tillage		Average
	Oilseed rape	Wheat	Conventional	Reduced	
N0	26.0[a]	26.7[a]	25.9[a]	26.9[a]	26.4[a]
N60	31.8[a]	31.3[ab]	33.2[ab]	30.0[a]	31.6[ab]
N90	29.8[a]	30.8[ac]	31.0[ac]	29.6[a]	30.3[ac]
N120	31.9[a]	32.7[ad]	33.2[ad]	31.3[a]	32.3[bce]
N150	30.6[a]	32.1[ae]	31.4[ae]	31.3[a]	31.3[aed]
N180	34.4[a]	35.2[bcdef]	36.2[bcdef]	33.0[a]	34.8[bcd]
N210	32.3[a]	34.5[afg]	34.4[afg]	32.0[a]	33.3[bcd]
N240	34.1[a]	35.0[bcdeg]	35.8[bcdeg]	33.3[a]	34.6[bcd]
Average	31.4[A]	32.2[A]	32.6[A]	30.9[B]	×

a,b,c,d,e,f,g – yields labeled with different letters are significantly different in columns depending on N-rate
A,B – yields labeled with different letters are significantly different depending on forecrop or soil tillage.

1000 grain weight. Wheat yield component showing the coarseness of grain is 1000 grain weight (TGW). TGW characterizes the quantity of nutrients in the grain. A large grain of wheat often has a higher germination energy. If the seeds contain more nutrients, they can develop stronger seedlings and build plants with a better-developed root system and stronger above soil-surface plant parts, – a result that leads to the higher grain yield (Protić *et al.*, 2013).

Our results show that nitrogen fertilizer had a significant impact on the TGW (p < 0.001; Table 2). The average 1000 kernel weight depending on the nitrogen fertilizer rates was 43.82 – 47.70 g (Table 5). It was observed that the increase of nitrogen fertilizer rate caused also increase of average TGW. This result coincides with another study in which it was also found that the increase of nitrogen rate significantly affected TGW (Skudra & Ruža, 2016). Studies of Hussain *et al.* (2002) suggested that the maximum TGW was obtained using highest fertilizer rates (in this study three fertilizing rates were used: NPK 35-25-25, 70-50-50 and 105-75-75 kg ha^{-1}). Low and medium fertilizer levels produced statistically similar TGW. Similar results were obtained also in our study. The highest average TGW was obtained applying the highest nitrogen dose (N240), but lowest – in control (N0). In variants where lower nitrogen fertilizer rates (N60, N90, N120) were applied the average obtained TGW were similar (Table 5).

Our results show that forecrop had a significant effect on TGW (p < 0.001; Table 2). Other authors found that crop rotation does not influence significantly TGW. But, in general, wheat produced in the rotation with lupin (*Lupinus* sp.) and oilseed rape produced

Table 5

1000 grain weight depending on nitrogen fertilizer rate, forecrop and soil tillage, g

N-rate	Forecrop		Soil tillage		Average
	Oilseed rape	Wheat	Conventional	Reduced	
N0	44.27[a]	43.38[a]	43.92[a]	43.73[a]	43.82[a]
N60	45.64[ab]	45.43[a]	45.87[a]	45.20[ab]	45.54[ab]
N90	46.08[ac]	45.63[a]	45.79[a]	45.91[ac]	45.85[ac]
N120	46.51[ad]	45.06[a]	46.30[a]	45.26[ad]	45.78[ad]
N150	47.99[bcd]	46.66[a]	47.54[a]	47.11[ae]	47.32[bcd]
N180	48.77[cd]	44.65[a]	45.69[a]	48.36[bcdef]	46.90[bcd]
N210	48.05[bcd]	46.09[a]	47.45[a]	46.80[afg]	47.16[bcd]
N240	49.03[d]	46.38[a]	47.62[a]	47.79[bcdeg]	47.70[bcd]
Average	47.04[A]	45.41[B]	46.27[A]	46.21[A]	×

a,b,c,d,e,f,g – yields labeled with different letters are significantly different in columns depending on N-rate
A,B – yields labeled with different letters are significantly different depending on forecrop or soil tillage.

Table 6

Grain weight per ear depending on nitrogen fertilizer rate, forecrop and soil tillage, g

N-rate	Forecrop		Soil tillage		Average
	Oilseed rape	Wheat	Conventional	Reduced	
N0	1.03[a]	1.09[a]	1.09[a]	1.04[a]	1.06[a]
N60	1.36[ab]	1.32[a]	1.40[ab]	1.28[ab]	1.34[ab]
N90	1.35[ac]	1.34[a]	1.37[ac]	1.32[ac]	1.34[ac]
N120	1.49[bcd]	1.42[a]	1.49[ad]	1.42[bc]	1.46[bc]
N150	1.46[ade]	1.41[a]	1.42[ae]	1.46[bc]	1.44[bc]
N180	1.65[bce]	1.59[a]	1.69[bcdef]	1.55[bc]	1.62[bc]
N210	1.60[bce]	1.56[a]	1.60[afg]	1.56[bc]	1.58[bc]
N240	1.71[bce]	1.53[a]	1.63[bcdeg]	1.62[bc]	1.62[bc]
Average	1.458[A]	1.400[A]	1.459[A]	1.399[A]	×

[a,b,c,d,e,f,g] – yields labeled with different letters are significantly different in columns depending on N-rate
[A,B] – yields labeled with different letters are significantly different depending on forecrop or soil tillage.

grain with a higher TGW if compared to wheat grown in monoculture (Maali & Agenbag, 2013). Our study results indicate that average TGW decreased when wheat was grown after wheat. A substantially higher TGW was obtained growing wheat after oilseed rape (Table 5).

Soil tillage did not significantly influence winter wheat TGW (Table 2). Similar results were obtained in another study (Cociu & Alionte, 2011). In our study, the average TGW depending on soil tillage method was almost identical: in conventional tillage variant the average TGW was 46.27 g, but in the reduced tillage variant – 46.21 g. When the conventional soil tillage was used, average TGW did not depend on nitrogen fertilizer rate. In reduced soil tillage variant, a significant difference of TGW was observed between the control (43.73 g) variant (N0) and two fertilization variants: N180 (48.36 g) and N240 (47.79 g).

Statistical data processing shows that the trial year had a significant impact on the TGW ($p < 0.001$; Table 2). The average TGW of winter wheat was higher (47.42 g) in the growing season 2014/2015 if compared with the year 2015/2016 (45.62 g).

Grain weight per ear. Grain weight per ear is an important component of yield. A change in grain weight per ear drastically influences the final yield (Protić *et al.*, 2013).

Applied nitrogen rate had a significant impact on grain weight per spike ($p < 0.001$; Table 2). The average grain weight per ear ranged from 1.06 to 1.62 g depending on the nitrogen fertilizer rate. The lower grain weight per ear was observed in control where no nitrogen was applied. The average grain weight per ear increased until nitrogen fertilizer rate N180, and at higher nitrogen fertilizer rates the grain weight per ear was similar to this or decreased (Table 6).

Results show that forecrop did not significantly affect ($p > 0.05$) the average grain weight per ear. A higher grain weight per ear was observed when oilseed rape was forecrop in all nitrogen application variants (Table 6). The smallest grain weight per ear in both forecrop variants was observed in control (N0; 1.03 g and 1.09 g when forecrops were oilseed rape and winter wheat, respectively), and then gradually increased with an increase of nitrogen rate up to the N180.

Soil tillage did not influence the grain weight per ear ($p < 0.05$; Table 2). A higher grain weight per ear in all nitrogen fertilization variants was observed when the conventional soil tillage (1.09 – 1.69 g) was used, but slightly lower – when reduced tillage (1.04 – 1.62 g) was used. In both tillage variants the grain weight per ear increased with an increase of nitrogen fertilizer rate: until the rate of N240 in reduced tillage variant, but in conventional soil tillage variant – until the rate N180.

Winter wheat grain weight per ear significantly differed depending on the growing year. The average grain weight per spike was significantly higher in 2014/2015 growing season (1.73 g) if compared to 2015/2016 (1.32 g). Three yield components (number of grain per ear, grain weight per ear and TGW) characterizing the individual plant productivity showed significantly higher values in 2014/2015.

Conclusions

1. Nitrogen fertilization increased the winter wheat grain yield after both forecrops and in both soil tillage variants. A significant average yield increase was obtained till the nitrogen fertilizer rate of N180; higher nitrogen fertilizer rates did not increase yield significantly. N-rate also significantly affected the values of all tested yield

components: number of ears per m^2, grain number per ear, 1000 grain weight (TGW), and grain weight per ear. An increase of yield component values was obtained by increasing N-rate up to N150 – N180 depending on specific component.

2. Forecrop had a significant impact on the wheat grain yield. Higher winter wheat yields were harvested when growing it after oilseed rape in comparison with wheat growing in resowings. Forecrop significantly influenced values of only one yield component – TGW.

3. Soil tillage method significantly influenced the winter wheat yield, and during the two-year (2014/2015 – 2015/2016) trial period higher yields were obtained by using conventional tillage (mould-board ploughing) if compared to reduced tillage (disk harrowing). Soil tillage variant significantly affected two evaluated yield components, but – number of ears per m^2 was higher in the reduced tillage variant, while values of grain number per ear was higher in conventional tillage variant. Grain weight per ear and TGW were not significantly affected by the researched soil tillage variants.

Acknowledgements

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SLAUGHTER RESULTS ANALYSIS OF GRASS–FED BEEF CATTLE

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Abstract
Cattle fattening, first of all, should be beneficial for a farmer, therefore, in Latvia more suitable are such average intense fattening methods as fattening with grass fodder. In the world, demand for beef, produced in an environmentally friendly manner, ensuring the appropriate animal welfare conditions, is growing. The aim of the study was to find out the fattening results of Hereford (HE) and Aberdinanguss (AB) pure–bred bulls and their crosses when fed with grass fodder. The study was conducted in 2015 and 2016 within the framework of the project 'Baltic Grassland Beef'. AB crossbreed bulls were slaughtered when they were 519 ± 16.6 days old, but HE pure-bred bulls - 584 ± 7.3 days old (p ≤ 0.05). The biggest live weight and slaughter weight showed HE crossbreed group bulls – 557 ± 19.4 kg and 293 ± 12.2 kg, respectively, but the biggest live weight daily gain from birth to slaughter was observed to AB pure–bred group bulls – 952 ± 24.7. Carcass conformation score in muscle development was the highest for AB pure–bred group bulls. Their average conformation score was 3.2 ± 0.08 points. In terms of fat score development, carcass with the best quality was obtained from HE crossbreed group bulls, the resulting fat score – 2.4 ± 0.10. The obtained results prove that pure–bred and crossbreed bulls used in this research are suitable for fattening with grass in the conditions of Latvia.
Key words: beef cattle fattening, grass fattening, bulls, carcass characteristics, growth.

Introduction

In recent years in Latvia, the number of beef cattle herd has increased as agro–climatic and ecological conditions are suitable for development of this sector. It is a great opportunity for farmers to manage their grassland and also gain some profit. Beef cattle farms are mostly organic and according to scientists, products grown in these areas are especially useful for human health (Lujane, Oshmane, & Jansons, 2013).

Carcass and meat quality are influenced by many factors, which can be divided into two groups: endogenous factors (directly related to the animal, such as breed, age, gender, etc.) and exogenous factors (food, weather conditions, slaughter process, etc.). These factors are combined in environmental factors group. From this group, feeding has a big role in high quality product sourcing (Dannenberger et al., 2006).

Considering the current economic situation in Latvia, cattle fattening should be inexpensive and profitable to the farmer. In this case, intensive feeding techniques, where mostly grain feed or concentrates are used, would not be suitable. In the world more popular has become grass–fed beef, where for cattle fattening mainly is used grass forage, but grain feeding is used only if necessary. This type of fattening is also closely related to the topical issue of preventing the direct competition between animals and humans for food products (feed no food) and reduction of environmental problems (Chassot, 2008).

Grass forage in Latvian weather conditions is the cheapest feeding material for summer period, but its economic efficiency depends on the grass yield and quality – the more economical is the feed obtained, the higher they are. Grassland productivity level and quality of the harvest can be meaningfully regulated, as they depend on the sward botanical composition and density. Grass dry matter contains all the necessary nutrients for animals, which allows us to get delicious and biologically wholesome meat, but at the same time ensures quality and quantity rising of meat. (Lujane, Oshmane, & Jansons, 2013).

So far in Latvia there have been separate studies of beef cattle fattening, however, there is a lack of research on the most appropriate choice of breeds of young animals for fattening with grass forage. Many foreign scientists (Hollo et al., 2012; Jukna et al., 2017; Pesonen, Honkavaar, & Huuskonen, 2013) have researched the growth of beef cattle breeds, fattening and carcass quality characteristics, but in general, these studies have been conducted on the intensive fattening conditions. The aim of this study was to explain the fattening results of HE and AB pure–bred bulls and their crosses (from father side HE and AB sires) using grass forage.

Materials and Methods

The study was conducted in 2015 and 2016 within the framework of the project 'Baltic Grassland Beef'. For fattening, bulls were fed with grass forage, in the winter with silage and hay, but in the summer – pasture grass, silage and hay.

In this research, 89 pure–bred and crossbreed bulls from different Latvian farms were used. Bulls were slaughtered in a sertified slauhgterhouse 'Agaras' (Lithuania).

Four study groups were created for data analysis:
1. Aberdinanguss pure-bred bulls (AB) – 24 bulls;
2. Hereford pure-bred bulls (HE) – 25 bulls;
3. Aberdinanguss crossbreed group bulls (AB crosbreed) – 16 bulls;

4. Hereford crossbreed group bulls (HE crosbreed) – 24 bulls.

AB crossbreed and HE crossbreed study groups were created from bulls whose fathers were AB and HE pure–bred sires, but from mother's side there were different beef breed and crossbreed cows.

Data on bulls belonging to the breed, date of birth, birth weight were obtained from the Latvian Agricultural Data Centre database, but the slaughter data – carcass weight, conformation and fat score – from the slaughterhouse 'Agaras'.

Using the growth rates of the bulls, the average daily weight gain in grams was calculated by the following formula (1):

$$a = \frac{Wt - W0}{t} \times 1000 \qquad (1)$$

where   Wt – live weight before slaughter, kg
W0 – birth weight, kg
t – age before slaughter, in days

Obtained from slaughter data, dressing percentage % was calculated according to the following (2):

$$K = \frac{Wk}{Wt} \times 100 \qquad (2)$$

where   Wk – slaughter weight, kg
Wt – live weight before slaughter, kg

After slaughtering of the bulls, their carcass weighing and muscle development evaluation was done according to the SEUROP classification. Beef carcasses for conformation are graded according to the EUROP scale: E – excellent (numerical designation – 1) U – very good (2), R – right (3), M – medium (4), P – poor (5) muscle development. Fat score was based on visual evaluation of carcasses in the range from 1 to 5, where 1 – very low, 2 – low, 3 – moderate, 4 – very good 5 – very high.

Analysis of the data acquired was based on the indicators of descriptive statistics: arithmetical mean, standard error and coefficient of variation. T-test for average values was used for significance determination. Different letters (a, b, c) on tables mark significant differences at $p \leq 0.05$. For trait relationship, correlation analysis was performed, which was established between the slaughter traits for all research group animals together (in total 89).

Results and Discussion

The average slaughter age of bulls from the study groups ranged from 519 to 584 days (Table 1). HE pure–bred group bulls were slaughtered as the oldest, the average age was 584 ± 7.3 days, which was significantly higher than for the rest of the group bulls – the difference between AB pure–bred group bulls was 48 days, with AB crossbreed group bulls 65 days, but with HE crossbreed group bulls for 22 days ($p \leq 0.05$). The AB crossbreed group bulls were slaughtered youngest. The average age at slaughtering was 519 ± 16.6 days, which is significantly different from HE pure–bred and HE crossbreed bull results ($p \leq 0.05$). Between AB pure–bred and AB crossbreed group bulls there are not significant differences between the average age before slaughter. In Pesonen, Honkavaar, & Huuskonen, (2012, 2013) research,

Table 1

Bulls slaughter results

Indicators	Pure–bred or crossbreed							
	AB (n = 24)		HE (n = 25)		AB crosbreed (n = 16)		HE crossbreed (n = 24)	
	x ± Sx	V, %	x ± Sx	V, %	x ± Sx	V, %	x ± Sx	V, %
Age before slaughter, days	536 ± 0.9[a]	12.0	584 ± 7.3[b]	6.2	519 ± 16.6[a]	12.8	562 ± 9.4[c]	8.2
Live weight before slaughter, kg	546 ± 13.7[a]	12.3	524 ± 8.7[a]	8.3	525 ± 22.2[a]	16.9	557 ± 19.4[a]	17.0
Daily weight gain from birth to slaughter per day, g	952 ± 24.7[a]	12.7	822 ± 14.6[b]	8.9	941 ± 40.7[a]	17.3	929 ± 36.0[a]	19.0
Slaughter weight, kg	280 ± 8.0[ab]	14.0	266 ± 4.3[a]	8.1	277 ± 11.6[ab]	16.8	293 ± 12.2[b]	20.4
Dressing percentage, %	51.3 ± 0.39[a]	3.7	50.9 ± 0.40[a]	3.9	52.8 ± 0.49[b]	3.7	52.4 ± 0.46[b]	4.3

a b c – significant differences between the study groups, $p \leq 0.05$.

similarly to our study, it was observed that AB pure–bred bulls were slaughtered earlier as HE pure–bred bulls. AB pure–bred bulls were slaughtered at the age of 526 days, with the difference to our study of 10 days, but HE pure–bred bulls 561 days old – the difference to our study of 23 days. In our study, the age before the slaughter was higher, which can be explained by the fact that fattening was carried out only with forage, therefore the animals were growing slower.

The average live weight of bulls before slaughter ranged from 524 kg to 557 kg. HE crossbreed bulls showed higher live weight before slaughter – 557 ± 19.4 kg, while HE pure–bred bulls were slaughtered at the lowest live weight – 524 ± 8.7 kg, however, significant differences between the groups did not exist.

The average daily weight gain from birth to slaughter in the study groups ranged from 822 g to 952 g. The biggest daily weight gain was observed for AB pure–bred bull group – 952 ± 24.7 g, which was over 130 g higher than for HE purebred bull group ($p \leq 0.05$). The differences in daily weight gain from birth to slaughter per day between AB crossbreed and HE crossbreed bulls were not significant.

The biggest slaughter weight was obtained from HE crossbreed group bulls – 293 ± 12.2 kg, which was about 13 kg more than from AB pure–bred bulls (280 ± 8.0 kg), 27 kg more than HE pure–bred bulls (266 ± 4.3 kg) and about 16 kg more than from the AB crossbreed group bulls (277 ± 11.6 kg). Significantly different slaughter weight results were between HE pure–bred and HE crossbreed group bulls ($p \leq 0.05$); among other groups significant differences were not identified. The Latvian study (Muizniece & Kairisa, 2016) proves that in organic farming conditions HE pure–bred bulls get carcass weight 298 kg before slaughter at the bull age of 615 days.

The biggest dressing percentage was showed by AB crossbreed group bulls – 52.8 ± 0.49%, while the lowest – by HE pure–bred bulls – 50.9 ± 0.40%; the difference is significant ($p \leq 0.05$).

AB crossbreed group bull dressing percentage is also significantly higher than AB pure–bred bull dressing percentage – 51.3 ± 0.39% ($p \leq 0.05$). HE crossbreed group bull dressing percentage – 52.4 ± 0.46% – is higher than AB and HE pure–bred group bull dressing percentage result ($p \leq 0.05$). There are no significant differences between AB and HE crossbreed group bull dressing percentage indicators. Using different fattening technologies, a number of researchers found out that the average AB pure–bred bull dressing percentage ranged from 55.2% – 59.3%, while for HE pure–bred bulls from 54.1% – 56.0%. (Barton et al., 2006; Pesonen, Honkavaar, & Huuskonen, 2012; Pesonen, Honkavaar, & Huuskonen, 2013; Chassot, 2015).

Evaluation of the development of the carcass conformation score ranged from 3.2 to 3.5 points. The best score was obtained from AB pure–bred bull group – 3.2 ± 0.08 points (Table 2). From this group 79% of carcasses were evaluated as R class, but 21% of carcasses as O class. The lowest score for the carcass was received by HE pure–bred bulls and HE crossbreed group bulls – 3.5 ± 0.10 points, which is significantly lower rating than from AB pure–bred bulls ($p \leq 0.05$). In HE pure–bred bull group 52% of carcasses were assessed as in the R class, but 48% in O class. By contrast, from HE crossbreed bull group 54% of carcasses corresponded to the R class, but 46% of carcasses – to O class.

Carcasses from all group bulls were evaluated as 2nd and 3rd fat class. In all study groups there were no carcasses which were evaluated as belonging to the 1st, 4th or 5th fat class.

Several foreign scientific studies have shown that AB pure–bred cattle carcass fat score is much higher than for late maturity breeds (Chambaz et al., 2003; Barton et al., 2006; Alberti et al., 2008; Pesonen, Honkavaar, & Huuskonen, 2012), which is also consistent with our study – AB pure–bred bull fat score was 2.2 ± 0.08 points, but HE pure–bred group bull fat score was only 2.1 ± 0.06 points. According to the classification of meat breeds of cattle after their maturation rate, AB pure–bred bulls belong to the early maturity breeds, but HE pure–bred bulls to medium late maturity breeds (Philips, 2010).

Table 2

Quality of bull carcasses

Indicators	Purebred or crossbreed							
	AB (n = 24)		HE (n = 25)		AB crossbreed (n = 16)		HE crossbreed (n = 24)	
	x ± Sx	V, %	x ± Sx	V, %	x ± Sx	V, %	x ± Sx	V, %
Conformation score, points	3.2 ± 0.08[a]	12.9	3.5 ± 0.10[b]	14.7	3.4 ± 0.13[ab]	14.8	3.5 ± 0.10[b]	14.7
Fat score, points	2.2 ± 0.08[a]	17.6	2.1 ± 0.06[a]	13.3	2.2 ± 0.10[ab]	18.4	2.4 ± 0.10[b]	20.8

a b – significant differences between the study groups, $p \leq 0.05$.

Table 3

Bull fattening and slaughter trait phenotypic correlation

Traits	Age before slaughter, days	Live weight before slaughter, kg	Daily weight gain from birth to slaughter, g	Slaughter weight, kg	Dressing percentage, %
Daily weight gain from birth to slaughter, g	- 0.39*	0.83*	–	–	–
Slaughter weight, kg	0.13	0.96*	0.83*	–	–
Dressing percentage, %	- 0.15	0.26*	0.33*	0.50*	–
Conformation score, points	0.09	- 0.44*	- 0.49*	- 0.52*	- 0.47*

*$p < 0.05$.

Among all study groups, HE crossbreed group bulls showed the highest fat score – 2.4 ± 0.10 points, which can be explained by the crossing result of the positive heterosis effect. The fat score of the HE crossbreed bull carcasses is significantly different from the fat score of the AB and HE groups pure–bred bulls ($p \leq 0.05$).

As shown in Huuskonen *et al*. (2009) study, which was carried out in Finland, by incorporating in the feed ration grain feed for HE pure–bred bulls, it is possible to gain carcass fat score up to 4.4–4.5. points, regardless of the keeping conditions. These indicators already are approaching the 5th fat class, which is considered undesirable because such carcasses are with too much fat. As Chassot (2008) concludes, if in fattening are used excessive amounts of grain feed or concentrates for such medium intense breed as AB, then it can lead to too fatty carcass.

According to our study, if for fattening is used grass, it is possible to get carcasses with enough fat level. Including grain in feed ration for pure–bred and crossbreed bulls would cause too big fat level formation, which might have a negative impact on the carcass quality. It would be necessary to feed grains only at the end of fattening, if the fat level is not developed enough.

To find out the relationship between the fattening and slaughter traits, correlation analysis was performed (Table 3). The results show that between the live weight before slaughter and daily weight gain from birth to slaughter, and the live weight before slaughter and slaughter weight there is a strong positive correlation - 0.83 and 0.96, respectively. Between the daily weight gain from birth to slaughter and slaughter weight, there also is a strong positive correlation – 0.83. The slaughter weight correlated average with dressing percentage and conformation score (0.50 and - 0.52). For other traits, the observed correlations are weak.

Positive correlation between slaughter weight and carcass conformation was found by Hickey *et al.*

(2007) in the Holstein sire breed group – correlation was 0.36. In our study, the correlation between traits slaughter weight and conformation score is negative – -0.52. This can be explained by the method which is used by EUROP scale grading because we used the lowest value for the best carcass conformation score.

Conclusions

AB pure–bred bulls were slaughtered youngest – at 519 ± 16.6 days of age, which was significantly different from HE pure–bred and HE crossbreed group bulls with the age of slaughter 584 ± 7.3 and 562 ± 9.4 days, respectively.

HE crossbreed group bulls showed the biggest weight before slaughter and slaughter weight - 557 ± 19.4 kg and 293 ± 12.2 kg, respectively. AB pure–bred group bulls showed the biggest daily weight gain from birth to slaughter – 952 ± 24.7 g, but the highest dressing percentage was gained from AB crossbreed group bulls, on average, $52.8 \pm 0.49\%$.

Carcass conformation score in the study groups was from 3.2 to 3.5 points, but the best score was for AB pure–bred group of bulls – 3.2 ± 0.08 points. The highest fat score showed HE crossbreed group of bulls – 2.4 ± 0.10 points.

The obtained results prove that pure–bred and crossbreed bulls used in this research are suitable for fattening with grass in the conditions of Latvia. The best fattening and slaughter results showed AB pure–bred and AB crossbreed bulls. HE pure–bred bulls grew more slowly and they showed worse slaughter results as other group bulls. Therefore, for fattening with grass fodder more suitable are HE crossbreed bulls because they showed better growing and slaughter results than HE pure–bred bulls.

Among the traits of live weight before slaughter and daily weight gain from birth to slaughter, live weight before slaughter and slaughter weight, and daily weight gain from birth to slaughter and slaughter weight had a strong positive significant correlation.

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NUMBER OF SERVICES PER CONSEPTION AND ITS RELATIONSHIP WITH DAIRY COW PRODUCTIVE AND REPRODUCTIVE TRAITS

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Abstract
The aim of our study was to determine up to what extent the number of services per calving (NSPC) affects dairy cow productive and reproductive performance. The study contains data from the Latvian Agricultural Data center about 26888 Latvian Brown (LB) and Holstein Black and White (HBW) breed cows that were born from year 2005 – 2010, closed at least 5 full lactations and were culled from herds. In data set we have included data about cow milk productivity (calculated in ECM), longevity traits and reproduction traits. The reproduction traits included the number of services per conception (NSPC), calving interval (CI) and calving to conception interval (CCI) in the first five lactations. The average lifespan of LB and HBW dairy cows was 3149.5 days and in this period 39570.6 kg ECM were obtained. LB breed cows were characterized by 23.5 days longer lifespan and by 6035.4 kg ECM lower lifetime milk productivity than HBW breed cows, but they showed higher reproduction trait scores than LB breed group. HBW cows had a significantly ($p < 0.05$) higher NSPC, CCI, number of milking days (MD) and CI than LB breed cows in all five analyzed lactations. The NSPC in the first lactation increased the calving age at the fifth lactation – cows with NSPC in the first lactation > 4, fifth time calved 170.7 days in LB breed group and 190.8 days in HBW breed group later than cows with one NSPC in the first lactation.
Key words: milk productivity, longevity, reproductive traits.

Introduction

Dairy farming in Latvia historically plays an important role not only between different animal husbandry branches, but also in the whole agricultural field. To ensure the profitability of dairy farming and to keep the cost of milk production as low as possible, farmers need to pay attention not only to the possibilities of increasing the cow milk productivity, but also of preventing the problems that affect cow longevity and productivity (Hansen, 2000).

In an ideal situation, in a farm it would be possible from one cow in one year (365 days) obtain one viable calf (in the best situation – heifer), however, with the rapid increase of the level of productivity, often in farms arises a situation that the first service after calving is belated and in some cases it needs to be repeated. The increased number of services per conception often indicates the problems with cow reproductive system, which has a negative impact on farms profitability (LeBlanc, 2007; Honarvar *et al*., 2010) and often results in culling from herd (Sewalem *et al*., 2008). The diseases of reproductive system in different studies are named as one of main factors that affects the cow's lifespan, because the first from herds are culled cows that have problems with insemination (Wathes *et al*., 2008). The reproduction traits that give us an insight into herd's and cow's individual health condition is the number of services per conception (NSPC), calving to conception interval (CCI) and calving interval (CI).

The NSCP is affected by different external factors, for example, the content of ration and its suitability for cows physiological needs, the frequency of feeding (Butler, Pelton, & Butler, 2006), housing system in the farm, season and weather conditions, the work quality of veterinary staff and the correct observation of heat (Nabenishi *et al.,* 2011). It is particularly important to ensure that cows at the beginning of lactation receive ration with optimized amount of energy so they could prepare for starting a new pregnancy cycle. However, the internal factors, such as high milk productivity, the age of the cow and different health problems can affect not only NSCP, but also the length of CI (Bello, Stevenson, & Tempelman, 2012; Dono *et al*., 2013).

For high yielding dairy cows, if they have some reproduction problems or diseases of reproductive system, milk productivity also decreases, which results in double losses from both – not acquired milk and the cow treatment expenses (Butler, Shaloo, & Murphy, 2010; Galvćo *et al*., 2013; Giordano, Fricke, & Cabarera, 2013).

The aim of our study was to determine up to what extent the number of services per calving (NSPC) affects the productive and reproductive performance of the dairy cows.

Materials and Methods

The data used in this study were obtained from the Latvian Agricultural Data center about Latvian Brown (LB) and Holstein Black and White (HBW) breed cows that were born from year 2005 to 2010, closed at least 5 full lactations and were culled from herds. The data set included cows' milk productivity, longevity and fertility traits:

- milk productivity (milk yield, fat and protein content in full and standard lactation);
- longevity (date of birth and culling, number of milking days);

- fertility traits (number of services per conception, calving to conception interval; calving interval).

To evaluate and compare the cow milk productivity, energy-corrected milk (ECM) was calculated using (1) formula:

$$ECM = milkyield \times$$

$$\times \frac{(0.383 \times fatcontent,)+(0.242 \times proteincontent,)+0.7832}{3.14}, kg \quad (1)$$

From the cow's birth and culling dates their lifespan (LS) was calculated, and from Amount of ECM in each lactation lifetime milk productivity (LMP) was calculated. To characterize the economic benefit of the analyzed cows, average milk productivity in one life day (LDMP) was calculated:

$$LDMP = \frac{LMP, kg}{LS, days}, kgECMperday \quad (2)$$

In the study, data about 26888 Latvian dairy cows (Table 1) were included. Cows were divided in four groups according to the number of services per conception (NSPC).

To determine the effect of factors on cow reproductive performance, factors were included in the following (3) model:

$$Y_{ijk} = \mu + B_i + L_j + S_k + e_{ijk}, \quad (3)$$

Where:
Y_{jik} – observations of variable of interest;
μ – underlying constant;

B_i – fixed factor cow breed;
L_j – fixed factor lactation;
S_k – fixed factor NSCP in the first lactation;
e_{iklm} – the random residual.

For the statistical analyses of influence of NSCP groups on the lifespan and lifetime milk productivity and reproductive performance, analysis of variance (ANOVA) was performed. Bonferroni pairwise comparison test was used to analyze the differences between NSCP factors groups' average values. In tables the average trait values were shown as least mean squares ± standard errors. Differences were considered statistically significant when $p < 0.05$. Significant differences ($p < 0.05$) in the tables were marked with different superscripted letters of alphabet (A, B, C, etc.). The mathematical processing was performed using the SPSS for Windows, version 15.

Results and Discussion

The lifespan and the amount of lifetime productivity are largely affected by their affiliation to the breed group. Latvian Brown (LB) breed cows belong to red breed group and, as it was determined in our previous studies, they are characterized by a longer lifespan, but lower lifetime and life day milk productivity than Holstein Black and White (HBW) breed cows (Cielava, Jonkus, & Paura, 2014; 2015). For analyzed cows, the average lifespan was 3149.5 days in which 39570.6 kg of energy-corrected milk (ECM) were obtained that makes on average 12.6 kg ECM per one life day (Table 2).

Table 1

The number of cows in different analyzed groups

Trait	LB	HBW	LB+HBW
N	16404	10484	26888
NSCP in first lactation			
1	9534	5475	15009
2	4087	2855	6942
3	1661	1160	2821
>4	1122	994	2116

Table 2

Milk productivity and longevity traits of LB and HBW breed cows

Trait	Breed		Difference	LB and HBW
	LB	HBW		
LS, days	3163.8 ± 4.28	3140.3 ± 3.43	23.5*	3149.5 ± 2.67
LMP, kg ECM	37217.3 ± 84.25	43252.7 ± 105.39	6035.4*	39570.6 ± 8.21
LDMP, kg ECM	11.8 ± 0.02	13.7 ± 0.03	1.9*	12.6 ± 0.02

*p < 0.05; LS – lifespan; LMP – lifetime milk productivity; LDMP – life day milk productivity.
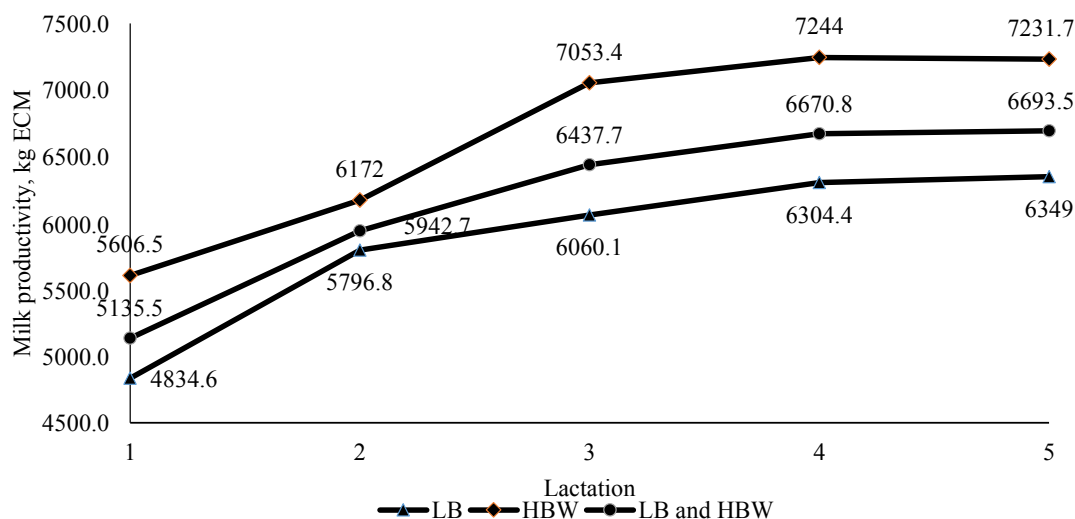
Figure 1. The average milk prductivity of LB and HBW cows from 1st to 5th lactation ABCD – milk productivity with different capital superscriptions differs significantly between lactations (p < 0.05).

In LB breed group, the cows lived on average 23.5 days longer than HBW breed cows, however, from LB cows in their life were obtained 6035.4 kg ECM less than it was from HBW cows. The average milk productivity per one life day was significantly lower for LB breed cows (11.8 kg ECM for LB and 13.7 kg ECM from HBW cows, respectively).

The average milk productivity showed a tendency to gradually increase from 5135.5 kg ECM in the first standard lactation to 6693.5 kg ECM obtained in the fifth lactation (Figure 1). The significant increase of milk productivity continued until the fourth lactation, after which such rapid productivity changes were not observed.

As determined previously, LB breed cows were characterized by lower milk productivity than HBW breed cows in life and they showed similar tendencies also by dividing milk productivity in different lactations. For HBW breed cows rapid increase of milk productivity was obtained from second to third lactation (+ 881.4 kg ECM; p < 0.05).

NSPC for the analyzed cows had a tendency to increase in each lactation (Table 3). In the first lactation the average NSPC was 1.76 times, which means that with the first service farmers impregnated 56.7% of serviced cows, but in the fifth lactation this indicator is significantly lower (on average 1.80 times) – with the first service impregnated 55.5% (p < 0.05) of serviced cows. One of the economically most important reproduction traits is CCI, which is defined as the time period from the calving until the first successful service. This indicator is often used in connection with NSPC, because it depends on the necessity of repeated services, but from the results of other authors we can conclude that the length of CCI is determined also by the productivity of a cow, the balance of energy

in ration (especially at the beginning of lactation) and health condition (Butler, Pelton, & Butler, 2010).

The LB breed cows in the first and consequent lactations had a significantly lower NSPC than HBW breed cows (accordingly 1.71 and 1.86 in the first lactation) and it had a tendency to increase with the age of cows. In the fourth lactation for LB breed cows NSPC was 1.74, but the fourth lactation HBW breed cows were serviced 0.2 times more. Although 55.8% of cows in the first lactation needed only one NSPC, there were 7.8% of cows that were serviced four times or more. CCI significantly longer were for HBW breed cows (128.3 days in the first and 138.5 days in the fourth lactation) and they were also characterized by highest milk productivity and NSPC, whereas in LB breed group the highest CCI were in the fourth lactation (123.8 days; p < 0.05).

With longer CCI, there is an impact on the number of milking days (MD) and length of CI in each lactation. From the length of CI we can make assumptions about the individual cow and herd reproductive health and about the cow's efficiency in herd (Pryce et al., 2004; Bujko et al., 2013). For analyzed cows, the average CI was 399.6 days long (from the third to fourth lactation for LB breed cows) to 407.3 days long (from the fourth to fifth lactation for HBW breed cows), furthermore, LB breed cows in all lactations had shorter CI than HBW breed cows. The reasoning behind the higher average reproduction trait values could be HBW breed's higher milk productivity in all lactations which can lead to lower pregnancy rates in this group that results in longer CCI and CI periods (Riecka & Candrák, 2011; Arbel et al., 2001). NSPC in the first lactation is a factor that affects not only the length of CCI and CI periods, but it is also one of factors that influences NSPC in cow's later life (Figure 2).

Table 3

Reproduction traits in different lactations of LB and HBW breed cows

Lactation	NSPC	CCI	MD	CI
LB and HBW (N=26888)				
1→2	1.76 ± 0.01[A]	120.5 ± 0.46[A]	341.0 ± 0.43[A]	400.9 ± 0.45[A]
2→3	1.78 ± 0.14[AB]	119.9 ± 0.44[A]	337.2 ± 0.42[B]	400.2 ± 0.44[A]
3→4	1.77 ± 0.07[A]	121.9 ± 0.45[A]	337.5 ± 0.44[B]	399.6 ± 0.48[A]
4→5	1.80 ± 0.07[B]	129.5 ± 0.48[B]	344.3 ± 0.46[A]	407.3 ± 0.51[B]
LB (N = 16404)				
1→2	1.71 ± 0.01[Aa]	115.3 ± 0.59[Aa]	335.9 ± 0.56[Aa]	396.4 ± 0.59[Aa]
2→3	1.70 ± 0.01[ABa]	114.4 ± 0.58[Aa]	331.4 ± 0.53[Ba]	395.5 ± 0.57[Aa]
3→4	1.70 ± 0.01[ABa]	116.4 ± 0.58[Aa]	332.3 ± 0.54[Ba]	397.4 ± 0.58[Aa]
4→5	1.74 ± 0.01[Ba]	123.8 ± 0.63[Ba]	337.7 ± 0.58[Aa]	404.7 ± 0.62[Ba]
HBW (N = 10484)				
1→2	1.86 ± 0.01[Ab]	128.3 ± 0.70[Ab]	349.9 ± 0.70[ABb]	409.2 ± 0.74[Ab]
2→3	1.90 ± 0.01[Bb]	128.2 ± 0.24[Ab]	346.1 ± 0.67[Ab]	409.1 ± 0.71[Ab]
3→4	1.92 ± 0.01[Bb]	130.6 ± 0.73[ABb]	346.1 ± 0.67[Ab]	411.5 ± 0.73[ABb]
4→5	1.94 ± 0.01[Bb]	138.5 ± 0.79[Bb]	353.4 ± 0.72[Bb]	419.3 ± 0.78[Bb]

[AB] – capital letters in superscription denote significant differences between lactations ($p < 0.05$); [ab] – traits with different superscriptions differ between breeds ($p < 0.05$) NSPC – number of services for conception; CCI – calving to conception, days; MD – milking days; CI – calving interval
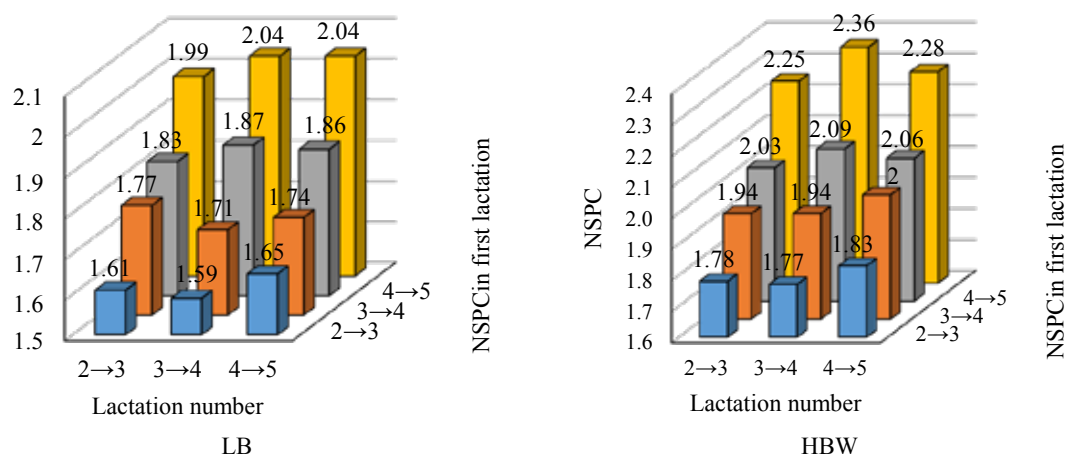
Figure 2. Average number of services to one conception for LB and HBW breed cows with different NSPC in the first lactation (LB – Latvian Brown; HBW – Holstein Black and White; NSPC – number of services per calving)
[ABCD] – traits with different capital superscriptions differ significantly between NSPC groups in one lactation ($p < 0.05$); [abc] – traits with different superscriptions differ between lactations ($p < 0.05$).

LB breed cows in all study groups had lower consecutive NSPC than HBW breed cows. The maximal NSPC (2.04 times per one calving) in LB breed group were in the third and fourth lactation for cows that in the first lactation were serviced four or more times, whereas HBW breed cows needed accordingly 2.36 and 2.28 services in the same groups. In LB breed cows, which in the first lactation were serviced one time, in the consecutive lactations

were observed having significantly lower NSPC (1.61 in the second and 1.65 in fourth lactation). The similar tendency occurred in HBW breed group, but the average NSPC in each group was higher than that for LB breed cows. Studies show that the breed of cows and cow milk productivity are the main factors that show the biggest impact on NSPC in different lactations, because of the tendency to repeat service for cows with higher milk productivity (Cummins *et*
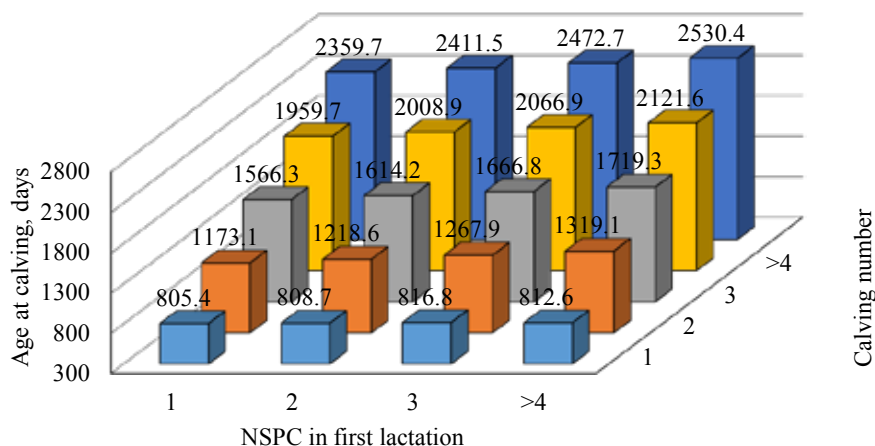
Figure 3. The average calving age at different lactations depending from number of services per calving
(NSPC) in first lactation for LB breed cows;
ABCD – traits with different capital superscriptions differs significantly between NSPC groups (p < 0.05)
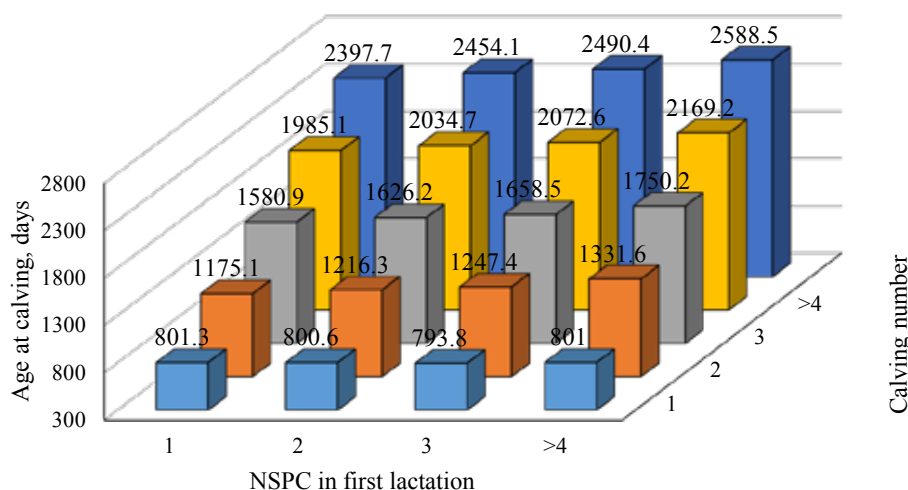
Figure 4. The average calving age at different lactations depending from number of services per calving
(NSPC) in first lactation for HBW breed cows;
ABCD – traits with different capital superscriptions differs significantly between NSPC groups (p < 0.0)

al., 2012; Bujko *et al.*, 2013). The main environmental factor that affects NSPC is the heat detection system in the farm. If heat detection is done properly and insemination process follows with a good execution, it can improve the effectivity of insemination (Wall *et al.*, 2003)

The NSPC in the first lactation and its effect on the calving age in consecutive lactations is given in Figure 3. In LB breed group there were no statistically significant differences between cow ages at the first calving in different NSPC at first lactation groups. But in the second time cows that in the first lactation were serviced one time calved 146.0 days earlier than cows that needed four or more services in the first lactation (1173.1 and 1319.1 days, respectively). LB breed cows that in the first lactation were serviced four or

more times at the beginning of fifth lactation were 170.7 days older than cows that in the first lactation were inseminated with one service.

In HBW breed group a similar tendency was observed where with the increase of NSPC in the first lactation also increased the age of cows at the beginning of consecutive lactations (Figure 4).

Analyzed HBW breed cows had the highest milk productivity, not only in lactation, but also in one life day, which could serve as the main factor for poorer reproductive traits in comparison with LB breed cows. A similar tendency was observed in the LB breed group, where there were no significant differences between ages of first calving in each NSPC group. In the second lactation, between calving ages of cows in the first and fourth group appeared difference of 156.6

days and in the fifth lactation it increased to 190.8 days. HBW cows in comparison with LB breed cows had the oldest calving age at the fifth calving and it amounted to 58.1 days in the group with NSPC four or more.

Conclusions

For Latvian Brown and Holstein Black and White cow breed groups, the number of services per conception showed a significant ($p < 0.05$) effect on their reproductive traits in consecutive and later lactations. With the increase of number of services per conception in the first calving came the increase of age at the calving in later lactations, which lowers the number of potential lactations in the cow's life and also points to the problems connected with the reproductive performance in farms. In the further studies there is a need to make deeper research in the relationships between different cow production and reproduction traits and about the factors that affect the productive and reproductive performance in herds.

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THE INFLUENCE OF KAPPA-CASEIN AND BETA-LACTOGLOBULIN GENOTYPES ON MILK COAGULATION PROPERTIES IN LATVIA DAIRY BREED

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Abstract
Milk yield, composition and milk coagulation properties can be affected by kappa-casein (κ-CN) and beta-lactoglobulin (β-LG) genotypes and breed. Latvian Brown (LB) and Latvian Blue (LZ) are local dairy breeds in Latvia. These breeds are not so high-yielding than other commercial dairy breeds, besides, the number of those animals decrease each year. The aim of the research was to analyze the influence of κ-CN, β-LG and breed on milk composition and milk coagulation properties. Data were collected from 56 Latvian Brown and 26 Latvian Blue in 2016. Widespread κ-CN genotype was AA (0.593) in LB breed and AB (0.636) in LZ breed, while β-LG highest frequency was BB genotype. Significant effect was not observed on milk yield, however the highest daily milk yield was from AB κ-CN genotype (19.7 ± 1.52 kg) in LB breed. Significant differences were observed in fat content – the highest fat content accordingly κ-CN was from AA genotype in LB (46.3 ± 1.89 g kg^{-1}) and 45.5 ± 1.37 g kg^{-1} from BB β-LG genotype in LB breed (p < 0.05). A lower protein content was observed from AA κ-CN genotype in LZ breed (33.8 ± 1.30 g kg^{-1}), while highest from BB genotype in both breeds. Curd firmness was not significantly different by genotypes and breed. Significantly shorter milk renneting time of β-LG was obtained from LB breed (14.6 ± 2.76 min, p < 0.05), while κ-CN genotype was not significantly affected.
Key words: milk coagulation properties, kappa-casein, beta-lactoglobulin.

Introduction

Beta-lactoglobulin (β-LG) and kappa-casein (κ-CN) are two of the most important proteins in the milk of mammals (Flower, 1996). During the past 70 years, β-lactoglobulin has been studied by every available biochemical technique (Flower, North, & Sansom, 2000). The concentration of β-LG in bovine milk varied from 2 to 3 g kg^{-1} (Kontopidis, Holt, & Sawyer, 2004). Messenger RNA coding β-LG is synthesized in the mammary gland, and β-LG contains residues of 162 amino acids. Main alleles are A and B for coding this protein and only two amino acids are different. Aspartic acid is substituted with glycine at position 64 and valine with alanine at position 118 (Qin *et al.*, 1999). Casein is milk protein which contains four casein fractions – α$_{s1}$-casein, α$_{s2}$-casein, β-casein and κ-casein. Two genetic κ-CN variants are more widespread – A and B. A variant has a threonine at position 136 and an aspartic acid at position 148 of the mature protein, while B variant has isoleicin and alanine residues at these positions, respectively (Alexander *et al.*, 1988).

The coagulation ability of milk is essential for cheese making. Milk with favorable coagulation properties (short coagulation and curd firming time and a firm curd) is expected to give more cheese with desirable composition than milk with unfavorable properties. Scientists have found that 8% of milk samples do not coagulate during 30 min and haveanalyzed the factors which affect milk coagulation. Several researchers found that parity did not affect coagulation properties, but some authors found the opposite effect (Lindström, Antila, & Syväjarvi, 1984; Davoli, Dall'Olio, & Russo, 1990).

According to the results of the previous studies from Tsiaras and co-authors (2005), A of β-LG allele is more prevalent than B allele – it was found that genotype frequencies were 0.28, 0.47 and 0.25 for AA, AB and BB genotypes β-LG. A similar tendency was found by Kučerová *et al.*, (2006). Scientists from Estonia found that A allele frequencies were 0.188, 0.138 and 0.319 for Estonian native, Estonian Red and Estonian Holstein, but B allele was found with frequency 0.813, 0.863 and 0.681, respectively (Värv *et al.,* 2009). According to the studies of Ren and his colleagues (2011), A allele and AA genotype of κ-CN are more widespread in Holstein and other high-yield dairy breeds, while the opposite situation was obtained for Jersey breed. The frequency of AA κ-CN genotype was 0.55 in Holstein, while this genotype was not observed in Jersey breed, but BB genotype of κ-CN with frequency 0.77 was observed in Jersey (Ren *et al.*, 2011).

Schaar and co-authors (1985) found that the milk coagulation time was shorter for the β-LG BB genotype (p < 0.001), while the curd firmness was not affected by the β-LG genotypes. The β-LG AA genotype had a favorable effect on milk coagulation properties in some studies (Schaar, Hansson, & Pettersson, 1985; Aleandri *et al.*, 1990 Ikonen *et al.*, 1999; Wedholm *et al.*, 2006). Pečiulaitienė and co-authors (2007) observed the highest milk yield and fat content from cows with AB genotype. Ng-Kwai-Hang and co-authors (1984, 1986) and Tsiaras with colleagues (2005) described the genotype κ-CN effect on milk yield, composition and milk coagulation properties.

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Animals with AB and BB κ-casein genotypes have the highest protein content and better milk coagulation properties.

Previous studies in Latvia have not described milk coagulation properties according to κ-casein and β-lactoglobolin genotypes.

The purpose of our research was to analyze κ-CN and β-LG genotypes and breed influence on milk composition and coagulation properties.

Materials and Methods

Data, blood samples and individual milk samples were collected from Latvian cow breeds (56 Latvian Brown (LB), 26 Latvian Blue (LZ)) from different regions of Latvia in 2016. Milk samples were collected during summer (July to August, 2016) period.

All cows were kept in small farms – on average 6 animals in each farm. Analyzed cows were grazed on pastures; grain meal and mineral additives were fed to them. LB cows were in 136 ± 8.1 lactation day and LZ – 144 ± 9.7 lactation day. Cows were milked twice. Average LB cows were 3.1 ± 0.17 parity and LZ – 3.5 ± 0.26 parity.

The blood samples were taken from the jugular vein (*Vena jugularis*) and collected in the K_3-EDTA coated sterile vacutainers, and stored at -20 °C until DNA extraction. The research was conducted at the Scientific Laboratory of Molecular Biology and Microbiology of Latvia University of Agriculture.

DNA was extracted by Genomic DNA Purification Kit# KO512 and DNEasy Blood@Tissue Kit (Fermentas, Lithuania) which was extracted by QIAcube (QIAcube, USA). β-LG alleles were identified using The PCR-RELP (Polymerase Chain Reaction and Restriction Fragment Length Polymorphism) according to Medrano and Aguilar - Cordova (1990) method.

Kappa-CN genotypes were identified using PCR-RFLP and electrophoresis on 3% agarose gel. The identification of κ-CN single nucleotide polymorphisms (SNPs) was done by methodology of Velmala *et al.* (1993). SNPs at positions 13104 and 13124 were examined to determine the nucleotide changes (A->C and A->G), which analyse κ-CN alleles A, B and also E. For digestion endonuclease *Hinf*I was used to detect the presence of alleles A and B, and endonuclease *BsuR*I (Fermentas, Lithuania) to detect the presence of the allele E.

Protein and fat content, milk density, curd yield and curd firmness, protein and fat ratio were detected at the Faculty of Food Technology of LUU. Protein content was detected according to ISO 8968-1:2014 using KjeltecTM 2100 (Foss, Denmark). Fat content was detected according to ISO 488:2008 using centrifuge (Funke Gerber, Germany). Curd yield (%) was calculated by weight of curd obtained from milk.

Density of milk was measured according to Latvian Standard 186:1999 using lactodensitometer (Labtajm, Ukraine).

The rennet (CHY-MAX 1000 IMCU/mL, Chr. Hansen, Denmark) used in the analyses of curd firmness was diluted 1:100 (v/v) and added 0.2 mL to 10 mL of milk. The curd firmness (in Newton's) was determined after 30 min of milk renneting at 35 °C using Texture Analyser TA-HD plus (Stable Micro System, UK). Compression method for determination of curd firmness (technical data – disc A/BE – d45, test speed 1.0 mm s^{-1}, distance in the depth of curd sample 8 mm) was used.

Renneting time in minutes was analyzed using 1:100 (v/v) of rennet solution into water and measuring the time until flocculation of milk was started at 35 °C. For the interpretation of results, all samples were divided into four groups (fast, average, slow and non-coagulating milks) based on the time devoted to the clotting of samples. The assessment of clotting time was the following: fast means flocculation formation during 10 min, average – 15 min, slow – more than 15 min, and non-coagulating – samples that did not coagulate at all.

Analyses of milk composition and coagulation properties were not provided for AE κ-CN genotype taking into account the low number of cows with this genotype. In tables we have not included data about the milk composition and coagulation properties from cows with non-coagulated milk.

Statistical data processing was carried out using MS Excel and ANOVA of SPSS 15.0 for Windows. The differences between groups were significant if $p<0.05$ and were marked with letters in superscript ([a, b, c]) between genotypes and ([A,B]) between breeds.

Results and Discussion

We observed κ-CN allelic frequencies 0.778, 0.213 and 0.009 for A, B and E allele in LB breed (Table 1). Similar allelic frequencies of A and B alleles were found in LZ breed. E allele was not found in LZ breed. Widespread κ-CN genotype of LB breed was AA with frequency 0.593, while frequency of BB genotype was 0.037. AB κ-CN genotype frequency of LZ breed was 0.636, while AA genotype frequency was lower compared with LB breed – 0.318. A similar tendency of κ-CN allelic frequencies was observed by Pärna with colleagues (2007) in Estonian Holstein breed. Estonian native breed A, B and E allelic frequencies were 0.725, 0.238 and 0.038, respectively (Värv *et al.*, 2009).

B allele of β-LG genotype was widespread in both breeds – the frequencies were 0.917 and 0.886, respectively. Accordingly, BB genotype of β-LG was with frequencies 0.852 in LB breed and 0.773 in LZ

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Table 1

The frequencies of κ-CN and β-LG alleles and genotypes

Protein	Alleles and genotypes	Frequencies of alleles and genotypes	
		Latvian Brown (n = 56)	Latvian Blue (n = 26)
κ-CN	A	0.778	0.636
	B	0.213	0.364
	E	0.009	0.000
	AA	0.593	0.318
	AB	0.352	0.636
	BB	0.037	0.045
	AE	0.019	0.000
β-LG	A	0.083	0.114
	B	0.917	0.886
	AA	0.019	0.000
	AB	0.130	0.227
	BB	0.852	0.773

breed, while frequency of AA genotype was 0.019 and this genotype was not observed in LZ breed. Estonian native and Estonian Red frequencies of B β-LG allele were 0.813 and 0.863 (Värv *et al*., 2009).

Significant differences were not observed between κ-CN genotypes and breeds. The highest milk yield was observed from AB κ-CN genotype in LB breed (19.7 ± 1.52 kg), while a lower milk yield was BB genotype in the same breed (Table 2). Tsiaras *et al*., (2005) have found the same milk yield tendency – the highest milk yield was from AB genotype, an average from AA and a lower milk yield was obtained from BB genotype.

A significantly higher fat content was observed from AA genotype in LB breed (46.3 ± 1.89 g kg^{-1}) compared with LZ breed - 38.2 ± 3.63 g kg^{-1} (p < 0.05). Different results were revealed in *Tsiaras et al.,* (2005) research – the highest fat content was observed from AB genotype. Lunden, Nilsson, & Janson (1997) had obtained no significant differences in fat content between the AA and AB genotypes.

Previous papers described a positive effect of B allele on protein content and protein yield (Ng-Kwai-Hang *et al*., 1984; Ng-Kwai-Hang, Monardes, & Hayes, 1990; Van Eenennaam & Medrano, 1991; Vallas *et al*., 2010). We did not find a significant difference, however a tendency appeared. The highest milk protein content was obtained from BB genotype in both breeds, while we found a lower protein content from AA genotype – 33.8 ± 1.30 g kg^{-1} in LZ and 34.4 ± 0.68 in LB milk samples.

The average milk density (Table 2) was 1028 kg m^{-3} in all genotypes and breed, except milk from LZ cows with AB genotype. According to the studies of Wangdi and co-authors (2014), the milk density can be affected by breed and vary from 1027 to 1030 kg m^{-3}. Milk density influences milk chemical composition especially solids-not-fat (Jasińska *et al*., 2010).

Curd firmness (Table 2) was not significantly different between breeds, however, the highest curd firmness was obtained from AB genotype in LZ breed (3.35 ± 0.18 N), while a lower value was BB genotype in the same breed. Curd firmness is a very important factor, mainly because the amount of milk used for cheese manufacture is growing worldwide, and several works (De Marchi *et al*., 2008; Wedholm *et al*., 2006) have confirmed the importance of MCP as well as curd firmness on cheese processing, yield and quality.

In previous studies it was found that breed and genotypes (κ-CN and β-LG) can affect curd firmness significantly (Sturaro *et al*., 2012; Vallas *et al*., 2012).

A significantly higher curd yield was observed from BB κ-CN genotype in LB breed (28.4 ± 3.89%) and LZ breed (28.8 ± 6.16%, p < 0.05) compared with genotypes AA and AB. Allele B showed a positive effect on curd yield in both breeds. Ng-Kwai-Hang and co-authors (1984) have confirmed that milk obtained from cows with BB genotype has the highest curd yield compared to the milk collected from cows with AA and AB κ-casein genotype.

Milk renneting time (Table 2) was not significantly different between breeds and genotype, however longer time was observed from AB genotype in LZ breed (18.6 ± 4.44 min). Zannoni and Annibaldi (1981) recommended that optimal value of milk coagulation time is 13 min. We obtained a closer result from AB κ-CN in LB breed – 14.9 ± 1.23 min. Milk renneting time is influenced not only by genotype, but also by

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breed, season, milk composition and pH (Marchi *et al*., 2013).

Significant differences in protein to fat ratio were found in AB and BB genotypes, as well as in LZ breed (p < 0.05). Composition of the cheese and its yield can be significantly affected by changes in the concentration of protein and fat in milk. According to the study of Guinee and co-authors(2007), a ratio of protein to fat in milk between 0.77 and 0.83 (in case of Latvian Brown) results in a significantly less fat retention during the cheese production compared to cheese produced from milk with a ratio protein to fat between 0.95 and 1.21 (in case of Latvian Blue). The actual cheese yield reducing increased ratio protein to fat in milk and extensive impact was observed on reducing the moisture content of fat free matter, fat in dry matter, salt content (Guinee *et al*., 2007).

Analyzing influence of β-LG on milk yield in LB and LZ breeds, we did not observe significant differences. We observed different tendencies in breeds. The highest milk yield was observed from BB β-LG genotype in LB breed, while the highest milk yield was from AB genotype in LZ breed. Matějíček and co-authors (2008) found that the highest milk yield was associated with AA β-LG genotype.

Significant differences were obtained in fat content (p < 0.05; Table 3). A higher fat content was observed in AB β-LG genotype in LB compared with LZ breed. Significant differences were obtained in BB genotype – the highest fat content was found in BB genotype LB breed (45.5 ± 1.37 g kg⁻¹, p < 0.05). A positive effect on milk fat content by BB β-LG genotype was obtained in the study of Zaglool and co-authors (2016).

Protein content was not significantly different between research groups. The highest protein content was obtained from BB genotype in LZ breed – 35.3 ± 1.19 g kg⁻¹.

Milk density was significantly different between LB and LZ breeds in AB β-LG genotype. The highest density was obtained in LZ breed (1030.4 ± 1.29 kg m⁻³), while lower value was obtained in LB breed (1027.9 ± 0.14 kg m⁻³, p < 0.05).

Milk coagulation properties are commonly defined by milk renneting time and curd firmness. A short milk coagulation time and a firmer curd are favorable for cheese production (Aleandri, Schneider, & Buttazzoni, 1989; Martin *et al*., 1997). Zannoni & Annibaldi (1981) study has revealed that the optimal milk renneting time is 13 minutes. Closer results we obtained from AB genotype in LB breed (14.6 ± 2.76 min).

Significant differences were not obtained in curd firmness and curd yield. The highest curd firmness was obtained from AB genotype in LB breed (3.79 ± 0.44 N), while lower curd firmness was from the same genotype in LZ breed (2.58 ± 0.52 N). The highest curd yield was observed from BB genotype – 24% in both breeds.

A significantly shorter milk renneting time was obtained from AB genotype in LB breed (14.6 ± 2.76 min), compared with LZ breed (21.7 ± 10.35 min, p < 0.05).

Protein to fat ratio was significantly different between genotypes in LZ breed. The highest protein to fat ratio was obtained from AB genotype (1.60 ± 0.39, p < 0.05) and this milk is not favorable for cheese making.

We observed average relationships between milk protein to fat ratio and curd yield. Phenotypical correlation coefficient was r_p = -0.56 in LB breed and r_p = -0.54 in LZ breed. According to Bojanić-Rašović

Table 2

Milk compositions and milk coagulation properties according to κ-CN

Trait	Latvian Brown			Latvian Blue		
	AA (n = 32)	AB (n = 19)	BB (n = 2)	AA (n = 7)	AB (n = 13)	BB (n = 2)
Daily milk yield, kg	19.6 ± 1.04	19.7 ± 1.52	14.6 ± 4.65	18.3 ± 1.14	16.7 ± 1.95	15.7 ± 7.67
Fat, g kg⁻¹	46.3 ± 1.89[a]	41.7 ± 2.04[a]	41.0 ± 3.37[a]	38.2 ± 3.63[b]	33.9 ± 3.24[b]	40.0 ± 5.39[b]
Protein, g kg⁻¹	34.4 ± 0.68	34.8 ± 0.81	36.7 ± 1.55	33.8 ± 1.30	35.5 ± 1.45	36.8 ± 1.48
Density, kg m⁻³	1028.1± 0.25	1028.7 ± 0.25	1028.5 ± 0.20	1028.7 ± 0.50	1029.2 ± 0.67	1028.7 ± 0.42
Curd firmness, N	3.20 ± 0.24	3.22 ± 0.31	3.24 ± 0.65	3.17 ± 0.50	3.35 ± 0.18	2.73 ± 0.75
Curd yield,%	23.7 ± 0.94[a]	24.0 ± 1.66[a]	28.4 ± 3.89	21.4 ± 1.55[a]	23.5 ± 1.35[a]	28.8 ± 6.16
Milk renneting time, min	18.2 ± 1.99	14.9 ± 1.23	17.1 ± 1.39	17.7 ± 3.99	18.6 ± 4.44	17.4 ± 2.84
Protein to fat ratio	0.77 ± 0.03	0.83 ± 0.06[a]	0.77 ± 0.03[a]	0.95 ± 0.10	1.24 ± 0.17[b]	1.01 ± 0.08[b]

[a,b] – differences were significant between breeds in same κ-CN genotype (p < 0.05).

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Table 3

Milk compositions and milk coagulation properties according to β-LG

Trait	Latvian Brown		Latvian Blue	
	AB (n = 7)	BB (n = 46)	AB (n = 5)	BB (n = 17)
Milk yield, kg	18.5 ± 1.33	19.6 ± 0.93	18.0 ± 1.76	17.3 ± 1.57
Fat, g kg^{-1}	37.9 ± 4.46^{a,A}	45.5 ± 1.37^{a,B}	25.8 ± 5.22^{b,A}	37.9 ± 2.39^{b,B}
Protein, g kg^{-1}	34.2 ± 1.09	34.6 ± 0.55	33.7 ± 1.98	35.3 ± 1.19
Density, kg m^{-3}	1027.9 ± 0.14^{a}	1028.5 ± 0.20	1030.4 ± 1.29^{b}	1028.7 ± 0.42
Curd firmness, N	3.79 ± 0.44	3.25 ± 0.19	2.58 ± 0.52	3.24 ± 0.27
Curd yield,%	22.9 ± 2.03	24.1 ± 0.89	19.3 ± 1.73	24.1 ± 1.16
Milk renneting time, min	14.6 ± 2.76^{a}	17.1 ± 1.39	21.7 ± 10.35^{b}	17.4 ± 2.84
Protein to fat ratio	0.96 ± 0.08	0.77 ± 0.03^{a}	1.60 ± 0.39^{A}	1.01 ± 0.08^{b,B}

^{a,b} – differences were significant between breeds in same β-LG genotype (p < 0.05).
^{A,B} – differences were significant between β-LG genotypes in same breed (p < 0.05).
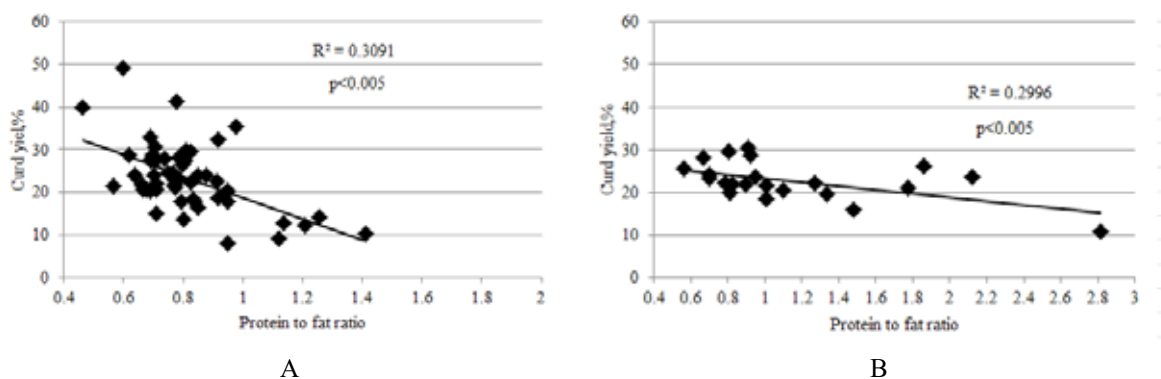
Figure 1. Relationships between milk protein to fat ratio and curd yield:
A – Latvian Brown and B – Latvian Blue breed.

and co-authors (2013), medium strong to no positive relationships were obtained between protein to fat ratio and curd yield (r_p = -0.67).

More extensive studies of milk coagulation properties could improve the knowledge about the Latvian local dairy breed and its milk perspectives for cheese making. Our results revealed BB and AB genotypes of κ-CN and β-LG positive effect on milk composition and coagulation properties. Therefore, for a better understanding and explanation of breed and genotype potential for cheese making further studies on milk protein profiles and genetic variants of different protein fractions during different seasons should be done.

Conclusions

Widespread κ-CN genotype was AA in LB breed and AB in LZ breed with frequencies 0.593 and 0.636, while the highest frequencies of β-LG was BB genotype.

Significant differences were observed in fat content – the highest fat content was in LB milk samples, accordingly, κ-CN was from AA genotype 46.3 ± 1.89 g kg^{-1} – and 45.5 ± 1.37 g kg^{-1} from BB β-LG genotype (p < 0.05).

Significantly shorter milk renneting time of β-LG was obtained from LB breed (14.6 ± 2.76 min, p < 0.05), while κ-CN genotype did not significantly affect this parameter.

A significantly higher curd yield was observed from BB κ-CN genotype – on average 28%, while β-LG genotype did not affect the curd yield significantly, however, the highest curd yield was obtained from BB genotypes in both breeds.

Acknowledgment

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CONCENTRATE DISTRIBUTION TO SHEEP USING AUTOMATIC FEEDING STATION

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Abstract
The research was conducted with the aim of studying the possibility of using automatic feeding stations for individual sheep (*Ovis aries*) feeding. The research was organized in 3 periods, in which 10–13 months old sheep – female only (1st research period), 6–10 months old sheep – female only (2nd research period) and 8–12 months old sheep – female only (3rd research period) were used. Part of the sheep did not visit the feeding station at all. Sequentially, over the research periods the percentage was 13%, 37% and 49%. Upon setting the concentrate daily ration 400 g per sheep, on the average the number of visits to the particular feeding station was 6.1 and 4.7 (sequentially in the 1st and 2nd research period). Upon increasing the concentrate ration amount up to 700 g per day, the average number of feeding station visits was 6.9 (in the 3rd research period). The number of visits to the automatic feeding station was varied (V > 10%). Over the research period live weight of the sheep increased significantly (p ≤ 0.05) for the subgroups of animals which made visits to the feeding station regularly during the entire research period. In all research periods, the average daily concentrate intake (373.5 g in the 1st research period, 333.1 g in the 2nd research period and 581.2 g in the 3rd research period) was 93%, 83% and 83% respectively, of the maximum established feeding standard.
Key words: feeding station, pelleted concentrate, intake.

Introduction

Since 1950 balanced nutrition of ruminants held in sheds has been in the focus of increased attention. For this purpose a special research was launched (Ungar, 1996).

Determination of the quantity of forage consumed by an animal and that, which is necessary, is important for animal cost and productivity level balancing. It has been proven by studies that poor nutrition of ewes during pregnancy lowers lamb live weight at birth (Robinson, McEvoy, & Sinclair, 1999), increases lamb mortality rate (Jordan & Mayer, 1989; Kleeman *et al.*, 1993; Hinch *et al.*, 1996) and reduces the amount of colostrum (Hall, Holst, & Shutt, 1992; O'Doherty & Crosby, 1996). Insufficiency of nutrients negatively affects udder mass and development, causing delay in the start of lactation (Mellor *et al.*, 1987) and reduces the ewe lactescence (Jordan & Mayer, 1989; O'Doherty & Crosby, 1996). At the same time, it is noted that excessive provision of nutrients also has a negative impact on the productivity of sheep (Ocak, Cam, & Kuran, 2005). When concentrate distribution is organized by scattering in trough, it is possible for stronger animals to push away the rest to consume much more concentrate than the desired diet. As a result, of ruminant feed fermentation volatile fatty acids and lactic acid are produced in the rumen. If an animal is unable to absorb the entire amount of volatile fatty acids and lactic acid produced through fermentation, they accumulate in the rumen and lower pH (Plaizier *et al.*, 2009). Regular (daily) extended period of decreased pH level (below normal – 6.5) in the rumen has adverse effects on feed intake, nutrient digestion and metabolite formation, as well as causes inflammation, laminitis, diarrhea and reduction in milk fat (Stone, 2004; Krause & Oetzel, 2006; Enemark, 2008). It has been proven that when highly productive cows are fed large amounts of concentrated feed, there is a tendency for development of acidosis (Bath, 1982) that draws attention to possible disease occurrence in other ruminants as well (Braun, Rihs, & Schefer, 1992).

Over time multiple methods have been used used to determine the amount of consumed feed. It is a very time-consuming and expensive process, which can be greatly facilitated by making use of computerized data recording software (Demment & Greenwood, 1987; Unwin & Martin, 1987). Usage of automatic feed distribution stations in sheep rearing is quite innovative. In Weihenstephan Technical High School Research Farm such an automatic station for feed distribution, which allows feeding concentrate in form of breadstuff or pellets, or finely chopped hay, was used in a research in 1999 (Wendl *et al.*, 1999). Using automatic feeding station to feed concentrates to sheep, it is possible to prevent nutrient shortage or saturation effects. It should be noted that with the automatic feeding station used in this research it is possible to ration concentrate only in the form of pellets.

The aim of this research was to study the possibility of using automatic concentrate feeding stations in sheep individual feeding. To achieve the research goal the following tasks were set: 1) to analyse frequency of visits to automatic feeding station; 2) to analyse changes in sheep live weight; 3) to analyse the amount of the daily concentrate intake.

Materials and Methods

The research on usage of automatic concentrate feeding stations for sheep feeding was carried out on the farm 'Mežoki' located in Latvia (57.016996, 21.632202). The study was carried out in production conditions. In total the research was carried out

over 3 periods, namely: from 21 February 2015 till 7 May 2015 (1st research period), from 1 November 2015 till 12 December 2015 (2nd research period) and from 13 December 2015 till 16 January 2016 (3rd research period).

In all research periods sheep (only female) for breeding were used. All sheep used in the 1st research period were born in the farm 'Mežoki' flock; at the beginning of the 1st research period there were 48 sheep born in the period from December 2013 till March 2014 (including). In the 1st research period the following sheep breeds were used: XX crossbreed (n = 10), 50% Latvian dark-head × 50% Texel (n = 24), 25% Latvian dark-head × 75% Texel (n = 14). The sheep of this group had not received feed concentrate before. In the 2nd research period 136 sheep were used, born in the period from December 2014 till May 2015 (including), except for two sheep, which were born in March 2014. Both sheep born in March 2014 had been used in the 1st research period as well. The sheep group of this research period consisted of 91 sheep born in the flock on the farm 'Mežoki' and 45 Texel purebred sheep, purchased in Germany in July 2015. In the 2nd research period the following sheep breeds were used: XX crossbreed (n = 4), 50% Latvian dark-head × 50% Texel (n = 52), 25% Latvian dark-head × 75% Texel (n = 31) and Texel (n = 49). Before the 2nd research period all the sheep of this group had received concentrate in unlimited amounts.

In the 3rd research period the same sheep were studied as in the 2nd research period, except for one (25% Latvian dark-head × 75% Texel), which lambed on 13 December 2015 and was taken out of the group. Thus in the 3rd research period the group consisted of 135 sheep (Table 1).

In the 1st research period six sheep did not visit the automatic concentrate feeding station, while during the 2nd and the 3rd research periods a total of 48 sheep did not visit the feeding station at all. Regrouping of the animals was observed in the 2nd and the 3rd research periods. The data obtained for analysis were grouped depending on the number of days an animal visited the feeding station: data on the sheep which did not visit the feeding station (Group 'N'), on the sheep which visited the feeding station daily during all the period (Group 'P'), and on the sheep which visited the feeding station part of the time period (Group 'D'). The figure following the letter in the name of the group denotes the research period. Data of Group D were subdivided into two other subgroups: data on the sheep which visited the automatic concentrate feeding station less than half of the number of days in the relevant period (group '1') and data on the sheep which visited the feeding station more than half of the number of days in the relevant period (group '2') (Table 1).

In every research period each sheep group was kept apart in a separate pen. All the sheep of one group

Table 1

Sheep distribution according to the number of days they visited the automatic feeding station

Subgroup	Average age at the beginning of research period, months	Number of sheep		Specific weight as compared with the total group, %		Automatic feeding station visiting, days
1st period total,	11	48		100		–
P1	11	26		54		76
D11	11	2	42	4	87	1 – 37
D12	11	14		29		38 – 75
N1	11	6	6	13	13	0
2nd period total	8	136		100		–
P2	8	17		13		42
D21	8	36	86	26	63	1 – 20
D22	9	33		24		21 – 41
N2	8	50	50	37	37	0
3rd period total	10	135		100		–
P3	10	54		40		35
D31	10	6	69	4	51	1 – 17
D32	11	9		7		18 - 34
N3	10	66	66	49	49	0

P1, P2, P3 – group of sheep which visited the feeding station daily during all the period, D11, D21, D31 – subgroup of sheep which visited the automatic concentrate feeding station less than half of the number of days in the relevant period, D12, D22, D32 – subgroup of sheep which visited the feeding station more than half of the number of days in the relevant period.

were provided continuous access to one automatic concentrate feeding station. The sheep were given free access to hay and water as well. Every third day access to haylage was provided.

In all research periods at the automatic feeding station the sheep were offered concentrate of the same content: 43% of cereals (barley (*Hordeum vulgare L.*)), 24% plant-based protein sources (wheat (*Triticum*) bran, feed beans (*Vicia faba*), sunflower (*Helianthus annuus*) coarse meal, soybean (*Glycine max*) coarse meal) 20% alfalfa (*Medicago sativa*) pellets and 13% the remaining ingredients (sugar beet (*Beta vulgaris* subsp. *vulgaris*) coarse meal, molasses – liquid, NaCl). Concentrate content: 83% of dry matter (DM), protein 19% in DM, crude fibre 25% in DM, metabolizable energy (ME) 11.87 MJ kg^{-1} of DM, net energy for lactation (NEL) 3.75 MJ kg^{-1} of DM, neutral detergent fiber (NDF) 23.51% in DM, acid detergent fiber (ADF) 8.9% in DM, P 0.49% in DM, Ca 1.27% in DM. Under the study the maximum daily concentrate feed rations for one animal according to the sheep groups were determined as follows: in the 1st research period – 400 g, in the 2nd research period – 400 g, in the 3rd research period – 700 g.

Before and after each research period the sheep live weight monitoring was organized with a New Zealand company's Tru-Test automatic weigh scales. Weighing accuracy is ± 0.1 kg for animals with live weight of up to 50 kg and ± 0.2 kg for animals with live weight of 50–100 kg. Live weight control dates: 7 February 2015 and 24 May 2015 (in the 1st research period), 18 October 2015 and 12 December 2015 (in the 2nd research period), 12 December 2015 and 16 January 2016 (in the 3rd research period).

After selection of sheep for the 1st and 2nd research periods and checking of live weight, a two week (14 days) adapting period was provided so that the sheep could get used to the automatic feeding station. After the adapting period, data collection in the automatic feeding station was started.

A BioControl Norway JSC compound concentrate feeding station for feeding of individual sheep was used in the study. The external measurements of the feeding station are 2 × 8 × 1 m, its mode of operation – continuous. Form of the concentrate feed – pellets. One standard dose dispensed in the feeding station – 25 g, maximum limit of intake at one visit to the feeding station – 100 g. Using the concentrate feeding station the following data were recorded: electronic ID number of the animal visiting the feeding station, date and time of the visit to the feeding station for each sheep, the amount of concentrate dispensed per visit, the amount of concentrate dispensed per day for each sheep after each visit, total concentrate amount for each sheep per day.

The concentrate intake quantity - 0 g caused as the result of faulty operation of the feeding station because of failure of the electrical power supply. It is possible, if the magnetic plate in the feeding station reads the sheep number, but dispenses no concentrate due to error. Recording of 0 g dispensed concentrate quantity has been registered only once during the entire period of research. In the 2nd research period sheep of subgroup P2 had concentrate intake above the determined ration, caused by the power supply failure on 18 November 2015, thus making no significant changes in the registration of concentrate quantity and data analysis, and data represented in the results.

The data were analysed with mathematical processing methods, using free software 'R Statistics'. The number of visits, quantity of compound concentrate fed, sheep live weight mean values, standard error and coefficient of variation were calculated, as well as the parameters obtained were compared between groups, determining significance of their differences and designating with the lower-case and capital alphabetical characters; a, b, c, A, B $p \leq 0.05$, or ** $p \leq 0.01$; *** $p \leq 0.001$; n. s. difference is not significant ($p > 0.05$).

Results and Discussion

The results of feeding station visits obtained (Table 2) show that in the 1st and the 2nd periods the number of visits of P1 and P2 group sheep was the largest (6.2 and 5.2 respectively). The mean number of daily visits was significantly different between the subgroups of the 2nd research period. The number of visits registered ranged from one to 14. The maximum (14) visits per day made sheep of subgroups D12 and D22. Mode and median of the number of visits in subgroups of the 1st and 2nd research period are similar. These indicators are similar with the mean number of daily visits too, except subgroup D21.

There was no significant difference among mean values of the number of visits made by sheep subgroups in the 1st research period. In the 2nd research period there existed significant differences ($p \leq 0.05$) between mean values of the number of visits to the feeding station in all subgroups.

In the 3rd research period sheep of subgroup P3 had the highest mean number of visits to the concentrate feeding station per day (7 visits); the mean number of visits to the automatic feeding station per day differs significantly between all subgroups. In the 3rd research period the mean number of visits to the concentrate feeding station per day for all subgroups was higher (6.9 visits) than in the 1st and 2nd research periods (6.1 and 4.7 visits, respectively) as well, which can be explained by the fact that in the 3rd period the

Table 2

Daily number of visits to the automatic feeding station

Group	$\overline{x} \pm S_{\overline{x}}$	Min	Max	Median	Mode	V%
1st period total	6.1 ± 0.03[A]	1	14	6	6	28
P1	6.2 ± 0.04[a]	1	13	6	6	27
D11	6.1 ± 0.23[a]	1	9	6	6	23
D12	6.0 ± 0.06[a]	1	14	6	6	32
2nd period total	4.7 ± 0.04[B]	1	14	5	5	37
P2	5.2 ± 0.06[a]	1	10	5	5	29
D21	2.3 ± 0.16[b]	1	7	1	1	79
D22	4.7 ± 0.05[c]	1	14	5	5	35
3rd period total	6.9 ± 0.05	1	14	7	8	31
P3	7.0 ± 0.04[a]	1	14	7	8	28
D31	1.9 ± 0.24[b]	1	6	1	1	74
D32	6.2 ± 0.20[c]	1	12	7	8	46

[a, b, c] – there are significant differences between subgroups, p ≤ 0.05, the differences between subgroups are determined separately within the limits of each research period. [A, B] – there are significant differences between results of research periods in total, p ≤ 0.05. P1, P2, P3 – group of sheep which visited the feeding station daily during all the period, D11, D21, D31 – subgroup of sheep which visited the automatic concentrate feeding station less than half of the number of days in the relevant period, D12, D22, D32 – subgroup of sheep which visited the feeding station more than half of the number of days in the relevant period.

daily concentrate ration was increased (from 400 g in the 1st and 2nd research periods to 700 g in the 3rd research period).

In all research periods the coefficient of variation for all subgroups was above 10%, which coincides with the results of Wedl *et al.* (1999) research.

Comparing the mean values of the daily concentrate intake (Table 3), it can be seen that in the 1st research period there were significant differences (p < 0.001) between subgroups P1 and D12. In the 2nd research period there were significant differences (p ≤ 0.05) between daily concentrate

Table 3

Daily concentrate intake quantity for sheep, g

Group	$\overline{x} \pm S_{\overline{x}}$	V%	Min	Max
1st period total	373.5 ± 1.17[A]	18	0	775
P1	378.4 ± 1.32[a]	16	0	775
D11	391.3 ± 5.41[ab]	9	25	475
D12	362.7 ± 2.33[b]	21	25	525
2nd period total	333.1 ± 2.42[B]	32	25	425
P2	356.6 ± 3.20[a]	24	50	425
D21	168.5 ± 12.12[b]	80	25	400
D22	336.4 ± 2.99[c]	30	25	400
3rd period total	581.2 ± 3.61	29	25	700
P3	597.4 ± 3.38[a]	25	25	700
D31	133.3 ± 20.83[b]	90	25	575
D32	500.6 ± 15.34[c]	44	25	700

[a, b, c] – there are significant differences between subgroups, p ≤ 0.05, the differences between subgroups are determined separately within the limits of each research period. [A, B] – there are significant differences between results of research periods in total, p ≤ 0.05. P1, P2, P3 – group of sheep which visited the feeding station daily during all the period, D11, D21, D31 – subgroup of sheep which visited the automatic concentrate feeding station less than half of the number of days in the relevant period, D12, D22, D32 – subgroup of sheep which visited the feeding station more than half of the number of days in the relevant period.

intake in all subgroups. In both periods the average daily concentrate intake was in the range from 168.5 g (subgroup D21) to 391.3 g (subgroup D11). In the 1st period subgroup D11 sheep had the biggest amount of daily concentrate intake (391.3 g) and in the 2nd research period – the sheep of subgroup P2 (356.6 g). The lowest average quantity of concentrate intake coincides with the lowest average number of visits to the feeding station for subgroups D12 and D21 (Table 2 and Table 3).

In the 1st and the 2nd research periods the variation coefficient of the concentrate intake quantity for all subgroups (except subgroup D11) is above 10%. Subgroup D21 has the highest coefficient of variation of the concentrate intake quantity (80%) and it also has the highest coefficient of variation (79%, Table 2) of the number of visits to the concentrate feeding station. The results for all subgroups in relation to the number of visits to the feeding station as well as to the quantity of feed intake point to the fact that the registered data are varied. It confirms the observation of Wendl *et al.* (1999) in the research done in 1999 on too great a scatter of the data depending on the type of food and the sheep individual needs.

After summarizing the mean values of feed intake in the 3rd research period, it is evident that there exist significant differences ($p \leq 0.05$) between all subgroups (Table 3). In the 3rd research period the average quantity of daily concentrate intake was 581.2 g. Sheep of subgroup P3 had the biggest daily concentrate intake quantity (597.4 g). The coefficient of variation of concentrate intake for the sheep groups of the 3rd research period is in the range from 25% (for subgroup P3) to 90% (for subgroup D31).

Figure 1 shows a strong positive relationship between the average daily concentrate intake and the average number of visits to the feeding station, as it was also indicated by the resulting correlation coefficient ($r = 0.69$, $p < 0.001$). Coefficient of determination was 0.522 and y value indicates if the number of daily visits to the feeding station increase is 1, it results in 52.74 g increase of daily concentrate intake.

Sheep average live weight before entire research period were compared. There were no significant differences ($p > 0.05$) between sheep average live weight within groups. Also sheep average live weight after entire research period were compared, there were no significant differences ($p > 0.05$) within groups and subgroups. Absence of significant differences between sheep subgroup average live weight after each research period can be explained by the fact that for the sheep subgroups, the average live weight of which was higher at the beginning, the average live weight gain was lower (N1, D21, D1), as compared with the sheep subgroups, the average live weight of which was lower at the beginning of the relevant research period (P1, P2, D31, P). The positive influence of concentrate on live weight gain has been proved also for animals during the grazing season (Bosing *et al.*, 2014).

Ater comparing the mean values (Table 4), the following sheep subgroups had a significant ($p \leq 0.001$) live weight gain: P1, P3, P and D2. There are no significant ($p > 0.05$) live weight differences for the following sheep subgroups: N1, D11, N2, D21, D22, N3, D31, D32, N and D1.

During the relevant research period, the live weight of the sheep of all subgroups (except D11 and N2) has increased. In the 2nd research period, the sheep average live weight gain of subgroup N2 is negative (-500 g), but it is positive in the 3rd research period, which cannot be explained by the usage of concentrate feeding station. Such live weight changes could be
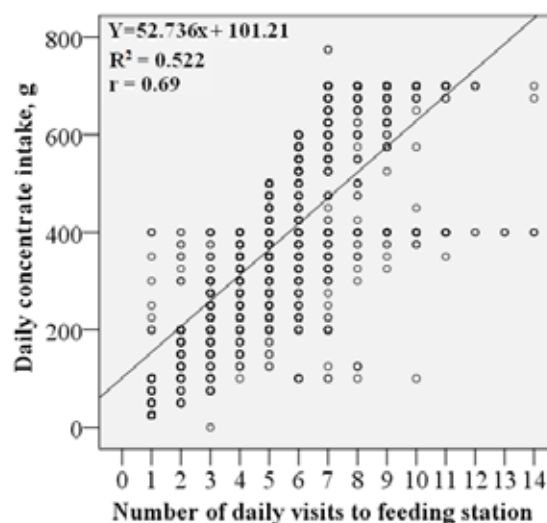
Figure 1. Relationship between daily number of visits to the feeding station and daily concentrate intake.

Table 4

Sheep live weight changes during the research

Group	Live weight, kg		Live weight difference, kg	Significance
	before the research	after the research		
	$\overline{x} \pm S_{\overline{x}}$			
1st period total	48.3 ± 0.91	51.2 ± 0.86	2.9	***
N1	50.0 ± 3.63	51.2 ± 3.81	1.2	n. s.
P1	47.0 ± 0.97	50.6 ± 0.96	3.6	***
D11	48.8 ± 3.75	48.5 ± 2.50	-0.3	n. s.
D12	49.9 ± 2.03	52.5 ± 1.76	2.6	**
2nd period total	50.6 ± 0.68	51.0 ± 0.62	0.4	n. s.
N2	50.3 ± 1.13	49.8 ± 1.07	-0.5	n. s.
P2	47.3 ± 2.09	49.9 ± 1.49	2.6	**
D21	51.4 ± 1.28	51.7 ± 1.25	0.3	n. s.
D22	51.8 ± 1.36	52.6 ± 1.20	0.8	n. s.
3rd period total	51.0 ± 0.63	52.3 ± 0.69	1.3	***
N3	50.1 ± 0.94	50.6 ± 0.94	0.5	n. s.
P3	51.6 ± 0.82	53.7 ± 0.82	2.1	***
D31	50.3 ± 1.99	51.6 ± 1.99	1.3	n. s.
D32	54.9 ± 3.81	56.9 ± 3.81	2.0	n. s.

** $p \leq 0.01$; *** $p \leq 0.001$; n. s. difference is not significant. N1, N2, N3 – group of sheep which did not visit the feeding station, P1, P2, P3 – group of sheep which visited the feeding station daily during all the period, D11, D21, D31 – subgroup of sheep which visited the automatic concentrate feeding station less than half of the number of days in the relevant period, D12, D22, D32 – subgroup of sheep which visited the feeding station more than half of the number of days in the relevant period.

related to the fact that before the 2nd research period subgroup N2 sheep had received an unlimited amount of concentrate, but with distribution of concentrate by automatic feeding station, they no longer received the concentrate, which was followed by live weight loss. In the 3rd research period, the sheep of subgroup N3 did not receive any concentrate as well, yet an average live weight gain was observed.

Upon increasing the daily concentrate ration for each sheep from 400 g to 700 g in the 3rd research period, the group as a whole gets a significant live weight gain ($p < 0.001$).

In the 3rd research period, the sheep live weight gain in subgroups D31 and D32 is higher than the live weight gain of sheep from the relevant subgroups in the 2nd research period (D21 and D22).

In different studies, it has been proved that during the grazing season diet supplementation with concentrate also significantly increases the feed intake of lambs (Bosing *et al.*, 2014) and the feed intake of lactating ewes in postpartum period in comparison with the animals whose diets were not supplemented with concentrate (Joy *et al.*, 2014).

In view of the sheep regrouping in the 2nd and 3rd research periods and the time required for concentrate intake, when determining the daily concentrate ration in the amount of 400 g and 700 g, the preferable size of a sheep group for one feeding station should not be more than 70 sheep.

Conclusions
1. During the research period, a part of sheep did not visit the automatic concentrate feeding station: in the 1st period – 13% sheep, in the 2nd and 3rd periods – 37% un 49%, respectively.
2. Setting the daily ration for a sheep as 400 g, the average daily number of visits to the concentrate feeding station was 6.1 (in the 1st period) and 4.7 (in the 2nd period). Upon increasing the daily concentrate ratio up to 700 g, the average daily number of visits to the feeding station was 6.9 (in the 3rd period). The number of visits to the concentrate feeding station varied ($V > 10\%$).
3. In the 1st, 2nd and 3rd periods live weight increased significantly ($p \leq 0.05$) for the subgroups of sheep which made regular visits to the feeding station. In the 1st period there was a significant live weight gain ($p = 0.006$) for the subgroup of sheep, which visited the feeding station from 38 to 75 days.

4. In all research periods, the quantity of average daily concentrate intake (373.5 g in the 1st period, 333.1 g in the 2nd period and 581.2 g in the 3rd period) was 93%, 83% and 83%, respectively, of the maximum set ration (400 g in the 1st and 2nd period, 700 g in the 3rd period).

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PRODUCTIVITY PERFORMANCE IN AGRICULTURE: COMPARISON OF THE BALTIC COUNTRIES

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Abstract
The productivity and its performance is one of the core topics of economics studies. The growth of productivity is an indicator of competitiveness, as well as a possible way to achieve economic growth and wellbeing. After joining the EU, the agriculture of the Baltic countries faced increasing competition of the EU Single Market, while having relatively lower productivity indicators. Since 2004, significant structural changes have taken place in the agriculture of the Baltic countries, and it is a topical question whether these changes and overall trends in the agricultural sectors of the Baltic countries have facilitated to increase productivity. Therefore, the objective of the study is to evaluate the productivity growth of the main production factors and the total factor productivity growth in the agriculture of the Baltic countries between 2004 and 2015, in relation to the changes in the use of the production factors. The paper focuses on the value added as output, and land, labour and capital as individual inputs to obtain partial productivity measures. The evaluation of TFP is based on the Index number approach, where TFP growth is a ratio of the Output index to the Input index. The calculations and analyses show that since 2004 both the agricultural output and value added have increased in the agriculture of the Baltic countries, and also productivity performance has improved.
Key words: production factors**,** total factor productivity, agriculture, Baltic countries.

Introduction

In the production process, as a result of human labour and use of machinery and specific technologies, after a certain period of time and consumption of materials the product is generated. If the product is sold in the market, the production costs are covered from the sales revenues, and the generated value added is a source for covering the costs of production factors.

Studies on the future of agricultural farms in Europe occasionally give a definition that a farm is viable if it has at least an income that covers its expenditures (Fritzsch *et al.*, 2011).

After joining the European Union (EU), in 2004 the agriculture of the Baltic countries demonstrated low partial productivity, particularly as to the efficiency in the use of labour (value added at current prices was 2.0 EUR per annual working unit (AWU) in Latvia, EUR 3.1 per AWU in Lithuania and EUR 5.4 per AWU in Estonia, compared to EUR 13.8 per AWU as the EU-27 average). Also, total value added per output unit was notably smaller than the EU average; consequently, the ability of farms in the Baltic countries to pay for production factors was lower. As a result, since 2004 significant changes have taken place in the farm structure in the Baltic countries: the total number of farms has fallen by about 1/3, and, along with an increase in agricultural output, the concentration in contribution to value added and management of production factors has increased too.

As an external factor, after joining the EU Single Market with free movement of goods and production resources the higher competition in agricultural product market as well as in the market of production resources, mainly labour, had an effect on the development of the agricultural sectors in the Baltic countries.

Also, the development of the agricultural sector in all three Baltic countries has been affected by the EU Common Agricultural Policy, where one of the five objectives for its establishing is to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular labour (Massot, 2016).

It is a topical question whether these structural changes and overall trends in the agricultural sectors of the Baltic countries have facilitated productivity growth in agriculture. Productivity growth is a desirable outcome of development and technological progress. As productivity not only determines wealth and economic growth as well as is an indicator of competitiveness, it also creates foundations for management decisions both at the firm level and also at the national level for policy makers (Beņkovskis & Bēms, 2014; Polak, 2017).

The objective of the study is to evaluate the productivity growth of the main production factors and the total factor productivity growth in the agriculture of the Baltic countries between 2004 and 2015, in relation to the changes in the use of the production factors. Therefore, the study analyses the dynamics of the utilisation of agricultural production factors and qualitative structural changes in the Baltic countries by comparing the indicators of 2015 to those of 2004, as well as calculates and analyses the partial and total factor productivity (TFP) growth in the agriculture of the Baltic countries between 2004 and 2015.

Materials and Methods

There are many different productivity measures, and the choice between them depends on the purpose of productivity evaluation and, in many instances, on the availability of data (OECD, 2001). One of the main problems in measuring productivity is the multiple production factors that are used in the production process, as different perspectives could be adopted to form the aggregates resulting in the application of various methods that differ in terms of accuracy, ease of implementation and data requirements (Diewert & Nakamura, 2002; Csaba, Irz, & Kuosmanen, 2014). To simplify the problem of aggregation, partial productivity measures are widely used in the economic analysis, which focus only on one output and one input at a time. The main advantage of partial productivity measures is the ease of calculation and interpretation, but they can sometimes provide a misleading indication of overall productivity when considered in isolation from other indicators (Csaba *et al*., 2014).

In its turn, the TFP measures consider all inputs and outputs used in the production process. The basic definition of the TFP is the rate of transformation of total input into total output and multiple methods which all can be viewed as measures of the TFP growth exist (Diewert & Nakamura, 2002).

In this study, the partial productivity measures of the main production factors (values at current prices and also at constant 2005 prices to obtain volume changes are used), as well as the TFP growth has been calculated. TFP growth has been measured, based on the Index number approach, where productivity growth is the change in output not explained by the change in input use. Therefore, the TFP growth has been defined as the ratio of the Output index to the Input index (Diewert & Nakamura, 2002; Kuosmanen & Sipiläinen, 2004):

$$TFP_t = \frac{I_{q,t}}{I_{i,t}}, \tag{1}$$

where I_q represents the growth rate of output and I_i stands for the growth rate of inputs, and t – time period considered (t = 2004, …, 2015). The variable used for the growth rate of output is the volume index of the output of the agricultural 'industry'.

Whereas, I_i has been aggregated using Fisher input index (Kuosmanen & Sipiläinen, 2004):

$$F_{i,t} = \left(\frac{\left(\frac{m_t}{m_{t-1}} x_{m,t-1} + \frac{l_t}{l_{t-1}} x_{l,t-1} + \frac{c_t}{c_{t-1}} x_{c,t-1} + \frac{r_t}{r_{t-1}} x_{r,t-1} \right)}{\left(x_{m,t-1} + x_{l,t-1} + x_{c,t-1} + x_{r,t-1} \right)} \right.$$
$$\left. \frac{\left(\frac{m_t}{m_{t-1}} x_{m,t} + \frac{l_t}{l_{t-1}} x_{l,t} + \frac{c_t}{c_{t-1}} x_{c,t} + \frac{r_t}{r_{t-1}} x_{r,t} \right)}{\left(x_{m,t} + x_{l,t} + x_{c,t} + x_{r,t} \right)} \right)^{1/2}, \tag{2}$$

where m – growth rate of intermediate consumption; l – growth rate of labour input; c – growth rate of capital input; r – growth rate of land input; and x_m, x_l, x_c, x_r are the weights for intermediate consumption, labour, capital and land respectively; t – time period considered (t = 2004, …, 2015).

The variables used in the calculations of Fisher input index were defined as follows: m – volume index of intermediate consumption; l – volume index of agricultural labour input; c – volume index of fixed capital consumption; r – growth rate of the utilized agricultural area (UAA); x_m – value of intermediate consumption; x_l – value of compensation of employees (including calculated remuneration for non-salaried labour force); x_c – value of fixed capital consumption multiplied by the average deposit interest rate (i.e., capital rental price according to (Groth, Gutierrez-Domenech, & Srinivasan, 2004)); x_r – value of rents (including calculated rents for owned land).

For other 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.

The main data sources for the study are Eurostat data from the Economic Accounts for Agriculture (EAA) and Farm structure survey, and DG Agri data from Farm Accountancy Data Network (FADN), complemented by the data from the national statistical bureaus of the Baltic countries. Different publications and papers, e.g., research papers and the reports of institutions have also been used in the study.

Results and Discussion

Production factors, being constituent elements of the key questions in economic theory (*what, how much and how to produce*?), having limited nature and presenting challenges for economic research in evaluation of productivity and distribution of income, continue to be a topical issue. While analysing the use of production factors and the changes in productivity, the authors of this paper keep to the traditional definition of production factors, namely, land, labour, capital and entrepreneurship. When analysing issues of productivity, this definition of production factors nowadays is used also by other researchers, both in Latvia and internationally (Coelli & Rao, 2005; Petrick & Kloss, 2013; Banse, Rothe, & Shutes, 2013).

The production factor land comprises UAA and soil fertility. Labour represents agribusiness employment (both paid and non-paid labour). Capital covers financial resources that are being invested as well as all means of production created and accumulated by humans and used in manufacturing of goods, including information and intellectual
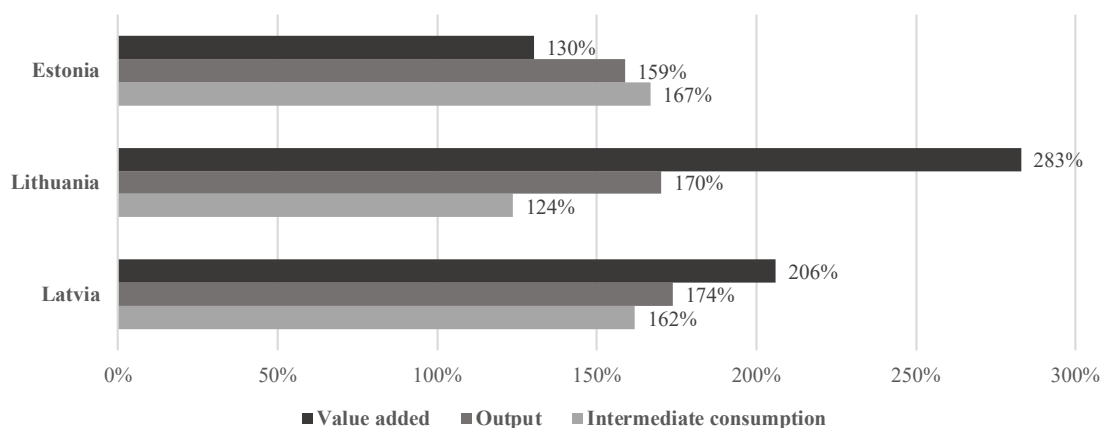
Source: calculations by authors, based on Eurostat (2017a) data.

Figure 1. Development of value added, output and intermediate consumption in the agriculture of Latvia, Lithuania and Estonia in 2015 compared to 2004 (at 2005 constant prices).

capital (patents, licences etc.). In agriculture, contrary to other sectors of economy, biological resources are used in production as well (productive animals and permanent crops), which also fall under this constituent. *Entrepreneurship* is not being analysed separately: nevertheless, the authors of this paper believe that the productivity of this factor expresses itself in the TFP growth calculations, revealing that part of the TFP growth which cannot be explained with the increase in volume of production factors, i.e., introduction of new technologies, combination of production factors and overall organisation of production (i.e., entrepreneurship as a contributor to the productivity growth).

The utilisation and structure of the production factors

In the time period since 2004 (Figure 1), agricultural output in the Baltic countries has increased by about 1.7 times (2015/2004, at 2005 constant prices). Whereas the intermediate consumption (at 2005 constant prices) has increased only by 24% in Lithuania and by about 60% in Latvia, and by almost 70% in Estonia (2015 compared to 2004); therefore, the total increase of value added in agriculture was even more impressive than that of output in Latvia and Lithuania – value added nearly tripled in Lithuania and more than doubled in Latvia, while the growth in Estonia was somewhat slower, by 30% (2015/2004, at 2005 constant prices).

There are two ways of increasing output – either by engaging more production factors or, alternatively, by increasing the productivity of utilisation of existing factors (Matthews, 2014). In the period starting from 2004 all Baltic countries have increased the UAA engaged in production. This increase was by 15% in Latvia and Lithuania and by 25% in Estonia (Figure 2).

The fact that additional areas of UAA are being engaged in agricultural production points to extensive development. However, the productivity of the use of UAA in all three Baltic countries has increased as well (value added per ha, at 2005 constant prices). When we compare 2015 to 2004, the productivity of the use of UAA has increased by 145% in Lithuania, by 80% in Latvia and by 4% in Estonia. Thereby, as to the use of UAA, both an increase in production efficiency and expansion were observed.

The structure of the UAA has remained unchanged since 2005 only in Latvia (Table 1) and the extra UAA engaged in agricultural production has been distributed proportionally between the main types of its use.

In 2013, the area of arable land decreased by 5 percentage points in Estonia, while that of permanent grassland and meadow increased, suggesting a more outspoken change in farm specialisation in Estonia in favour of animal farming. Given that in Estonia UAA have increased overall by 25%, of which about 65% pertain to permanent grassland and meadow, the shift in the specialisation of agricultural production is even more evident. Conversely, in Lithuania the areas of arable land have increased by 13 percentage points while those of permanent grassland and meadow have decreased; therefore, all additionally engaged UAA were diverted to arable land, suggesting of crop farming being selected by Lithuanian farms as their preferred specialisation.

In Latvia and Estonia, the use of fertilisers and other soil improvers (intermediate consumption) for the purpose of increasing soil fertility in 2015 compared to 2004 has increased considerably both in terms of value and volume (Table 2). It is interesting to mention that in Lithuania the productivity of the use of UAA has been achieved without increasing the
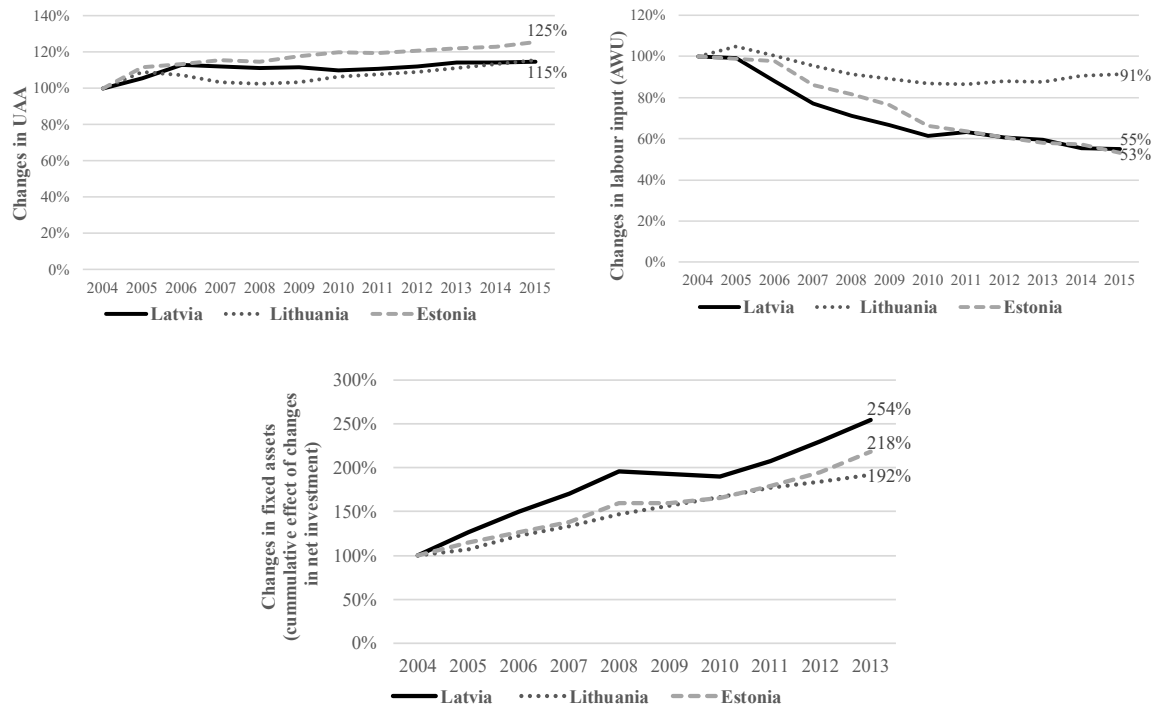
Source: calculations by authors, based on Eurostat (2016), DG Agri FADN (2017), CSB of Latvia (2016c), Statistics Lithuania (2016) and Statistics Estonia (2016) data.

Figure 2. Development of the use of the main production factors in the agriculture of Latvia, Lithuania and Estonia in 2004 – 2015 (2004 = 100%).

Table 1

Use structure of the UAA in Latvia, Lithuania and Estonia in 2005 and 2013

UAA type	2005			2013		
	LV	LT	EE	LV	LT	EE
Arable land	63%	67%	71%	65%	79%	66%
Permanent crops	2%	1%	0%	0%	1%	0%
Permanent grassland and meadow	35%	32%	29%	35%	20%	34%

Source: calculation by authors, based on Eurostat (2017b) data.

consumption of fertilisers and other soil improvers per 1 ha of UAA.

At the beginning of the analysed period the proportion of agribusiness employment in overall employment structure was high in the Baltic countries, while average remuneration was low in comparison to the EU average level. In Latvia, a study on the potential development scenarios of rural areas arrived at a conclusion that at the EU average productivity level, even the full utilization of agricultural potential cannot stop the decrease in agribusiness employment in Latvia due to high labour density in Latvian agribusiness (Leimane, Krievina, & Miglavs, 2011). According to statistics, the labour input in Latvian agriculture has decreased by about half since 2004 (Figure 2). The situation is similar in Estonia, where

labour input in 2015 was also about half of the level in 2004, while the decrease in Lithuania was relatively small, by 9%.

With a shrinking labour input and growing value added, an increase in labour productivity has been recorded in the agriculture of the Baltic countries when comparing 2015 to 2004: in Latvia, value added per AWU has increased by 3.8 times, in Lithuania by 3.1 times and in Estonia by 2.5 times (at 2005 constant prices). Despite of that, at the end of the period in Estonia value added per AWU is considerably higher than in Lithuania and Latvia – EUR 13.7 per AWU, EUR 7.4 per AWU and EUR 4.8 per AWU respectively; thus, in absolute terms, Estonia has demonstrated a higher growth of productivity in agribusiness employment since 2004.

Table 2

Use of fertilisers and soil improvers in Latvia, Lithuania and Estonia in 2004 and 2015

	Values at current prices			Values at constant prices (2005)		
	EUR ha^{-1}		%	EUR ha^{-1}		%
	2004	**2015**	**2015/2004**	**2004**	**2015**	**2015/2004**
Latvia	20.3	75.3	371%	24.5	39.9	163%
Lithuania	45.5	100.4	221%	56.5	55.9	99%
Estonia	16.5	57.9	352%	17.4	42.4	244%

Source: calculation by authors, based on Eurostat (2017a) data.

Table 3

Farm managers by their agricultural education in Latvia, Lithuania and Estonia in 2005 – 2013, % of total number of farms

	2005			2013		
	Practical experience only	**Basic training**	**Full agricultural training**	**Practical experience only**	**Basic training**	**Full agricultural training**
Latvia	66%	12%	22%	58%	13%	28%
Lithuania	69%	19%	12%	65%	19%	15%
Estonia	67%	11%	22%	60%	14%	26%

Source: calculation by authors, based on Eurostat (2017a) data.

Since 2004, in the Baltic countries the qualifications of those engaged in agriculture have become more advanced. The analysis of education and hands-on experience of farm managers leads to a conclusion that in all three Baltic countries the share of farm managers having obtained full agricultural training has increased (by 3 percentage points in Lithuania and by 6 percentage points in Latvia), with a concurrent decrease of the share of farm managers having only practical agricultural experience and skills (Table 3).

In the course of production process, production factors form a reciprocal structure and interact in a technologically organised manner. An analysis of interconnection between the dynamics of labour input and capital investment allows concluding that against the background of increased output, a fall in labour input in the agriculture of the Baltic countries has been possible on account of its substitution with capital (Figure 2). Starting from 2004, significant investments towards development of fixed assets have been made in the agricultural sectors of the Baltic countries. According to generalised FADN farm group data, total net investment amount in 2005-1013 was EUR 2,555 million in Lithuania, EUR 1,366 million in Latvia and EUR 872 million in Estonia. In Lithuania, this equals EUR 960 per ha of agricultural land in these farms in 2013, in Latvia EUR 870 per ha and in Estonia EUR 840 per ha. As an effect of net investment, the highest resulting increase in the value of fixed assets is observed in Latvia (by 2.5 times),

followed by Estonia (by 2.2 times) and Lithuania (by 1.9 times).

As a result of long-term investment, the structure of fixed assets in Latvia has not undergone any major changes in 2013, investment in land contributed 35% of total value of fixed assets, while the contribution of investment in buildings was 26%, that of technological machinery and equipment was 31% and that of productive animals was 7%. As to Lithuania, in 2013 compared to 2004 there has been a 15 percentage point increase in the share of technological equipment in terms of value, amounting to 46%; investment in land being 32% and investment in buildings being 15% of total value of fixed assets. As to Estonia, in 2013 investment in technological machinery and equipment dominated in the structure of fixed assets – 36% (an increase by 13 percentage points compared to 2004), while investment in land contributed 25%, investment in buildings 31% and investment in productive animals 8% to total value of fixed assets.

Evaluation of the total factor productivity growth

TFP growth reflects the part in production efficiency growth that is not due to the increase in the volume of factors invested in production. Thereby the TFP growth is a result of combined effect of multiple elements associated with production management and organisation (entrepreneurship), as well as the implementation of new technologies, management skills, changes in production organisation, and economy of scale.
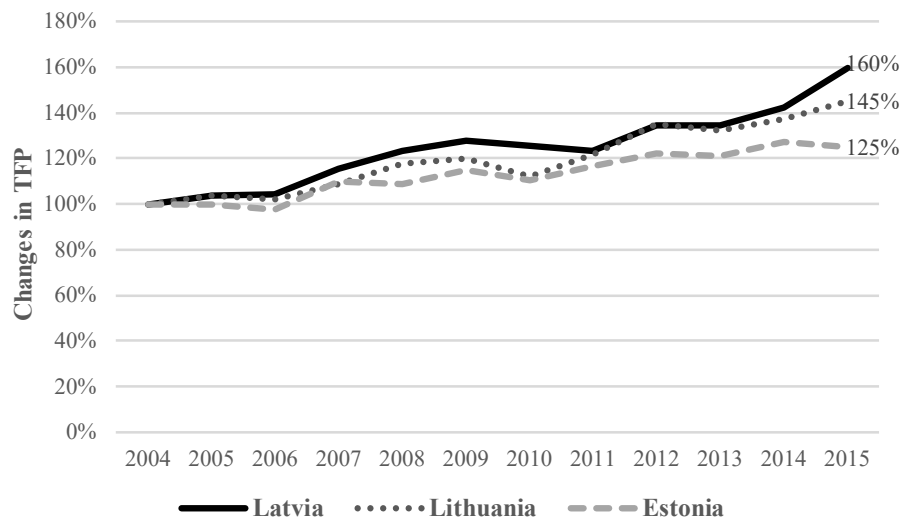
Source: calculations by authors, based on Eurostat (2017a; 2016), CSB of Latvia (2016a; 2016c), Statistics Lithuania (2016a; 2016b), Statistics Estonia (2016); DG Agri FADN (2017) data.

Figure 3. Development of the total factor productivity growth in the agriculture of Latvia, Lithuania and Estonia in 2004 – 2015 (2004 = 100%).

The calculations performed by applying the Index number approach evidence that between 2004 and 2015 the fastest TFP growth by 60% has been observed in the Latvian agriculture. (Figure 3).

The analysis of the TFP growth in combination with the dynamics of the utilisation of production factors and the changes in the partial productivity performance of the factors concerned leads to a conclusion that, as to Latvia, the ability to productively use investments in the development of capital was the driver of a faster TFP growth, enabling a rise in labour and UAA utilisation productivity and restricting the increase of intermediate consumption, which, as a result, was slower than that of agricultural output (Figure 1). The qualification of farm managers, too, is relatively higher in Latvia than in the rest of the Baltic countries.

Also in Lithuania, a growing productivity of UAA has largely facilitated the TFP increase (by 45%), including structural changes and a higher share of arable land, as well as investment in capital and production organisation, which enabled to raise the labour productivity and also to curtail the growth of intermediate consumption relative to output.

Contrary to other Baltic countries, in absolute terms, Estonia already at the beginning of the period demonstrated a higher productivity both in the utilisation of labour and UAA. Thus, a relatively slower TFP growth (by 25%) does not speak of inferior performance in absolute terms: in 2015 labour productivity (value added in EUR per AWU) in Estonia was by 84% higher than in Lithuania and almost 3 times as much as in Latvia. In the period

since 2014, the TFP growth in Estonia was facilitated by the ability to combine investment in capital, thereby achieving an increase in labour productivity; conversely, an increase in intermediate consumption, which was higher than that of output (Figure 1), slowed down the TFP growth.

Despite the fact that the TFP growth in Latvia was faster over the analysed period, value added per full-time employee is the lowest among the Baltic countries, and this continues to determine the relatively low average remuneration in the sector.

Conclusions
1. Since 2004, both the agricultural output and value added have increased in the agriculture of the Baltic countries, and also productivity performance has improved.
2. The UAA engaged in production has increased in all Baltic countries, especially in Estonia. Along with the expansive development direction which enabled a growth in agricultural output, the productivity of UAA (value added per ha, in constant prices) has also increased in all Baltic countries. Lithuania has demonstrated the highest growth of the productivity of UAA (2015 compared to 2004); moreover, it has been achieved without an increase in the consumption of fertilisers and other soil improvers per hectare of UAA. However, it should be mentioned that structural changes in the use of UAA point to a shift in specialisation in Lithuania, where preference is given to crop farming, while animal farming is more favoured in Estonia, but in Latvia

the structure of the use of UAA has not changed significantly.

3. Starting from 2004, labour input in agriculture has been decreasing: in Latvia and Estonia labour input in 2015 was about one half of the 2004 level, while the decrease in Lithuania was relatively small. With a simultaneous investment in the growth of fixed assets and upgrades in the farm machinery and equipment, all three Baltic countries have been able to achieve higher labour productivity: in Latvia, value added per full time employee has increased by 3.8 times, in Lithuania by 3.1 times and in Estonia by 2.5 times (at constant prices).

4. The TFP growth dynamics between 2004 and 2015 has been similar in the Baltic countries. Agriculture in Latvia reports the most rapid cumulative TFP growth. This was fostered by an ability to efficiently use investments for development of capital, allowing an increased productivity in the use of labour and UAA, and restrict the increase of intermediate consumption, which, as a result, was lower than that of agricultural output. In Lithuania, the TFP increase is the result of a growing UAA productivity, including structural changes in the use of UAA, as well as investment in capital and production organisation, which enabled to curtail

the growth of intermediate consumption and also to raise the labour productivity relative to output. The TFP growth in Estonia was relatively slower; it was facilitated by the ability to combine investment in capital, thereby achieving an increase in labour productivity, however, an increase in intermediate consumption, which was higher than that of output slowed down the TFP growth. Contrary to other Baltic countries, in absolute terms, Estonia already at the beginning of the period demonstrated a higher productivity both in the utilisation of labour and UAA. Thus, a relatively slower TFP growth does not speak of inferior performance in absolute terms.

5. Despite the fact that Latvia demonstrated the fastest TFP growth after the EU accession, value added per full-time employee is nevertheless the lowest among the Baltic countries, and this continues to determine the relatively low average remuneration in the sector and has a negative effect on the competitiveness of the sector.

Acknowledgements

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THE IMPORTANCE OF THE LEADER PROGRAMME 2007 – 2013 IN THE RURAL AREAS DEVELOPMENT IN POLAND

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Abstract
The article deals with the implementation of the LEADER programme in Poland. The aim of the paper was to present the influence of the LEADER programme 2007 – 2013 on rural areas development taking into account its objectives. This topic is current in the context of the Rural Development Programme 2007 – 2013 evaluation and search for effective tools for supporting rural areas. The results of research conducted in 2016 among residents and local action groups are presented. Firstly, the LEADER programme had little impact on the possibility of finding work outside the agriculture. Secondly, the realized projects have contributed to the improvement of the quality of life of the residents in rural areas, especially when it comes to meeting the needs of tourism and leisure. The programme was of great importance in underpinning social capital in the countryside, especially its behavioral and bonding dimension. It is very significant taking into account the low level of social capital in rural areas in Poland. An overall level of activity of rural residents and other entities increased, so as the propensity to engage in joint initiatives and the level of trust. The observed effects of the LEADER programme may in the future contribute significantly to the endogenous development of rural areas.
Key words: rural areas, endogenous development, social capital, LEADER approach, Local Action Groups, Poland.

Introduction

Rural areas in Poland occupy 93 percent of the area inhabited by 40 percent of Poland's population (CSO, 2015)[1], which means they are very important in the country's development policy. The development level of rural areas is strongly differentiated both regionally and interregionally (Rosner, 2007; Rakowska & Wojewódzka, 2010; Stanny & Drygas, 2010; Stawicki, 2015) (NUTS 2), depending mostly on the location of rural areas vis-à-vis urban centres. The analyses of disparities in the level of development in Poland point, among others, to the existing discrepancies between the development level of rural areas and that of other areas (Grosse, 2004; Rosner & Stanny, 2014). The main socio-economic problems in rural areas include poorly developed social and hard infrastructure, high unemployment level, poorly developed services and low level of education of the local residents. Research studies corroborate a dynamic development of rural areas in the recent years, a phenomenon which is also confirmed by observable convergence processes (Wojewódzka-Wiewiórska & Dudek, 2016). Moreover, the characteristic feature of rural areas in Poland is the low level of social capital which is very differentiated spatially (Czapiński, 2013), owing to such factors as the historical policies of the countries occupying Poland at the time of the Partitions, impact of many religions, changes in the administrative borders, operation of the communist regime or migrations, particularly in the recent years. In the rural areas, the level of social capital is much lower than in the cities (Wojewódzka-Wiewiórska, 2015, 2016).

In Poland, instruments supporting the development of rural areas and solving its problems included the Rural Development Programme 2007 – 2013 (RDP 2007 – 2013), a component of the EU Common Agricultural Policy. The programme's main goal was to implement the concept of multifunctionality of agriculture and rural areas; it comprised specific objectives reflected in the Programme axes, i.e. improving the competitiveness of agriculture and rural areas; improving the environment; improving the quality of life, and social activation (RDP, 2007).

The LEADER approach was the Axis 4 of the RDP 2007 – 2013, which covered 4.2% of its funds. The aim of the LEADER programme was building social capital by stimulating the activity of rural communities and engaging them in the process of designing and implementing local development strategies (LDS). Implementing this goal in practice is significant because building and developing social capital, regarded as a major factor underpinning the development of rural areas (Kłodziński, 2003; Antoci et al., 2009; Wojewódzka-Wiewiórska, 2011a, 2011b; Lopolito et al., 2015), lies in promoting the creation and strengthening of relationships between the community members. For these reasons, the object of the research is the implementation of the LEADER programme and its effects for rural development in Poland. The essence of the LEADER is local partnerships and cooperation of many entities, enabling the pooling of resources, knowledge and skills. There are formed local action groups (LAGs) where the social, economic and public sector cooperate, using local resources and the involvement of the local population. It reflects

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[1] According to the Central Statistical Office of Poland rural areas are defined as rural communes and rural parts in urban-rural communes.

Table 1

The LEADER programme 2007 – 2013 broken down into measures in Poland

Measure code	Title of the measure	Limit of funds for measure of RDP 2007 – 2013		Number of beneficiaries
		(PLN)	%	
413	Implementation of Local Development Strategies: • Diversification towards non-agricultural activities • Establishment and development of micro-enterprises • Village renewal and development • Small projects	2 452 124 566.42	81.4	15 327
421	Implementation of cooperation projects	48 039 512.72	1.6	333
431	Running the Local Action Groups, acquisition of skills and activation	513 048 396.46	17.0	336
	Total	3 013 212 475.60	100	15997

the new approach adopted by the EU concerning the multifunctional development of rural areas stipulating an active involvement of the local communities. Rather importantly, the intervention areas are not determined by administrative boundaries but by the way in which development processes evolve[2]. There were 336 LAGs operating in the 2007 – 2013 perspective, scattered unevenly across the provinces (voivodships).

The assumptions and tasks of the RDP relating to the LEADER initiatives take into account the specific nature of the rural areas in Poland, notably the level and determinants of social capital development. Three measures were distinguished (Table 1): implementation of LSD, implementation of cooperation projects and running the LAGs. The division of funds into measures was clearly differentiated. The vast majority of funds were devoted to the implementation of LSD, which reflected the diagnosed development needs of rural areas. This measure covered the largest number of beneficiaries.

The aim of the paper is to present the influence of the implementation of the LEADER programme under RDP 2007 – 2013 on rural areas development in Poland. To reach the purpose, the following tasks have been set: 1) to define the importance of the LEADER for creating jobs outside agriculture; 2) to identify changes in the standard of living in rural areas in the opinion of the residents; 3) to indicate the importance of the LEADER programme in the development of social capital, including the types of social capital.

Materials and Methods

The basis of the study was an analysis of existing data. Consideration was taken of the very wide material which contains programmatic and strategic documents of RDP 2007 – 2013, binding legal acts, LAGs report and implemented LDS. The research was conducted in 2016, the time span covered the years 2007-2015. In the next stage of the research, the report uses the data of the Ministry of Agriculture and Rural Development (31 Dec 2015) and findings from the RDP 2007 – 2013 evaluation study from 2016 (Ledzion *et al.*, 2016). Based on the data of the Ministry regarding the allocation of funds under the RDP 2007-2013 (Axis 4), the communes and local action groups were selected for in-depth research. Quantitative methods were used, comprising: CAPI survey of rural residents in 10 communes (n = 500) and a CATI survey of LAG representatives (n = 120). Qualitative methods were also applied: IDI with representatives of LAG and implementing institutions. In the discussion of the results of the study, the research carried out in other European Union countries on the effects of the LEADER approach for rural development was taken into account.

The literature identifies several categories of social capital (Krishna & Uphoff, 2002; Grootaert & Bastelaer, 2002; Kaasa & Parts, 2007; Skawińska, 2012) which were included in the study. Social capital describes relationships between people such as social ties, norms of reciprocity or trust and is based on the willingness to cooperate, which improves the performance of groups and institutions alike (Fukuyama, 1997). This is reflected in self-organisation and self-governance, mainly as part of voluntary associations. Structural capital refers to all state and local institutions operating in a given area such as foundations or associations. Another category known as behavioural capital comprises trust

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2 According to the RDP, rural areas include: rural municipalities, urban-rural municipalities with the exception of towns with a population exceeding 20 thousand residents, and urban municipalities with the exception of towns with a population exceeding 5 thousand residents.

as well as shared norms and values. Depending on the types of ties between individuals, we can talk about bonding capital (with strong family and neighborly ties), bridging capital (with ties with individuals other than family and neighbours) and linking capital (for interactions between communities from various sectors and tiers of authorities).

Results and Discussion

Rural residents assessed what changes took place in the years 2007 – 2013 in the place of residence.
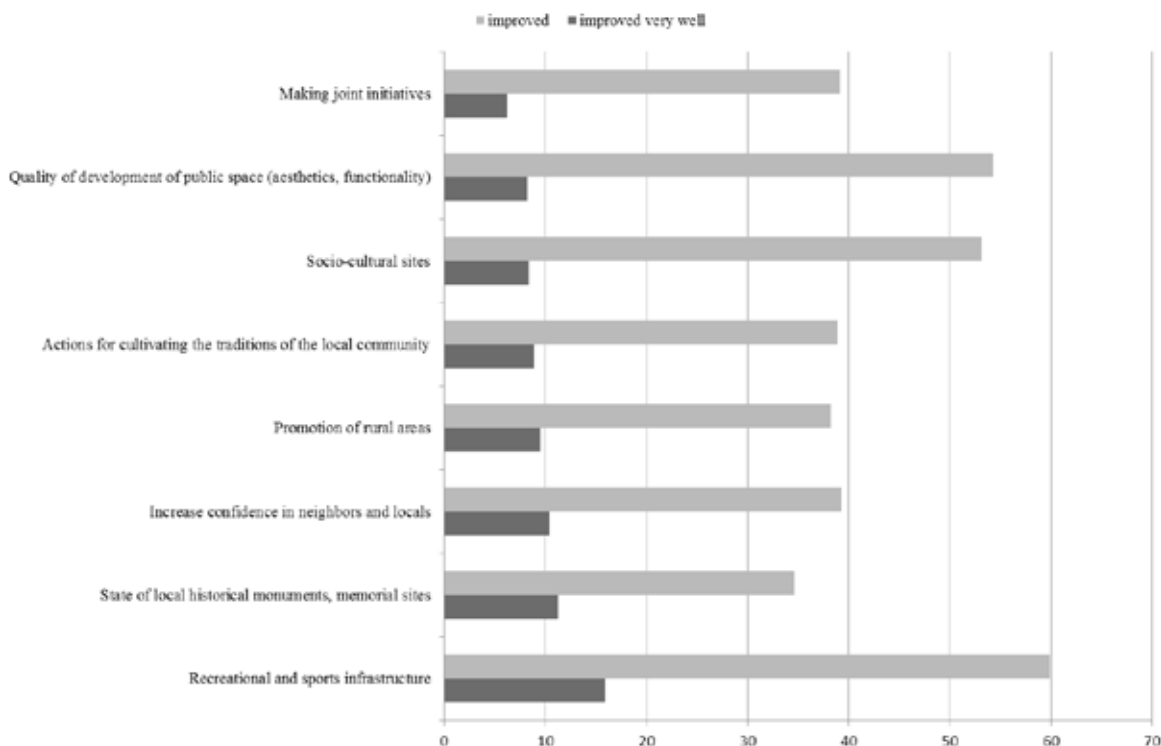
Figure 1. Changes in rural areas in Poland in 2007 – 2013 in the opinion of its residents (%).
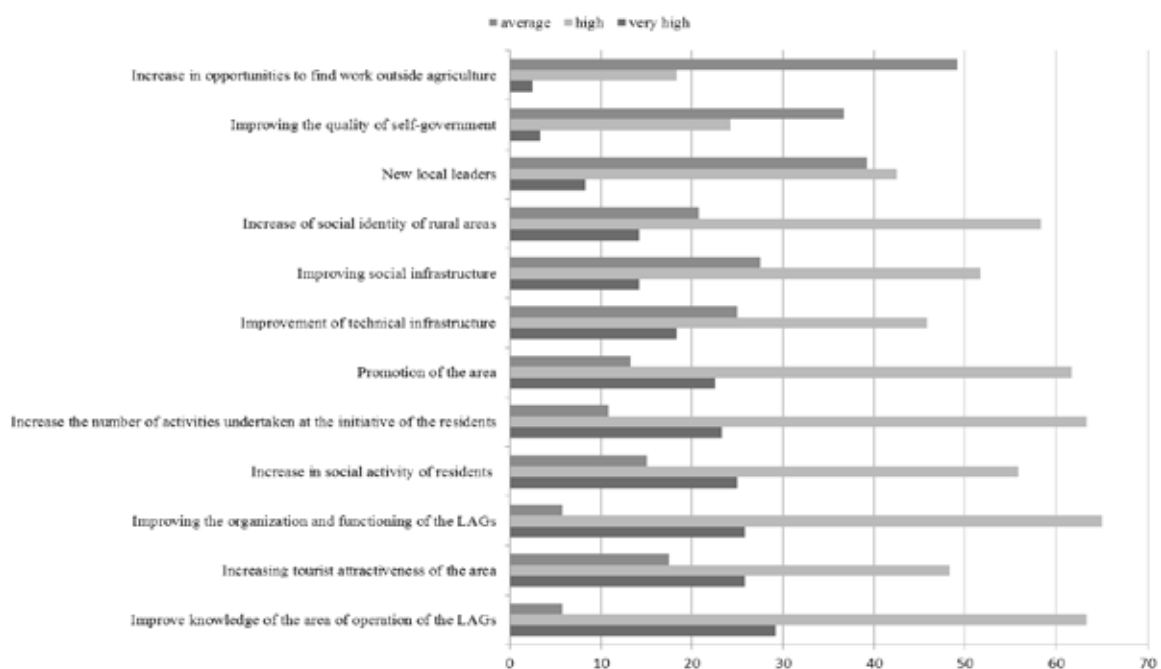
Figure 2. Impact of activities implemented by the Local Action Groups 2007 – 2013 on rural areas development in Poland in the opinion of LGD representatives (%).

It turned out that the inhabitants see a significant improvement in all the indicated areas (Figure 1). According to them, the situation has improved the most in terms of recreational and sports infrastructure, quality of development of public space and socio-cultural sites.

The representatives of the LAGs pointed out different aspects of rural development affected by their actions (Figure 2). According to the surveyed, the greatest influence LAGs on the development of the area concerned increased knowledge of the LAG's area and improvement of the functioning of the LAG itself. The relatively least influence of LAGs was on the possibility of employment outside agriculture and to improve the quality of governance at the local level. These analyzed in detail research results combined with the results of qualitative research have allowed to determine the impact of the LEADER on rural development. The research demonstrated the multi-faceted impacts of the LEADER approach on the development of rural areas.

Firstly, they involve building the local potential in the sphere of employment and creating new jobs outside agriculture. Altogether, more than 3,000 jobs were created, i.e. fewer than originally expected. The relatively modest impact of Axis 4 on job creation is a consequence of the way the funds were allocated: public funds in Axis 4 accounted for 7.8% funds in Axis 3, which was reflected in a very small number and value of projects implemented as part of Axis 4 compared to Axis 3. The minor role of LAGs in employment diversification is also corroborated by the surveys of LAGs and residents of rural areas. According to the surveyed LAGs, the impact of the LEADER programme on employment opportunities outside of agriculture was rather mediocre (49% answers), or high or very high according to about 21% of the respondents. It was pointed out that the relevant actions were rather difficult to execute, not least because of procedural and organisational issues associated with the submission of applications. The residents of rural areas were aware that job opportunities outside agriculture had increased, with 40% being of the opinion that such conditions had been improved. It can be said that the role of the LEADER programme in creating new jobs depends on the actual needs in that regard, the specific nature of rural areas and the role of agriculture.

The projects carried out by LAGs as in the Czech Republic were directly reflected in the improved quality of life of the residents in rural areas (Nunvarova, 2014), mainly due to providing them with access to new infrastructure. The tangible outputs include a huge number of either newly built or upgraded facilities, i.e. 7,000 as part of small projects, 10,000 as part of the renewal and development of rural

areas (including modernisation), and 650 facilities as part of interregional and international cooperation. In addition, public space has been revitalised in some 6,000 villages, a much bigger number than originally anticipated. These effects are recognised by the local residents. In their opinion, the overall standards of living in their municipalities have improved, as indicated by 85% of the respondents.

Axis 4 had a particularly significant impact on certain spheres of life, such as recreation, preservation of traditions and promotion. Projects from those spheres provided many opportunities for meeting new people from the neighbourhood and other milieus (e.g. other parents in a playground, residents during picnics, local community leaders from various municipalities during the preparation of a cookbook based on local produce); all these activities, through increased trust and contacts established with people other than family or direct neighbours has helped to develop social capital, especially bridging capital. At the same time, LAGs are hardly recognised by the local residents, which may considerably reduce the possibility of attributing the changes observable in the quality of life to the results of activities implemented by LAGs.

The residents most frequently listed the following benefits derived from LAGs' activity: development of technical infrastructure (sports grounds), social infrastructure (recreation sites), new jobs, better living conditions, overall development of the municipality. In their opinion, LAGs and their activities are viewed positively, as entities that produce specific results and bring desirable changes for a given area. It should be borne in mind that certain effects arising from projects implemented by LAGs such as e.g. promotion of rural areas and their assets or improved aesthetic value of their villages may positively affect the quality of life of the local residents in the future (Nunvarova, 2014). Tourists' interest in a given area may e.g. drive the development of the local enterprise, help to increase the incomes of the local residents and encourage them to undertake new joint initiatives promoting the development of their 'little homeland', and this is partly dependent on how, and how effectively, rural areas will be supported in the future.

The LEADER 2007 – 2013 programme helped to increase social capital and boosted the involvement of the rural communities in local matters, as was also found in other EU countries (Kis *et al.*, 2015; Lopolito *et al.*, 2015). In the residents' opinion, in the case of 60% municipalities the residents are interested in becoming engaged in matters associated with the development of their village or community; recently, the situation regarding embarking on joint initiatives such as meetings or trips has improved, as indicated by 45.3% of the respondents. According to 47.1% of

the surveyed residents, the overall trust in neighbours and other local residents has also increased.

The survey also suggested the emergence of new leaders who launch various initiatives promoting the development of rural areas. LAG representatives who have direct contacts with the residents of the LAG impact area pointed to a distinct increase in the local residents' activity who have now learnt to cooperate. This is reflected in an increased number of associations, also due to the fact that some of the already existing organisations have acquired a formal status, notably the so-called Farmers' Wives' Associations. All this has boosted the existing structural capital.

Greater activity of the local residents is confirmed by the increasingly growing interest in social consultations and many queries about the possible means of engaging in the development of a specific area, which is also corroborated by the conclusions from the study with representatives of the implementing institutions. The very structure of the LEADER programme entailing the need to include representatives of various sectors is conducive to the development of social capital.

LAG representatives pointed out that such forms of cooperation had never been present in Poland's rural areas before, nor looking at problems from many different points of view, taking into account the bottom-up approach which is needed to effectively diagnose and resolve various problems afflicting rural areas. Due to participation in joint initiatives bringing together many people from the local community and representing various milieus (activists, businesspeople, members of the authorities), the local communities become more responsible for the place that they live in and with which they identify, and look more broadly, not at an area confined to their own municipality but rather an area that has certain common features or attributes that can be used to promote development, such as natural assets. This in turn has increased management capacity in rural areas due to the involvement of other entities than the local authorities alone. The conclusions of other authors have been confirmed (Arabatzis *et al.*, 2010; Pechrova & Boukalova, 2015).

It can be concluded that the activities undertaken as part of the LEADER programme have considerably increased participation and strengthened the social sector, a statement that is not always true in relation to businesspeople who above all want to pursue their individual goals and believe that their initiatives and economic effectiveness are curtailed by excessive bureaucracy. The observable merging of communities from various sectors and tiers of the authorities means that bonding capital is being forged. One important feature of projects implemented as part of LAGs is providing support and promotion of cultural activity, especially among young and elderly people, strengthening the bonds with the place of residence, coupled with integration and activation of the local residents (Nunvarova, 2014), both important factors underpinning the development of social capital.

Conclusions

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

1. The activities carried out as part of the LEADER Programme relating to the creation of new jobs outside agriculture were of little significance for shaping the labour market in rural areas as this was dependent on the needs and unique characteristics of a given area.

2. The implemented projects positively affected the standards of living of the residents in rural areas, mainly as regards satisfying social needs of the residents in the sphere of recreation and leisure. Thanks to the Programme small infrastructure amenities, so important for the residents and usually either marginalised or neglected in the earlier development policies, were considerably improved.

3. The LEADER Programme played a significant role in building social capital nationwide, especially with regard to behavioural capital. An overall level of activity of rural residents and other entities increased, so as the propensity to engage in joint initiatives and the level of trust. Bonding capital was also increased, largely due to the structure of the Programme itself. Locally, the significance of the Programme varied depending on the level of social capital at the inception of the intervention and on the existing determinants concerning capital development.

In assessing the impact of the LEADER Programme on the development of rural areas, the small overall financial allocation should also be taken into account, with Axis 4 representing ca. 4% of the RDP 2007 – 2013 public expenditure. The evaluation of the programme results for the development of rural areas requires time and should be made together with the analysis of the remaining RDP 2007 – 2013 components.

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DEVELOPMENT TRENDS IN THE NATIONAL ECONOMY SECTORS IN THE BALTIC STATES IN 2005-2015

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Abstract

The processes of globalization in the world economy have a significant impact on different processes and development in all national economy sectors. Innovations and technological development have also increased the competition between economic operators. Faster growth is also observed in service industries. The global economic downturn affected the Baltic States whose development suffered a sharp decline at the end of 2008 and in 2009. A sudden drop in the demand in export markets, as well as the decline in the demand in the domestic markets due to low purchasing power contributed to the deterioration of the economic situation in the Baltic States, particularly in the manufacturing and construction sectors. Starting from 2011, the economic indicators in the Baltic States have been growing and here the export of goods and services can be mentioned as the main contributor to the development of the economy in the Baltic States. Significant changes in the development of economic sectors started in 2013 due to Russia's economic problems. During the period 2005 – 2015, most of the value added to the overall structure of the national economy in all three Baltic States was brought by trade and manufacturing.

The aim of the research is to analyse the national economy sectors in the Baltic States during the period 2005 – 2015 in order to determine processes that affected the development of economy sectors in each of the countries, or the opposite – the recession, thus finding the most competitive sector of the national economy of the Baltic States.

Key words: national economy sectors, Baltic States, competitiveness.

Introduction

After joining the European Union in 2004, the Baltic States experienced a rapid economic growth and at the same time a sharp rise in commodity prices, which led to high inflation. In 2009, along with the economic downturn in the global economy, the Baltic States experienced a sharp decline in the national economy when the volumes of the products sold in the domestic market and the volumes of export products dropped. In early 2010, the national economy in the Baltic States gradually recovered; the most successful economic stabilization took place in Estonia, followed by Lithuania and Latvia. One of the most important priorities of Estonia for the year 2010 was the fulfilment of the Maastricht criteria, and with the introduction of the Euro on 1 January 2011 Estonia joined the Eurozone. Other priorities to be mentioned are promotion of the quality of education and preparation of the independence of the energy sector (Ministry of Economic Affairs and Communications of Estonia, 2005). In Latvia, the top priorities were reducing the unemployment and promoting entrepreneurship, as well as structural reforms in the public institutions. Like Estonia, Lithuania set the following priorities: accession to the Eurozone, as well as diversification of energy suppliers (competition) and increasing the independence in the energy sector. Lithuania as the last of the Baltic States joined the Eurozone on 1 January 2015.

The following tasks have been defined to reach the aim - to analyse the structure of the national economy in each of the Baltic States; to study the key sectors of the national economies; to determine the most competitive sector in the long-term development in each of the Baltic States and to draw conclusions.

Materials and Methods

During the research, quantitative and qualitative methods were used – monographic or descriptive method, analysis and synthesis method; data statistical research methods – grouping, comparison, analysis of relative and average indicators, establishment and analysis of dynamic series. For labour market analysis, statistical data of 10 years were compared. Calculations and data processing were performed using the software Microsoft Excel. Data on the national economy sectors were retrieved from the Statistical Bureaus of each Baltic State, as well as from the national reports on the development of the national economy. To calculate the value added by each sector to the overall structure of the national economy, the authors used the data of the Central Statistical Bureau data on gross value added broken down by kinds of activities, at current prices, without separating into subsectors, but on the basis of key sectors according to the NACE classification. To calculate growth rates the authors used the data of the Central Statistical Bureau data on gross value added broken down by kinds of activities, at current prices, separating in subsectors on the basis of key sectors according to the NACE classification.

Results and Discussion

According to the statistical classification of economic activities (Eurostat, 2017), in the European Community the national economy sectors are divided

into agriculture, forestry and fishing; mining and quarrying; electricity, gas, steam and air conditioning; water supply, sewerage, waste management and remediation, manufacturing; construction. The rest are service industries – wholesale and retail trade, repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities; information and communication; financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities; other service activities; public administration and defence; compulsory social security; education; human health and social work activities; arts, entertainment and recreation; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organizations and bodies.

The development of the national economy sectors in Latvia

On the basis of the reports on the national economy by the Ministry of Economics of the Republic of Latvia for 2005 – 2015 (Ministry of Economics of the Republic of Latvia, 2005; 2015), the fastest growing economy sector is service sector,

Table 1

The structure of the national economy of Latvia by value added, 2005 – 2015, %
(designed by the authors according to the data of the Central Statistical Bureau of Latvia)

Economic Activity	Year										
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture, Forestry and Fishing	4.3	3.7	3.7	3.3	3.7	4.4	3.9	3.7	3.7	3.5	3.4
Mining and quarrying	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Manufacturing	13.0	12.1	11.4	10.8	10.9	13.4	13.2	13.1	12.7	12.3	12.3
Electricity, gas, steam and air conditioning supply	2.2	2.1	2.0	2.5	3.4	3.9	3.5	3.3	3.2	3.0	2.8
Water supply, sewerage, waste management and remediation activities	0.7	0.7	0.7	0.8	1.2	1.0	1.0	0.9	0.9	0.9	0.9
Construction	6.7	8.5	10.1	10.1	7.7	5.0	5.9	6.4	6.5	6.7	6.4
Wholesale and retail trade; repair of motor vehicles and motorcycles	16.5	16.8	15.6	14.0	15.1	15.6	14.7	14.1	14.0	14.1	14.0
Transportation and storage	12.3	9.8	8.4	9.3	10.5	10.5	10.5	10.5	10.2	10.1	9.5
Accommodation and food service activities	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.6	1.7	1.8	1.9
Information and communication	4.6	4.1	3.6	3.8	4.2	4.6	4.3	4.3	4.4	4.4	4.6
Financial and insurance activities	4.4	5.2	5.2	5.6	3.6	3.4	4.0	4.1	4.0	4.5	4.7
Real estate activities	9.5	11.3	12.3	11.1	11.2	10.2	11.0	11.9	12.6	13.2	13.3
Professional, scientific and technical activities	3.8	3.6	4.1	4.5	4.6	4.5	4.6	4.5	4.4	4.1	4.2
Administrative and support service activities	2.3	2.2	2.4	2.5	2.5	2.8	3.1	3.0	3.0	2.8	2.9
Public administration and defence; compulsory social security	7.3	7.9	8.4	8.5	7.8	7.5	7.5	7.3	7.3	7.3	7.4
Education	5.0	4.6	4.6	5.4	5.9	5.2	4.9	4.8	4.9	4.9	5.0
Human health and social work activities	2.8	2.7	2.6	3.0	3.2	3.1	2.9	2.9	3.0	3.2	3.3
Arts, entertainment and recreation	2.0	2.2	2.1	2.1	1.7	1.8	1.9	1.9	2.0	2.0	2.1
Other service activities	0.8	0.7	0.8	0.7	0.8	0.8	0.8	0.9	0.8	0.8	-
Activities of households as employers	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	-

especially commercial services. The construction sector witnessed a very rapid growth in the period from 2007 to 2008; this growth was due to the changes in the lending policy of the financial institutions. Whereas, in manufacturing there was a decline; if in 2005 the share of manufacturing in value added was 13.0%, then in 2008 it was 10.8%, which is lower by 2.2 percentage points (Table 1). Table 1 shows the structure of the national economy during the period from 2005 to 2015.

During the economic downturn, i.e. in 2009, a number of production companies were forced to close their activities due to the sharp decline of the purchasing power in both domestic and foreign markets.

In Latvia, manufacturing has a small share in the overall structure of the national economy, which is significantly below average in the European Union; only Cyprus, Luxembourg, the Netherlands and the UK have a smaller share of manufacturing in the national economy (in the total value added). In 2010 – 2012, manufacturing had a major role in the overall development of the national economy, but closing of the JSC 'Liepājas Metalurgs' (metallurgical company) had a significant impact on the manufacturing sector from 2013 onwards.

In addition to the analysis of the structure of the national economy, the authors carried out the analysis of the growth rates. When analysing the growth rates, the first quarter of 2007 saw the most significant increase in manufacturing as compared to the first quarter of the previous year, and it was 31.4%, while in 2015 there was a downward trend in all quarter indicators in the transportation and storage sector as compared to 2014. This trend continued also in 2016. Financial and insurance activities, as well as real estate activities experienced a very sharp increase; in the first quarter of 2011 the growth in financial and insurance activities was 71.4% against the first quarter of the previous year.

Taking into consideration these three national economy sectors – manufacturing, trade and real estate activities, which during the period from 2005 to 2015 accounted for about 40% in the overall structure of the national economy, even during the economic downturn in 2008 and 2009 they continued to develop and maintain or even increase this proportion, within the framework of this research, the authors conducted a thorough analysis of the above three sectors in order to identify those sub-sectors which stimulate the overall development of the sector and the factors contributing to the development.

The share of manufacture of food products, beverages and tobacco products in manufacturing as to the value added amounted to 26.0% in 2005, the second highest share belongs to the manufacture of

wood and of products of wood and cork – 17.2%, while in 2015 these shares were 23.6% and 27.0% accordingly. These two sub-sectors account for nearly 50% of total manufacturing. According to Sutcliffe & Glyn (2003), the importance of the manufacturing sector is underestimated, considering only the value added or employment in the sector. Many other sectors are closely related to the manufacturing sector. Parts of agricultural, mining, energy, construction, transportation, and financial, as well as many other business services, are highly dependent on manufacturing results. Therefore, some of these sectors also participate in manufacturing markets. Many other sectors are involved in manufacturing processes indirectly, through integration with manufacturing products (Pekarskiene & Susniene, 2013). It means that all Baltic state countries need to invest more in manufacturing, thereby increasing added value not only in manufacturing, but in other sectors too.

Manufacturing as a whole is significantly impacted by exporting possibilities and volumes which grew starting from 2010 onwards and decreased in 2013 due to the influence of Russia's economic deterioration and food import restrictions (Danske Bank, 2014). A steady growth has been observed in the woodworking sector, which in spite of the various national restrictions and export shrinkage, shows a significant increase. 75% of production is exported and mainly to the European Union countries. This position highlights the role of resources, which are obtainable in the particular country, and in the Latvian case, wood is the most important resource, also for international trade. Many authors, Maddison (1995), Hirst & Thompson (2003), Feenstra (1998), Sutcliffe & Glyn (2003), refer to international trade as one of the most important forms of integration into the global economy. If an economic sector is more globalized, the greater the portion of its output is exported (Pekarskiene & Susniene, 2013). It means that the development of export output will always be one of the main goals to achieve, especially in the Baltic countries, because economy of these countries is relatively small comparing with other European countries.

The development of the national economy sectors in Estonia

After the collapse of the Union of Soviet Socialist Republics and regaining of independence, Estonia has been the fastest growing country among the Baltic States. Telecommunications and information technology, textiles, chemical products, wood and its products, shipbuilding, electronics, transportation, food and fishing, various services are the key sectors in the national economy of Estonia. Estonia produces

Table 2

The structure of the national economy of Estonia by value added, 2005 – 2015, %
(designed by the authors according to the data of the Central Statistical Bureau of Estonia)

Economic Activity	Year										
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture, forestry and fishing	3.5	3.1	3.5	2.7	2.4	3.2	3.9	3.7	3.5	3.6	3.4
Mining and quarrying	0.9	1.0	1.0	1.0	1.2	1.4	1.4	1.3	1.5	1.6	1.4
Manufacturing	16.6	16.5	15.9	15.5	14.1	15.7	16.6	15.9	15.5	16.2	15.8
Electricity, gas, steam and air conditioning supply	2.8	2.5	2.4	2.4	3.5	3.9	3.5	3.3	3.9	3.7	3.2
Water supply; sewerage, waste management and remediation activities	0.9	0.9	0.9	1.0	1.0	1.1	0.9	0.9	0.8	0.8	0.7
Construction	8.6	9.8	10.6	9.6	7.1	5.9	6.9	7.3	6.9	6.4	6.2
Wholesale and retail trade; repair of motor vehicles and motorcycles	14.4	14.4	13.8	12.8	11.7	11.8	12.1	12.5	12.2	12.0	11.9
Transportation and storage	8.5	8.4	7.8	7.7	8.0	9.0	8.8	8.9	8.9	8.4	7.8
Accommodation and food service activities	1.7	1.7	1.6	1.7	1.5	1.5	1.6	1.7	1.8	1.8	1.8
Information and communication	4.7	4.5	4.6	4.9	5.5	5.3	5.0	5.1	5.4	5.6	6.0
Financial and insurance activities	3.9	4.4	4.7	5.4	4.4	4.1	3.9	3.9	3.6	3.9	4.0
Real estate activities	9.8	9.7	9.6	9.7	10.6	9.8	9.7	9.8	9.8	9.8	10.1
Professional, scientific and technical activities	4.4	4.4	4.6	4.9	5.3	5.3	5.0	4.9	4.9	5.0	5.3
Administrative and support service activities	3.3	3.5	3.4	3.5	3.8	3.7	3.8	4.0	4.1	3.6	3.8
Public administration and defence; compulsory social security	5.7	5.4	5.7	6.6	8.0	7.5	6.8	6.6	6.7	6.9	7.3
Education	4.6	4.3	4.2	4.8	5.5	5.0	4.5	4.4	4.5	4.6	4.7
Human health and social work activities	3.1	3.0	3.1	3.4	3.9	3.7	3.4	3.4	3.5	3.7	4.0
Arts, entertainment and recreation	1.8	1.8	1.8	1.5	1.4	1.3	1.3	1.4	1.5	1.5	1.6
Other service activities	1.0	0.9	0.8	0.9	1.0	0.9	0.9	0.9	1.0	1.0	1.0

90% of the electricity needed in the country, and uses wood, peat and biomass as alternative sources of energy (Ministry of Economic Affairs and Communications of Estonia, 2005; 2015). The information gathered in Table 2 shows how the structure of the national economy of Estonia has changed during the ten-year period.

In 2005, the highest share in the structure of the national economy belongs to the manufacturing sector, but during these 10 years the proportion of manufacturing tends to be decreasing. Trade is in the second place with exactly the same downward trend, real estate activities are in the third place – with a growing tendency in the overall structure of the national economy (Table 2).

When analysing the sub-sectors of manufacturing in more detail (Figure 1), the manufacture of wood and paper products and printing made up to 19.5% of the manufacturing sector in 2005 and 21.8% in 2015, thus taking the first position in the manufacturing sector in the overall structure of the national economy. The second major share belongs to the manufacture of food products, beverages and tobacco products, and manufacture of basic metals and fabricated metal products is in the third place. The manufacture of basic metals and fabricated metal products has gradually increased its share in the overall structure of the manufacturing sector – from 9.6% in 2005 to 12.6% in 2015.

2005

13.1
13.2
2.9
10.2
3.9
4.3
4.7
19.5
9.6
11.8
0.2 5.0
1.4

2015

5.8
11.8
13.0
4.2
6.2
5.4
4.9
21.8
12.6
3.5
7.9 0.4
2.4

manufacture of food products, beverages and tobacco products
manufacture of textiles, wearing apparel and leather products
manufacture of wood and paper products, and printing
manufacture of coke and refined petroleum products
manufacture of chemicals and chemical products
manufacture of basic pharmaceutical products and pharmaceutical preparations
manufacture of rubber and plastic products, and other non-metallic mineral products
manufacture of basic metals and fabricated metal products
manufacture of computer, electronic and optical products
manufacture of electrical equipment
manufacture of machinery and equipment n.e.c.
manufacture of transport equipment
manufacture of furniture; other manufacturing; repair and installation of machinery and equipment

Figure 1. The structure of manufacturing in Estonia in 2005 and 2015, %.
(designed by the authors according to the data of the Central Statistical Bureau of Estonia)

Manufacturing, trade and real estate activities account for almost 40% in the overall structure of the national economy. Figure 1 illustrates the structure of manufacturing.

In this sector more than 1,000 companies operate exporting their products mainly to Sweden, Finland and Latvia. Estonia has around 6,000 manufacturing companies; one in five workers is employed in manufacturing. The share of manufacturing in the overall structure of the national economy is higher than average in the European Union (Ministry of Economic Affairs and Communications of Estonia, 2005; 2015).

During these ten years, large amounts of investment from countries such as Finland and Sweden have flowed into Estonia; these investments are essential for the national economy of Estonia. Therefore, the manufacture of basic metals and fabricated metal products has increased its share and competitiveness in the overall structure of the national economy (Ministry of Economic Affairs and Communications of Estonia, 2005; 2015).

The development of the national economy sectors in Lithuania

More than 50% of the overall structure of the national economy in Lithuania consists of manufacturing, trade and transportation and storage.

In addition, it should be noted that all these industries very gradually but with each year are increasing their share in the overall structure of the national economy, see Table 3 (Ministry of Economy of the Republic of Lithuania, 2002; 2012; Bank of Lithuania, 2002; 2012).

In Lithuania, the share of manufacturing is above average in the European Union, while the transportation and storage sector has significantly increased its share from 9.0% in 2002 to 13.0% in 2012. When analysing the structure of the national economy of Lithuania, particular attention was paid to the transportation and storage sector, as this sector in Lithuania, and the European Union as a whole, plays a significant role because it is growing faster than average in the European Union; and also the volumes of exported production in this sector are higher than average in the European Union (Langviniene & Sliziene, 2014). On the whole, the development of this sector is unstable, because it is affected by global processes, such as one-third of the total production is exported to the CIS countries, and these countries, mainly Russia, are introducing various obstacles for the European Union countries (transport documentation, volumes, etc.).

When analysing manufacturing in more detail, 60% of it consists of manufacture of food products, beverages and tobacco products (22.4% in 2002 and

Table 3

The structure of the national economy of Lithuania by value added, 2002 – 2012, %.
(designed by the authors according to the data of the Central Statistical Bureau of Lithuania)

Economic Activity	Year										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Agriculture, forestry and fishing	5.4	5.0	4.6	4.8	4.2	3.9	3.7	2.8	3.3	3.8	4.0
Mining and quarrying	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.3	0.4	0.4	0.4
Manufacturing	18.3	18.6	20.0	20.1	19.4	17.8	17.5	16.8	18.9	20.5	20.8
Electricity, gas, steam and air conditioning supply	3.5	4.2	4.0	3.6	3.2	3.0	2.8	3.4	3.3	2.8	2.9
Water supply; sewerage, waste management and remediation activities	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.8	0.9	1.0	1.0
Construction	6.3	7.0	7.2	7.8	9.4	11.2	11.2	6.6	5.9	6.5	6.0
Wholesale and retail trade; repair of motor vehicles and motorcycles	17.7	17.5	17.7	17.5	17.0	16.9	17.4	17.6	17.9	17.9	18.6
Transportation and storage	9.0	9.3	9.2	9.5	9.8	9.9	9.4	10.7	12.0	12.2	13.0
Accommodation and food service activities	1.6	1.5	1.5	1.4	1.3	1.3	1.3	1.4	1.3	1.3	1.3
Information and communication	5.1	5.0	4.4	4.1	3.9	3.7	3.4	3.9	3.6	3.1	3.1
Financial and insurance activities	2.1	1.7	1.7	2.2	2.7	3.3	3.3	2.2	2.6	2.7	2.2
Real estate activities	6.5	6.2	6.2	6.4	6.5	6.5	6.9	7.3	6.6	6.0	5.7
Professional, scientific and technical activities	2.6	3.3	3.3	3.4	3.5	3.9	3.6	4.1	3.7	3.6	3.4
Administrative and support service activities	1.4	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.1	2.0	2.2
Public administration and defence; compulsory social security	7.9	7.7	7.4	6.9	6.9	6.4	6.6	7.4	6.7	6.2	5.8
Education	5.7	5.2	5.0	4.5	4.4	4.2	4.7	6.1	5.3	4.8	4.5
Human health and social work activities	2.9	2.7	2.7	2.7	2.9	3.0	3.3	4.0	3.6	3.5	3.4
Arts, entertainment and recreation	0.8	0.7	0.8	1.0	0.9	0.9	0.8	1.0	0.9	0.9	0.9
Other service activities	1.7	1.6	1.4	1.1	0.9	0.8	0.8	1.0	0.9	0.8	0.8
Activities of households as employers	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1

24.9% in 2012), manufacture of furniture, jewellery, musical instruments, toys; repair and installation of machinery and equipment (12.2% in 2002 and 15.7% in 2012), manufacture of chemicals and chemical products (6.2% in 2002 and 12.5% in 2012), as well as manufacture of wood, paper, printing and reproduction (13.3% in 2005 and 11.5% in 2012). In Lithuania, in several sectors a clear tendency to expand opportunities in the local market are observed, as in recent years there has been stagnation of exports due to the Russia's economic crisis and the restrictions set on imports; therefore new possibilities are created to realize the products internally, thus compensating for lack of export opportunities, and new markets are searched.

In Lithuania there are very many businesses working in wood processing but they are small and this hinders rapid development of the sector. In addition, these companies lack process automation. Thus, it is impossible to manufacture products in large quantities and in a short time, as in other countries where this sector is growing faster (Finland, Sweden). The food sector still accounts for the largest share of the national economy in Lithuania, in recent years this has been highest among all the Baltic States. Lithuanian food products are mostly exported, since

the internal market is small. The export partners are Latvia, Estonia, Germany and Poland, as well as Russia, which in the future is considered to be one of the largest export partners in this sector.

Upon analysis of the results of the research, the authors believe that in the period from 2005 to 2015, the national economy sectors of the Baltic States have evolved gradually, with the exception of the global financial crisis period in 2008 and 2009. The dynamics of the growth rate in 2014 and 2015 in comparison with the previous years has been relatively slow, but positive.

The most competitive sectors in the long-term development in each of the Baltic States are the service sector (real estate activities, financial activities, transportation and storage) and manufacturing (manufacture of wood and products of wood and cork, manufacture of food products, beverages and tobacco products).

Conclusions

1. The largest share in the overall structure of the national economy belongs to manufacturing in Latvia (from 13% in 2005 to 12.3% in 2015), Estonia (from 16.6% in 2005 to 15.8% in 2015) and Lithuania (18.3% in 2002 to 20.8% in 2012).
2. Approximately 40% of the overall structure of the national economy in each Baltic State consists of three sectors (in Latvia – manufacturing, trade and real estate activities, in Lithuania – manufacturing, trade and transportation and storage, in Estonia –

manufacturing, trade and real estate activities). In manufacturing, in Latvia the greatest value is added by manufacture of food products, beverages and tobacco products and manufacture of wood and of products of wood and cork (in 2015 accounting for more than 50%), in Lithuania – manufacture of food products, beverages and tobacco products, manufacture of chemicals and chemical products, manufacture of furniture (in 2012 accounting for more than 50%), in Estonia – manufacture of food products, beverages and tobacco products; manufacture of wood and of products of wood and cork; manufacture of basic metals and fabricated metal products (in 2015 accounting for approximately 50%).

3. As a result of the analysis, the sector that is the most competitive and significantly affecting the structure of the national economy in each Baltic State has been identified. In Lithuania it is transportation and storage, in Estonia and Latvia – the manufacture of wood and of products of wood and cork.
4. Manufacturing has been underestimated in the overall structure of the national economy, since virtually all other national economy sectors depend on the development of the manufacturing sector.
5. The economic development and output volumes of each Baltic State are related to global developments, the relations between the European Union and other countries, especially Russia and the former CIS countries.

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LEGAL ASPECTS OF THE SUPREME AUDIT INSTITUTIONS IN THE BALTIC SEA REGION

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Abstract
The legal regulation of the public sector auditing among the Supreme Audit Institutions (SAI) of the Northern and Central-European countries holds the potential to offer new perspectives on the functioning and independence of these public audit institutions. This paper aims to examine the external audit practice among the Baltic Sea Region countries as it is defined in the laws and legal acts aimed at the functioning of the particular institution. The task was carried out by conducting an analysis of the legal regulation of the corresponding supreme audit institutions. Overall, SAIs in the Baltic Sea Region closely cooperate with the Parliaments in the reporting phase. Meanwhile, most of them are closely integrated with the legislative power during the phase of the appointment of the head of the audit institution as well as during the budgeting phase and later on during the reporting phase. The research shows that among the Baltic Sea Region countries the Supreme Audit Institutions pursue audits in diverse range of fields as stipulated in the legal regulations. The paper also indicates a space for further research in the field of the SAI legal regulation, audit merit and further interrelation with the executive and legislative powers as well as the impact of such cooperation on the functioning of the accountability system in the particular country.
Key words: supreme audit, accountability, oversight, governance, performance.

Introduction

Supreme Audit Institutions (SAIs) are public administration institutions which are prevalent in almost every country and are tasked with the purpose of ensuring sound public finance management of the functioning of the public sector. The public oversight performed by the SAIs, can have positive impact on the performance of the state bodies and the overall use of public resources (Otetea, Tit, & Ungureanu, 2015).

In most cases, the SAIs audit the government offices and agencies under the governance of central government. In some cases they may also pursue audits of the local self-governments. The SAIs provide the executive and legislative powers with an independent analysis of the management of public finances as well as the implementation of the state policies by the public administration. This allows for further improvements to the policy making and implementation process.

In addition, the public audit can benefit the citizens directly by providing them with independent insight information; thus, helping them hold the central government and the political system accountable (Bringselius, 2011) This is believed to be a prerequisite for the quality functioning of any democratic state to help reach the broader good (INTOSAI, 2013).

The SAIs are also in the situation to add value to the lives of citizens by improving the quality of public management and lobbying for change in the quality of services and the overall functioning of the state institutions via proactive communication with the citizens, parliament, civil society, public institutions and other stakeholders (Akyel, 2014).

According to the Lima Declaration, a guidance document of the SAIs, the public sector auditing should focus on every aspect of functioning of a state while informing the government and the public with the use of objective reporting (INTOSAI, 1998).

At the moment, there is a lack of research focusing on the functioning and legal provisions of the SAIs of the Baltic Sea Region (BSR) countries and their role in the regional development with the help of municipality audit. The SAI of the BSR consist of the SAIs of the following EU Member States: Estonia, Latvia, Lithuania, Poland, Denmark, Sweden and Finland.

Altogether almost 85 million people (17% of the whole EU population) reside in the BSR – a region which some believe is one of the most dynamic regions of Europe, in some way also due to its high human development index (EUBSR, 2017).

The **aim of the paper** is to examine the legal basis for the external audit practice in the BSR in order to underline the existing similarities between the functioning of the selected supreme public audit institutions.

The tasks of the paper include: 1) comparing the audited fields and mandate of the SAIs of the BSR; 2) defining the appointment procedure of the lead managers, which defines the functioning of SAIs, and institutional independence prescribed in the legal regulations.

Materials and Methods

Analysis of literature, e.g. legal regulations, research papers, academic papers other scientific literature, and internet resources, i.e., official websites of the SAIs, was conducted to prepare this scientific paper. The chosen **research methods** include analysis of the publicly available information on the functional

and organisational principles and statistical data of the SAIs in the BSR. The research was conducted in the beginning of the year 2017 and reflects the current developments in the research area.

Results and Discussion

The supreme audit institutions can effectively provide a truly independent audit only if they are independent from any political influence (INTOSAI, 2001, 2011).

The SAIs of the BSR can be differentiated based on the model of functioning – the *Westminster* model, the Napoleonic model and the Collegiate or Board model. Each different model has stronger ties to a different institution: the Napoleonic to the judiciary, the Board to the legislator, and the Westminster to the executive (EIF, 2014).

Under the Westminster model, which is also known as the audit office and monocratic model, the SAIs (National Audit Offices) are run by the Auditor General and are closely linked with the parliamentary accountability system while mainly focusing on the value-for-money financial audits. In some cases this system may offer greater authority and responsibility to the auditor general (or President) as a person rather than the institution with some occasions when the authority to some level is shared with the subdivisions (Noussi, 2012). This type of functional model has been chosen by the SAIs of Estonia, Latvia, Lithuania, Poland, Denmark and Finland.

The SAIs functioning according to the Collegiate (or Board) model have multiple member governing board, which takes decisions jointly with the collegially elected head President. The members of the Board are elected for a fixed term by the Parliament. The audit work may be further split into subcommittees, in which the decision making follows the same collegiality principles. Similarly to the Westminster model, under the Board model the auditors do not have legal rights to penalize the public officials. The SAIs in most cases are a part of the parliamentary accountability system and have close partnership with the PAC (Transparency International, 2013).

Most of the SAIs in the Baltic Sea Region have chosen similar functional models and similar institutional basic principles. Analysis of the legal provisions indicates that the majority of SAIs in the BSR follow the Westminster – monocratic model. The only exceptions are the SAI of Germany (Bundesrechnungshof, 2017) and the SAI of Sweden (Santiso, 2009). Both of the organisations pursue the collegial i.e. the board model.

Meanwhile under the judicial also, known as the Napoleonic model, the SAIs are known as the Courts of Audit or the Courts of Account (Noussi, 2012) – independent institutions which are neither subordinate nor obliged to report to neither the Government nor the Parliament. The President of the Court is usually chosen from within Members of the Court for a non-limited period of time. The functioning of the courts is mainly focused on the legality audits while the auditors (the judges) have the right to sanction the public officials or to grant discharge (Transparency International, 2013).

The Court of Audit (or Accounts) is a self-standing public body which deals only with financial matters while its main focus is on verifying the legality of the Governments' transactions. The above mentioned reasons define why in the corresponding public accountability system there is often no Public Accounts Committee and the follow-up on the Courts activities is rather limited (Noussi, 2012).

The authors have to acknowledge that none of the SAI of the countries of the BSR have pursued the judiciary model, which is in contrast with the situation in the West-South part of Europe where the judiciary model is more prevalent.

The SAIs essentialy can be defined by the legal regulation on their audit merit, appointment practice and the institutional independence (INTOSAI, 1998) which has a great impact on their successful functioning

The first fundamental element which defines the functioning 1) **Comparing the audited fields and mandate of the SAIs of the BSR.**

In order to acknowledge the role and purpose of a public audit institution, it is important to evaluate its audit merit along with the legally imposed importance. Since the municipalities hold an important role in the regional development, their overall effectiveness and efficiency affects the further successfulness of the regional policy. Thus, the municipal audits hold a great potential for regional development. Thereby it is important to assess both the overall mandate and the audited fields by the SAIs.

The data shows (Figure 1) that the SAIs of Estonia, Latvia, Lithuania, Poland and Germany have the mandate to audit municipalities.
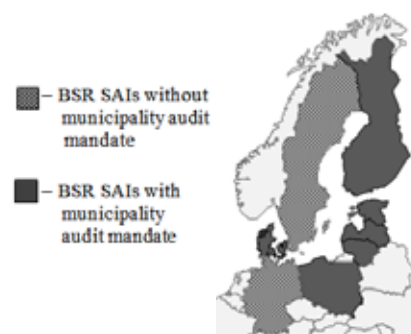
Source: author's compilation (map:showeet.com)

Figure1. SAIs with municipality audit mandate.

Table 1

The Audit Merit of the SAIs of the Baltic Sea Region

SAIs by country of origin	Central Government Departments	Local governments	State share Companies	Foundations	Public Agencies	State funded bodies	State Aid Beneficearies	EU Fund transfers	National Bank
Germany	×	-	×	-	-	-	×	-	-
Poland	×	×	×	-	-	-	×	-	×
Denmark	×	-	-	×	×	×	×	-	-
Sweden	×	-	×	×	×	×	-	-	-
Finland	×	-	×	-	×	-	×	×	-
Estonia	×	×	×	×	-	-	-	-	×
Latvia	×	×	×	-	×	×	-	-	-
Lithuania	×	×	-	-	-	-	×	×	-

Source: author's compilation based on Sveriges Riksdag, 2016; Bundesrechnunghof, 2017; LR VK, 2017; LT VK, 2017; NIK, 2015, 2017; Rekvizitai, 2017; Riksrevisionen, 2017; VTV, 2017.

The 'Scandinavian' SAIs – SAIs of Denmark, Sweden and Finland' – do not have the mandate to audit the municipalities. In the meantime these functions are fulfilled by the local auditors of the municipalities as it is the case of Sweden and Finland (Local Government Act, 1995; SKL.SE, 2014), while in Denmark the audit is performed by the private audit firms (Brusc, 2015). The overall audit scope of the SAIs can be further observed (Table 1).

The overall audit merit of the SAIs includes multiple different audit fields. For the analysis nine of the audit fields were selected covering the following fields: Central government departments, local governments, state share companies, foundations, public agencies, state funded bodies, state aid beneficiaries, EU fund transfers and national bank (Table 1). It can be observed, that all of the SAIs audit the central government departments, while most of the SAIs audit State companies or enterprises with state owned capital (except for SAIs of Lithuania and Denmark), followed by audit of beneficiaries of state aid. In the meantime, there are some audit fields which due to their specifics are audited only by some SAIs – public agencies and state funded bodies. There are some specific cases, for instance, the audit of EU funds, which is pursued by the SAI of Lithuania and Finland. The SAI of Poland has a very specific audit merit which includes 'examining of the legality and compliance of the implementation of the state budget and submitting of its opinion on monetary policy and analysis of state budget execution similarly to the Appropriation Control Report merit of the SAI of Denmark. The comparison of the audited fields indicate that the majority of SAIs share the basic principles of audit domains which include the audit of state departments and audit of state-run or state capital companies and state aid receivers-beneficiaries. In the

meantime, there are standalone SAIs which audit the National Banks and EU funds. This indicates of the diverse nature and focus of these SAIs that they tend to cover in their audits. In the meantime, the reporting practice of the SAIs of Sweden, Lithuania, Latvia and Denmark to report to the Public Accounts Committee of the corresponding National Parliament indicate of the close relationship in the accountability system.

The second fundamental element, which has to be examined when analysing the legal regulations of the SAIs, is related to the **2) appointment procedure of the lead managers and institutional independence.**

There are significant differences between the observed institutions concerning the overall term of office of the head of the institution.

When comparing the SAIs according to the overall term of the head of the institution, it can be seen (Table 2) that the overall length of the term among the SAIs with a *Westminster* model range between four and six years with the exception of the SAI of Denmark in which the Head of SAI is appointed without a fixed tenure with the limitation of 70 years as the retirement age – a factor seen as a precondition for securing the independence of the SAI (Rigsrevisionen, 2017).

Meanwhile, the heads of both the SAI of Sweden and SAI of Germany, which are following the Board model, are appointed for a longer median term – seven and twelve years accordingly (SNAO, 2002; Bundesrechnungshof, 2017). The case of the Swedish SAI is somewhat different compared to peer organisations since it is governed by three Auditors Generals. This specifics is considered by many, including even the institutions' staff itself, a cumbersome obstacle to its effective functioning (Bringselius, 2011). The overall length of the term among the SAIs of a Westminster model range between four and six years. The exception is the SAI of Denmark

Table 2

Appointments of the lead managers of the SAIs of BSR

SAIs by country of origin	Appoint.Head of the SAI (years)	Appointment of AG/President App. – appointed Nom. – nominated	Appointment of Board/Council Members
Germany	12	Nom. by executive App. by the Legislator	Members are appointed by the President of the Federal Republic
Poland	6	Nom. by Parliamentary Speaker/ group of 35 MPs App. by the Legislator	Appointed by the Speaker of the Parliament Nominated by the President of the SAI
Denmark	indef. until the age of 70	Nom.by the Public Accounts Committee App. by the Legislator	–
Sweden	7	App. by the Parliament	Appointed by the Parliament
Finland	6	App. by the Parliament	(Director Generals, other officials) Appointed by the Auditor General
Estonia	5	Nom. by the President App. by the Parliament	–
Latvia	4	Nom. and App. appointed by the Parliament	Nominated by the Auditor General Appointed by the Parliament.
Lithuania	5	Nom. by the the President. App. by the Parliament	Appointed by the Auditor General

Source: author's compilation based on Sveriges Riksdag, 2016; Bundesrechnunghof, 2017; LR VK, 2017; LT VK, 2017; NIK, 2015, 2017; Rekvizitai, 2017; Riksrevisionen, 2017; VTV, 2017.

in which the Head of SAI is appointed without a fixed tenure time. Nonetheless, a more comprehensive research should be carried out to acquire information on the reasoning behind the different range of terms for the office. The authors underline that the overall procedures for appointing the head of the institution remain similar – in all of the observed countries it is appointed by the parliament. Nonetheless, there is a difference whether the procedure is carried out by a single or two chamber parliament. However, the SAIs can also be distinguished by the nomination process of the officials. In all of the observed cases the procedure for appointment of the head of the institution is based on a decision by a single chamber parliament or two chamber parliament (legislator). The nomination procedures, the SAIs differ substantially. In some cases (SAI of Latvia, Sweden, Finland, Latvia) the heads of the SAIs are nominated by the Parliament, while in others by the Speaker of the Parliament-group of MPs (SAI of Poland), president of the state (SAIs of Estonia, Lithuania), or the executive (SAI of Germany). The procedure for appointment of a Board or Council (directors generals, vice presidents and other high standing officials) members of the SAI can be separated by their appointment by the auditor general (SAI of Lithuania and Finland), appointed by the president of the state (SAI of Sweden), or by a nomination from the head of the SAI and an

appointment by the Parliament (SAI of Latvia, Poland). In all of the observed cases the procedure for appointment of the head of the institution is based on a decision by the single chamber parliament or two chamber parliaments. In most cases (SAI of Latvia, Sweden, Finland, Latvia) the heads of the SAIs are nominated by the Parliament and only in few cases less likely by the speaker of the parliament and in case of Germany by the executive power. In the meantime, the procedure for appointment of the Board or Council members of the SAI can be separated by whether they are appointed by the auditor general, the president of the state or with a nomination from the head of the SAI and an appointment by the Parliament.

The second fundamental element of SAIs independence is related to the funding of the institution. The majority of sampled SAIs submit their budgetary appropriations indirectly to the Parliament via the Parliaments Committees as in the case of SAI of Finland and Denmark. Meanwhile in the case of SAI of Latvia, Estonia and Germany, it is submitted to the Ministry of Finance, thereby they could possibly find themselves in a conflicting situation where the budgetary allocations are dependant on a decision of the auditee. Thus, it can be concluded that there is a visible potential for a breach of institutional independence. The second group of SAI submit their budget proposals directly to the Parliament (SAI of

Sweden and Poland). This group The budgetary appropriations of the last group of SAIs is determined solely by the parliament (SAI of Lithuania and Germany) which is granting these institutions a higher grade of insitutional independence.

The last point concerns the subordination of the observed SAIs within the BSR. The SAIs of Sweden, Lithuania, Latvia and Denmark report to the Public Accounts Committee of the corresponding National Parliament (SNAO, 2002; Rigsrevisionen, 2017; LT VK, 2017; LR VK, 2017;) while the Polish SAI reports to the lower chamber of the Parliament (NIK, 2017). The Finnish SAI, however, is subordinate to the Parliament (VTV, 2017). The Estonian SAI, on the other hand, is the only institution with a constitutional status granting constitutional independence from either the Executive or the Legislative branches (Riigikontroll, 2014).

Conclusions

The **comparison of the audited field and mandate** of the SAIs indicate of the many similarities both in the functional as well as the legal functioning of the Supreme Audit Institutions of the Baltic Sea Region. Overall the majority of SAIs in the Baltic Sea Region function according to the monocratic model, followed by the Collegial or the Board model (in two cases present). In the meantime none of the observed SAIs function according to the Judicial model. Every SAI audit the central government departments, while the majority of SAIs audit State companies or enterprises with state owned capital. The third most common audit merit is the audit of

beneficiaries of state aid. Less frequent is the audit of EU funds, which is pursued by the SAI of Lithuania and Finland.

The **examination of the appointment procedure** indicated that the observed SAIs can be distinguished by the nomination process of the officials and the legal regulation concerning the independence of the institution. The findings show that from the observed cases only the SAI of Latvia and Estonia submit their budgetary appropriations to its auditee – the Ministry of Finance thus undermining their independence. To some extent the independence of the SAI of Germany is undermined by the nomination process of its president by the Executive power. Meanwhile the SAI of Estonia is the only SAI granted with the constitutional independence.

The further research should focus on defining the the practical implications of application of a certain institutional model as well as the appointment procedure of the auditor general and other officials which affect the independence of the institution and its relation with the functional audit mandate. Another field of study may focus on the audit mandate of particular SAIs and their implication on the overall performance of the accountability system in the concerned country. Thus, since the observed SAIs are not fundamentally different, they can be included in a further comparative research.

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BUSINESS CLUSTERS FORMATION FOR REGION DEVELOPMENT IN LITHUANIA

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Abstract
The aim of the research is to prepare proposals for assurance of the business clusters formation regarding the regional development potential upon study of the clusterization of Lithuanian regional companies. After extensive analysis of scientific literature, the qualification of the cluster, their structure, main features, goals and benefits to its members, region, and sector where cluster is based, are observed. From analysis of relevant secondary data the main problems that hinder the development of clusters in distinct regions of Lithuania are distinguished. It is revealed that clusterization in Lithuanian regions lags far behind big cities, it is much more passive and clusters there often reach only the level of a micro-cluster. Clusters are most developed in the tourism and food industries, using traditional means instead of high-techs, failing to benefit from EU support for clustering development. In order to improve the clusterization situation in Lithuania and its development in the regions, more attention and investment are to be allocated for promoting cooperation between the companies and the business and science, research sectors, and joining the international cluster. The state support should be prioritized in the rural regions locating less clusters, forming a reliable means and communication network for these clusters' development.
Key words: cluster, clustering, region development.

Introduction

Due to ever-expanding modern business market and establishing of new enterprises, the productivity and competitiveness are becoming increasingly important for companies' longer existence and strengthening of their development in the local and international markets. This is difficult to assure for small businesses regardless of their activity, because consistent corporate governance requires specialists representing each value chain, the availability of which require additional costs. In this case, they can be supported not by an attempt to compete, but by pursue to cooperate, which can be ensured by the clusters formation, where they are provided with broader opportunities based on collaboration. It can be noted that the cooperation in clusters promotes inter-organizational relations, cooperation between business, education, and government institutions. Representatives of different sectors work together within clusters united by a common goal, without consideration of existing differences in terms of size or expertise.

Due to a growing popularity of modern networked organizations it can be observed that clusters combining these two aspects should become a priority and focus area for each company's successful survival. In addition, the innovation and the knowledge economy contribution, which enable ensuring the competitiveness of the company's activities in the region and innovation for other businesses in the region as well, are positively assessed and widespread. Despite the observed significant benefits of clustering, companies hardly tend to cooperate and are more in favour of their independence, a mistrust of other companies in the region is demonstrated. It can be argued that the clustering process analysis has recently earned a lot of attention in the scientific literature and studies, but there is a lack of approach on ensuring the regional development coherence. In this context, it is possible to formulate the research problem whether enterprise clustering processes are sufficient for their development in different regions of Lithuania.

Consequently, the research object is business clusters formation in Lithuania in the context of regional development, and the aim of the research is to prepare proposals for assurance of the business clusters formation regarding the regional development potential upon study of the clusterization of Lithuanian regional companies. To achieve this aim, the following research objectives are raised: (1) to analyse the concept, structure of cluster and to identify their main features and benefits for companies and the region, (2) to analyse the business clusters formation in Lithuania, (3) to provide proposals for clustering and regional development synergies.

Research methods are analysis of scientific literature on business clusterization for region development and secondary data on clustering in Lithuania analysis.

Materials and Methods

One of the forms of cooperation is the cluster. Unlike the consortium, which is a temporary partnership, whereas the cartel has an illegal nature, the cluster mostly is defined in the scientific literature according to M. Porter (2000) as a geographical concentration of interconnected companies, specialized suppliers, service providers, companies in associated industries and associated institutions of a certain direction (universities, trade and standards associations), which compete but also cooperate with each other. In fact, Boja (2011) defines the cluster not as a group

of merely economical, but also as social entities. A. Kuah (2002) points out that the cluster is composed of competing but at the same time combining for the improvement of results in the regional profit and growth rate. Following A. Kamarulzaman and N. Mariati (2008), it can be noted that clusters are formed by enterprises similar in their activities, and not merely the ones active in the established geographic area, thus ensuring immediacy between the cluster actors and their formal and informal interaction, agglomeration economy, and high social capital (Stalgiene, 2010). According to R. Jucevicius (2008), the cluster in its narrow meaning is an economic agglomeration that consists of companies operating in the related and supportive activity areas; while the cluster in its broad sense is the regional system of social production and innovation, with a large concentration of actors with different competences, whose close interrelation not only guarantees the economic performance, but also promotes the sharing of knowledge, technology transfer and development of new products. The dynamism of clusters is emphasized, based on knowledge creation, profit enhancement and promotion of innovation. Cluster companies operate in the same market and regional resources, and ensure the competitive advantage compared to other companies in the region (Kind & Meier zu Kocker, 2013).

Based on R. Jucevicius (2009), the cluster is composed of: (1) kernel – it is usually drawn from major cluster companies that sell their products or services to customers outside the cluster, (2) ancillary activities that require specialized equipment or raw materials, finance and specialized services for the core activities of the cluster, (3) and infrastructure: the 'soft' social infrastructure, composed of educational institutions, training organizations, professional associations, and the 'hard' physical infrastructure of municipal structures.

S. Kind and G. Meier zu Kocker (2012) mention other cluster entities such as financial institutions, businesses, educational and government institutions, media and non-governmental organizations (NGOs). Business enterprise is represented by small and medium-sized enterprises (SMEs), which are defined as the main cluster centre, the kernel. Meanwhile, non-governmental organizations represent the organizations promotion and cooperation, various associations, chambers of commerce that are aiming to support and encourage clustering.

A. Oyarce-Gatica and M. Mardones (2012) provide triple helix model, showing the exchanges and relations between businesses, universities and public institutions in order to increase the region's economic growth. According to the authors, universities provide funding for research and development (R & D), into which the state invests to achieve business sector

growth. Thus, these elements ensure overall economic growth of the region and the state. According to them, all three elements interact with each other, including the fields of production, distribution, new and useful knowledge, information and innovation by their activities. Moreover, the relations of the cluster elements create a social network, through which companies receive a greater benefit for a better dissemination of information and knowledge between the cluster actors.

R. Jucevicius (2008) suggests the following cluster classification: (1) micro clusters – a group of 5–15 small enterprises, cooperating in various activities such as co-organized learning, marketing, jointly designed and developed product; (2) value chains, consisting of companies engaged in various sectors, creating specific value chains in order to ensure a productive cluster activity; (3) supply chains, consisting of companies that ensure supply of materials and other components necessary for production performed by larger companies; (4) sectoral clusters, made up of a group of companies engaged in similar activities, which develops a network of excellence; (5) geographic clusters that are divided into local, regional, national and international according to their geographical area.

Summarizing Kuah A. (2002), R. Jucevicius (2008) and Cluster Network of Excellence (2016), the following key clusters benefits for businesses are highlighted: cluster-owned companies are more productive and profitable; faster growth companies; the opportunity is provided to compete not only in domestic but also in international markets; it is easier to go beyond the limits of other markets for co-organized marketing and sales; companies attract new investors; the opportunity is provided to obtain cheaper, faster and easier access to specialized information and knowledge; creation of activity synergies; the opportunity is provided to implement large orders and to participate in public procurement; easier implementation of value chain activities by allocating them among different entities; skilled labour force; increased competitiveness of all cluster system; creating more favourable conditions for innovation; socialization and community culture.

Establishment of clusters promotes business development in the area where they are located, and combining into the clusters is useful not only for businesses but also for the whole region. The formation of such clusters has been recently observed throughout the world, and the regions where the clusters concentration is large become the economic engine of all the surrounding regions.

R. Zadeh (2007) states that the benefits of clusters can be grouped into the company, regional and national levels. In case of the regional level, the benefit
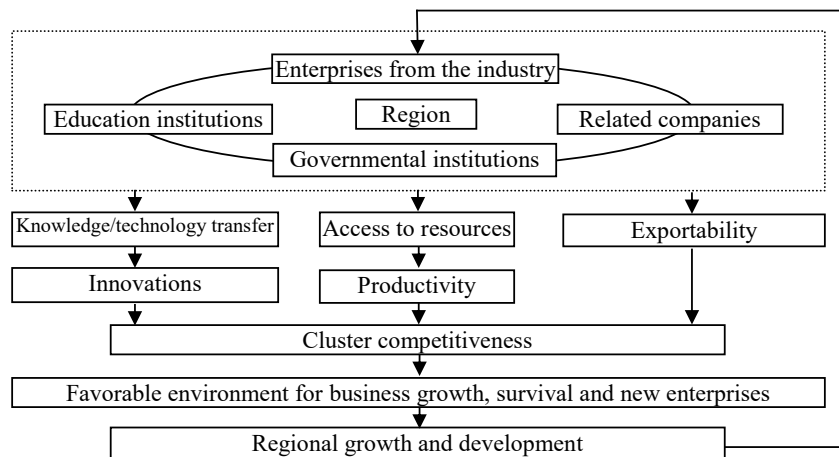
Source: According Z. Garanti ir A. Zvirbule – Berzina (2013).

Figure 1. Region Cluster Effect on Regional Growth and Development.

is linked to specific local companies and it includes facilitating access to the relevant labour, research, knowledge, specific professional services, suppliers and customers and innovative products in the region. Therefore, the emergence of clusters can often be based on the promotion and support of the regional authorities. Clusters are formed in regions regardless of the quality of the business environment, but a better business environment provides better conditions for successful operations and development of clusters. According to K. Mills, E. Reynolds and A. Reamer (2008), and R. Jucevicius (2003), clusters are the main mechanism for increasing of regional competitiveness. J. Cincikaite and G. Belazariene (2001) state that clusters increase the regional competitiveness by improving productivity of industries and adaptation to a changing environment, innovation, and continuously expand cluster boundaries by attracting new members to the cluster from other regions. Meanwhile, Z. Garanti and A. Zvirbule-Berzina (2013) provide a broader scheme depicting the influence of a cluster to the region (see Fig. 1):

They argue that combining into clusters allows companies to secure economic growth and development, and this influences the whole region's economic growth and development. The resulting cluster, particularly in influencing corporate activities and educational and public institutions, provides benefits for the entire region, and according to K. Mills, E. Reynolds and A. Reamer (2008), cluster competitiveness is conducive to the whole region in business growth and development, and to the creation of competitive advantages. Then non-cluster companies try to keep up with the cluster companies and be competitive with them, and this allows for expansion of the regional business market. The correlation of the clusters formation with economic indicators has been analysed (Ketels, 2003): the stronger the clusters

in the region, the higher are wages there, the cluster is associated with a higher GDP, and the improved corporate performance is evidenced as well. Cluster activities may not only bring tangible economic benefits to individual regions, rural areas, but at the same time can improve the prevailing social situation: reduce the number of harmful addictions, conflict situations, thus allowing the state to reduce the funds allocated for social benefits. There is an opportunity to improve living conditions in the regions, to raise the level of infrastructure, to invest in social care, culture, etc. Over time, this should result in the reduction of regional and territorial exclusion.

On the other hand, according to R. Jucevicius (2009), S. Kind, G. Meier zu Kocker (2012), Rosenfeld (2002), a success of the cluster activity depends also on regional restrictions and insularity, low supply of industrial real estate, poor infrastructure in the region, the obtained state financial support, utilization of innovation and technical capacity or investment. Ch. Ketels (2003) highlights failures associated with government intervention in the market, misused support to clusterization, conflict of interest, or the support of high-tech clusters even when there are no necessary conditions in the region. Removal of cluster barriers and promotion of cluster processes should be the priority of national and regional policies, as the impact of clusters on economic development and wage growth is proven and significant.

Methods. This study was extensive analysis of scientific literature, as well as analysis of available relevant secondary data, which was collected from government bodies, NGOs, foreign development agencies, relevant local organisations, funded projects reports, previous researches, assessments, and their reports of clusterization, etc. A source of secondary data analysis was both quantitative and qualitative data. The aim of a secondary analysis is usually

to address new research questions by analysing previously collected data, so here research questions are: (1) the development of clusterization in Lithuania and its regions, as well as the current situation thereof, (2) the cluster distribution in separate Lithuanian regions, (3) clusterization in individual sectors, (4) the benefit of clusterization for the cluster members and the regional development, (5) financial and other support provided to clusters by the state, and (6) issues faced in individual regions by the companies that are determined to form cluster. During the data processing the content analysis method has been used, by which clusterization of Lithuanian regions has been examined.

Results and Discussion

Accelerated formation of clusters in Lithuania started in the period of 2010 to 2013, when 31 clusters were established. Currently, there are 51 clusters in Lithuania (KlasterLT, 2016). In the Global Competitiveness Report of 2014-2015, Lithuania occupies the 89th place out of 148 countries by the development status of clusters and is ahead of Latvia (the 90th place), but lags behind Estonia (the 76th place). It is positive that Lithuania has achieved the best result in the past five years in this list. However, clusters in Lithuania are relatively new and small - the average cluster age being 3.1 years, consisting of approximately 12 companies, academic and research institutions and other entities. It can be argued that clustering processes in Lithuania are still quite new and requiring attention and support of the state and cluster consulting firms.

The study shows that part of the clusters has only started formation, is still in the initial stage or there are merely groups of companies, unified by pursue to take advantage of support of the EU Structural Funds. The clusters are usually formed by smaller enterprises featuring the widest range of activities, in order to obtain specific resources or services that they are lacking, which can be ensured by cooperation of the cluster. To achieve all this, financial support is necessary, which can be allocated by the authorities and the educational and research institutions included into the cluster, where the required specialists will be prepared.

Based on the study of the source clusters in Lithuania, it can be said that although clusterization gains more and more attention, the clusters formation processes are different in each sector. In Lithuania, clusters are basically present in 7 business sectors: chemicals, electronics, food and beverage, wood and furniture industry and services that are changing the client's physical or mental qualities and material good characteristics, and information services sectors.

The companies most actively combine clusters by common purpose in the service sector (Mrazauskaite, 2016) – there are 32 clusters; so, given this fact it can be said that there are more companies in Lithuania engaged in the services sector, and clustering is more developed there due to better conditions. The most developed sectors are medical and tourism sectors, including their clusters that are becoming more in numbers (Navickas & Malakauskaite, 2009). Meanwhile, in areas such as IT services and the automotive industry, there is a need for new investment and attracting new members in order to facilitate their activities, by combining competent professionals. For example, one such cluster is the cluster of Baltic automotive parts established in 2013, which currently has 14 members and despite of that still relies on intermediaries for production of the required products and seeks for new members (Razmaitė, 2013). Currently, the maximum number of clusters is recorded in the information technology (IT), tourism and medical and health sectors. The activity in these sectors is probably determined by their specifics, as the service sector is easier to build, while the business is more mobile. The companies are used to cooperate with each other in the past as well, even without forming a cluster. For example, 'in order to attract an even greater flow of tourists, especially from abroad, and in order to steadily promote and advertise their local country or region's tourism by consistently formulating and implementing strategies, the tourism sector enterprises have naturally become aware of the need to cooperate' (Lasionis, 2016). Meanwhile, the food and beverage and wood industry clusters operate most successfully in the industry area, although not every potential is utilised in these sectors, whereas the electronics and the chemical industry are facing the issues of limited resources and skilled manpower (Svetkauskas, 2003).

Clusters formation in Lithuania requires focus on regions with relatively developed business, industry and technology infrastructure that provides the necessary cluster resources and services. The clusters in Lithuania are mainly established in the economically strongest cities (even 76 percent of them are located in Vilnius, Klaipeda, Kaunas and Alytus), where there is a variety of resource-rich service providers required for clusters. However, in Lithuanian regions certain micro-clusters can also be detected, while some regions have their own clear specifics (Birzai, Druskininkai, Kedainiai, Mazeikiai, Ignalina, etc.) (Cluster map of Lithuania, 2016.). The study counted only 140 (24 percent) regional companies from a total of 580 companies belonging to clusters in Lithuania. Of all the clusters in Lithuania, only 26 of the 51 clusters have at least one member located not in a major city.

Clear Digital World Cluster, Natural Mineral Water Cluster and Uzupis Creative Cluster go beyond the boundaries of the region, adding members of the neighbouring Latvia, Estonia, Belarus, where the latter cluster even has 2 members from Great Britain. However, they cannot be designated as international level clusters and the role of internationalization in the cluster having a higher level than micro-clusters is clearly insufficient in the regional level as well. In particular, in the fields of IT services and high-tech, as well as in medical area, most clusters are exceptionally primarily based in Vilnius, some in Kaunas, Klaipeda and Siauliai, without any members from more distant Lithuanian regions.

In the distant regions, located away from the state capital, and especially in rural areas or small resort towns the most typical representatives are those of the tourism clusters (seeTable 1) – there are 6 of them in total: clusters of Anyksciai, Pamarys, Zemaitija, Ignalina, Birzai and Kedainiai tourism. They all or almost all have members that are not located in big cities but rather based in remote areas, as well as their members – cluster coordinators. Also, about half of the members of the food industry clusters are located in non-metropolitan areas and contribute to sustainable regional development. It should be noted that the regional distribution of clusters can be clearly linked to the nature of activities of cluster members, which requires the rural tourism attraction centres situated in the regions, agricultural resources or cheaper labour available therein. The opposite reasons are inherent in the demand of IT, medical or other high-tech

Table 1

Data analysis of regional clustering in Lithuania

Cluster name	Regional	Type	Coordinator	Funding of Inoklaster LT(+)
Anyksciai Tourism	19/20	Micro cluster	Association, Anykščiai	-
Pamarys Tourism	18/20	Value chain	Association, Klaipeda dist.	-
Zemaitija Tourism	13/14	Micro cluster	Association, Plunge	-
Ignalina Tourism	13/14	Sectoral	Association, Ignalina	-
Birzai Tourism	13/13	Micro cluster	Association, Birzai district	-
Kedainiai Region Tourism	8/9	Micro cluster	PI, Kedainiai	-
National Food Farm	6/9	Micro cluster	Association, Kauno dist.	-
Food (Fruits and Vegetables)	3/5	Sectoral	JSC, Kaunas	Absence of contract
Smart Food	3/8	Micro cluster	Association, Vilnius	-
Lithuania Car Parts Producers/ Exp.	7/14	Micro cluster	Association, Siauliai	-
Baltic Car Parts	5/17	Micro cluster	Association, Kaunas	-
Energy-efficient and Passive Houses	5/8	Sectoral	Association, Kretinga	-
Baltic Furniture	2/8	Sectoral	Association, Siauliai	-
Bio Power Plant Development	2/4	Sectoral	JSC, Kedainiai	74 424 Eu, accomplished
Clear Digital World	1/13	Micro cluster	JSC, Vilnius	254 828 Eu, accomplished
Fotoelectricity Technologies	2/26	Sectoral	PI, Vilnius	3 445 722 Eu, accomplished
Innovative Energy-Consumption	2/9	Sectoral	JSC, Vilnius	Absence of contract
Smart IT Cluster	1/12	Value chain	PI, Vilnius	Terminated
Lithuanian Laser Association	1/17	Sectoral	Association, Vilnius	-
Lithuania Medical Tourism	2/14	Value chain	Association, Vilnius	-
Plastics and New Materials	4/15	Sectoral	PI, Vilnius	Absence of contract
Lithuanian Plastics	2/13	Micro cluster	Association, Siauliai	-
Natural Mineral Water	1/9	Sectoral	JSC, Vilnius	Absence of contract
New Generation of Science and B.	2/28	Value chain	Association, Klaipėda	-
Health Cluster iVita	2/11	Micro cluster	JSC, Kaunas	102 508 Eu, accomplished
International Health	3/12	Sectoral	Association, Vilnius	-

to provide for both sufficiently competent human resources and technological equipment, so their clustering is absolutely not spread in rural areas. The difference in excellence and at the same time the level of objectives raised is reflected by diverse cluster type chosen, since the micro-cluster type is dominant in rural regions, including the strengthening tasks of organization level functions, whereas the clusters located in major cities often reach the sector level objectives, when they pursue to become specific skills development centres, or the value chain type objectives, when the cluster unites the members that offer different performance to the market in order to complete customer satisfaction by cluster capabilities.

The formation objectives nominated by clusters are mostly corporate development opportunities, innovation and increasing innovative applications, new investment attraction and communications creation and support between different companies, while less common objectives are the analysis of clusters formation experience, public procurement, technical standards and private infrastructure project development.

Among the most favourable and best conditions for promoting cluster development in Lithuania are rather cheap qualified workforce, a convenient location for logistics, well-developed logistics, good infrastructure and technology. An important factor in the development of rural areas is an innovative product design and development. The most common issue discussed in scientific debate and practical analysis is agro-tourism development and the social value created thereby, synergy emerging from a new producer cooperatives, development of clusters and rural innovation incubators (Milone & Ventura, 2004).

The main identified problems of clusterization development in Lithuania are such as lack in cooperation culture, search for distant partners, while considering the nearby businesses as competitors, lack of responsibility for the quality of operations after the merger, lack of interest in innovation and successful activities of the merging company, which does not encourage improvement, lack of business-to-business confidence, which impedes attraction of new members into clusters, low management level of competence and limited local raw material resources (Pasiliauskas, 2012). The clustering process is also prevented by the emigration of the skilled labour force in the regions, and the resulting shortage of skilled labour force as well as unfavourable assessment of particular specialties by the youth (Žinių ekonomikos formumas, 2012; Jucevicius, 2010).

As for each company, the clusters are facing major challenges in the formation and the market establishment stage, when they are most in need of financial support in order to accelerate and facilitate

this stage. Complete cluster formation generally requires about three years and the state involvement and support is needed mostly up to establishment of the cluster. In 2011, when the peak of clusters formation was reached, the companies were mostly encouraged to combine by a greater access to the European Union (EU) funding, while recently clusters are being formed naturally – for the economic benefit. However, some data proves the cluster members' passivity in coordinators' activity, and the interest in coordinators' status shows that the majority of them are structures of association type, while public institutions or limited liability companies that would have more political and economic incentives to develop clusterization in the regions, are significantly less common.

However, only a quarter of all countable clusters can be regarded as naturally formed clusters. Another reason for clusterization – emerge of information technology, tourism clusters are more initiated by the state, local authorities, or certain associations of these sectors, not at the company's initiative.

Emerging clusters initiatives in Lithuania are eligible for the European Union financial support. According to Ziniu ekonomikos forumas (2012) the main EU support measures 'Inoklaster LT' and 'Inoklaster LT +' have been validated and confirmed in 2008, thus approving the Lithuanian Innovation Strategy of 2010-2020, which highlights the companies' involvement in the international promotion of cluster opportunities and provides for the plan of support measures for clusters formation and further operation of clusters competencies network. Under 'Inoklaster LT' measure the support of over 568 thousand EUR by 6 applications was provided alone in 2016 (for more information see http://lvpa.lt/lt/paraiskos/priemones-inoklaster-lt-antras-kvietimas-342). Another planned support measure 'Ingeb E-3' has been approved for strengthening of the innovation system in order to ensure the development of R & D. As for Lithuania clusters internationalization, it should be noted that there is a notable Lithuanian cluster involvement in various international projects, such as the 'Baltic Sea Region 2007 – 2013' and 'Eureka Eurostars' (Global Cluster Observatory, 2016.).

Nevertheless, only 15 of the 51 clusters were able to take advantage of these support measures, and none of the major tourism and food industry clusters active in Lithuanian remote areas did not utilise the support, which means that the EU support had no impact for clustering development in the regions. There are a number of barriers, which prevent utilisation of support programs for each cluster initiative. Support can be given only to cluster initiatives, which aim to find out the cluster emergence opportunities and its potential participants to develop or strengthen national or regional level cluster, to form or strengthen cross-

sectoral cluster, to create or strengthen a joint regional business system, to form or improve the competence networks linking different areas of expertise. On this basis, it can be said that only potential clusters or clusters that have already started formation process are able to get the support. Support measures 'Inoklaster LT' and 'Inoklaster LT +' require at least 5 enterprises, while 'Ingeb E-3' – at least 10 enterprises to be involved to receive the support. It can be argued that the required number is not large, and there is a possibility that companies can combine their activities in order to benefit from the support, while the regional micro-clusters fail to do so. According to the data provided by Ziniu ekonomikos forumas (2012), the consultations of innovative service providers provided to businesses on the importance and benefits of clusters can help to reduce this risk. Currently these consulting services are provided by 'Lithuanian Innovation Centre', 'Science, Innovation and Technology Agency' and Public Institution "Enterprise Lithuania", which consult Lithuanian businesses on the clusters creation (Briediene, 2013), formation, growth, development, governance and legal issues, and support in finding the required financing resources and new cluster members not only in Lithuania but also abroad.

Conclusions

Cluster policy is becoming an attractive alternative to the traditional and unjustified industrial policy, geared to the priority sectors of the economy and corporate sponsorship, because it is based on the assumption that the regional well-being is determined not by the specific individual companies, but rather on the operation of the groups of them linked by productive relationship in the region. Therefore, the main subject of the cluster policy is creation of the entire industrial system of the region, supporting productive relationship among actors.

It has been established that clusterization processes in Lithuania are still relatively new compared with international experience. The more distinct clusterization processes take place in the service sector in Lithuania, as compared to the industry. The main problems that hinder the development of clusters in

Lithuania are passivity of the cluster members on the predominant role of a coordinator, lack in confidence among members, education, and government sectors, which impedes attraction of new members, emerging lack of skilled labour force due to emigration, rising prices of labour resources and limited local resources.

Clusterization in Lithuanian regions lags far behind the big cities, is much more passive, clusters there often reach only the level of a micro-cluster. Clusters are most developed in the tourism and food industries, using traditional means of action, rather than the modern high-techs, employing cheaper labour force in the regions, failing to become a centre of excellence and benefit from the EU support for clustering development.

From the point of view of separate regions, the state support should be prioritized in the rural regions locating less clusters rather than in the regions surrounding major cities. In order to improve the clusterization situation in Lithuania and its development in the regions, more attention and investment are to be allocated for promoting cooperation between the companies, the business and science, research sectors, strengthening their confidence in each other and interrelations, promoting development, growth of existing clusters, their joining the international clusters and formation initiatives of new clusters, creation of support programs for implementation of easy clustering processes. Cluster management after its formation has to focus on each management areas such as training, competence and development, information dissemination and communication, collaboration, marketing and internationalization. Higher education institutions ensure preparation of a skilled workforce for the cluster, legal counselling and the opportunity to benefit from the EU and state support, which enable R & D and training infrastructure. The clusterization processes need to be effectively managed, aligning the bottom-up and top-down processes, and linked to the education, business and technology infrastructures, in order to ensure a longer cluster survival and its increased efficiency for the enterprises and the entire region development.

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TERRITORIAL DEVELOPMENT ASSESSMENT IN LATVIA

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Abstract
It is important for every country that its territory develops evenly and in a balanced way. In the European Union (EU), a special focus is placed on the development of rural territories, as predominantly rural regions in the EU represent 57% of the territory and 24% of the population. In Latvia, the development of rural territories depends on economic growth in the key industries for the rural areas – agriculture and forestry, and logging that contributed to 4.3% of GDP and employed 9.5% of the labour force in 2011. Therefore, the **research aim** is to perform an assessment of the administrative territories of Latvia. The research analysed the municipalities of Latvia in terms of population and change in the population as well as in terms of revenue and income and change in the revenue and income. The research found that in Latvia the best economic performance was demonstrated by the municipalities with a population in the range of 8-12 thousand. In the period 2004 – 2014, the number of residents decreased by more than 20% in 49 municipalities of Latvia. Such municipalities are located far away from the capital city, and poor economic performance indicators with a prevailing primary sector were typical of the municipalities. The municipalities with higher tax revenue had larger populations, which increased in the period of analysis, and such municipalities are located in the vicinity of Riga and high economic performance indicators were characteristic of them.
Key words: administrative territories, development, indicators.

Introduction

The problems of development and assessment of territories have been urgent both to policy makers and to researchers. However, still there is no single approach and methodology developed in the world and Latvia with regard to what principles and indicators have to be employed to assess the development level and pace of a particular territory (a region, a municipality, a rural territory or a town or city) as well as the influencing factors. L.G. Bellù (2011) emphasises that territorial development means the development of a specific region (space) achievable by exploiting the specific socio-economic, environmental and institutional potential of the area, and its relationships with external subjects. The problem of development of rural territories is of great importance in the EU, as predominantly rural regions in the EU represent 57% of the territory and 24% of the population. In 2009, they generated 17% of the total gross value added and 22% of the employment (European Commission, 2011). In land use terms, rural areas represent 93% of the EU-27 territory, with 20% of the population living in predominantly rural areas and 38% in significantly rural areas (ECORYS Nederland BV, 2010). Rural areas still account for almost half the world's population, but after 2020, it is expected that rural population will begin to decline, especially in China and India (Eppler, Fritsche, & Laaks, 2015). M. Ambrosio-Albalá and J.Bastiaensen (2010) stress that rural studies have broadened their focus from merely technical and economic agrarian issues to a wider array of topics, inspired by disciplines such as sociology, politics, anthropology, ecology and history. The free circulation of capital in the newly expanded trading spaces and the conversion processes that local areas are obliged to undertake

together with technological innovations give rise to new maps of production with their inevitable outcome of losses and gains (Boisier, 2005). Rural areas have, for long generations, provided most of the food, fibre, timber, firewood, water and minerals upon which an increasingly urbanised Europe depends. They have provided also the skills with which these resources are gathered, processed and transported. There is currently growing worldwide pressure on resources of all kinds (Dower, 2013). A research study by ESPON (2013) has found that three key issues for territorial development are: 1) the need to better understand patterns of differentiation, between different kinds of rural areas; 2) the nature of the different opportunities for development which each of them faces; 3) the way in which such opportunities depend upon and may be strengthened by interaction between rural and urban areas. I. Dunmade (2014) also has a similar opinion that provincial/federal policies and incentives that encourage collaboration are also essential for successful voluntary rural-urban communities' partnerships. It is important to study the impacts of political differences and demographic changes on rural-urban regional economic partnership. The changes in economic policies have resulted in changes in economic activities in some localities, caused demographic changes in some municipalities and consequent reduction in revenue generations and attendant difficulty in maintaining infrastructural services at the local level.

Not only in Latvia but also in the entire Europe rural territories face depopulation. In Latvia, approximately 30% of the population live in rural areas; of them, about 20% may be regarded as rural residents in terms of lifestyle and economic base (Vitola, 2013). In Latvia, the development of rural territories depends

on economic growth in the key industries for the rural areas – agriculture and forestry, and logging that contributed to 4.3% of GDP and employed 81.9 thousand residents or 9.5% of the labour force in the country in 2011 (Zemkopības ministrija, 2016). The **research aim** is to perform an assessment of the administrative territories of Latvia.

To achieve the aim, the following specific **research tasks** were set: 1) to analyse the municipalities of Latvia in terms of population and change in the population; 2) to assess the municipalities of Latvia in terms of revenue and income as well as change in the revenue and income. The **object of the research** is municipalities in Latvia.

Materials and Methods

The research employed the administrative division of the territory of Latvia that existed at the beginning of 2015 – 9 cities of national significance (with more than 25000 residents) and 110 municipalities (Administratīvo teritoriju…, 2008). In view of the 2009 administrative and territorial reform in Latvia, the available data on civil parishes were recalculated into the data for municipalities (population, personal income tax (PIT) revenue). Indicators expressed in Latvian lats (LVL) were converted into euros based on the official exchange rate set by the Bank of Latvia: 1 EUR = 0.702804 LVL (LB, 2013). Since municipalities are large territorial units, for methodological purposes the research applied the approach of grouping according to selected criteria to perform a very detailed analysis. Such an approach allows sufficiently clearly identify associations through analysing a broad spectrum of indicators; yet it does not allow precisely determine the quantitative effects of the indicators.

The present research analysed 110 municipalities, employing indicators showing the demographic situation, economic growth and available resources. A comparative analysis of the municipalities was performed by grouping the municipalities according to significant indicators of their development and growth: the number of residents in 2014 and its change since 2004 as well as the amount of tax revenue collected by the local governments – PIT revenue per capita in 2013 and change in the PIT revenue since 2004. The selected indicators reflected both the current situation and the trend since the base year (2004). The research used data of the Central Statistical Bureau of Latvia (CSB), the State Regional Development Agency (SRDA) and the State Land Service (SLS). The present research analysed the amounts of support payments disbursed by the Rural Support Service (RSS), which is responsible for the administration of the EU's CAP and Common Fisheries Policy support payments that are funded by the European

Agricultural Guarantee Fund (EAGF), the European Agricultural Fund for Rural Development (EAFRD) and the European Fisheries Fund (EFF). The amounts of funding disbursed in municipalities by other funds – the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF) were analysed as well. Lursoft data on top 20 enterprises in terms of turnover, which were grouped into three categories, were used for business characteristics. The primary sector is comprised of agriculture, hunting, forestry, fisheries and mining. The present research classifies the primary sector into three categories: agriculture, forestry and other industries. The secondary sector consists of manufacturing, electricity supply, gas supply, water supply and construction. The research classifies this sector into the following categories: food production, wood processing that includes such economic activities as 1) sawing, planning and impregnation, 2) manufacture of carpentry and joinery products, 3) manufacture of furniture, 4) manufacture of wood packaging etc., as well as other manufacturing industries. The tertiary or services sector – enterprises providing various services for businesses and households – are classified into two broad categories: private services (wholesale and retail trade, construction, etc.) and public services (utilities, education, health care, electricity production, waste management etc.). Energy production belongs to the category of public services (LLU, 2015).

Results and Discussion

1. Assessment of territories in Latvia in terms of population and change in the population

According to the research study by ECORYS Nederland BV (2010), the key barriers reported through case studies to growth in rural areas are primarily: 1) demographic evolutions and migration (loss of young people and ageing); 2) infrastructure and accessibility; 3) the sectoral structure of the economy. Accordingly, one of the most frequently employed indicators to characterise a municipality in Latvia is the number of residents. Despite the fact that one of the objectives of the 2009 administrative and territorial reform was to establish maximally similar administrative territories in terms of population size, currently large disparities in population size are observed across the municipalities. An increase in indicator values reflects successful development in the municipalities, whereas low or negative indicator values indicate potential stagnation and the lack of development. The research grouped the municipalities into five groups by population size – there were 37 municipalities with a population of less than 4 000, 30 municipalities with a population ranging from 4 000 to 8 000, 23 – with a population ranging from 8 000 to 12 000 and 20 – with a population of more than

12 000. The average values of influencing factors were calculated for each group (Table 1). After grouping the municipalities by population size, one can conclude that: 1) in the municipalities with a larger population, incomes and wages, and salaries of their residents were higher as well as the turnover of enterprises was considerably higher, whereas in the municipalities with a population of more than 20 000 the mentioned indicators tended to decrease; 2) the best economic performance indicators if measured per capita were specific to the municipalities with a population ranging from 8 000 to 12 000. In the mentioned municipalities, the investment level and the turnover of enterprises were higher, and the proportion of public sector employees was lower; 3) the primary sector prevailed in the municipalities with a small population – the UAA and the forest area were large, whereas the total amount of RSS-administered support payments was relatively small in the municipalities,

which indicated ineffective land management in such municipalities. Similar trends may be also observed elsewhere in Europe – the key economic sectors are currently 1) agriculture; 2) tourism; 3) food and drink and 4) construction. Within the first three sectors, diversification of regional economies is considered key in driving growth (ECORYS Nederland BV, 2010).

In the eyes of residents, the attractiveness of a territory is characterised by population changes in a long-term – the present research analysed the situation in a 10-year period. The municipalities were grouped into three groups: the first group consisted of 49 municipalities where the population decreased by more than 20% in 2014 compared with 2004; the second group included 43 municipalities where the population decreased by less than 20%, and the third group had 18 municipalities, in which their populations increased (Table 2). Analysing the situation in the

Table 1

Characteristics of the municipalities of Latvia grouped by population size in 2014

Indicators	Population in the municipality				
	≤ 4000	4 000 – 8 000	8 000 –12 000	12 000 – 20 000	> 20 000
Number of municipalities in a group	37	30	19	10	14
Change in the population in 10 years	0.81	1.02	0.96	1.14	0.88
Distance to Riga (average for the group), km	158	123	99	135	110
Boundary municipalities of Riga	0	3	4	2	2
Pieriga municipalities	2	9	7	3	3
Boundary municipalities of republican cities	3	6	6	2	5
PIT revenue per capita, EUR	341	396	471	438	411
Increase in PIT revenue per capita, %	2.05	1.98	1.81	1.77	1.63
Average monthly wage and salary, EUR	562	640	709	646	656
Foreign investment per capita, EUR	136	747	1489	1751	1458
ERDF, ESF, CF funding per capita, EUR	1693	2477	1554	1205	1067
Local government equalisation funding per capita, EUR	889	799	271	234	642
Managed UAA per capita, ha	3.90	2.91	1.57	1.17	1.91
Land quality, points	37	37	38	36	40
Forest area per capita, ha	5.58	4.32	2.88	2.41	2.25
Amount of EAGF, EAFRD, EFF funding per capita, EUR	3431	2704	2205	1182	951
Turnover of top 20 enterprises:					
Total turnover per capita, EUR	5195	7460	9388	13650	8840
Primary production, turnover per capita, EUR	1886	1372	804	367	687
Secondary production, turnover per capita, EUR	1387	2194	3390	3181	2328
Services sector, turnover per capita, EUR	2076	4056	5500	10397	5952
Total support payments disbursed by the RSS, EUR	4747	4703	5659	5780	6313
Area-based support payments, EUR	2811	3085	3519	3842	3837

Source: authors' calculations based on LLU, 2014, 2015, CSB, 2016a, 2016b, SRDA, 2016, Riga, 2016, RSS, 2016a, 2016b, 2016c, 2016d, SLS, 2014, LV, 2013, Lursoft, 2016.

aspect of population change, a very explicit trend may be observed – the populations of municipalities located in the vicinity of Riga increased in size. Since 2004, the mentioned municipalities have had considerably greater PIT revenue increases, a higher average wage and salary and, consequently, higher per-capita PIT revenues paid to the local government. Entrepreneurship in the municipalities has been considerably more active – higher investment levels and a higher total turnover of enterprises per capita (more than twice higher than in other municipalities). The highest turnover was reported in the services' sector (EUR 13 809 per capita or three times higher than the average in the country); the turnover of secondary sector enterprises was also high – 1.7 times higher than the average in the country. However, the sizes of primary resources were the smallest – the managed UAA (0.86 ha per capita) as well as the forest area (1.28 ha per capita) were very small and the quality of land was low (on average, 35 points); consequently,

the amounts of support payments disbursed by the RSS were the smallest. A characteristic feature of the mentioned municipalities was the amount of absorbed agriculture-related EU funding per capita – it was up to two times lower than in other groups of municipalities. Positive development was also indicated by the fact that the mentioned municipalities did not receive subsidies from the Local Government Equalisation Fund; they made contributions to the Fund – EUR 394 per capita. An opposite situation was observed in 49 municipalities where the population decreased by more than 20%. The municipalities are located further away from Riga and their economic situation is poorer: low wages and salaries, small amounts of PIT revenue paid to the local government, small investments and a lower turnover of enterprises, where a large role is played by the primary sector. The municipalities received large subsidies from the Local Government Equalisation Fund. Compared with other groups of municipalities, the municipalities

Table 2

The municipalities grouped by change in population size in Latvia in the period 2004 – 2014

Indicators	Change in the population		
	< -20%	≥ -20% – 0%	≥ 0%
Number of municipalities in a group	49	43	18
Change in the population in 10 years	6211	11214	10647
Distance to Riga (average for the group), km	181	110	40
Boundary municipalities of Riga	0	0	11
Pieriga municipalities	0	7	17
Boundary municipalities of republican cities	3	10	9
PIT revenue per capita, EUR	305	405	624
Increase in PIT revenue per capita, %	1.55	1.73	3.31
Average monthly wage and salary, EUR	564	631	797
Foreign investment per capita, EUR	316	908	2174
ERDF, ESF, CF funding per capita, EUR	1811	2027	976
Local government equalisation funding per capita, EUR	1113	604	-397
Managed UAA per capita, ha	3.53	2.59	0.86
Land quality, points	37	38	35
Forest area per capita, ha	2.74	5.71	1.28
Amount of EAGF, EAFRD, EFF funding per capita, EUR	3178	2436	813
Turnover of top 20 enterprises:			
Total turnover per capita, EUR	4440	7419	17672
Primary production, turnover per capita, EUR	1603	1242	418
Secondary production, turnover per capita, EUR	1244	2753	3701
Services sector, turnover per capita, EUR	1767	3607	13809
Total support payments paid by the RSS, EUR	5600	4981	4547
Area-based support payments, EUR	3580	3057	2704

Source: authors' calculations based on LLU, 2014, 2015, CSB, 2016a, 2016b, SRDA, 2016, Riga, 2016, RSS, 2016a, 2016b, 2016c, 2016d, SLS, 2014, LV, 2013, Lursoft, 2016.

have better performed with regard to absorbing EU funding, the funding related to agriculture and rural development in particular. The greatest size of managed UAA per capita and the greatest amount of RSS-administered support payments, including area-based ones, indicated the key income sources for their residents. In the municipalities where the population decreased by less than 20%, the situation was average. The municipalities attracted the greatest amounts of ERDF, ESF, CF funding per capita as well as had the largest forest areas per capita.

After grouping the municipalities by change in population size in 2014 compared with 2004, one can conclude that an increase in the population and positive economic performance indicators were interrelated. Besides, not always a large population was the most essential factor – it was rather the location of the municipality. However, there are a number of discussible aspects – large retail and wholesale trade enterprises were located in Pieriga municipalities, which theoretically positively influenced the local territories and their economic situation. Statistical data and calculations show better performance in terms of enterprise turnover and wages and salaries, but it does not always reflect the real situation. A number of enterprises, which were usually international companies and did not do their business in the entire territory of Latvia, were registered, because of various reasons, in Pieriga municipalities; therefore, one cannot assert that entrepreneurial development was the merit of a particular municipality.

2. Analysis of the municipalities in terms of revenue and income and change in the revenue and income

The second group of indicators showing trends in the development of the municipalities involves PIT revenue; most of the PIT revenues (80%) are paid to local governments and are their key source of their tax revenues. The amount of PIT revenue per capita reflects the income level of residents and, consequently, the life quality of the residents. Grouping the municipalities by per-capital amount of PIT revenue paid to the local government resulted in four groups – most municipalities (43) belonged to the group with a per-capita amount of PIT revenue in the range of EUR 281-380 in 2013 (Table 3).

An analysis of the indicators for the groups of municipalities revealed a number of explicit trends. The municipalities with a greater per-capita amount of PIT revenue had larger populations that had increased since 2004, shorter distances to Riga (all the boundary municipalities of Riga belonged to the group with the highest PIT indicators), a higher average monthly wage and salary and considerably greater investments. The municipalities did not receive funds from the Local Government Equalisation Fund – they made

contributions to the Fund. However, their primary production resources were smaller than those of other groups, including the managed UAA, the quality of land and the forest area, which resulted in a very low turnover of primary sector enterprises. The amounts of support payments disbursed by the RSS, including area-based payments, were average, while relatively small amounts were attracted from EU programmes for agriculture and rural development. In contrast, the municipalities with a small per-capita amount of PIT revenue had diametrically opposite indicator values, indicating an unfavourable economic situation where primary production prevailed – with large land and forest resources and large per-capita amounts of RSS-administered support payments.

The PIT is one of the most significant income sources for local governments and an analysis of the data showed that the smaller the per-capita amount of PIT revenue is collected by a municipality, the larger subsidies the municipality receives from the Local Government Equalisation Fund. This indicates instability and potential stagnation. There are sharp disparities in PIT revenue across the municipalities in relation to the distance to Riga – the further the municipality is located away from Riga, the smaller is the per-capita amount of PIT revenue, which shows the positive effect of the capital city.

In analysing the situation, it is important to examine not only the current situation, based on the most recent data available, but also the trend observed in a longer term. Changes in the amounts of PIT revenue paid to the local government in 2013 compared with 2004 were analysed in order to identify how the municipalities developed in the 10-year period (Table 4).

Grouping the municipalities by pace of increase in PIT revenue does not allow definitely asserting that a faster pace of increase is positively related to the highest values of economic indicators and to positive changes caused by the other influencing factors. An explicit trend was observed in relation to increases in the population, the average monthly wage and salary, the per-capita amount of PIT revenue in 2013, and the total turnover of enterprises per capita – the values of the indicators increased if a faster pace of increase in PIT revenue was observed, whereas the amount of subsidies from the Local Government Equalisation Fund decreased.

One cannot definitely assert that more intensive development in terms of increase in PIT revenue was observed in the municipalities that are located the closest to Riga or had the largest populations. This means that in a long-term, economic growth has been influenced by other factors as well. There is an interesting aspect related to investment – as the pace of increase in PIT revenue accelerates,

Table 3

Characteristics of the situation in the municipalities grouped by per-capita amount of PIT revenue in 2013

Indicators	Amount of PIT revenue per capita, EUR			
	≤ 280	281-380	381-480	≥ 481
Number of municipalities in a group	18	43	26	23
Population	7019	7414	10129	11724
Change in the population in 10 years	0.77	0.78	0.84	1.46
Distance to Riga (average for the group), km	234	147	110	40
Boundary municipalities of Riga	0	0	0	11
Pieriga municipalities	0	0	4	20
Boundary municipalities of republican cities	3	5	5	9
Increase in PIT revenue per capita, %	2.23	1.63	1.66	2.45
Average monthly wage and salary, EUR	532	583	644	769
Foreign investment per capita, EUR	107	538	998	1854
ERDF, ESF, CF funding per capita, EUR	909	2188	1787	1591
Local government equalisation funding per capita, EUR	1572	931	494	-341
Managed UAA per capita, ha	4.67	3.09	2.61	0.66
Land quality, points	37	38	39	36
Forest area per capita, ha	5,43	5,02	3,92	1,34
Amount of EAGF, EAFRD, EFF funding per capita, EUR	3785	3012	2518	521
Turnover of top 20 enterprises:				
Total turnover per capita, EUR	3207	5633	7457	15689
Primary production, turnover per capita, EUR	1198	1768	1261	398
Secondary production, turnover per capita, EUR	731	1693	3110	3441
Services sector, turnover per capita, EUR	1443	2367	3219	12124
Total support payments paid by the RSS, EUR	6029	4792	5047	5420
Area-based support payments, EUR	3831	3005	3086	3353

Source: authors' calculations based on LLU, 2014, 2015, CSB, 2016a, 2016b, SRDA, 2016, Riga, 2016, RSS, 2016a, 2016b, 2016c, 2016d, SLS, 2014, LV, 2013, Lursoft, 2016.

the amount of investment considerably decreases, except for the fourth group of municipalities with the fastest pace of increase in PIT revenue where the amount of investment was the greatest. A similar situation was observed in relation to the amount of attracted EAGF, EAFRD, EFF funding. In contrast, the values of other indicators varied across the groups of municipalities, showing no explicit increase or decrease trends. For example, the group of municipalities with the fastest pace of increase in PIT revenue had small amounts of land and forest resources, whereas the third group comprising the municipalities with a medium fast pace of increase in PIT revenue had large amounts of the mentioned resources. This indicates that economic development, the dependent indicator of which is the pace of increase in PIT revenue, may not be definitely explained by means of the indicators used.

In addition, more detailed data should be analysed, employing also subjective indicators and the human factor, e.g. the professionalism of local government officials of a particular municipality, the attractiveness of a territory in the eyes of its residents, government policies on, for example, the location and reorganisation of health care and educational institutions.

Within a regional economy, we can increase prosperity (i.e., generate more outputs or wealth) in two ways: 1) first, we can grow the economy through increasing inputs – either by attracting new resources from outside the region (such as human capital, businesses and investments) or by more fully deploying existing resources (underemployed labour, underdeveloped real estate, etc.); 2) second, we can increase the productivity and efficiency of the regional economy (increase outputs per unit of input) – by improving efficiency of market operations and governance; enhancing the interactions and synergies between different kinds of economic activity; and improving how the assets of the economy are

Table 4

Characteristics of the situation in the municipalities grouped by change in the amount of PIT revenue in the period 2004 – 2013

Indicators	Increase in PIT revenue, %			
	≤ 150	151-200	201-250	≥ 251
Number of municipalities in a group	37	45	16	12
Population	10188	8971	6770	7431
Change in the population in 10 years	0.78	0.95	1.00	1.26
Distance to Riga (average for the group), km	150	137	92	94
Boundary municipalities of Riga	0	3	3	5
Pieriga municipalities	3	8	6	7
Boundary municipalities of republican cities	0	10	5	7
PIT revenue per capita, EUR	355	371	436	567
Average monthly wage and salary, EUR	590	622	665	716
Foreign investment per capita, EUR	1075	581	849	1179
ERDF, ESF, CF funding per capita, EUR	2020	1853	1037	1564
Local government equalisation funding per capita, EUR	569	820	755	275
Managed UAA per capita, ha	2.18	3.15	3.37	1.95
Land quality, points	37	38	37	36
Forest area per capita, ha	4.30	4.05	4.41	2.84
Amount of EAGF, EAFRD, EFF funding per capita, EUR	2251	2711	2875	1987
Turnover of top 20 enterprises:				
Total turnover per capita, EUR	5496	6188	11176	16169
Primary production, turnover per capita, EUR	811	1605	1591	986
Secondary production, turnover per capita, EUR	1961	2100	2072	3813
Services sector, turnover per capita, EUR	3008	2608	7715	11516
Total support payments paid by the RSS, EUR	5736	4802	5624	4341
Area-based support payments, EUR	3778	2860	3437	2670

Source: authors' calculations based on LLU, 2014, 2015, CSB, 2016a, 2016b, SRDA, 2016, Riga, 2016, RSS, 2016a, 2016b, 2016c, 2016d, SLS, 2014, LV, 2013, Lursoft, 2016.

organized and deployed spatially (George Washington Institute…, 2011).

Conclusions

1. The municipalities of Latvia are diverse in terms of population size. The municipalities with larger populations have higher resident incomes and a higher turnover of enterprises. The best performance indicators were demonstrated by the municipalities with a population in the range of 8 – 12 thousand. Such municipalities had the highest investment level, larger enterprises in terms of turnover and a lower proportion of public sector employees. In contrast, the prevalence of primary production and ineffective land management were specific to the municipalities with small populations.

2. In the period 2004 – 2014 in Latvia, the population decreased by more than 20% in 49 municipalities (45% of the total). Such municipalities are located far away from the capital city and low economic performance indicators and the prevalence of the primary sector were typical of them. The population increased in 14 municipalities that are situated close to Riga and had active entrepreneurship and high economic performance indicators.

3. The municipalities with the highest tax revenue collected had larger populations that increased in the period of analysis, and such municipalities are located in the vicinity of Riga and high economic performance indicators were characteristic of them. In contrast, the municipalities with small per-capita amounts of PIT revenue had diametrically opposite indicator values, indicating an unfavourable economic situation where primary production prevailed – with large land and forest resources and large per-capita amounts of RSS-administered support payments.

4. The PIT is one of the most significant income sources for local governments, and the smaller the

per-capita amount of PIT revenue is collected by a municipality, the larger subsidies the municipality receives from the Local Government Equalisation Fund. Grouping the municipalities by pace of increase in PIT revenue does not allow definitely asserting that a faster pace of increase is positively related to the highest values of economic performance indicators and to positive changes caused by the other influencing factors, as in a long-term economic growth has been influenced by other factors as well.

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SMART SPECIALISATION STRATEGY ASSESSMENT IN BALTIC STATES

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Abstract
Smart specialisation strategy (RIS3) is topical for each European Union member state – including the Baltic States. It is a smart tool for the European Union (EU) Structural Funds absorption from 2014 to 2020. Each EU member state has set their own priorities based on the country specialisation and economy strengths and weaknesses. For RIS3 development evaluation, there is RIS3 Assessment Wheel developed – a tool for assessing the RIS3 in a chosen region and positioning it between other regions. The aim of research is to find main differences between RIS3 development in the Baltic states. The tasks of research are 1) to compare existing RIS3 Assessment Wheel of Latvia and create authors version of RIS3 Assessment Wheel of Latvia; 2) to create RIS3 Assessment Wheel of Lithuania and Estonia; 3) to make comparisons between created RIS3 Assessment Wheels. The research performed is mainly based on the desk research by using content analysis and the monographic method. In all three Baltic States, there is a lack of information available about revision of priorities in connection with RIS3 development. In order to achieve the aims set in RIS3, it is essential to finish work on RIS3 legislation in Latvia, and introduce the systematic approach to RIS3 target evaluation in all Baltic States.
Key words: smart specialisation strategy, RIS3 Assessment Wheel, Baltic States.

Introduction

National strategy for smart specialization has an ex ante conditionality for the European Union (EU) Structural Funds use from 2014 to 2020. The strategy envisages detecting smart specialisation priorities with the greatest potential to increase the competitiveness of national economies and mobilising resources for implementing the priorities (Boekholt *et al.*, 2015). Smart specialisation is also topical for Baltic States as the EU Member States. The main aim of the smart specialization strategy (RIS3) in Latvia is to increase innovation capacity and to create an innovation system that promotes and supports technological progress of economy (Informatīvais ziņojums "Par..., 2013). Lithuanian RIS3 priority is defined as the development and commercialisation of thematically-focused, innovative technologies or processes that have high potential to transform the Lithuanian economy, while concentrating available research, development and innovation potential and responding to global tendences and challenges (Martinaitis *et al.*, 2013).The goal of smart specialisation in Estonia is to become more competitive, the country must move up in the production chain and concentrate more on innovation and development, finding areas that increase their efficiency, avoiding relying mainly on low wage levels as their competitive edge (Estonian Development Fund, 2013).

For assessing the smart specialization strategy in a chosen region and positioning it between other regions, Joint Research Centre by European Commission has published the RIS3 Assessment Wheel. It is a synthetic tool allowing condensing a big amount of information in one model which shows the smart specialization development in chosen region. In Latvia, there are already two opinions of the RIS3 Assessment Wheel of Latvia – state government institutions and other Latvian researchers. Based on available information about RIS3 in all three Baltic States, authors will give their own opinion and evaluation about RIS3 in Latvia, Lithuania and Estonia using RIS3 Assessment Wheel.

The aim of the paper is to assess smart specialisation of Latvia, Estonia and Lithuania using smart specialisation assessment tool RIS3Assessment Wheel. The tasks of research are: (1) comparing already published versions of the RIS3 Assessment Wheel of Latvia and create articles authors' version; (2) create RIS3 Assessment Wheel of Lithuania and Estonia; (3) compare and evaluate the smart specialisation strategy development in Latvia, Lithuania and Estonia using the RIS3 Assessment Wheel.

Materials and Methods

The European Commission has developed a smart specialisation platform where information about the RIS3 Assessment wheel is published. It is an assessment tool for RIS3 development in a country or region. The assessment wheel includes different activities, e.g. self-assessments, peer-reviews, expert contributions, presentations at dissemination, discussion and negotiation meetings etc. RIS3 Assessment Wheel includes six steps – analysis of the regional context, governance (ensuring participation and ownership),elaboration of an overall vision for the region future, identification of priorities, coherent policy mix, monitoring and evaluation mechanisms. Each step consists of 3 critical factors. The scaling tool (from 0 to 5) of each factor measures the seriousness of the evidence provided in the process. The meaning of each critical scaling: 0 means no information available on the specific element, 1 means poor, 2 means to be

improved, 3 means fair, 4 means strong and 5 means excellent. In this visual 'spider graph', it is easy to recognize the strengths and weaknesses, and it shows the necessary further activities such as completion or a rise of the national or regional RIS3; preparation and implementation of funding programmes; applicable consideration of territorial features, needs and priorities in multi-level governance process; reflexion on training needed in a specific defined segment and cooperation activities definition; benchmarking reviews and comparisons; the establishment of mutual learning or twinning tools (Foray *et al.*, 2012).

In this article, the used tool RIS3 Assessment Wheel which allows evaluation of RIS3 development in the region or country is very subjective and assessment is informal. Therefore, it is very important to see the authors of each composed wheel because evaluation of the factors of a wheel depends on researchers' knowledge, experience and available information and information quality about each factor of the wheel.

The use of RIS3 Assessment Wheel step by step is described in RIS3 Guide. The first step is <u>analysis of the regional context</u>. The analysis consists of following critical factors: regional / national assets, outward dimension and entrepreneurial dynamics. It is necessary for asset in the regional context the existing assets to evaluate major regional strengths and weaknesses and to identify any innovation system bottlenecks and key challenges of economy and society. Smart specialisation central principle is economic differentiation. The idea of it is that by diversifying regional economy's unique, localised know-how into new innovations and combinations which are close to next to it, the regional economy has a possibility to build its competitive advantage. To evaluate this factor, expert assessments and targeted surveys, SWOT analysis and regional profiling studies can be used (Foray *et al.*, 2012).

The next factor – outward dimension which identifies competitive advantages of region through systematic comparisons with other regions. The region should identify relevant flows of goods and linkages, services and knowledge releasing possible integration with partner regions. To evaluate this factor, interregional rounds of interviews and work groups, comparative studies) can be used (Foray *et al.*, 2012).

The analysis of entrepreneurial dynamics gives a possibility to build a systematic understanding of economy and society areas with the future development greatest potential and areas need to be encouraged and extracted or that are ready to be tapped. For effective appreciation of entrepreneurial dynamic should improve statistics on entrepreneurial activities and entrepreneurial actors (firms, individuals and organisations with entrepreneurial knowledge)

and management and governance bodies responsible for RIS3 engage in direct discussion. To evaluate this factor, consultation and auditing tools, interviews with firms and cluster management, observations and monitoring organisations mixed working groups can be used (Saublens, n.d.).

Step 2 – <u>Governance: ensuring participation and ownership</u>. In the first subsection – governance structures – it is necessary to identify specific bodies and define their tasks, roles and responsibilities. In the RIS3 process, such organisation types as public authorities, universities and other knowledge-based institutions, investors and enterprises, civil society actors, and international experts should be involved. Thus, both market and the civic society involvement are achieved. The next factor – broad participation shows interactive, consensus-based application of collaborative leadership principles speaking about quadruple helix – interaction between the academic world, public authorities, business community and innovative users. In collaborative leadership involved actors must manage conflict themselves, so requiring the emergence of collaborative practice. As the last factor of this step – management and communication speaks about the use of open forum discussion and citizen dialogue which nowadays can be solved with the e-governance tool. E-governance facilitates closer cooperation between society and governance (Foray *et al.*, 2012).

Step 3 – <u>Elaboration of an overall vision for the future of the region</u>. It consists of following critical factors: broad view of innovation, grand challenges and scenario analysis. This step deals with shared comprehensive scenario of society, regional economy and environment by all stakeholders. It speaks about clear and shared future vision and main goals that should be achieved in the region. Future vision should involve all regional stakeholders (Saublens, n.d.).

Step 4 – <u>Identification of priorities</u> – consists of revision of past priorities, consistency and critical mass. Firstly, it is important to do a critical revision of past experiences, then align it with context analysis and harvest entrepreneurial discoveries. Smart specialisation involves making smart choices. The highest potential impact on the regional economy can be reached by selecting the right priorities and channelling resources towards the highest potential investments. Therefore, it is also important to mention concentration of resources to the limited number of priorities (Online S3 Platform:..., 2016).

Step 5 – <u>Policy mix</u> includes roadmap, balance and framework conditions. The roadmap is the most effective instrument to implement smart specialisation strategy. The roadmap could be an effective action plan which also allows experimentation through pilot projects. An action plan should contain consistent

and comprehensive information about strategic aims, implementation timeframes, tentative budget allocation and identification of funding sources. But pilot projects generate the main tools for policy experimentation and allow testing policy measures before implementing them at a larger scale (Online S3 Platform:..., 2016).

Step 6 – <u>Monitoring and evaluation</u> with following critical factors: output and result indicators, monitoring and RIS3 update. This step considers the selection of a limited number of outputs and result indicators linked to priorities with clearly identified baseline and targets, then about mechanisms supported by appropriate data collection to verify how the actives in the RIS3 strategy are delivering the output and result targets and also about the revision of priorities and policy mix as a result of the monitoring exercise (Foray *et al.*, 2012).

The European Commission collects the annual national report of each EU member state, so the national reports of Latvia, Lithuania and Estonia were used as main documents for creating RIS3 assessment wheels of all three Baltic countries by authors. There were also various other documents available at the beginning of 2017 used and authors' knowledge about the economic situation in Baltic countries. Each factor was studied carefully, and well-considered and well-grounded decision of its assessment was made.

Results and Discussion

In **Latvia,** there has already been published two RIS3 Assessment Wheel of Latvias' RIS3 development. The first RIS3 Assessment Wheel was published by government officials in 2014 – the

Ministry of Education and Science, Deputy State Secretary A. Kiopa (Fig. 1.).

As seen in Fig. 1, there are some positions with evaluation 0 as there is no information available on the specific element – scenario analysis, roadmap, framework conditions and RIS3 update. But also some positions are evaluated as excellent – regional/ national assets, broad participation, consistency and output and result indicators. In general, some positions show good results, but it is seen that some factors should be improved.

In spring 2016, Latvian researchers M. Pelse and M. Lescevica published their own newer version of the RIS3 Assessment Wheel in Latvia (Fig. 2). In this version many factors are evaluated better, but there are just 2 factors with an excellent mark and no factors with 0 marks. As in the government wheel the evaluation of factors was drastically different, in this wheel more factors are better evaluated. Such an evaluation has been explained with new measurements, organising RIS3 popularising seminars and conferences and also developing new RIS3 supporting documents during this time. For further steps for RIS3 development, the national and regional RIS3 should be upgraded; appropriate territorial features, priorities and needs in governance process at national level should be considered; funding programmes prepared and negotiated; reviews, comparisons and benchmarking done; reflection on training activity needed in a specific defined segment and cooperation activities defined and mutual learning tools established (Pelse & Lescevica, 2016).

After another year RIS3 Assessment Wheel for Latvia looks different (Fig. 3). Most of positions
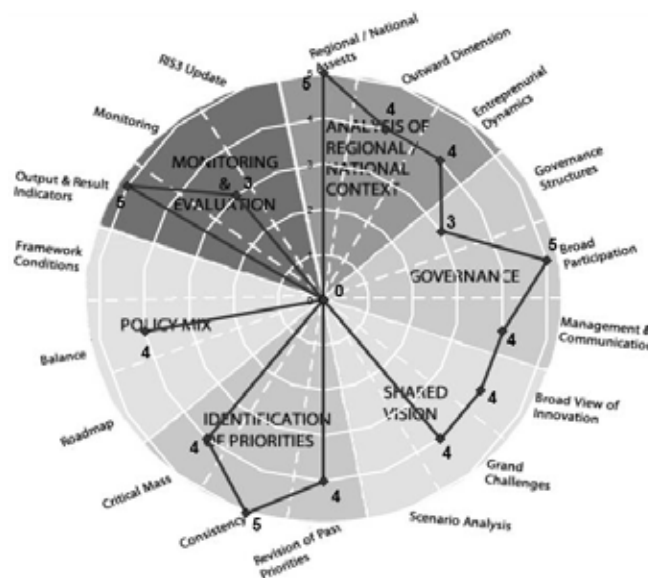
Source: Pelse & Lescevica, 2016.

Figure 1. RIS3 Assessment Wheel of Latvia by government officials.
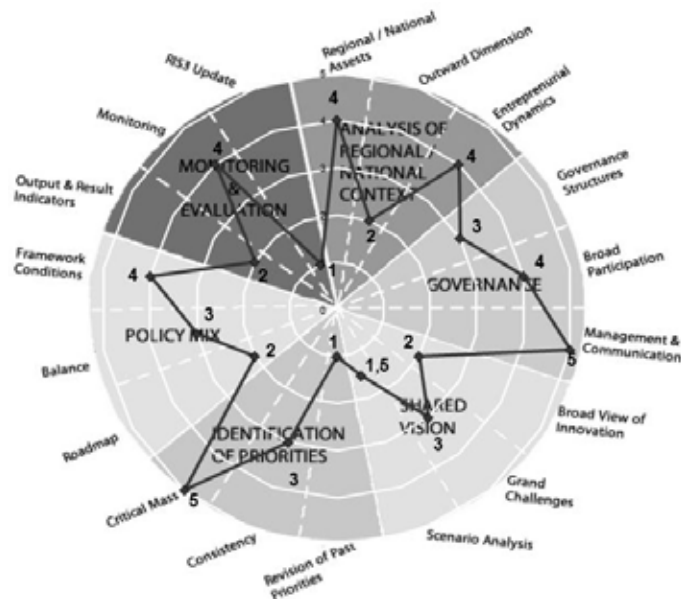
Source: Pelse & Lescevica, 2016.

Figure 2. RIS3 Assessment Wheel of Latvia by other Latvian researchers.

article's authors evaluate not as highly as Latvian researchers Pelse and Lescevica in their assessment wheel and even also comparing with government opinion in 2014. About RIS3 Update and Roadmaps all three versions of assessment wheels coincide – significant improvement should be made in these areas. Consistently good rating has such factors as regional/national assets, management & communication, critical mass and monitoring. Since the beginning of the RIS3 development in Latvia, there have been many RIS3 popularising seminars and conferences organised, there is more and more

new RIS3 documentation being developed, but the state has not accepted even the informative report of the Development of a Smart Specialization Strategy for Latvia yet and there is no law or other official government document on the state level about RIS3.

In articles authors' opinion, the most important step of the RIS3 Assessment Wheel is Monitoring & Evaluation – it is the promoter of RIS3 development in the country of region. As seen in all versions of assessment wheel, during the years in Latvia the situation of RIS3 monitoring and evaluation has not improved yet. As there is no organised legislation
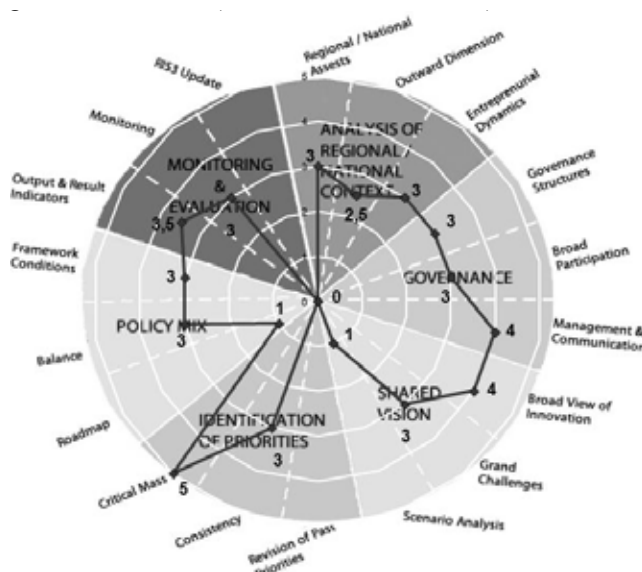
Source: authors' construction.

Figure 3. RIS3 Assessment Wheel of Latvia by articles authors.
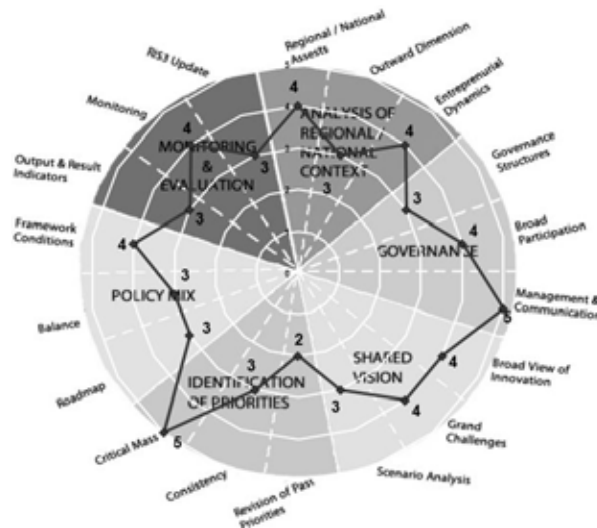
Source: authors' construction.

Figure 4. RIS3 Assessment Wheel of Lithuania.

about RIS3 on the state level, the monitoring and evaluation process goes on its own accord.

Low evaluation of all three versions of assessment wheels has a factor Scenario Analysis. In Latvia, there is low activity about RIS3 risk assessment and contingency plan for possible future changes (European Commission, 2016c). Responsible institutions for RIS3 development in Latvia should work more on this factor foreseeing possible risks and also contemplating and considering possible future changes of RIS3 development in organised conferences and seminars.

Generally speaking, 3 years have passed since the first assessment of Latvia's RIS3 was done, but comparing first two steps of the assessment wheel there are small differences in all three versions opinions. Governance related factors are unchanged because there are no changes in government policy; there is small activity from the government side.

RIS3 of **Lithuania** has a good evaluation in all factors (Fig. 4). Comparing article authors' assessment wheel version with RIS3 of Latvia – all factors are with the same or higher evaluation, which means that in authors' opinion RIS3 in Lithuania is developed better in all fields. In Lithuania, the Research & Innovation policy mix has improved significantly in the context of the National Strategic Reference Framework 2007-2013 and the Lithuanian Innovation development programme 2014-2020 (Paliokaite, 2014).

Referring to governance investment in RIS3 development in Lithuania, the situation is similar to one in Latvia – governance should be more involved in RIS3 development process. In the Annual Report of Lithuania, they recognize that they still have weak governance systems and inadequate and fragmented research and innovation policy, thus impeding state

transition to a more value-added economy. Although most reforms concerning state-owned enterprises are in place, there is still a need for ensurance of their implementation and compliance (European Commission, 2016d).

There are just 2 excellent evaluations of factors: Management & Communication and Critical Mass because the state is interested in working on organising open forum discussions and citizen dialogues. Also, they have detected research fields, and limited RIS3 development priorities.

In Lithuania, special attention to RIS3 monitoring has been paid. Besides annual reports they have monitoring and evaluation mechanism where the actual implementation of priorities is monitored at the technology level. Each of 20 priorities in Lithuanian RIS3 can be broken down into a set of very specific technologies. The aim of the monitoring function is to assess how science and business applications compliment technologies (Lapienis & Remeris, 2016).

The RIS3 of **Estonia** seems a little similar to RIS3 of Latvia, the same way as in the case with Lithuania, all factors have been evaluated equally or higher as articles authors' RIS3 of Latvia, except Management & Communication factor. Comparing wheel of Estonia and wheel of Lithuania the evaluation of RIS3 development in both wheels is similar. In Estonian RIS3 wheel, two factors – Revision of past priorities and RIS3 Update have low rate, and also just two factors have excellent rate – Critical Mass and Governance structures. These factors are excellently rated because Estonians have clearly set three thematic fields on which smart specialisation strategy concentrates: ICT, health and resource efficiency. Also, they have defined collaboration between stakeholders – two ministries are involved

Source: authors' construction.

Figure 5. RIS3 Assessment Wheel of Estonia.

in policies and implementation related to research and innovation – the Ministry of Education and Research and the Ministry of Economic Affairs and Communications. Among the non-government expert bodies, the most outstanding and respected science policy advice organisation is the Estonian Academy of Sciences. Estonian Development Fund (together with the private sector) performs risk capital investments into new and growth-oriented technology. Although one review report stated that the general connection between sectoral ministries, societal stakeholders and the core research and development system is inadequate. There are too many organisations involved in implementing the innovation policies. Given the size of the country, the number of organisations is disproportionate; the main problem in the existing governance system is a lack of the main coordinating body (Eljas-Taal & Hamza, 2013). Therefore, factor management & communication is not so highly evaluated.

Estonia has in general a very high share of research and development expenditure within the GDP (European Commission, 2016a). Public sector research is above average, and Estonia has a large number of people with tertiary education. Speaking about the factor Outward dimension – it has a lower rate because in spite of active participation in Framework programme and other international programmes, the patterns of Estonian international cooperation have no specific orientation. Also, in the factor Entrepreneurial Dynamics, there is a need to focus on fewer and stronger clusters (European Commission, 2016b).

The factor Roadmap has a media evaluation because Estonian Rural Development plan 2014-2020 developed by state foresees smart specialisation as a possibility for small rural producers to specialise in niche products in order to survive in the competition. Also, Estonians have thought about RIS3 monitoring and are planning to introduce a systematic monitoring of the implementation of the smart specialisation creating an additional inter-ministerial monitoring body (Eljas-Taal & Hamza, 2013).

Conclusions

1. RIS3 development assessment tool RIS3 Assessment Wheel is an informal tool evaluation whose result depends on assessing time, available information and authors' opinion.

2. Comparing three assessments done by government officials, other researchers and authors, one can conclude that in Latvia highly rated factors are 1) Regional/national assets, 2) Management & communication, 3) Critical mass and 4) Monitoring. In article authors' opinion, the most important factor is Monitoring & Evaluation as it is the promoter of RIS3 development in the country of region. Unfortunately, during the previous years in Latvia the situation of RIS3 monitoring and evaluation has not improved yet – there is no national legislation about RIS3 on the state level.

3. Situation analysis in Lithuania showed better RIS3 in comparison with Latvia – factors are evaluated by higher ratings, meaning that Lithuania is higher developed in all fields. The factors with highest ratings are two – Management & Communication and Critical Mass because the state is interested in working on organising open forum discussions and citizen dialogues. Also, they have detected research fields and limited RIS3 development priorities.

4. Estonia's RIS3 evaluation results are closer to Lithuania – all factors have been evaluated equally or higher than in Latvia, except the factor Management & Communication. Two factors have excellent rate – Critical Mass and Governance structures. Estonian government has defined collaboration between stakeholders – sectoral ministries, societal stakeholders and the core research and development system.

5. In all three Baltic states, there is a lack of information available about revision of priorities in connection with RIS3 development. Therefore it can be concluded that in Latvia, Lithuania and also in Estonia there is low governance activity regarding to the RIS3 development and evaluation process. In order to achieve the aims set in RIS3, it is essential to finish work on RIS3 legislation in Latvia and introduce the systematic approach to RIS3 target evaluation in all Baltic States.

Acknowledgements

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ANALYSIS OF RURAL AREAS DEVELOPMENT OF THE REGION USING THE ADL-MODEL

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Abstract
The paper presents an approach for the analysis of rural areas' socio-economic development. Rural regions include spheres of human activity: institutional, environmental, social, labor, industrial, economic, technological development spheres. Under the development of the rural regions, changes in the variables of different spheres of human activity in the region, increasing the potential for human development, is understood. Human Development Index measures the potential for human development measurement. The model of socio-economic development of the rural regions presented in the article is characterized by both endogenous and exogenous variables of the model. Model of socio-economic development of the rural regions is presented in the form of six econometric equations, each of which is an ADL-model. Each ADL-model contains endogenous and exogenous variables. The article presents the structural form of a system of economical equations in each one equation there is more than one endogenous variable. It shows the transition from the structural form to the form of the system of economical equations, where each equation has only one endogenous variable. The system of equations was developed for the rural regions of Russia. Baseline data were obtained from the database of the State Statistics Committee of Russia. The article provides a solution to the system of equations. The solutions to the model can be used for developing strategic development of each separate rural region or a combination of all the rural regions.
Key words: rural regions, socio-economic development, ADL-model.

Introduction

The development of the rural regions is one of the key targets for the regional politics. However, today there is no single process to measure this process. And there are several reasons for it. First of all, regions differ in terms of socio-economic and technological development (Tritsch & Arvor, 2016). This fact is a major obstacle to choose the best method and to check the indicators of development of the rural regions with different regional qualities. These indicators of the rural development are usually chosen within helix dependence from the set goal to the subject matter. Secondly, there is no unified opinion, which methods to be used when measuring the development of the rural regions.

Chromy *et al*. (2011) considering rural regions as any country area, conclude that the key factors of analysis must include indicators that measure social-economic and institutional environment. Looking at the example of the Czech Republic (Straka & Tuzová, 2016), 14 indicators can be highlighted, mostly the social-economic development indicators.

Some studies employ such indicator as the agricultural land usage indicators. Bonfiglio, Arzeni, & Bodini (2017) measure eco-efficiency of arable farms in rural areas. Authors conclude that farms are more eco-efficient if they are led by young farmers and participate in agri-environmental schemes. Bański & Mazur (2016) classify the rural regions using the cognitive methods. The authors concentrate on the methodological procedure of the new typology, which accounts for three aspects: development dynamics, economic structure and transport-wise accessibility.

Provenzano, Arnone, & Seminara (2016) implanted the Smart Specialization Strategy and the Quintuple Helix Model, highlighting the importance of connecting the innovation process with rural territories. Jeong *et al*. (2016) introduce a hybrid model, as the combined application of the geographic information systems (GIS) and the multi-criteria decision analysis (MCDA) with the fuzzy DEMATEL method in order to make rural housings' suitability map. The sixteen criteria were clustered into four groups, namely physical, natural, environmental and socio-economic group. Weight coefficients are also proposed to be used to distinguish the importance of the factors within the model.

The purpose of the study is to design a mathematical model for the development of rural areas. The mathematical model must contain several interrelated equations. Each equation connects the resulting (endogenous) and influencing (exogenous) variables. The authors intend to use such a model for analyzing and forecasting the indicators of rural development. It is possible to see how endogenous variables behave with the change in exogenous variables.

The local tasks of the study are the following:
- Describe the object of research - a specific rural area;
- Choose the type of mathematical model;
- Describe the method of empirical verification of the model;
- Check the model using the statistics of a particular rural area.

Materials and Methods

We analyze the development of Yalutorovsk municipal area for the period 2000 – 2015. The area is a part of the Tyumen region, one of the typical Russian regions. Data was taken from the Federal State Statistics Service of the Russian Federation (http://www.gks.ru). The choice of the Tyumen region is proved in resent papers by Rudenko (2015) and Tcvetkov *et al.* (2015). The area has around 50 thousand people. The population has been growing since the year 2000. The municipal territory is located in a relatively good place regarding the climate. The area has only one large populated community (a small town) and around 30 small villages. Around 50 percent of the local population is in the populated areas, which is relatively far from the average Russian statistics, which says that 74 percent of the population lives in cities. The third part of population is concentrated in urban settlement and the other parts of population are distributed over the territory of the district. The area is a rich region for natural resources. Analysis of infrastructural industry (electrical, transport, and informational industries) shows us the region as the area with contradictory state of the economic spheres. On the one hand, per capita incomes of the population are higher than in other regions and the average monthly nominal wage is quite high. On the other hand, financial indexes of the region show us that the area is subsidized. Analysis of the industry differentiation of the municipal territory shows us the absence of differentiation of the economy, the dominating of livestock sectors and the dependence of the municipal territory on the meat market situation. Rating of the region in the ranking of subjects of the Russian Federation in terms of investment in fixed assets among the subjects is lower than the average for Russia, but it is not the smallest one.

Despite quite high income of the population, higher education is not so popular. For 1000 people only 159 have higher professional education. This is the 78th place out of 83 in Russia. In terms of population size per doctor, we can say that the health situation in the region is not so bad. However, it is not entirely clear how rural settlements are provided with health services, primarily engaged in livestock farming and located far from a large the urban-type settlement - the center of the district, equipped with hospitals. An analysis of the state of the infrastructure transport industry in the municipal territory shows that the only major population center, the urban-type settlement, is not connected with other rural settlements neither by regular bus routes nor by railway.

Basic transport for this region is a car. In addition, the region has only one power station – gas turbine power station, the total length of power transmission lines of which is about 500 km. (Romashkina, Didenko, & Skripnuk, 2017). The municipal territory produces less electricity than it is necessary.

The housing sphere of the municipal area has poor conditions according to analysis. There were no dilapidated living quarters existent in the district at the end of 2015, but houses equipped with water supply are only 50% of the entire houses. Houses that are equipped with hot water supply and sewerage constitute only 40%.

Seventy percent of population has its own computer, fifty percent has access to the Internet, many people have a mobile phone, but the information and telecommunication environment of the territory is poorly developed.

The region takes the last place in the rating of innovation in the Russian regions. Looking at the analysis, we can state the following conclusions: there is underdeveloped infrastructure - lack of standard roads, railways, and low power supply and communication services. There is lack of population, and therefore lack of permanent workforce. The expansion of the range of products, reorientation of sales markets, and development of new types of production in order to increase production efficiency is not carried out in the region.

The analyzed territory depends on the supply of goods from other districts of Russia. The transportation of goods is hampered by the poor condition of the transport infrastructure. There is insufficient production efficiency. The analyzed territory has a small percentage of the population with higher education; there is no right number of qualified staff, which creates an obstacle for innovative development.

Development of the region is usually understood as the process of the steady positive development of the area, in which an individual is living and working. The development of all the spheres should be interconnected from within. The spheres in which a person is making a living are usually the following: natural environment, production and manufacturing sphere, social systems, ecological system, public institutions. The scientific and technological progress develops all spheres of life and working conditions of a person. The science-technological progress is the key factor in the change of all the areas in which an individual is living and working. In this case, sustainable development is considered from the point of view of the following three components. The first component is the economical component. It is necessary to use environmentally sound technologies in accordance with the economic component of sustainable development. We must use the energy (or natural materials) effective technologies at all stages of the product life cycle. The second component is the social component. The social component of sustainable development means an increase of

living standards of the population of the territory. The third component is the ecological component. The conservation of ecosystems, careful attitude to natural resources, conservation of flora and fauna is the goal of the ecological component of sustainable development.

Based on the above, we can give a general definition of the sustainable development of the analyzed territory. The sustainable development of the analyzed territory is the policy of using the territory, which characterizes the following conditions: a) a uniform change of the areas that surround a human in the territory – flora and fauna, sphere of production, social institutes, ecological systems; b) it is necessary to assess the change in the spheres of human activity from the point of view of economic, social and environmental perspectives; c) the purpose of changing the areas of the territory is to increase the human development index (HDI).

The theory of spatial economics and the theory of modeling is the methodological base of the sustainable development of the analyzed territory.

The theory of spatial economics is a modern discipline, but the development of theory for a specific territory that gave a push towards spatial economics development comes from the times of Adam Smith and David Ricardo. The significant contribution towards the development of the scientific categories of the theory of spatial economics was made by Max Weber, J. Thünen, Wolfgang Kasper, Stanislaw Korenik and Katarzyna Mishchak, and a Nobel laureate Paul Krugman (Tabata, Eshima, & Sakai, 2015). If the task of the spatial economics is the coverage of the wide region of the spatial phenomena for the development of the region, then the main task of the theory of the modeling is in giving the research such a technology to create such models, which would be enough to fully record the interesting properties of the space and then it would be quicker and easier to research the data and transfer the results on to the original (Grazi, Bergh, & Rietveld, 2007). Thus, using the mechanisms of the theory of spatial economics and the theory of modeling that include modeling of the development of the analyzed territory, it is possible to analyze the problems that the development of the rural region faces.

The ADL-model (autoregressive distributed lags model) is chosen as the theoretical model for the research, in which a regression equation is used to predict current values of a dependent variable based on both the current values of an explanatory variable and the lagged (past period) values of this explanatory variable. The model is generalized in case there is a multiple number of exogenous variables X. In general, all exogenous variables are included in the model with the same number of the lags, but there might be an exception of a lag of some variables.

ADL-model is the following:

$$y_t^i = \sum_{j=1}^{k^1} a_0 y_{t-j}^i + \sum_{j=1}^{k^2} a_1 x_{1,t-j}^i +$$

$$+ \sum_{j=1}^{k^3} a_2 x_{2,t-j}^i + \sum_{j=1}^{k^4} a_3 x_{3,t-j}^i + E_t \qquad (1)$$

Where, k^1, k^2, k^3, k^4 – quantity of lags of the variables; E_t – reminder that creates the white noise.

The model states that if in any moment of time t takes place a change in the constant variable X, then the change will influence the value of the variable Y in the future moments of time.

Results and Discussion

Primary data. The procedure for working with primary data includes two stages: a) analyzing and choosing both endogenous and exogenous variables that fit with the process that was being analyzed and that were showing the content of the variables; b) collecting the necessary both endogenous and exogenous variables.

Analysis and choice of the necessary endogenous and exogenous variables. The result of the analysis allowed us to choose the following six variables for the region: the proportion of the volume of region in the total volume of production of the region in the year t (y_t^1); the share of the export of the region from the total export of the Russian Federation in the year t (y_t^2); a level of a salary of the population in the year t (y_t^3); a pollution levels of the atmosphere in the analyzed territory in the year t (y_t^4); the volume of the shipped goods from the total volume of the shipped goods of the Russian Federation in the year t (y_t^5); the development level of the infrastructure branches of the region (y_t^6). For each endogenous parameter there are exogenous parameters, including the above stated six endogenous parameters. The task was to choose exogenous parameters for each endogenous parameter from the list of all available variables following the logical of the economic progress that is in the model.

List of exogenous variables: volume of shipped innovative goods, works, services (x_t^1); labor productivity (x_t^2); innovative technologies expenses (x_t^3); doctors salaries per 10000 population (x_t^4); growth rate of the labor productivity (x_t^5); development level of the manufacturing industries (x_t^6); proportion of the social infrastructure industries (x_t^7); energy expenses (x_t^8); average annual population level (x_t^9).

Empirical test model method. Method of empirical test model contained several stages.

(A) The correlation analysis was used to choose the exogenous variables that are closely connected with each endogenous variable. The correlation coefficients and their significance level were determined for pairs of variables.

(B) The analysis of the autocorrelation of the time series both endogenous variable and exogenous variables was performed. Analysis is done to select lags that had the highest impact on the resulting variable.

(C) Analysis of multicollinearity of exogenous variables. To find the multicollinearity of the variables, correlation matrix variables are analyzed, the importance is measured using the standard error criteria and Box-Pearsons Q-criterion. One variable from the pair of the variables was deleted from the analysis if the pair of the variables had a correlation greater than 0.8.

(D) The time series were checked for the presence of stationarity properties. We used Dickey – Fuller unit root test.

(E) The system of equations is represented in the structural form of the model. The structural form of the model is an econometric model in which the relationships between the current endogenous variables and the influencing variables are fixed in the form of equations.

(F) Determining identifiability of the equations of the structural form of the model by the criteria of identifiability. A necessary condition of identifiability is: $D+1=H$ – equation identifiable; $D+1<H$ – equation unidentifiable; $D+1>H$ – equation overidentifiable, where H is a number of endogenical variables of i-equation system; D – is a number of exogenous variables that are in the model, but exogenous variables are not included in the current equation. Sufficient condition of identification: equation is identifiable if by the absent variables (endogenous and exogenous) it is possible from the coefficients from the different equation systems to get matrix, a determinant that does not equal to zero, and the rank of the matrix is not lower than the number of endogenous variables in the model minus one.

The method to estimate the coefficients of the structural model was determined according to the following rules. It is necessary to choose an OLS (ordinary Least Squares) method if the model is identifiable. It is necessary to choose a two step OLS method if the model is overidentifiable. Definition for the overidentifibale equation of theoretical values of endogenous variables is from the left side of the equation. For substituting it into the actual values, we use the standard OLS method for the improved structural form of the overidentified equation.

The coefficients of the equations of the structural model were calculated and the transition from the structural model to the reduced model was carried out. The number of equations in the reduced model is equal to the number of the endogenous variables. The endogenous variable is expressed through the predefined model variables in each equation of the reduced model. The adequacy of the equations in the reduced model was evaluated on the basis of the F-criterion of Fisher. The coefficients of the regression equations in the reduced model were determined by the OLS method.

Empirical testing of the model. Empirical testing of the models' development was carried out on statistical data of agricultural region of Russia. The structural model with selected and substantiated endogenous and exogenous variables is constructed in the form of a system of equations.

From the structural form of the model a transaction was mode to an improved structural form. The reliability of each equation of the improved model is verified by Fisher's F-criterion, the coefficients of the equations were calculated, the reliability of the equation coefficients was estimated using Students' t-criteria.

For the first equation: $F_{tabl} = 9.01 < F_{actual} = 32.274$ => model is statistically correct, equation of regression is reliable for the level of significance $a = 0.05$ and is the following:

$$y_t^1 = (3.287E-010)x_t^2 + 0.013x_t^6 - 0.054x_t^7 + \\ + (-7.913E-008)y_{t-1}^3 + (4.607E-009)x_t^8 + \\ + 0.004 \qquad (2)$$

For the second equation: $F_{tabl} = 6.39 < F_{actual} = 7.689$ => model statistically correct, equation of regression is reliable for the level of significance $a = 0.05$ and is the following:

$$y_t^2 = 0.368x_{t-1}^7 + (1.074E-009)x_{t-1}^8 + \\ + 5.781y_{t-1}^1 - 0.994y_{t-1}^5 - 0.022 \qquad (3)$$

For the third equation: $F_{tabl} = 9.01 < F_{actual} = 134.535$ => model statistically correct, equation of regression is reliable for the level of significance $a = 0.05$ and is the following:

$$y_t^3 = 0.008x_{t-1}^7 + 1020194.030\,x_{t-1}^6 - 0.028x_{t-1}^8 - \\ - 2.137x_{t-1}^9 + 0.198y_{t-1}^3 + 162825.498 \qquad (4)$$

For the forth equation: $F_{tabl} = 5.59 < F_{actual} = 6.335$ => model statistically correct, equation of regression is reliable for the level of significance $a = 0.05$ and is the following:

$$y_t^4 = -78515.947\, x_t^6 + 313.464 \qquad (5)$$

For the fifth equation: $F_{tabl} = 5.41 < F_{actual} = 11.882$ => model statistically correct, equation of regression is reliable for the level of significance $a = 0.05$ and is the following:

$$y_t^5 = -0.131 x_t^6 + 0.131 x_t^7 + (2.722E - 009) x_t^8 + \\ + 0.007 \qquad (6)$$

For the sixth equation: $F_{tabl} = 9.01 < F_{actual} = 35.274$ => model statistically correct, equation of regression is reliable for the level of significance $a = 0.05$ and is this:

$$y_t^6 = (-3.919E - 008) x_t^2 + 138.472 x_t^6 + \\ + 17.397 x_t^7 + (-5.130E - 007) x_t^8 + \\ + (8.183E - 006) y_{t-1}^3 + 0.306 \qquad (7)$$

The necessary conditions for identification of model were considered for each equation. All six equations were overidentified. If they were overidentified, then the whole system was overidentified, and consequently, for determination of the indexes of the equation we used two-step OLS (Ordinary Least Squares). The improved structural shape of the model was used for equations 2,3,4,5,6,7, we calculated theoretical indexes of endogenous variables for all overidentified equations, which was in the left part of the equation, substitution of the initial indexes of exogenous variables in the right part of the equations. After that, the theoretical indexes of the endogenous variables were substituted for the actual values. Herewith, the reliability of the regression equation was estimated on the basis of the Fisher F-criterion, calculated the coefficients of the equation by OLS, we estimated the reliability of the coefficients based on the T-test of the Student. The system of econometric equations in its complete form is shown below:

$$\begin{cases} y_t^1 = (3.287E - 010) x_t^2 + 0.013 x_t^6 - 0.054 x_t^7 + (-7.913E - 008) y_{t-1}^3 + (4.607E - 009) x_t^8 + 0.004 \\ y_t^2 = 0.368 x_{t-1}^7 + (1.074E - 009) x_{t-1}^8 + 5.781 y_{t-1}^1 - 0.994 y_{t-1}^5 - 0.022 \\ y_t^3 = 0.008 x_{t-1}^7 + 1020194.030 x_{t-1}^6 - 0.028 x_{t-1}^8 - 2.137 x_{t-1}^9 + 0.198 y_{t-1}^3 + 162825.498 \\ y_t^4 = -78515.947 x_t^6 + 313.464 \\ y_t^5 = -0.131 x_t^6 + 0.131 x_t^7 + (2.722E - 009) x_t^8 + 0.007 \\ y_t^6 = (-3.919E - 008) x_t^2 + 138.472 x_t^6 + 17.397 x_t^7 + (-5.130E - 007) x_t^8 + (8.183E - 006) y_{t-1}^3 + 0.306 \end{cases} \qquad (8)$$

Conclusions

In this article, we used the theory of Spatial Economics and the simulation theory to analyze the development of the rural region. Each sphere of the rural territory was estimated by indicators, which are endogenous and exogenous variables of the model. For each endogenous indicator of the model there are concrete exogenous indicators. Selected and grounded endogenous and exogenous variables allowed us to formulate a system of equations in the so-called structural form of the model. Sometimes the model of structural form can be transformed into an independent system of equations. In our case, the model of structural form could not be transformed into a model with independent system of equations. The model of structural form was transformed into the so-called model of improved structural form. Finding the solution for the model of improved structural form is shown in the article. The empirical checking of the development model was carried out on the statistical data of the rural region of Russia. The necessary and sufficient conditions for the identification of the model have been analyzed and shown that among the equations of the model there are no unidentifiable equations, all equations are overidentified. A two-step OLS was applied and the possibility of solving the system of econometric equations was shown.

Acknowledgements

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GEOGRAPHICAL TENDENCIES OF MAIN PRODUCE IMPORTS
OF LATVIA 2000-2015

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Abstract
Foreign trade as part of the main economic relationship between a country and the global market, its regions and super-players is a significant research object. This paper deals with a particular case, exploring Latvian import in first one and a half decade of the 21st century. Since in Latvian academic society economic issues are largely dominated by economic scientist, this is an attempt by geographer to look at special aspects of mentioned ties and relationships. Research is focused around main producing sectors of economy such as agriculture, fisheries and forestry.
With the aim of establishing clear ties between Latvia and its major import markets, the statistics of foreign trade was analysed using frequency analysis. The research shows that Latvian major import markets, although, similarly with its export markets, are located in the Baltic Sea region and have some differences. Major import markets are usually countries with bigger internal market, than Latvia's. Import does follow the pattern of export markets in its separation into East and West groups with similar characteristics. Major difference, however, is differentiation of markets, where majority of high quality goods are being imported from a wider variety of markets, in contrast to export, where consolidation was a major pattern. This shows a rather close competition on world markets for potential clients, and a way for further economic change in Latvian industrial structure and operations.
Key words: foreign trade, frequency analysis, agriculture, forestry, fisheries.

Introduction

This paper is a continuation of a bigger research, first published in 2015 (Berjoza & Paiders, 2015), where export markets and flow of goods in similar economic sectors were studied. Foreign trade is an important aspect of international economy and relations. Today economic ties between two countries may be considered a stronger bond than religious, cultural or political ones (Birzins, 2004). Hence, it is imperative to study this phenomenon in its fullest and amass not only empirical data, but also qualitative data to efficiently and precisely analyse causes and consequences of changing dynamics of modern economy.

Foreign trade consists of two distinct flows of goods and services – export and import. Later unlike the first is not generated locally, but is acquired in foreign markets and brought in by entrepreneurs and locals to satisfy the demand. There is no contradiction, as the 'generation' mentioned above refers to production of product or service, not the demand for it. In a broader view, it is possible to speculate that all economic actions are generated locally steaming from the local demand, but that is not always true, and even more often it is not accurate. This research, however, attempts to explore import markets in similar manner as its authors did in their previous work (Berjoza & Paiders, 2015) – to analyse the spatial development of foreign trade of Latvia in particular, its import markets of major commodity groups using frequency analysis. This is achieved by:
- evaluating the existing extent of research in the field and completing a statistical overview in the period of interest;

- gathering import data of main commodity groups and using frequency analysis to pinpoint the major and continuously stable markets;
- analysing the results of the frequency analysis and interpreting them with additional qualitative data to explain a positive or negative trend, without relying on pure empirical data.

It is also important to note other works in this field dealing with similar problems. For example, foreign trade influence on sectoral development (Chaney, 2014; Novy, 2013; Bērtaite & Liepa, 2011, Kantar et al., 2011), long term changes in foreign trade of one region, country or its group (Eaton et al., 2011; Berentsen, 2012; Devaeva, 2006), foreign trade as a descriptor of international integrity and a tool for further European/World integration (Fadejeva & Meļihovs, 2009), its role in industrial (Gingrich, 2011; Villoria & Hertel, 2011) or socio-economic (Herekenrath, 2007) development, finally, foreign trade as international relations and influence tool (Bergeijk, 2009; Haibo, 2004) (for more reference to Berjoza & Paiders, 2015).

Materials and Methods

The data used in this research were taken from the Central Statistical Bureau of Latvia. The data from the year 2000 to 2015 were collected for all foreign trade transactions in the selected groups, which represented the major sectors of the Latvian economy such as agriculture, fisheries and forestry. The data from the whole data set were selected based on four digit international goods nomenclature:
02 – Meat and its processed goods;
03 – Fish and its processed goods;

04 – Milk and its processed goods;
10 – Grains;
11 – Grain processed goods;
16 – Prepared foodstuffs and conserves;
44 – Forestry goods;

The mentioned groups were further processed to fit the preliminary analysis criteria by being sorted by a year, month, and country in one matrix. The preliminary analysis involved the preparation of a binary matrix, by substituting any positive trade instance for 1 and the rest for 0. Using the formula below, a frequency of import can be calculated:

$$P = \sum (N1+N2+N3+ \dots +Nx)/X, \qquad (1)$$
Frequency calculation formula

Where – P is frequency,
X – is a number of months in the observed period,
and N – is a value for every month in the matrix. Thus, the analysis gives a string of frequencies that describe the import frequency for any import position of goods to a given state. For further analysis, the data were transformed again combining all the data into 5 major groups: 02 – meat products, 03 – fish products, 04 – milk products, 10 – grains and its products and 44 – forestry products. Further some countries were excluded (Yugoslavia and its succession states, Sudan and ex-Dutch colonies in the Caribbean), as they were in the periods of transition, and these might have caused serious misinterpretations and heterogeneities in the matrixes.

The transformed data of 5 columns were used in calculating a function from the relative frequency that would give an opportunity to determine whether the H_0 could be dismissed. H_0 was formulated as follows: import from any selected country/market at any selected time is random in nature. For that purpose, R. Fisher φ-function is the best (See Formula 2) (Krastiņš & Ciemiņa, 2003).

$$\varphi = \frac{2\pi}{180} \arcsin(\sqrt{p}) \qquad (2)$$

Fisher φ calculation formula, where p- is frequency

Then, using formula in Figure 3, t-empirical can be calculated, and using formula in Figure 4 t-theoretical can also be obtained:

$$t_a = \frac{|\varphi_1 - \varphi_2|}{\sqrt{\dfrac{n_1 + n_2}{n_1 \times n_2}}} \qquad (3)$$

T_{emp} calculation formula

$$\upsilon = n_1 + n_2 - 2 \qquad (4)$$

T_{theo} calculation formula

Formula 4 shows the calculation for the degrees of freedom, where n_1 is the number of observations in the general set, but n_2 the number of observations for one country, φ_1 is Fisher transformation for indicator frequency for the general set, φ_2 is Fisher transformation for indicator frequency in the general for one country: V – Number of the degrees of freedom; T – theoretical is based on the T – distribution (T-tables) according to degrees of freedom.

As a result, it is possible to obtain T_{emp} value that can give a relative frequency from which it is possible to speculate a possibility of import occurring in any randomly selected month from the country under observation. Hence, all countries can be divided into 3 groups, after the calculation of t-statistics of significance:

1. Import markets – where the import occurrence probability is statistically high – where T_{emp} is greater than 2, and the average frequency of the import group is smaller than that of the observed country;
2. Import markets – where the import occurrence probability is statistically low – T_{emp} is greater than 2, and the average frequency of the import group is greater than that of the observed countries. This group also includes all the countries with no import records;
3. Import markets – where import has eventual character – T_{emp} is less than 2, and H_0 cannot be dismissed.

Results and Discussion

This paper is a continuation of a previous publication (see Berjoza & Paiders, 2015), with its focus on import rather than export. Compared to export, which is being locally produced or created from local and imported resources, import is fuelled, first of all, by local consumption and then a need for resources for further production that stimulates export. Thus this part of the study can be viewed as an attempt to connect the flows of goods into a loop that can loosely be described as part of global economic cycle.

Starting of the analysis, in order of succession, first (i.e. meat and its products) group of goods is one of very short preservation time, thus its geography as noted before (Berjoza & Paiders, 2015) is limited. Significant markets are shown in Figure 1, where it can be seen to be restricted to European countries only. Here it can be largely attributed to the advantages of EU common economic space and the fact that Latvia itself does not produce enough raw meat in any form

Figure 1. Import markets by probability for meat and its products in the observed period.

to fully supply its internal demand and support more sophisticated production.

Looking into this group in detail, it reveals that main import markets for unprocessed meat are relatively close to Latvia and encompass the Baltic Sea region, similarly to its export markets (Berjoza & Paiders, 2015). On the other hand, more distant partners such as France, Italy Spain and Benelux nations dominate the processed and well-preserved product import. Fresh, chilled and frozen meat mostly being imported from Poland, Germany, Lithuania, Hungary, Estonia and Denmark. Finland, Sweden, Austria and UK can be considered in the balance zone, where both raw and processed meat products are being imported in balance to each other.

Research also reveal that major trading partners are Poland, Germany, Lithuania and Estonia, while more distant countries such as Spain, Italy, France and UK can be described as premium goods importers, which means constant import of high quality produce in small amounts for relatively high prices. In case of the USA and Belarus, the methodology did not show a constant economic connection that can be both a sign of declining or developing economic relations.

Continuing the analysis of the second (i.e. fish and fish products) group, it can be noted that import markets are similar to export markets, though, there persist differences. The overall geography of import markets is wider than it was for export ones (Berjoza & Paiders, 2015). There are various new countries involved such as New Zealand, Argentina, Uruguay, Chile, Indonesia and Philippines. Similarly, largest import markets are the ones in the Baltic Sea region - Lithuania, Estonia, Finland, Sweden, Denmark and Germany although now there appear to be some other

big importers like Norway, UK, France, Spain and USA. Analysed by product groups, most of fresh or chilled fish are being imported from closer markets, while frozen fish is being delivered from every corner of the world, including destinations like Thailand, Vietnam, China, New Zealand and Argentina. A number of import markets, mostly in Asia and South America, fall into a variable probability group and the best explanation to this is unstable nature of trade relations and distance.

There are significant changes in market pattern in Europe, as most of the east and south European countries lose their significance, compared to previous study of export (Berjoza & Paiders, 2015). It can be explained with the fact that those countries do not produce demanded goods for Latvian markets, which is being filled with qualitative and relatively cheap products of German, French, British and Italian fish industries. It can be noted particularly well in import values of preserved and canned fish imports, where largest markets are the closest ones to Latvia geographically and are the members of European common market. Eastern and non-EU partners remain, but their significance strongly varies due to external factors (here various major political and economic occurrences).

In Figure 2, it can be observed that milk and dairy import markets are rather diverse, but a sense of east-west division remains. It is particularly visible due to insignificance of Belarus and Ukraine. In general, major markets for fresh milk and other fresh dairy products are close to Latvia – them being Lithuania, Estonia, Poland, Germany, Denmark and Russia. On the other hand, more distant EU countries like France Benelux, Spain and Italy mostly participate in import of expensive high quality goods such as cheese. The

Figure 2. Import markets by import probability for milk and dairy in the observed period.

3rd group of products can be divided into two distinct sections – that of fresh goods, with short preservation and expiration times, and that of fermented goods, which can be stored considerably longer. Thus, it can be said that immediate neighbours of Latvia are bigger import markets as they can produce and trade both fresh and fermented good of general consumption, while more distant markets may provide luxurious or high quality fermented products.

In Figure 3 a good example of such can be observed. Among 7 biggest importers of cheese and cottage cheese are both close and distant countries. So it can be noted that with time international trade grew and developed greatly increasing amounts of import from Lithuania, Poland and Estonia, while demand for relatively expensive goods from France and Italy remained low. In this Figure, it can also be noted how major political and economic occurrences – around 2004, 2009 and 2014 have influenced the amounts of import.

It is safe to assume, that in 2004 with Latvia's accession to the EU its imports began to grow significantly, but in 2009 suffered a short but still visible damage from recession and financial crisis. Although crisis struck many sectors, imports of cheese and cottage cheese recovered quickly (which also indicates the collapse of local produce); it fell again in 2014 with some recovery next year. Here the
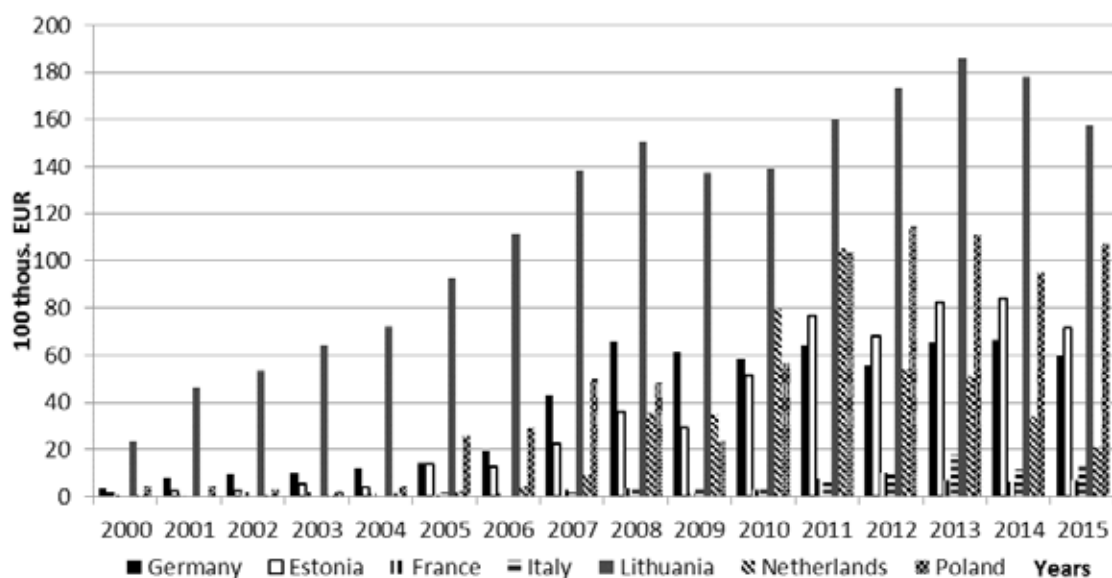
Figure 3. Cheese and cottage cheese import volumes by major import markets in the observed period.

Figure 4. Import markets by import probability for grain and its products in the observed period.

changes might be attributed to oversaturation of local and global markets due to worsening of political and economic situation in the region.

The forth (i.e. grain and it products) group is a relatively complex one, as it has many positions involved and requires a more detailed inspection. Figure 4 shows import markets for all 21 produce positions and indicates most significant partners in Europe, Americas, Asia and even Africa; on the other hand, in Figure 5 particular positions import markets can also be observed. Comparing them reveals, that wheat and wheat-rye mixture (one of the biggest imports) is being imported from much narrower region compared to overall imports in Figure 4. This

difference is another indication of validity for relative frequency method in analysing trade flows and patterns.

Breaking down import markets by goods in the 4th group, it can be noted that closer markets tend to produce more goods and export them in more varying amounts than distant ones, which usually deal in big single time transactions or smaller periodical ones. Take variable nature of import from South and Southeast Asian countries in Figure 4 as an example, where imports of various goods were seasonal and not all year round, as for example, in imports from Latvia's neighbours such as Lithuania, Estonia or Poland.

Figure 5. Import markets by import probability for mixture of wheat and rye in the observed period.

Figure 6. Import markets by import probability for wood and forestry produce in the observed period.

Figure 7. Import markets by import probability for log and wooden beam in the observed period.

Similar pattern in market-good dependency can be observed analysing the fifth group imports. Here we at first might observe significant variation of markets in Figure 6 and a sharp fall in it in Figure 7. Comparatively, to grain imports wood and its produce imports vary greatly due to nature of particular countries export and sectoral structure. Good examples, in this case, being Indian and Chinese imports in Figure 6 being that of highly processed construction materials, plywood, wooden element and containers, compared to varying nature of rare wood and log import from central African nations in Figure 7

Apart from those differences, there is a significant internal difference in trade pattern between far and close markets. In Europe, Latvia's close markets

actively trade not only in logs and beams, but also in plywood, firewood, sawed construction materials and containers, while further markets specialise in decorative elements, sophisticated construction materials and high quality plywood and furniture. Among significant import markets Germany, Sweden, Poland and Check Republic can be noted as universal suppliers. Lithuania, Russia, Estonia and Finland can be described as importers of log, beam, sawed materials and generally of wood resources for local industry. Finally, distant markets such as the USA, France, Norway, while also trading in raw and lightly processed wood, are listed as major importers of wooden decorative elements, furniture and specific wooden produce.

Conclusions

Findings from analysing the import flow have generally confirmed many of the previous paper (Berjoza & Paiders, 2015) results and methodology used, proved to be useful in studying the import as much as it was useful in studying export. Overall, it can be concluded that relative frequency method is a good tool for observing long term relations between nations by analysing some continuous process or phenomenon that can be tracked and measured for a prolonged period of time.

By analysing Latvian import markets of agriculture, fisheries and forestry and observing the differences between the data acquired through two different empirical methods, it can be said that Latvian major importers are located in the Baltic Sea region (including Estonia, Lithuania, Finland, Sweden, Russia, Belarus, Poland, Germany, and Denmark) and adjoining nations (such as the Czech Republic, Norway, Slovakia, the Netherlands, Hungary and Austria). These findings are similar to those made previously, but in addition there are several new markets of significance: France, Spain, Italy and the UK. Those new markets are significant in importing section of trade mostly due to high demand for high quality and luxurious goods. The USA, Canada, China and some other Southeast Asian countries can also be mentioned as a stable trading partners for Latvia, but their significance usually encompasses particular products group or even position. It is evident that import markets are more diverse and poses wider geography, compared to export – indicating a larger competition for markets globally and regionally than that observed in the study of export.

In addition to the results obtained, through this study a number of questions remain unanswered, particularly a better explanation for appearance of variable probability markets, the diversification and specialization of countries, periodicity of trade trends and patterns and also significance of Latvian trade for its main trading partner. All these questions pose a challenge and an opportunity for further work on the topic and a need for further studies in appliance of devised methodology and re-examination of data collected.

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SUPPORT PAYMENTS FOR AGRICULTURE AND RURAL DEVELOPMENT IN LATVIA

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Abstract
The European Union (EU) Common Agricultural Policy (CAP) affects the development of the agricultural industry and rural areas in all the Member States. A very important role is played by various support payments as one of the policy instruments. The CAP has been developing and is being reformed; therefore, it is important to assess the effect of various CAP support instruments on the development of the agricultural industry. Therefore, the **research aim** is to assess the support instruments and kinds of support as well as their effects on selected agricultural indicators. The research study proceeds in three stages or phases: first, the identification of the total amount of support payments paid and the key kinds of support; second, a detailed analysis of the key kinds of support; third, the identification of associations between the amounts of support payments and other agricultural and farm performance indicators. The research found that in the period 2005 – 2014 in Latvia, the total amount of support amounted to EUR 4.3 billion, of which EUR 520 million or 12% were received by approximately 1000 FADN farms. The most significant kinds of financial support in Latvia were direct payments, accounting for 47% of the total amount of support and financial assistance provided for rural development with 39%. The total amount of financial support and the amount of area-based payments affected the key agricultural indicators as well.
Key words: support payments, kinds of support payments, indicators.

Introduction

Until the early nineties of the last century, the CAP was mainly oriented to support markets. Prices were guaranteed and complemented by export subsidies and import restrictions. Agricultural production was stimulated through guaranteed prices, and farm incomes depended on output prices and quantities. Over the last two decades, the CAP was reformed four times, mainly to shift support from production and prices to direct income supports (Fragoso *et al*., 2011). Since the Agenda 2000 reforms, the CAP has been characterised as having two 'pillars' through which funding is disbursed. Pillar I provides subsidies to farmers and accounts for about 90% of the overall budget (Lowe, Buller, &Ward, 2002). The CAP's second 'pillar' is rural development. Introduced in 1999, the second pillar consolidated numerous funding measures for only about 10% of total CAP expenditure (Watts *et al*., 2009). M. Raggi, L. Sardonini and Viaggi D. (2013) stress that the current CAP payments are important for staying in/exiting farming activities. In 2013, a new Common Agricultural Policy was defined after several years of negotiations between the EU Commission, the Member States, the EU Parliament and the Council of Ministers (Burnya &Terrones Gavira, 2015). For this reason, it is necessary to assess the performance of the CAP's support instruments in the previous period. In Latvia, farmers have to take into consideration the eligibility criteria set by the CAP since 2004. For these reasons, the **research aim** is to assess the support instruments and kinds of support as well as their effects on selected agricultural indicators in Latvia. To achieve the aim, three specific **research tasks** were set: 1) to

examine the support instruments and the key kinds of financial support in Latvia; 2) to perform a detailed analysis of the key kinds of financial support in Latvia; 3) to identify causal relationships between the amounts of support payments and other agricultural and farm performance indicators.

The **object of the research** is support instruments for FADN farms.

Materials and Methods

Analysis, synthesis and logical construction, as well as a statistical analysis method – correlation analysis – were employed to perform the research tasks. The present research analysed information and data of the Central Statistical Bureau (CSB) and the Rural Support Service (RSS). The research design process used special and general literature, methodological materials on the EU financial support for agriculture and rural development etc. The Farm Accountancy Data Network (FADN) was exploited to identify the effect of support payments on the economy of farms in Latvia. The FADN is a European system of sample surveys conducted every year to collect accountancy data from farms with the aim of monitoring the income and business activities of EU agricultural holdings. Moreover, the FADN is an important informative source for understanding the impact of the measures taken under the CAP on different types of agricultural holdings (European Commissions, 2017). A FADN farm sample includes not less than 1000 farms in order to ensure a representative sample of farms in Latvia (LR Zemkopības ministrija, 2017).
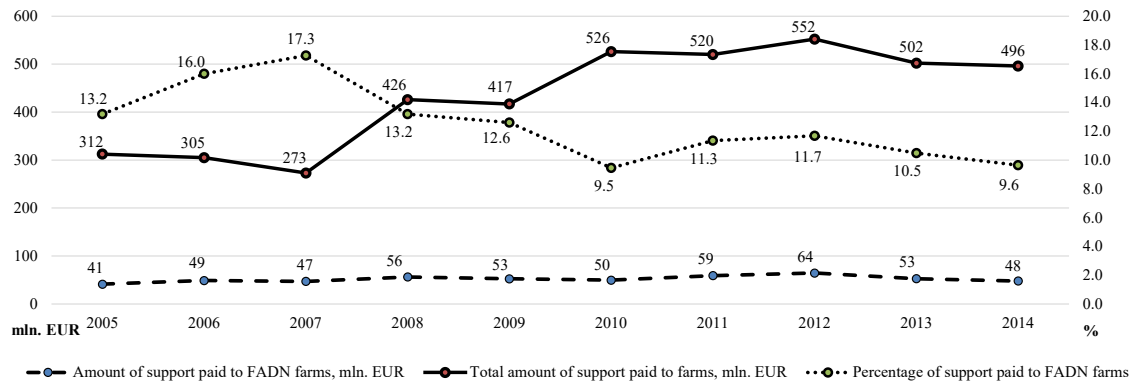
Source: authors' calculations based on based on Datu bāze ... (2016); Lauku atbalsta dienests (2016a, 2016b).

Figure 1. Total amount of support paid to farms, the amount of support paid to FADN farms, mln. EUR, and the percentage of support paid to FADN farms in Latvia in the period 2005 – 2014.

Results and Discussion

1. Characteristics of support payments for agriculture and rural development in Latvia

The economic performance indicators of FADN farms were affected by support payments in Latvia in the time period 2005 – 2014. In the period of analysis, the total amount of support paid to FADN farms reached almost EUR 519.5 million, which comprised on average 12% of the total amount of financial support paid in this period – EUR 4329.5 million (Figure 1).

A comparison of change in the amount of support in the period 2005 – 2014 reveals that it increased by 59% in the country as a whole, while an increase for FADN farms was relatively steady – the increase was only 17%. In 2013, the FADN summarised data on 1000 farms (LVAEI, 2014), which accounted for 1.2% of the total number of farms in the country. In 2005, 932 farms (LVAEI, 2014) or 0.7% of the total farms were included in the FADN. In the period of analysis, the total number of farms decreased in absolute terms by 51208 (CSB, 2016a; 2016b) or 38.5% in relative terms. This indicates that the performance of FADN farms was better than the performance of the entire

agricultural industry, as 1.2% of the farms received 10.5% of the total amount of support paid in the country in 2013.

The financial support paid may be classified into three main groups:

1. (EU and national) **direct payments**, which include the Single Area Payment Scheme (SAPS), complementary national direct payments (CNDP) that are called transitional national support since 2013, and various special support schemes that have been introduced to support agriculture – CAP Pillar 1. Until 15 October 2006, their source of finance was the guarantee section of the European Agricultural Guidance and Guarantee Fund (EAGGF), while after this date the source of finance for SAPS and special schemes was the European Agricultural Guarantee Fund (EAGF) and CNDP were funded from the government budget.

2. Support payments for **rural development** or CAP Pillar 2, which consisted of SAPARD funding and the funding of the Structural Funds (SF) for the period 2004 – 2006, were funded from the
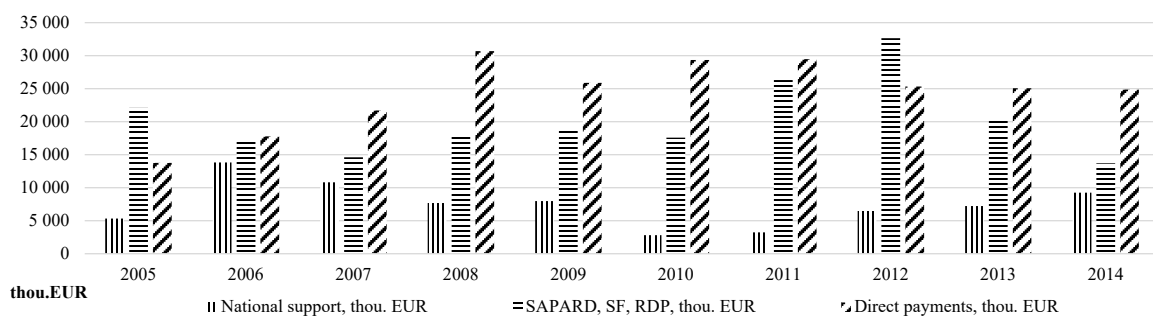
Source: authors' calculations based on Datu bāze ... (2016).

Figure 2. Distribution of financial support paid to FADN farms in Latvia in the period 2005 – 2014, thou. EUR.

guidance section of the European Agricultural Guidance and Guarantee Fund (EAGGF), the national government budget, the allocations for the Rural Development Plan 2004 – 2006 (funded from the guarantee section of the EAGGF and the national government budget) and the Rural Development Programme 2007 – 2013 (RDP 2007 – 2013) (funded from the European Agricultural Fund for Rural Development (EAFRD) and the government budget).

3. **National support** payments (national subsidies); the source of finance is the government budget.

The distribution of financial support paid to FADN farms in the period 2005 – 2014 was as follows: 1) direct payments – EUR 244 million or 47% of the total;

2) support for rural development – EUR 201 million or 39%; 3) national subsidies – EUR 75 million or 14%. The distribution of financial support for every year is shown in Figure 2. The amount of direct payments paid to FADN farms steadily increased in the beginning of the period – until 2008, while after that it stabilised at EUR 25-29 million annually. The amount of support for rural development depends on the financial phase of the period – at the beginning of the period the amount is smaller, in the middle of the period it increases, but at the end of the period the amount decreases. In contrast, the amount of national financial support consistently decreased, which is understandable, as national funding is required both for paying direct payments and for co-funding rural development projects.

Table 1

Percentage distribution of direct payments, the total amount of which exceeded EUR 500 thou. by kind of support for FADN farms in Latvia in the period 2005 – 2014

Indicators	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SAPS payments	34.6	32.9	32.7	28.9	42.5	44.5	49.3	58.4	64.0	64.8	45.6
Decoupled CNDP for areas (since 2007)	10.4	17.5	20.7	13.5	15.1	12.7	11.2	11.7	11.1	7.0	12.9
Special support for milk production	48.9	35.3	18.1	11.8	13.9	0.0	0.0	0.0	0.0	0.0	9.9
Stubble field in the winter period (since 2008)	0.0	0.0	12.6	10.2	14.2	11.6	10.8	8.7	6.4	4.9	8.6
CNDP for slaughtered or exported cattle	0.0	0.0	0.0	0.0	0.0	15.0	11.1	10.9	11.1	8.5	6.2
School fruits	0.0	8.2	7.8	5.4	6.3	4.2	2.6	2.0	2.1	0.0	3.9
Decoupled CNDP for milk sold within the limit of the quota	0.0	0.0	0.0	0.0	0.0	4.7	4.5	4.6	4.5	5.5	2.6
Decoupled CNDP for areas under field crops (since 2010)	0.0	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Restructuring of the sugar industry	1.0	1.4	1.5	1.5	2.4	2.5	2.2	2.1	1.9	1.3	1.8
Decoupled CNDP for slaughtered or exported cattle (since 2007)	0.0	0.0	0.0	0.6	0.8	0.9	3.2	3.8	3.5	3.5	1.8
Diversification support for sugar beet producers	0.0	0.0	3.4	2.3	2.7	2.4	0.0	2.3	0.2	1.6	1.6
EU direct payments + CNDP> EUR 5 000	0.0	0.0	0.0	0.0	0.0	0.0	3.4	3.7	3.8	2.6	1.4
Separate payments for sugar production	5.1	4.6	1.8	1.2	1.4	1.3	1.1	0.0	0.0	0.0	1.4
CNDP for suckling cows	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Decoupled CNDP for cattle (since 2011)	0.0	0.0	1.5	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.3
Support for energy crops (since 2007)	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.7	0.6	0.3	0.2
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-8.9	-9.3	0.0	-1.1

Source: authors' calculations based on Datu bāze ... (2016).

Table 2

Rates of the most significant direct payments in Latvia in the period 2005 – 2014, EUR

Kind of support/ year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SAPS payments per ha	26.18	31.45	36.38	46.38	55.61	63.50	76.12	79.00	86.16	99.06
CNDP for areas under crops, ha	67.36	53.27	28.87	39.70	27.63	-	-	-	-	-
CNDP for areas under feed crops, ha	15.50	12.62	11.21	9.02	6.63	-	-	-	-	-
CNDP for milk production, t	16.35	28.56	-	-	-	-	-	-	-	-
Decoupled CNDP for milk production, t	-	-	35.05	33.69	31.96	30.14	28.24	26.00	25.00	20.00
Decoupled CNDP for areas, ha	-	-	25.57	30.73	35.68	32.31	26.00	19.00	19.00	15.00
Decoupled CNDP for areas under crops, ha	-	-	-	-	-	36.31	28.98	28.00	28.00	23.00
Separate payments for sugar production, t	-	9.96	12.01	14.68	15.87	11.94	7.95	7.89	7.88	-

Source: authors' construction based on LR Zemkopības ministrija (2006, 2007, 2008, 2010, 2012, 2014, 2015).

2. Analysis of kinds of support payments in Latvia

Direct payments. In the period 2005 – 2014, FADN farms received 29 kinds of support as direct payments. The key kinds are presented in Table 1.

In the period of analysis, the most significant kinds of direct payments were SAPS payments with 46%, CNDP for milk production within the limit of the quota (decoupled in 2007) – 13%, CNDP for areas under crops and feed crops – 10%, decoupled CNDP for areas (from 2007) – 9%, decoupled CNDP for areas under field crops (since 2010) – 6% and separate payments for sugar production with 4% of the total amount of support. Besides, the share of SAPS considerably increased – from 34% (EUR 4.7 million in 2005) to 65% (EUR 15.9 million in 2014) – in the total amount of direct payments. In addition, financial discipline was applied in 2012 and 2013, which resulted in a decrease in the number

Table 3

Percentage distribution of support for rural development, the total amount of which exceeded EUR 500 thou. by kind of support for FADN farms in Latvia in the period 2005 – 2014

Indicators	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Farm modernisation	0.0	0.0	0.0	33.0	46.3	37.6	64.5	73.7	51.5	35.6	38.6
Less-favoured area support	17.8	26.0	33.0	24.7	24.7	28.7	19.2	14.6	24.3	35.7	23.3
Structural funds	52.3	30.1	16.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	10.2
Organic farming development	4.6	10.1	8.3	9.0	9.7	12.9	9.5	7.7	12.1	17.6	9.7
Wind erosion reduction	0.0	15.9	20.3	16.4	16.6	17.2	0.0	0.0	0.0	0.0	7.3
Meeting the EU standards	15.0	14.4	18.1	5.7	0.0	0.4	0.0	0.0	0.0	0.0	4.7
Support to enterprises	0.0	0.0	0.0	0.0	0.6	0.5	4.4	2.0	8.5	3.3	2.1
SAPARD (until 2006)	8.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Infrastructure related to agricultural and forestry development and adaptation	0.0	0.0	0.0	0.0	0.0	0.9	0.7	0.6	1.5	4.8	0.7
Maintenance of biodiversity in grassland	0.6	1.1	1.0	0.9	0.7	0.8	0.6	0.4	0.7	1.0	0.7
Support for semi-subsistance farms	0.5	0.3	2.3	2.0	1.0	0.3	0.1	0.1	0.1	0.1	0.6
Areas with restrictions for the purposes of environmental protection	0.8	1.2	0.4	0.4	0.3	0.4	0.3	0.2	0.4	0.6	0.5
Introduction and promotion of integrated horticulture (since 2008)	0.0	0.0	0.0	0.1	0.1	0.2	0.6	0.6	0.9	1.2	0.4

Source: authors' calculations based on Datu bāze ... (2016).

Table 4

**Rates of the most significant rural development support payments in Latvia
in the period 2005 – 2014, EUR**

Support measure	Period 2004-2006	Period 2007-2013
Less-favoured area support	Category 1 – 33 EUR ha^{-1}; Category 2 – 46 EUR ha^{-1}; Category 3 – 64 EUR ha^{-1}	Category 1 – less than 25 EUR ha^{-1}; Category 2 – less than 40 EUR ha^{-1}; Category 3 – less than 58 EUR ha^{-1}
Organic farming development	First transitional year – 139 EUR ha^{-1} Second transitional year – 139 EUR ha^{-1} The farm is given an organic farming certificate – 82 EUR ha^{-1}	Permanent meadows and pastures, nectar crops 138 EUR ha^{-1}; field crops on arable land, permanent grasses on arable land and grassland for seed production, fallow land 108 EUR ha^{-1}; potato, starch potato 318 EUR ha^{-1}; vegetables (incl. spice crops) and household gardens 357 EUR ha^{-1}; fruit trees and berry bushes 419 EUR ha^{-1}
Wind erosion reduction	Per ha of green area (except permanent meadows and pastures): nitrite-sensitive territories – 23 EUR ha^{-1}; other areas of Latvia – 40 EUR ha^{-1}	Not available.

Source: authors' construction based on MK noteikumi...(2004); LAP (2007 – 2013).

of eligible support payments (above EUR 5000 and EUR 300000) and in the total amount disbursed – by EUR 2.2 and 2.3 million respectively, and by EUR 4.5 million in the entire period. Rates of the key kinds of direct payments are presented in Table 2. SAPS rates increased 3.8 times in the period 2005 – 2014; besides, the payments for particular crops were replaced by decoupled (historical) payments, which indicate changes in the CAP.

Rural development support payments. In the period 2005 – 2014, FADN farms received 24 kinds of financial support for rural development. The key kinds are shown in Table 3. In the period of analysis, the most significant kinds of support for rural development were as follows: investment support under the RDP 2007 – 2013 with 39%, less-favoured area support (less-favoured areas and areas with restrictions for the purposes of environmental protection under the RDP 2004 – 2006 and 'Payments to farmers in areas with

handicaps other than mountain areas' under the RDP 2007 – 2013) – 23%, structural funds – 10%, support for organic farming development under the RDP 2007 – 2013 – 10%, wind erosion reduction – 7% and meeting the EU standards (support measures under the RDP 2004 – 2006) with 5% of the total amount. The greatest amount of support for rural development was reported in 2012, at EUR 32.4 million, of which investment support under the RDP 2007 – 2013 comprised 74% of the total. FADN farms received the smallest amount of support for rural development in 2014 – EUR 13.4 million, of which less-favoured area support accounted for 36% of the total.

The rates of area-based support payments for rural development per hectare of farmland are shown in Table 4, while the key eligibility criteria for investment support are presented in Table 5.

In the period 2007 – 2013 in Latvia, the rates of less-favoured area support payments decreased, while

Table 5

**Key eligibility criteria for the most significant support measures for investment in rural development in
Latvia in the period 2005 – 2014, EUR**

Eligibility criteria	SAPARD	SF	Meeting the standards	EAFRD
Purchase of new machinery	x	x*	Construction of manure storage facilities; meeting the hygienic standards in milk production; meeting the standards for cowsheds to guarantee milk hygiene; reconstruction of cages to ensure the welfare of laying hens; equipping an artificial ventilation system with an alert device and the establishment of an emergency ventilation system; construction or reconstruction of a water supply system at livestock sheds; construction of cages for young livestock; establishment of farrowing boxes for sows and pigsties for weaned piglets.	x
Purchase of new equipment	x	x		x
Construction, reconstruction, renovation	x	x		x
Investment in permanent crops	-	x		-
Purchase of breeding livestock	Milk and meat	x*		-

*not included in eligible costs of projects submitted from 2006 onwards
Source: authors' construction based on MK noteikumi...(2004); LAP (2007 – 2013); Upite (2010).

Table 6

Percentage distribution of support for rural development, the total amount of which exceeded EUR 500 thou. by kind of support for FADN farms in Latvia in the period 2005 – 2014

Indicators	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Payments for cows held	15.2	9.4	11.8	22.1	62.7	20.3	41.5	0.0	0.0	24.1	19.1
Support for establishment of a herdbook and assessment of productivity data: dairy cows	0.0	0.0	0.0	20.2	0.0	38.9	0.0	77.4	49.4	30.8	18.9
Promotion of investment in agriculture – partially subsidised loans	13.1	8.0	12.6	25.0	22.6	11.5	17.7	7.1	9.6	8.0	13.0
Support for investment in the agriculture	29.5	19.4	21.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9
Compensation for losses caused by agro-climatic conditions	7.0	42.2	0.0	0.0	0.0	1.1	0.0	0.0	0.1	0.0	8.4
Support for establishment of a herdbook and assessment of productivity data: sows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.8	27.9	6.3
Identification of genetic quality: in sows	3.8	2.8	24.0	7.9	0.0	0.0	0.0	0.0	0.0	0.0	5.1
Purchase of breeding livestock	7.4	4.1	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Support for livestock breeding and raising in pig farming: piglet	3.8	3.6	4.9	4.0	0.0	0.0	0.0	0.1	0.0	0.3	2.1
Education, science and information	5.8	0.8	2.5	6.6	0.4	0.0	0.0	0.0	0.0	0.0	1.6
Support for livestock breeding and raising in pig farming: sows	0.0	0.0	0.0	3.1	0.0	3.8	24.5	0.0	0.0	0.0	1.5
Support for promotion of investment in agricultural and enhancement of technological resources for investment in 2012/2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	0.0	0.0	0.9
Support for establishment of a herdbook and assessment of productivity data: meat cows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	3.3	0.9
Support for integrated production of permanent crops	0.0	1.0	1.2	1.7	1.6	4.0	0.0	0.0	0.0	0.0	0.8
Support for livestock breeding and raising in pig farming: boars	0.0	0.0	0.0	0.2	6.1	0.1	0.0	0.0	0.0	0.0	0.7
Other	14.4	8.7	9.0	9.3	6.6	20.4	16.3	5.0	6.1	5.7	8.8

Source: authors' calculations based on Datu bāze ... (2016).

the rates of support payments for organic farming development diverged across crops.

National support. The percentage distribution of the key kinds of national support is shown in Table 6. In the period 2005 – 2014, there were 73 kinds of nation financial support for FADN farms. In the same period, the most significant kinds of support for FADN farms were as follows: payments for cows held – slightly more than 19%, support for establishment of a herdbook and assessment of productivity data: dairy cows – almost 19%, promotion of investment in agriculture – partially subsidised loans – 13%, support for investment in the agricultural industry (in 2005 – 2007) – 9%, compensation for losses caused by agro-climatic conditions – 8%, support for establishment of a herdbook and assessment of productivity data for sows – 6%, identification of genetic quality in sows – 5% and purchase of breeding livestock in a foreign or the Latvian market with 3% of the total amount of national support funding. The greatest amount received by the FADN farms was reported in 2006 – EUR 13.8 million, of which EUR

5.8 million or 42% were compensations for losses caused by agro-climatic conditions.

3. Relationships between the amounts of support payments and other agricultural and farm performance indicators

A correlation analysis that explores the strength of relationships between a dependent variable x_n (support payments) and several independent variables y_n was done to identify the strength of relationships between various indicators of farm performance (Arhipova & Balina, 2000). Three dependent variables were taken: x_1= total amount of support payments for FADN farms, mln. EUR; x_2= area-based support payments for FADN farms, mln. EUR; x_3 = support payments for investment for FADN farms, mln. EUR, and a correlation between the mentioned three variables and selected other farm indicators was identified for

Table 7

Strength of the relationships between the amounts of support payments and other indicators for FADN farms in Latvia in the period 2005 – 2014 (correlation coefficient value r)

Indicators	Total support, mln. EUR (x_1)		Total area payments, mln. EUR (x_2)	
	r	Sig.	r	Sig.
At least one indicator shows a strong correlation ([r]>0.8)				
Agricultural exports, mln. EUR	0.884	0	0.796	0.01
Total area payments for agriculture, mln. EUR	0.873	0	0.876	0
Area under maize, thou. ha	0.84	0	0.827	0
Area under potato (CSB data), thou. ha	-0.806	0	-0.677	0.03
Long-term investment by FADN farms, mln. EUR	0.889	0	0.837	0
Revenue earned by FADN farms, mln. EUR	0.82	0	0.749	0.01
Revenue from grain earned by FADN farms, mln. EUR	0.839	0	0.637	0.05
Revenue from vegetables earned by FADN farms, mln. EUR	0.694	0.03	0.834	0
Production costs for FADN farms, mln. EUR	0.869	0	0.814	0
Milk sold (CSB data), thou. t	0.879	0	0.833	0
Wheat produced by FADN farms, thou. t	0.818	0	0.725	0.02
Fixed asset depreciation for FADN farms, mln. EUR	0.868	0	0.788	0.01
A medium-strong relationship ([r] is >0.5, but < 0.8)				
Area payments received by FADN farms, mln. EUR	0.797	0.01		
Total support payments made by the RSS, mln. EUR	0.772	0.01	0.611	0.06
UAA (CSB data), mln. ha	0.73	0.01	0.764	0.01
Area of pastures and meadows (CSB data), thou. ha	0.794	0.01	0.667	0.03
Area under permanent crops (CSB data), thou. ha	-0.775	0.01		
Area of pastures and meadows on arable land (CSB data), thou. ha	0.792	0.01	0.667	0.03
Arable land area (CSB data), thou. ha	0.628	0.05	0.692	0.03
Revenue from rapeseed earned by FADN farms, mln. EUR	0.783	0.01		
Revenue from legumes earned by FADN farms, mln. EUR	0.565	0.09	0.725	0.02
Revenue from other agricultural activities earned by FADN farms, mln. EUR	-0.715	0.02		
Revenue from feed production earned by FADN farms, mln. EUR	0.798	0.02	0.722	0.02
Revenue from milk earned by FADN farms, mln. EUR	0.788	0.01	0.724	0.02
Revenue from cattle earned by FADN farms, mln. EUR	0.775	0.01	0.724	0.02
Revenue from pigs earned by FADN farms, mln. EUR	0.603	0.07	0.7	0.02
Revenue from poultry earned by FADN farms, mln. EUR	-0.689	0.03		
Revenue from egg production earned by FADN farms, mln. EUR	-0.517	0.12	-0.696	0.02
Agricultural work units on FADN farms, employed individuals	-0.697	0.02		
Milk output (CSB data), thou. t	0.682	0.03	0.793	0.01

Source: authors' calculations based on CSB data (2016a; 2016b; 2016c, 2016d).

the period 2005-2015. When performing a correlation analysis, the tool *IBM SPSS Statistics (Version 22)* was exploited and a correlation matrix was computed. Since the correlation matrix is symmetric relative to its diagonal, only the values placed above and under the diagonal have to be computed. The main results are summarised in Table 4. The total amount of support payments and the amount of area-based support payments have affected the following key agricultural indicators: the value of agricultural exports, the utilised agricultural area, areas under certain crops and revenue from the key kinds of agricultural production. The analysis has shown that CAP direct payments as a whole have been effective in pursuing a more equitable distribution of farm household income among the farm household population (Severini & Tantari, 2015). Since the support payments (both the total amount of support payments and the amount of area-based support payments) strongly correlated with the total production cost for FADN farms, the main cost items (seeds, fertilisers, plant protection products, purchased feed, maintenance of machinery and equipment, fuel and lubricants, depreciation, paid labour and land rent) also demonstrated strong correlations. As the amount of support payments increased, a few farm indicators decreased (areas under potato and permanent crops, revenue from other agricultural activities, output of poultry meat and eggs as well as agricultural work units). However, the amount of support payments for investment for FADN farms, mln. EUR, (x_3) had a strong correlation (0.997 at sig.0.00) only with fixed asset depreciation for the FADN farms.

Conclusions

1. Support payments play an important role in the performance of farms in Latvia. In the period 2005-2014, the total amount of financial support equalled EUR 4.3 billion, of which EUR 520 million or 12% were received by approximately 1000 FADN farms. The amount of support for FADN farms ranged from EUR 41 million in 2005 to EUR 64 million in 2012. In the period of analysis, FADN farms received three key kinds of support: direct payments – 47%, support for rural development – 39% and national support with 14% of the total.

2. The detailed analysis of the key kinds of support revealed that:

   * there were 29 kinds of direct payments in the period 2005 – 2014, while the most significant one was SAPS payments, accounting for 46% of the total; besides, their rates per ha increased 3.8 times. The other significant kinds were as follows: CNDP for milk production with 13%, CNDP for areas under crops and feed crops – 9% and decoupled CNDP for areas with 15%;

   * among the kinds of support for rural development (totally 24), the most significant ones were as follows: investment support with 39% of the total in the period 2007 – 2013 and environment-related support payments with 45%;

   * the significance of national subsidies decreased, yet their diversity (74 kinds) indicated that by means of this support the country sought to solve problems for which no EU support was available.

3. The correlation analysis showed that the total amount of support payments and the amount of area-based support payments affected the key agricultural indicators – the value of agricultural exports, the utilised agricultural area, areas under certain crops, and revenues from the key kinds of agricultural production as well as key cost items.

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THE DISABLED PEOPLE, A TOOL FOR A RURAL RE-DEVELOPMENT THE CASE OF MARVEJOLS (LOZÈRE, FRANCE)

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Abstract

Marvejols is a small town located in Lozère (France). Traditionally, the region was poor with an agricultural oriented economy. However, by the 1960s a new type of business was launched: the residential care facilities for disabled people, especially in relation to Jacques Blanc, a key person in the organization and development of this business. This economic activity brought jobs and new attractiveness, counterbalancing decline in traditional sectors. Nevertheless, currently, situation is less favourable, and the local players try to find out a new strategy, particularly in relation to diversification. In this study, our main aim was to understand conditions of starting and growing of this business. Moreover, we would like to understand current fragilities and attempts to adapt the economy of the territory. In this way, our students and we have chosen this area in relation to the economic and historical weight of its activity. The organization of field trips and survey was conducted in a comprehensive approach perspective. Therefore, we took account parameters working in this territory, such as strategies, psychologies (individual and collective), networks and identities. Human dimensions are strong, especially in discourses, and our main result is a better understanding of the local situation, with comparisons to close cases (Corrèze, Creuse). Furthermore, the quality of the geographical analysis provides working relations with the stakeholders.

Key words: declining rural areas, residential care facilities, disabled people, territorial capital, local development.

Introduction

Marvejols is a small town (about 5,000 inhabitants in 2014[1]) located in the *département* of Lozère, a French administrative level (figure 1). In this case, separating town and *département* is impossible, a large part of issues is so close. Lozère is located in the South part of *Massif Central*, an old massif consisting of several mountain ranges and plateaus. This *d*épartement is considered as one of the most rural in France, in relation to its high rate of farmers and low population, the lowest with less than 77,000 inhabitants in 2014 (Kourdo, 2017), while the median population of French *départements* is about 525,000 in 2009. Moreover, Lozère is too much isolated to benefit from urban influence, despite the fact that a motorway, the A 75, has been built to open up Massif Central. Certainly, it participates in development process but the daily road traffic stays low.

Within a specific cognitive and collective context (Giddens, 1991), local players built a collective action process (Chignier-Riboulon, 2014). People with disabilities appeared a resource for stakeholders, developing a type of health economy. In the beginning taking people (children overall) from towns and cities was a tradition, but since the late 1960s, it became a political and economic strategy to counterbalance the population decline and the weakness of agriculture. In this paper, we analyze Marvejols region more precisely. Our geographical perimeter includes both the small *urban area*[2] of Marvejols (figure 2) and the close municipalities linked by a strategic network

for developing health sector. The total population is low in a French perspective: about 9,000 inhabitants (2014) in the urban area of Marvejols (municipalities are underlined on figure 2) and about 5,300 in the municipalities around (La Canourgue, Saint-Germain du Teil...).

Over decades disabled people were considered as a new opportunity, especially in this South-Western part of Lozère. However, nowadays, the situation is more complex. Changes affect this health business, like new competition with other *d*épartements, and local authorities try to diversify the offer, for instance, by attracting and accompanying new households with business micro-projects. Otherwise, communication policies work on image and attractiveness, for example, a 'welcoming territory' or 'an exceptional living environment' according to a leaflet of Gévaudan-Lozère Association, an official organization. Then, we have to separate official discourse and reality.

Materials and Methods

One of the research focuses on our laboratory is the study of marginalized areas, especially rural, or small towns in rural areas. Therefore, Marvejols presents parameters (economic, social…) of marginalization and decades of endogenous regeneration. In human sciences, results depend, for a large part, on human dimensions, linked to territorial, historical… relations (Ray, 1998, for instance). These ones guide perceptions of development and, more widely, the building of a future. In this way, collective and individual

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1 Demographical data are taken from national census, organized by INSEE, the French national agency for statistics.

2 This name has been given by INSEE. It takes the commuting relations between the centre (Marvejols) and the peripherical municipalities when at least 40% of the working population works in the centre.
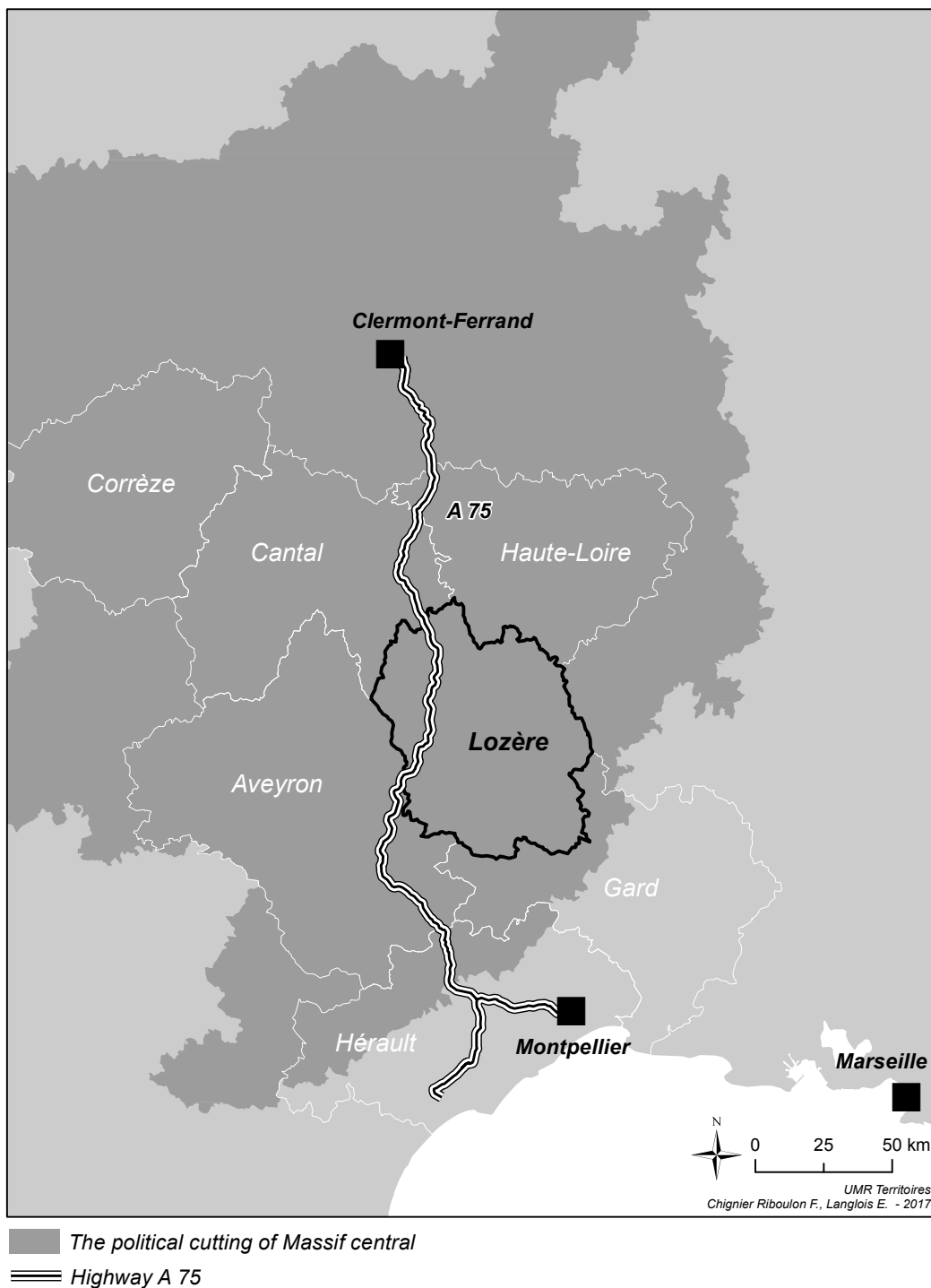
Figure 1. Lozère, a French inner periphery.

psychologies are central. Then, even if most of human behaviours have been studied and classified, with their evolution steps, it is very difficult to propose models, because geographical contexts modify analysis. In this study, our main result is the improvement of the understanding of area, for providing better advice to stakeholders. The second result is helping our students to keep analytic distance in research or professional way. For understanding the current weight and logics of the disability business, first we chose a fieldwork. Marvejols was probably the best, in relation to the key role played by this economic branch. Second, we prepared the fieldwork and a survey. The survey was prepared to get information from different types of players on the ground. We have conducted this work in a twofold direction: the first aim was to confront
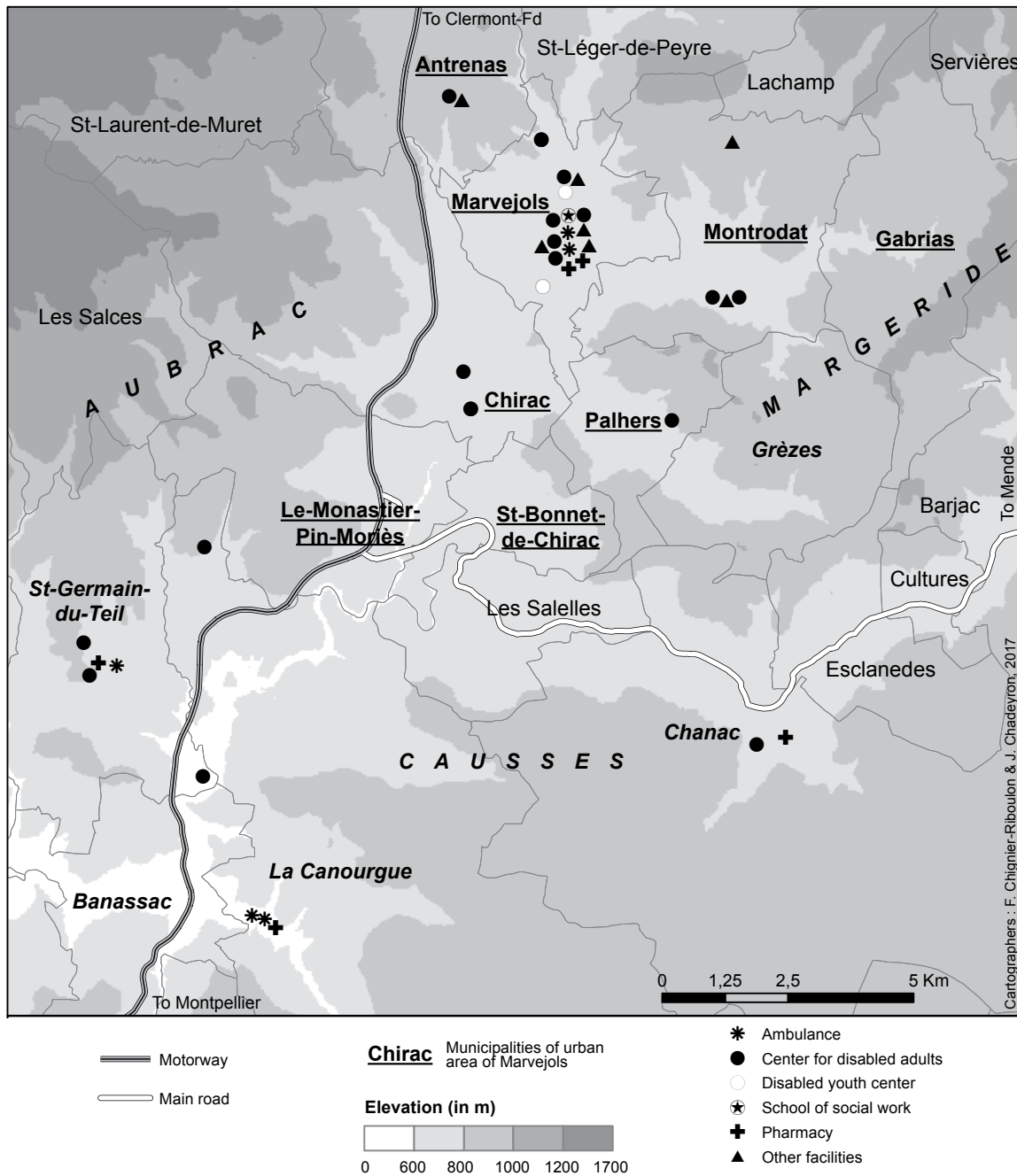
Figure 2. Medico-social facilities in Marvejols mountainous region.

data (mainly from INSEE and from FINESS[3], the database of the Ministry for Social Affairs) with local observation; the second was in relation to the survey to get discourses and feelings on the current situation and future evolution. Then, the survey was built in a qualitative perspective, focused mainly on people involved in local development. Those are various: politicians, employees of public local structures working for development and planning, managers or employees (nurses, for example) of health structures, small enterprises. More broadly, residents and shopkeepers of the city centre were interviewed. Interviews were semi-open. For officials and managers, their duration was from 45 minutes to more than one hour and a half. Interviews were shorter for inhabitants and shopkeepers, about 10 to 20 minutes. For the first group, questions can be summarized in three categories: the career and life paths of the interviewee, a presentation of the structure with the geographical origins of the employees, and the impact of people

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3   FINESS database provides information on every type of health structure.

with disability on the local economy. For the second, the only one question was on the impact of disabled people on the economy. 56 people were interviewed: 8 politicians, 7 entrepreneurs, 6 shopkeepers, 14 residents, 11 employees of medical amenities and 10 people working in public development structures. Except for shopkeepers and residents, we have met the local key players. The total of people is not so high because population is low, and most discourses are similar in many ways. On key issues most people have no clear idea on flow of working population towards their region or on the economic impact of health structures, but everyone is convinced of their central influence. Moreover, sometimes, interviews were complicated or impossible because this small rural world of high plateau is relatively closed to strangers, and everyone knows each other. Consequently, interviews have been de-identified except for Jacques Blanc; he is now almost retired from politics but was a central, respected, player of the relative regeneration of the region. Finally, if we took appointments with politicians and health structures, we did not do the same with residents and shopkeepers; we asked them directly to try to get information.

This research work was conducted with our students of Master 2 in 2015 and 2016, one week on field in November. For them, this research work was a concrete aspect of research. Beyond the survey they could analyze the geographical dimensions: observation of the distances, social or geographical, comparisons between stakeholders' discourse and their perceptions of the health centres or the city centre, or those of inhabitants.

A Marginal Region, but a Strong Identity

Lozère experienced a very long period of rural exodus. Traditionally, the agricultural land is in owner-occupation. Nevertheless, soil is often poor and the climate is hard, with long, very windy and snowy winters. The landscape presents high plateaus (figure 2): Margeride (granitic), Causse (calcareous) and Aubrac (volcanic and granitic); most of the population lives in lower lands, close to narrow valleys. Nowadays, forests cover about 48% of the *d*épartement, while it was only 10% in the 19th century (manager of the planning service, ONF[4]), when the peasantry was more numerous, but very poor. In spite of the rural exodus since 19th century, the agricultural working population stays at a high level (12.2%, Marasovic, 2013), in comparison with the French rate (3.6), ranking Lozère 4th in *départements* with highest rates (Marasovic, 2013). High rates are considered as factors characterising backward areas. Demographically, the current population is about a

half of those of the end of the 19th century (Marasovic, 2012). In the same period, French population was less than 40 millions of inhabitants, and approximately 65 million in 2015. Therefore, the population is more and more aging. The natural increase is negative. The net migration was low over decades and became positive in the last decade, in relation to migrants' flows and the settlement of new inhabitants, often linked to health business. Moreover, the building of the A75 involves a modest development along the motorway, unlocking the region, according to interviewees. In Marvejols urban area and close municipalities, migration has helped to maintain population, and the opening of the A75 facilitates the settlement of households. Interviewees frequently underline this aspect. Also, they underline the issue of keeping young people in this rural area, then they have to find job. Lodging, treating and training people with disabilities provide jobs for youth. The Marvejols region is a kind of inner periphery in France. This situation has perpetuated a strong feeling of territorial identity (di Méo, 2002) and marginality. A declining area like Marvejols tends to reinforce its strong identity, in relation to decades of marginalization and inward looking attitude (Chignier-Riboulon, 2016). Local players worked and continue to do so to support territorial cohesion. If 'Stakeholders are territorialized' (Gumuchian & Pecqueur, 2007), they are often more territorialized in long term marginalized region (Chignier-Riboulon, 2014). However, local players have used their territorial capital by founding a new axis of development. Lacquement and Chevalier (2016) continue the analysis of Putnam (1993) by underlining different dimensions of territorial capital: first, the capacity of community to organize itself co-operation networks; second, the setting up of local governance; third, the building of strategies of development. Networks, governance are based on common interest for a better life and future, belonging Krugman's definition of public asset (1995). These territorial interrelations are embedded (Pecqueur & Zimmerman, 2004), building a tangle where everyone tries to take advantages, with relations of domination and dependence.

Building a Strong Activity

The construction of a strong activity is a combination of several elements (Courlet, 2008). Among them, cultural aspects, like social, historical and geographical identity, are central. These elements can be picked up by a local personality becoming a leader, as Georges Frêche, a mayor, in Montpellier (Viala & Volle, 2010), France, a minister in Mielec (Jarcewski & Gwosdz, 2007), Poland, or a priest in Benedita (Chignier-Riboulon & Fournier, 2003),

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4   ONF, *Office National des Forêts*, National agency for forestry.

Portugal. In Marvejols, housing, educating, training disabled people, and particularly young mentally ill people, started with a priest, Lucien Oziol. Born in 1920, he was a vicar in Marvejols parish and in charge of children. He met François Tosquelles, a psychiatrist, working at Saint-Alban de Limagnole Hospital (North of Lozère), and found out that children stayed with adults in the hospital (Oziol, 1977). Then, he decided to found a specific establishment for young people, in 1956. He named it 'Le clos du nid' and the first implementation was in the municipality of Grèzes (figure 2). One of the most important people for understanding the construction of this economic sector is Jacques Blanc (interviewed on November, 9th, 2015). All the other interviewees have mentioned him as a local famous person. He is now retired but continues to be a key player, as he stays the president of the association 'Le clos du nid' and he is still the mayor of the municipality of La Canourgue. He is a neuropsychiatrist and he worked at the 'Clos du nid' in the end of the 1960s. He began a political career and was elected mayor (1971- until now), member of Département Council (1970 – 1988), a member of French Parliament (1973 – 2001). Later, he became president of the Languedoc Region (1986 – 2004) and senator (2001 – 2011). Thanks to his long political career, he took a large part of this specific development focused on disability and participated in its organization. By the end of 1960s, a doctor was a notable in rural areas. By becoming a local official, he used every parameter to develop his project, combining humanity and business, in a 'local integrated development' (Torre & Vollet, 2016). According to definitions of innovation by Klein (2014), Jacques Blanc has contributed to weave organizational and institutional networks. In these types of declining countryside, everybody knows everybody. Interrelationships are a strong element to mobilize citizens and overall other local officials. Therefore, development of health structures and a very long support from officials are strongly linked. The development created or reinforced networks. First, they are geographical, to involve officials and other leaders (associations, for example). Then, the growth of the branch brought demands of mayors for building a new facility in their municipality. Second, they are social by creating jobs for local people. These jobs weave proximity relations and, slowly, clientelism. Then, leaders emerge and consolidate their power on the territory. Finally, 'resource is a local players' construction' (Gumuchian & Pecqueur, 2007). Furthermore, Jacques Blanc has worked at different geographical scales. By the early 1970s, he was elected member of the Parliament (1973) and met Valéry Giscard d'Estaing, participating in his presidential campaign. He defended two bills in favour

of disability. They were voted on June 30th, 1975. The first one was about schooling and training for disabled people, with allowance rates. The second one concerned the creation of different types of medico-social institutions. The law organized quantitative and qualitative aspects, with legal standards, and funding. More importantly, he proposed a clause, called 'original place of residence'. It implies that the cost of medical and social cares are financed by the département where the person lived before arriving at a residential care facility in Lozère. Thus, medico-social institutions in Lozère benefit from funding provided by central State or other départements. According to Jacques Blanc, Lozère was a pioneer, and Marvejols region was the first for building working centres for disabled people. He also considers the central position of this activity in local economy: 'Without medico-social sector, Lozère would not exist'.

Central Position in the Local Economy

The national scale presents strong inequalities between French départements. According to Rapegno & Ravaud (2015), working on disabled adults, interdepartemental disparities are from 1 to 40. The two authors have analyzed the evolution since 1981: Lozère has increased by more than 4 the number of medico-social institutions whereas its population is about the same. Therefore, last data indicate a national average rate of 2.71 beds for 1000 inhabitants. The rate is 10 times more for Lozère. The second département (Corrèze, figure 1) has a rate of 9.75 %, 18 points less; so, the authors have created a specific statistical class for Lozère (Rapegno & Ravaud, 2015).

Consequently, the employment depends directly or indirectly on this growth. Direct jobs are evaluated to 4,500 in Lozère (Marasovic, 2013). The Marvejols region is the most important place for this economic sector. About 2,000 to 2,800 direct jobs are in relation to medico-social (according to estimates of politicians and managers of structures). Currently (FINESS, 2017), 33 medico-social structures work with disabled people (figure 2), and most of the interviewees speak about the strategic position of this sector: 'no more Lozère without medico-social economy'. The biggest enterprise, the association 'Le clos du nid', employs 839 people full time and about 200 part time. The firm offers 1,034 beds and manages 21 health structures in different sites, in and outside Marvejols; its turnover was 59 millions of euro in 2015 (head and managers of the association).

Beyond direct jobs and activities, the sector provides a local business. Several small enterprises are linked to these establishments: for instance, ambulances and pharmacies. 5 pharmacies are located in the region and it is too much for the population of local municipalities. In Marvejols, the two pharmacies employ 13 people and may be considered important;

a large part of the turnover is provided by the orders of health structures. Indirect jobs are also numerous: garages, maintenance, road and construction works and a large part of craftsmen live thanks to the medico-social sector. This pool of jobs has contributed to maintain public services, like schools, and to save local markets, such as land or real estate ones. The unemployment rate is low, about 6.4%.

Moreover, one of the first aims was to attract households and professionals from outside the *département* to counterbalance demographical decline. Henceforth, *dé*partement and Marvejols region provide more jobs than residents, then net migration was positive in the 2000s, about 10,000 people came and 3,000 stayed between 1999 and 2009 (Marasovic, 2013). Therefore, a survey of INSEE (Marasovic, 2012) and the interviewees give us elements on new inhabitants. Most of them come from neighbourhood *Départements*, especially from Gard or Aveyron (Figure 1) to work in social, medical and education sectors and in the related branches. More widely, a part of the highest skilled jobs, as doctors, are held by French people coming from elsewhere, or by foreigners.

Towards an Integrated Centre

Beyond residential care facilities and humanity, disabled people are also a resource for local development, and local stakeholders consider the organization is close to a cluster model. According to Claude Courlet (2008), a cluster presents an economic specialization, with enterprises with distinct skills providing a complementarity process. Firms are usually numerous and small with relations based on competition and a formal (or informal) co-operation. Certainly Marvejols region has got similarities, but situation is quite different: political leaderships and lobbying are central; main enterprises are integrated in public or social sector; competition is not the main dynamics, but social and political networks, even if, in clusters, political dimension contributes to reinforce or perpetuate the economic system.

However, local players continually worked to develop a wide medico-social sector, and tried to adapt it for capturing and controlling the market. At the beginning, in the 1970s and 1980s, the main aim was to offer a response to the social demand. After this period, the objective was to create the need, by studying society evolution. Consequently, they built an enlarged offer, more and more complete. Therefore, the youth was slowly replaced by adults. By 2016, only 10% of the residential population were less than 18 years old (according to heads of structures). The idea, humanitarian and economic, was to accompany people along their life until the end. During decades, children were taken and when they were of age, there was no solution for them. Providing solutions for adults and later for seniors was also a strategy to keep the resource in the territory. Then, new services were organized and built: a school to train social workers or a facility for high-level sportsmen with disabilities.

Weakness and New Adaptation

Medico-social sector in Marvejols region has almost become a mono-industry, but collective representations slowly have changed the look on disabled people. Since the 1990s and moreover the 2000s, sociological and, later, political speeches have been modified. Therefore, proximity is the current dominant idea. In this field, proximity is understood as closer relations with family. Then, geographical proximity has become a necessity. The bill n° 2005-102 (February, 11th, 2005) encourages creation of new spaces and beds in other French *dé*partements. The official policy incites to rebalance. Otherwise, more than 80% of the disabled people in Marvejols come from other *dé*partements. Moreover, this economic activity depends strongly on public expenses. ARS (French central public administration organizing health policy in regions) services in the *département* precise about 65 million euro are transferred by social security in Lozère facilities for people with disabilities. This issue is important and redistributing these social funds across *départements* will be a loss for Marvejols and Lozère. In addition, situation becomes more difficult and complex: central government decided to decrease the total of Administrative regions by creating larger ones. Then, Lozère population represents a smaller rate in the new one, Occitanie. In particular, Occitanie size is 73,000 km² with 5.7 million inhabitants; Lozère only represents 1.35% of the total population, and its influence risks to decline. Every interviewee spoke about this issue.

To resist and adapt to the current economic system, local stakeholders use different types of strategies. First, the traditional lobbying of politicians: they argue Lozère is a part of "Hyper-rural" such as it has been definite in Bertrand's report (2014), the senator of Lozère, and everyone considers reducing this business is a danger for Lozère. The second response is based on an improvement of services and buildings (refurbishing). For instance, 'Le clos du nid' spent 7 million in this way in the last years. The third one is to provide better services and to complete them by new ones. The objective is to work on quality because quantity is stopped. For example, public policy supports Equiphoria, a centre using horses for autistic people, or it builds a high level centre for athletes with disabilities in Montrodat. For this last case, they hope to get the preparation of athletes for paralympic games. The idea is "to be and to stay at the forefront" (Jacques Blanc) with a permanent innovation capacity.

The diversification of the local economic activity is the fourth. Para-public associations or agencies ('Lozère nouvelle vie', 'SoLozère'...) work to attract new households. They support them to finalize their business plan or project, and they help them to settle, as in other declining *d*épartements of Massif Central, like Cantal or Haute-Loire (figure 1). This policy for attracting new inhabitants receives grants from EU (Leader program). Furthermore, an incentive policy was launched in 1996 (called ZRR, Revitalization for Rural Zones) to support declining rural areas: new enterprises have no tax on profits and land (for at least five years).

Nevertheless, situation remains fragile, the slowdown in net migration since the beginning of the 2010s (Canonéro & Marasovic, 2016; Kando, 2017) involves a stagnation of the Lozère population, because natural growth continues to be negative. Fortunately, the situation in Marvejols region is a little bit better with a slow densification of the population along the motorway.

Conclusions

Lozère and especially Marvejols region developed an opportunity linked to health business, the long-term treating and training of people with disabilities. This economic sector has brought value-added and jobs; but finally it has almost become a mono-industry and dependence stays strong. Probably, in spite of adaptations, the sector and the territory have marked a turning point. Local players try to develop new attractiveness linked to well-being branch (close to health) or, more widely, to quality of life in Lozère. However, results are mixed and competition on quality of life is strong, particularly in Massif Central. Forecasts for the future stay difficult.

Marvejols was a good place (demographical size, marginality, former and current economic development policies) for analyzing social psychology, stakeholders' representations and communication policies. The study and, especially, the fieldwork, with the interviews and observations, provide a better understanding of the local issues and representations. Therefore, the diagnostic has brought new perspectives for organizing development and governance.

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CREATIVE SYNERGY AS A POTENTIAL FACTOR FOR THE DEVELOPMENT OF SOCIAL INNOVATIONS

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Abstract
In today's context of social sciences and practical discussions teamwork, synergy and synergy effects are considered to be one of the most important research objects. Creativity leads any organizational structure to successful solution of a problem and promotes the achievement of not individual but synergy goals, which are the result of generated and practically applied social innovations. The potential of teamwork synergy is transmitted through team dynamics, team creative process, as well as team purpose. The aim of this research is to identify the indicators describing the potential of synergy regarding team creative process and to evaluate their importance in the team creative process while developing innovative solutions. A case analysis method is applied: two different teams, which performed creative tasks, were chosen and analysed. In order to estimate the potential of synergy of creativity, a set of quantitative and qualitative indicators was formed. Features describing each indicator were evaluated by using questionnaires filled by the teams participating in the research. In addition, the teams were observed, in order to estimate the team creative process. The results of the research are valuable for authorities of organizations, who aim at greater synergy results and social innovations encouraging the development of public, social and business interests and creating multiplying effects of ideas. The generalized findings of the research are presented in the article, as well as the applied methods of scientific literature analysis and synthesis, abstraction.
Key words: creative synergy, group dynamics, teamwork, social innovations.

Introduction

Society influenced by the globalization processes faces many challenges, which insist on integrated, complex as well as collective decisions. Scientists and practitioners agree that while making collective decisions, interested parties share their knowledge and experience, adopt specific roles and become involved in the process of creativity – in this way synergy of knowledge complementarity occurs.

Authors Kelley (2001), Paulus & Nijstad (2003), Sawyer (2007), Tu (2009) *et al*., agree that teams allow multiple perspectives, skills, and expertise to come together and meld brainpower to achieve more successful performance. Consequently, teams are a primary source of creativity and innovation in any organization. Climer (2016) summarised Katzenbach & Smith (1999) research results and found out the new definition of word team and present it a rather aspirational one, 'a team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable' (Climer, 2016). It is necessary to discuss about team, which makes collective and innovative decisions, because in modern organizations employees are empowered to work independently and leadership style shifted from so popular democratic or liberal leadership to transformational. In this way, a field for the development of new, panoramic thinking, extraordinary insights and social innovations is created. Authors of this article agree with Bissola & Imperatori (2011) statements that creative teams are not the 'simple sum of individual creative skills'.

Rather, teams have incredible creative potential if the group dynamics and team processes are high functioning (Bissola & Imperatori, 2011; Hülsheger, Anderson, & Salgado, 2009).

Previous scientific researches and insights have served to highlight the fact that in the context of modern knowledge society it is not sufficient to analyze the experience of teams related to collective decisions while using ordinary methods and approaches. Collective actions help to achieve synergetic results only in that case when the team has clearly defined objective (team purpose), creative actions start at the beginning of team formation process (team creative process) and the team is dynamic (team dynamics), open and able to adapt to changing environment.

Aim of the research – creative synergy as a potential factor for social innovations.

This research aims to identify the indicators that are describing potential of synergy regarding team creative process and to evaluate their importance in the team creative process while developing innovative solutions.

Research objectives are as follows: to analyse theoretical conceptualization of creative synergy and social innovations; to identify the indicators describing the potential of creative synergy; to evaluate the expression of potential creative synergy in the team creative process while developing innovative solutions.

Research methods: the analysis and synthesis of scientific literature, induction and deduction, observation of team working, questionnaire and logical abstraction methods.
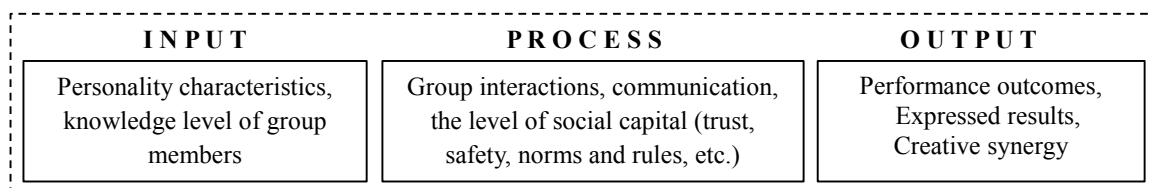
Creativity involves an ability to come up with new and different viewpoints on a subject. It involves breaking down and restructuring our knowledge about the subject in order to gain new insights into its nature. However, any definition of creativity is complicated because the concept has many dimensions (Creativity and..., 2017). Climer (2016) analysed various types of studies related to creativity. Author concluded that definition of creativity has involved four 'P', e.g. creative process, creative product, creative person and creative environment (sometimes referred to as 'press', in order to maintain four 'P' words). Plucker *et al*., (2004) attempted to incorporate the four 'P' within the definition: 'Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful defined with a social context'. More simply creativity can be defined as novelty that is useful.

Creativity and innovations in scientific literature are analyzed as inseparable and complementary phenomena; thus, in this case, innovations cannot be defined by traditional definition considering an innovation only as a novelty. Panoramic view has to be adopted and it is necessary to admit that innovation creates synergetic effects only when new product, service or process and etc., makes social changes of a lasting nature in the multilayered process of new idea transformation. Csikszentmihalyi (1996) explained this complexity within the systems theory. He states, 'Creativity does not happen inside people's heads, but in the interaction between person's thoughts and a sociocultural context. It is a systemic rather than an individual phenomenon'. Sawyer (2007) explores the power of creativity in teams and the factors that foster and diminish creativity in groups. When the variables that foster creativity exist in a team at just the right level, the team achieves creative synergy. Creative synergy is defined as the interactions among team members where the collective creative results are greater than the sum of their individual efforts. Climer (2016) through an extensive literature review has concluded that three components are needed for creative synergy with a team: team dynamics, creative team process, and team purpose.

Also, team couching is an important technique applied to motivate and encourage team to focus on final work. During teamwork the following techniques could be applied: assessment of teamwork, identification of team mission, improvement of principles of teamwork, estimation of input and expectations of team members. In addition, a technique of force field analysis, session of feedback, promotion of emotional intelligence, method of questions can be applied in teamwork for the improvement of team effectiveness (Misiukonis, Matusevičiūtė, & Grajauskas, 2015). After taking into consideration the principles of teamwork, it can be stated that team work is favorable activity for creativity and innovations. Sources, knowledge and qualification can be concentrated in team and this influences the team success significantly. A person, who cooperates with a group, tends to solve situations while using creativity (Hardagon & Bechy 2006).

Despite the fact that creativity is very promoted, creative thinking of team is not analyzed very widely in scientific literature. There are many individual techniques promoting creativity; however, group techniques can be distinguished as well. Buzys (2016) states that he has found 99 techniques for creativity development – these techniques can be applied in team activities as well. The following techniques can be used: six thinking hats, SCAMMPER (substitute, combine, adapt, magnify, modify, put, eliminate, rearrange, and reverse), NAF (novelty, attractiveness, and fulfillment), visual stimulation, a tree of problems, a source of wealth, life river, geologists of ideas, and etc. However, it is necessary to reconsider the fact that each technique should be applied while observing feelings and behavior of the group.

Team dynamics. Devitt, Philip, & McLachlan (2010) team dynamics defined as team ability adapt to each other's opinions, working methods and microclimate. According to Anderson (2005), the determinants that describe team dynamics are the following: team cohesiveness, team independence, team heterogeneity, team opportunistic practices, and team hypothesis-driven thinking. Team variables have a unique relationship with student affect and simulation performance.

INPUT	PROCESS	OUTPUT
Personality characteristics, knowledge level of group members	Group interactions, communication, the level of social capital (trust, safety, norms and rules, etc.)	Performance outcomes, Expressed results, Creative synergy

Source: developed by Hackman, 1987; Climer, 2016.

Figure 1. Input, process, and output categories.

Authors of this article would like to add to previously mentioned determinants describing team dynamics confidence among team members, respect to each other's work methods and skills, satisfaction in teamwork when members feel free to reveal themselves and express their thoughts. Creative synergy and team dynamics occur only in area of open communication – when team members are free to share their knowledge, positive and negative experiences and when teamwork unites the differences of team members and transform them to advantages.

Input variables are factors that are determined before a group gets together. This may include personality characteristics, past experience, and diversity of the team. Process variables, on the other hand, include variables that occur once the group begins interacting, such as communication, trust among the group, team climate, and sense of safety within the team (Hülsheger et al., 2009). It is worth to mention that planned team results or creative synergy occurs when an innovation, which addresses social challenges in the long term, takes place. Team members help to make a change, which is not individual or team's change, but societal.

Panoramic view has to be adopted and it is necessary to admit that innovation creates synergetic effects only when new product, service or process and etc., makes social changes of a lasting nature in the multilayered process of new idea transformation.

Team creative process. In the scientific literature (Lubart, 2001; Basadur, Gelade, & Basadur, 2014), numerous creative processes developed over the years have been analyzed, but most follow some variation of problem-finding, problem-solving or decision-finding, and decision-implementation. While analyzing the process of making decisions, it is possible to identify interferences in communication, knowledge and experience, which lead to the lack of team synergy and social innovations. Authors of this research believe that the process of team creativity has to be analyzed while revealing the potential of creative synergy, which is described by the following factors: format of team forming, time of teamwork and time for decision-making, capacity of team's strategical thinking, methods of decision-making awareness, depth and width of analyzed situations/made decisions, anticipation of alternatives of decisions/ideas and implementational steps.

Team purpose. Understanding the purpose of team actions and the expected outcomes – is a critical component for teams to achieve creative synergy. While a team may be assigned a specific purpose, team members work together to further develop and identify with that purpose; therefore, it is a critical internal-process variable for a team's creative synergy (Climer, 2016). Team purpose is always challenging

and exceeds the normal team capacity. Creative synergy will be achieved only in that case when the team will be able to think outside the box and generate such social innovations, which create not individual benefits and effects of multiplication. After analysis of determinants that are describing creative synergy, it is worth to develop understanding of the role of social innovations as an outcome of creative synergy.

Social innovations traditionally are defined as generation and implementation of new ideas while aiming to formulate effective networks of relations among people and social interactions and which are directed to the implementation of mutual objectives (Marcy et al., 2007; Mumford, 2002). According to Phill et al., (2008), social innovations are not only products, processes or technology – they also can be principles, ideas, and a part of legislation, social movement, intervention or other kind of facility. However, as Moulaert et al., (2013) emphasize, social innovations are more related to the process creating innovative social networks among individuals and their groups than to specific products or achievements (Moulaert et al., 2013). *Social innovations* are new decisions (products, services, models, markets, processes, and etc.) corresponding to social need (more effective decision than the existing one), new possibilities, relations or better use of resources. Social innovations are oriented towards the enhancement of societal capacity to operate (Caulier-Grice, 2012). *Social innovations* are the development of new ideas (products, services, models) aiming at the satisfaction of social needs. Scientists have described three dimensions, which are satisfied by social innovations: the satisfaction of human needs (content dimension); changes in social relation especially with regard to governance (process dimension); an increase in socio-political capability and access to resources (empowerment dimension) (Gerometta, Hausermann, & Longo, 2005).

Impact of social innovations can be related to the development of new institutions or new social frameworks. It can be admitted that social innovations do not solve social problems, but create social changes. They appear as new ideas or alternatives while applying new social practices in specific social groups. Santana (2014) and Daniel (2010) state that social innovations develop collective well-being. According to Santana (2014), social innovations are new social practices formed from collectives, specifically orientated towards achievement of the certain goal related to social changes or social networks that are necessary to be developed. The main distinctive properties of social innovations are orientation to novelty and targeted actions oriented towards desirable result. Social innovations are related to the actions of planned, coordinated, goal oriented

| Prompts | → | Proposals | → | Prototyping | → | Sustaining | → | Scaling | → | Systemic change |
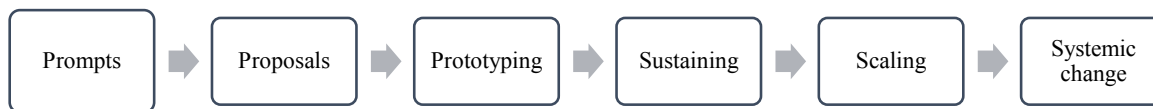
Source: developed by Caulier – Grice (2012).

Figure 2. Classical model of the process of social innovations.

and legal activities and which are performed by social agents and aim at social changes encouraging the development of new social practices in the future (Howaldt, 2010).

However, the most popular model described in scientific sources of social innovations is composed of six stages (Caulier – Grice *et al*., 2012): *I stage.* Needs or problems are highlighted. It is a primary stage, which is one of the most important, because the success of the party initiating the whole process may depend on the relevance of the problem. *II stage.* Proposals for satisfying needs – ideas are developed. Several alternatives are necessary – they have to be assessed respectively. It is not only a level of ideas – this level relates to financial indicators, which have to be identified for the implementation of the idea. *III stage.* Prototyping. Testing idea in practice. Firstly, on the inovation level testing phase is activated in the most cases or the inovation itself is introduced in the stage of prototyping. Thus, there is a high number of innovative decisions that failed. Testing is a risk mitigation factor, which can determine wheter the decision is good or not. *IV stage.* A specific model is developed. Social innovation is oriented towards process; thus, in the most cases it is possible that a certain new structure, measure, method or other results can occur. Consequently, it can become a business model which is implemented by the society following principles of social innovations. *V stage.* Development of social innovations. Success of social innovation also depends on level of its dissemination and on what extent the society is reached. Innovation is considered to be successful when it is disseminated widely. *VI stage.* Systemic changes. Due to the fact that the public sector is a common initiator of social innovations, social innovation leads to the implementation of systemic changes, which empowers the society to act and exist in the market.

In addition, elements of social innovations have to be highlighted together with the model: *I level:* novelty, effectiveness, society empowerment to operate from idea to its implementation, social needs. *II level:* openness and cooperation, development of skills and attitude, new relations, cross-sectoral cooperation, usage of funds and resources in more efficient way. In the whole process of social innovations, team or group work is relevant. Parties can pass all stages of the development of social innovations only while cooperating in creative process.

Creative process of the decision making and implementation is also very important in developing social innovations, because it helps to reach the team purpose step by step, follow the stages of the creation of social innovations and apply creative, synergistic methods.

Materials and Methods

In order to estimate teamwork while developing social innovations in synergic conditions, a questionnaire was composed from three groups of questions. In the first group statements defining the team purpose were distinguished; the second group of questions estimates team dynamic and changes occurring in teamwork; the third group of questions was used to estimate teamwork. Two stages are important for the research. In order to identify properly the principles of teamwork, it is necessary to make observations during teamwork. The research of this article is composed of two research methods.

Firstly, two researchers perform observation while following observation protocol. Each team is estimated objectively. Received data has to be compared and it has to be complemented with researchers' observations and questionnaires filled by the teams. Kardelis (2016) states that while applying qualitative and quantitative methods in researches, analyzed phenomena can be estimated more sufficiently. According to Žydžiūnaitė (2017), an important role is played by the researcher in certain researches – he or she can identify additional information relevant to research.

Representatives of youth organizations and members of university community participated in the research. There were in total 10 teams analyzed; every team was composed of 5 members. In order to estimate statements, Likert scale was applied: 1 point – I totally disagree, 2 points – I disagree, 3 points – I neither agree nor disagree, 4 points – I tend to agree, 5 points – I agree, 6 points – I totally agree.

Two researchers observed how teams performed each task. To sum up, it can be stated that 8 teams out of ten formulated goals and clear results, 7 teams out of ten operated dynamically, made decisions effectively, organized work, team members motivated and supported emotionally each other as well as encouraged each other to take actions. Team leaders, idea developers, observers, work organizers and goal oriented individuals were developed in teams. In 9 teams out of ten, teamwork depended on emotional

level and members, who have strong characters. In most cases, the team leader, who possessed leadership qualities, set the work atmosphere.

Results and Discussion

Creative synergy is achieved in that case when team members are united by the common goal. The first group of questionnaire was aimed to estimate the strength of goal and to coordinate achievement of goal and development of social innovations.

Respondents agreed that a team is united by the common goal (5.6 points). However, they also stated that the team tries not only to achieve formulated goal but also best possible results (5.6). In the theoretical part relevance of teamwork while developing social innovations was highlighted; during the research, respondents also agreed that only a strong team is able to develop social innovations (5.4). Representatives

of youth organizations and members of university community participated in the research – they were acquainted with social innovations on theoretical level; consequently, while estimating competences of team, respondents stated that the team should be qualified while developing social innovations (5.0). Also, the attention has to be paid to the fact that social innovations are oriented towards solution of social problems and respondents tend to agree with this statement (4.2). Creative synergy of team develops social innovations and acts in certain stages. Social innovations have to complete 6 stages from idea to its implementation; however, the respondents stated that stages of the social innovation development are more unclear than clear (3.6). Other estimated statements are connected to each other – they were introduced only to check the strength of respondent's opinion and are not discussed in details.

Statement	Value
Aim of our team - to achieve mutual goal	5.6
Our team aims to achieve best results	5.6
Only a strong team is able to develop social innovations	5.4
It is very important to choose proper methods while developing SI	5.2
Final developed result is important to team	5.2
Qualification of team is important in development of SI	5.0
Team mebers were devoted and determined for the sake of team	4.9
Team members followed their commitments to the team	4.9
Team members were motivated to achieve best results	4.8
All team members were determined to achieve mutual goal	4.8
Hard to develop social innovation for social problem	4.2
All stages of the development of social innovations are clear	3.6

Figure 3. Estimation of Team Goal Achievement.

Statement	Value
Team members openly shared their knowledge,…	5.3
Team members paid attention and listened to each other	5.3
Team members respected each other's work methods…	5.3
I felt free to express my thoughts and I was comfortable…	5.2
Actions of our team depended on our knowledge and…	5.2
When a team faced a problem, we united and worked…	5.1
Our team work united our differences and transformed…	5.0
Team members were open and reliable	4.9

Figure 4. Team Dynamics.

Principles of operation are important in creative process for each team. Synergy in this case is necessary when the team is trying to achieve mutual goal; thus, dynamic and principles of operation have to be harmonized. Every team can estimate its dynamic while analyzing achieved results.

Team dynamics in this group of questions was estimated while taking into account more human factor. Formation of member's role and emotional level are very important factors in team. Members of teams participating in research shared their knowledge, experience and information freely (5.3). Also, it can be observed that team members developed relations to each other and tried to listen to each other (5.3). According to received results, emotional state of teams was stable, because participants were able to reveal themselves and participate in all processes (5.2). While estimating synergy of team members and knowledge, it became obvious that team operation while performing tasks deepened on acquired knowledge and experience (5.2). Similarly to earlier group of questions, it became clear that the team had mutual goal and tried to achieve it; team members solved problems together and tried to work with them (5.1). Teamwork enabled teams to identify their differences and transform them into advantages (5.0). To conclude, it can be stated that the most important role in team dynamics is played by the human factor and team success depends on it.

Teamwork follows specific principles and each team operating in synergic way and developing social innovations reveals through these principles. Harmonized actions are a challenge to each team and there are cases when teams become demotivated; thus, it is very hard for them to achieve positive results. Researchers observed the results of demotivated team (i.e. few attempts to achieve goal which failed, demotivation of one person, and introduction of destruction in team by one person). After interviewing the respondents, it can be observed that teams fixated their ideas visually and in written (5.0). In order to achieve better results, teams tended to perform a
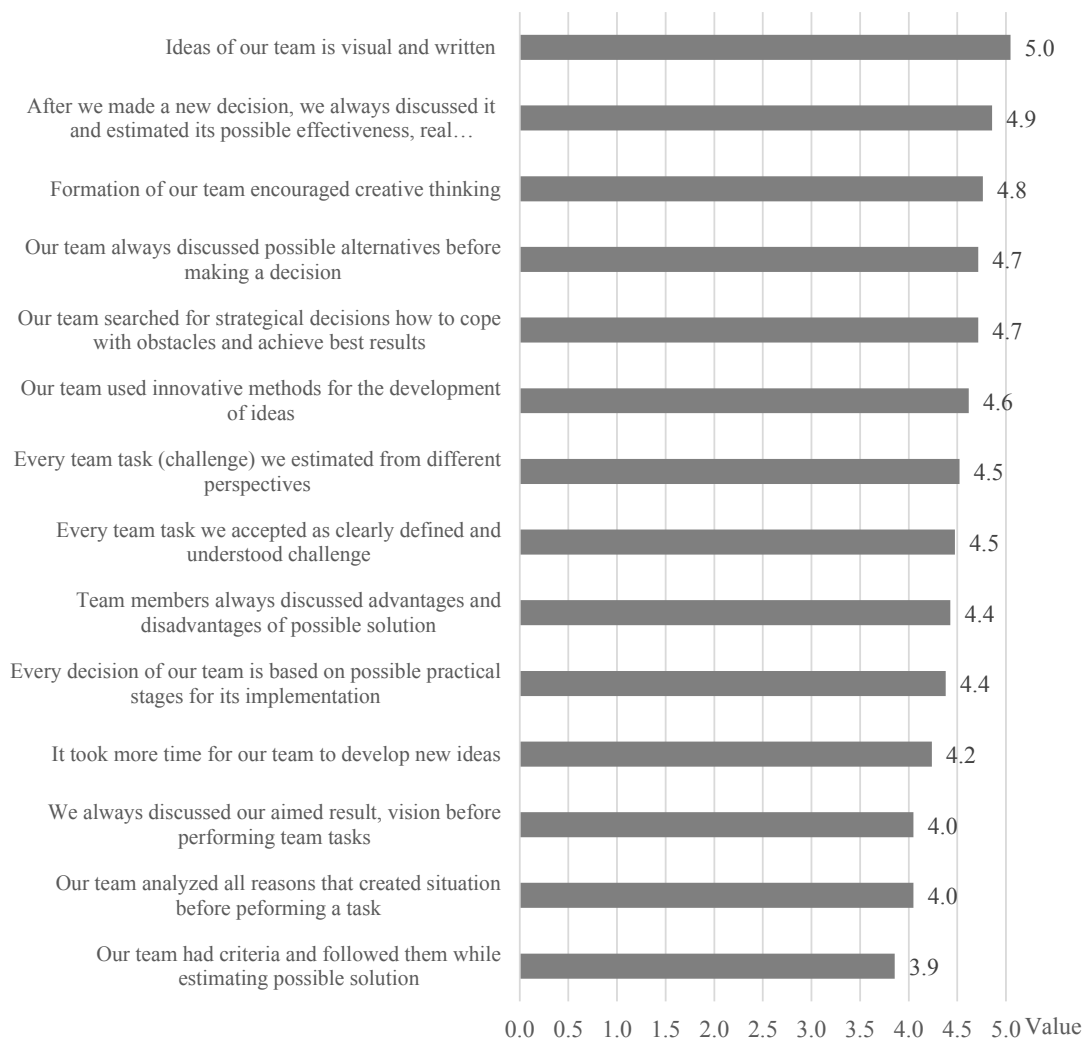
Figure 5. Team activities.

deeper analysis and estimation of decision-making (4.9). Various creative methods were used for formation of teams; the research has shown that these methods encouraged teams to act creatively (4.8).

This group of questions is connected with former groups of questions and teams distinguish team's orientation towards goal while solving various problems (4.7). The formed teams estimated presented tasks creatively, innovatively, and accepted each task as a challenge. While interpreting research results, it can be stated that these teams worked on high level of motivation in order to achieve their goal. According to estimated statements, it can be concluded that teams acted intentionally, made grounded and motivated decisions (4.4). Teams estimated possible solutions according to their developed criteria (3.9); thus, it can be stated that they spent more time on development of new idea (4.2). The performed research has shown that formed groups of respondents were enough oriented towards systemic and purposeful work, accepted presented tasks and acted in concentrated manner.

Conclusions

Creative synergy as a potential factor for social innovations should be understood as a phenomenon which is new and open for scientific studies. More and more scientists and practitioners are discussing teamwork dynamics, common/collective goals and its created social value, social innovations. According to this idea, social innovations can be analyzed as an outcome or creative process and synergy among team members, their knowledge complementarity, shared roles and responsibility.

Indicators that are describing the potential of creative synergy are formulated according to the key elements of creative synergy and it is: team purpose, team creative process and team dynamics. Each of these elements has a various types of characteristics that merge and complement each other, thus the synergy is created.

The analysis of empirical studies has carried out that well identified team purpose and team dynamics is the most important potential of creative synergy. The common goal of the team and well selected methods, common vision and actions philosophy is leading team to synergy effects and the satisfaction of team results. The analysis of team dynamics has showed that the social innovations can be identified and implemented, if only the team is open minded, flexible and tolerant for other opinions, knowledge and experience.

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ETHICAL ASPECTS OF PRIVATIZATION PROCESS IN THE PUBLIC AGRICULTURE SECTOR

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Abstract
Lease of farm lands is the most important process of proprietorial changes in the state's agriculture sector. As an effect of turbulent socio-economic conditions and legal solutions resulting from country's agricultural politics, its share in land's management has significantly shrunk. Currently there is around 1.1 million ha of land in lease, which makes up for 23% of the land acquired by the Agricultural Property Agency of the State Treasury. After 23 years of 3.2 million ha of lands acquired by the Resource (68.5%) has already been managed permanently and 2.5 million ha (53%) have been sold. Lease allows fast temporary management of the farm lands acquired by the State's Treasury, and a buying-out, mostly by the hitherto leaseholders, afterwards. The range and the structure of area of sales agreement of farm lands indicates that it was acquired by a relatively small group of buyers. Such a structure of permanent management of the State's Treasury's farm lands might bring some hesitations and questions on rationality of the proprietorial changes from the social interest view and ethics.
Key words: management, business ethics, agricultural property of the State Treasury.

Introduction

The beginning of the process of proprietorial changes in the state's agriculture sector in Poland dates back to 1990. Farm households had to adapt quickly to new conditions due to the change of socio-economic system. As a result of the change, financial situation of most households got worse which strongly affected state households. This has led to serious losses since 1991. Reshaping and remodelling of the system was based on the Act on the Management of Agricultural Real Estate of the State Treasury (AMAREST) from October 19, 1991. The Act enabled introducing the Agricultural Property Agency of the State Treasury, which was formed to execute proprietary rights and other property rights of the State Treasury's farm properties. The Agricultural Property Agency (APA) is its legal successor (Runowski, 2013; Fedejko & Others, 1993).

Though national agriculture sector has never been dominant, it had a significant manufacturing and political role. In the late 1990s national sector made up for 19% of farm lands and produced 18% of global agricultural production, 19% of the final production and 21% of merchandise[1]. National share in agriculture was varied spatially. It covered most parts in the regions of northern and western Poland. As a result of management of agricultural real estate, the scale of the problem and outcomes of proprietorial changes of the sector show significant spatial differentiation (Ziętara, 2013; Marks-Bielska, 2010; Marks-Bielska, 2013; Marks-Bielska, 2014b).

A term of privatization is closely connected with a process of proprietorial changes. It means limiting state's role in management or in property rights in favour of the private sector. Following Savas

(1992) changing proprietorial right from state to private is supposed to lead to better, fuller and more efficient fulfilment of society's needs. He stresses the connection of privatisation process with several various motives such as pragmatic, ideological, economic and populist. The pragmatic motif indicates that the privatisation should be delivered wisely which would increase its effectiveness and efficiency of the management. The ideological motif assumes limitation of the state's influence in favour of private institutions. It shows that government's decisions are based politically; therefore, they are less trustworthy that the decisions based on the rules of market economy. The economic motif is based on the assumption that state's enterprises and properties might be used better when being private and this will allow the country gaining more profit as the burden would be passed on private objects. The last mentioned motif (populist) assumes that privatization offers a bigger spectrum of social services. Moreover, it allows people to define their needs and creates feeling of companionship. It is then based on blood or neighbour bound or on a bound resulting from being a part of various voluntary associations rather than on bounds created by developed bureaucracy.

Adam Smith formulated basic rules leading to 'National treasure'. He indicates that three prerogatives play important roles in economic development and those are: endeavouring one's benefits, sharing workload and free trade which should benefit both sides of the transaction (Rourke, 2009). Bearing in mind that striving for richness is nothing bad, ethical behavior of participants of the trade are more of the value. Penc (2003) defines ethics of behaviour as "*spectrum of socially accepted within a society moral*

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[1] Statistical Agriculture Yearbook 1993, CSO, Warsaw

norms prescribing duties and deciding on moral orientation as well as people's moral practice, on their choices made in complex and difficult situations, when equal values and moral rules seem to eliminate one another". Chosen ethic rules have significant influence on moral consciousness of people and determine their behavior. Business ethics should be also mentioned in this context as a direct outcome of idea of Corporate Social Responsibility (CSR). CSR is a concept according to which, at the level of forming as well as while running a business, enterprises should nurture social interest, environmental protection and their relationship with various groups of interest. Assessed by stakeholders, CSR plays the main role in business. Carroll (2009) suggested four dimensions that describe CSR:

- Philanthropic – associated with realisation of programmes supporting society, engaging in helping local society and volunteering,
- Ethic – expected by the society and determining its actions according to law, avoiding unwanted behaviours and providing with ethical leadership,
- Legal – required by the society and connected with protection of natural environment, consumers rights, obeying anticorruption laws and delivering contracts,
- Economical – required by the society, connected with maximisation of profits and minimisation of costs as well as choosing right strategic decisions.

Economic dimension of corporate social responsibility refers to Milton Friedman's opinion. He finds it the only right way to gain profit and obeying law. Currently most conceptions of CSR join mentioned forms of social responsibility and refer to need of obeying both ethical, moral and legal norm in business. At the same time they extend the frames of traditionally perceived ethics and law (Goodpaster & Matthews Jr., 2007; Wieteska-Rosiak, 2012)[2]

Penc (2003) describes the business ethics as '*serious reaction on legal regulations, market signals and needs of society and environment, as well as foreseeing employers intentions and trends in economy in order to act beneficially for the environment'*. As a base of ethical management he suggests running a business according to public interest without a necessity of using legal force of any specific moral norm. According to him, ethical actions are those which are motivated by one's own benefit only when they do not influence negatively social interest. As this follows, ethical actions not only require well written law referring to corporate

social responsibility, but also rules of economy, which would make ethics beneficial and unethical actions might lead to bankruptcy. In this context, norms and values formed by companies which directly or indirectly take part in the process of management of agricultural properties and at the same time are facing problems and decisional struggles, might be a matter of research. Such approach is an excuse for looking for connections between stakeholders (institutions, contractors and other objects with legal personality) and using knowledge from the spectrum of ethics and using it in economic practice.

Materials and Methods

This paper is an attempt of describing the process of proprietorial changes in state's sector with a reference to values of business ethics. Analysis and assessment is based on statistical data referring to management of agricultural properties of the State Treasury in years 1992 – 2014 and legal-formal regulations referring to the trade of farm lands.

Results and Discussion

The change of the socio-political system which started in the middle of 1989 was the main reason of privatisation of state's agricultural sector. The introduced system was based on the rules of market economy and it resulted in unleashing prices, limiting or liquidation of material dotation, introducing strict anti-inflation policy and opening the market for foreign markets (Jaworowski, 1999; Mioduszewski, 2006; Sadowski, 2009). Transformation of proprietary relations was an indicator of upcoming proprietary changes in agriculture. It was mostly directed towards limiting the state's property and increasing and strengthening private property through privatisation of management initially (agricultural lands' administration and lease), and then through full privatisation of agricultural properties finally. In over 23 years of the formed trust institution, four characteristic periods resulting from realization given proprietary rights of the State Treasury can be listed (Nawrocki & Podgórski, 2009; Mioduszewski & Niedzielski, 2012; Figure 1):

- I period (1992 – 1995) – actions focused mostly on acquisition of agricultural properties to the Resource of CAP (a total of 4.4 MLN ha which constituted for 93.2% of properties under acquisition). Most of the properties came from the acquired 1666 national agricultural properties. After the acquisition properties functioned as Agricultural Properties of The State Treasury under temporary management.

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2   following: A.B. Carroll: Business and Society: Ethics and Stakeholder Management, College Division South-Western Publishing Co, Cincinnati, Ohio, 1993.

Restructuration plans were prepared and on the base of them, the final forms of management were chosen. The acquired properties were managed mainly in a form of lease (over 2.7 MLN ha – 62%). A part of Agricultural Properties of The State Treasury (332 thousands ha – 7.5%), as properties capable of running the business efficiently, were put into administration. Moreover, the Agency signed agreements on payment of obligations of institutions and contractors. All the acquired obligations were paid by the end of 2000 according to those contracts;

- II period (1996 – 2003) – the process of leasing and selling agricultural properties is continued (average 150 thousands ha per year). At the same time in some areas, where before the noted demand was rather restrained, the derivative demand for lands appeared. As a consequence of those changes in demand, in 1999 legal regulations were introduced and they enabled organising limited auctions. Furthermore, following the market changes and in the perspective of upcoming joining the European Union by Poland, in 2003, based on the Act on Forming Agricultural System (AFAS)[3], notations were added to the Act on the Management of Agricultural Real Estate of the State Treasury from October 19, 1991. They introduced territorial limitations to the process of selling land by the Agency – up to 500 ha of farm lands per contractor could be sold. The area above that limit could only be leased. The Agricultural Property Agency was obliged to obeying rules from the AFAS in order to improve territorial structure of farm lands, prevent from excessive concentration of agricultural properties and to ensure that the farm households are run by qualified people. According to Article 23 of the Polish Constitution from April 2, 1997[4], family households are a base of state's agricultural system. Following the AFAS a family household is a household where the total area of farm lands (owned and leased) does not exceed 300 ha, which are run personally by a private farmer with proper qualifications and has at least 5 years of experience in working on a farm, who lives in the same commune as one of the agricultural properties included in the household;

- III period (2004 – September 16, 2011), increased demand for land and parallel

shortening supply of lands from the Resource of CAP were noted. Around 100 thousands ha of lands were sold every year. As a consequence, prices of land rose 5 times – from 3.7 thousand PLN to 17.2 thousand PLN – Figure 2). This was caused by joining the European Union by Poland and supplying Polish farmers with support (subsidies) from the Common Agricultural Policy of the European Union;

- IV period (September 16, 2011 – end of III quarter of 2015) – changes introduced in the the Act on the Management of Agricultural Real Estate of the State Treasury resulted in some major changes in the process of the Resource's management in the matter of tasks delivered by the APA. Those changes forced actions leading to firm management of possessed properties. Lease was acclaimed to be a temporary form of management and sale a firm one. In this period 120 – 150 thousands ha of lands belonging to the Resource were sold per year. Moreover, in order to execute rules from the AFAS and in relevance to the upgraded AMAREST to the signed lease contracts, additional notations were added – within 6 months the Agency offered the tenants excluding 30% of the area of farm lands. Within 3 months from receiving notification, the tenant was obliged to decide and deliver a statement on accepting or declining the proposed changes. In case there was no such statement or the statement declined the proposed change, the tenant lost his pre-emption. Such changes were not introduced into agreements signed before the introduction of the Act on Changing the Act on the Management of Agricultural Real Estate of the State Treasury from September 16, 2011 if the total area of the leased farm land was not bigger than 300 ha. In that moment some doubts regarding its accordance to the Civil Code and to the Polish Constitution were raised, as it limited and deprived tenants from their acquired rights. The assigned authorisations will be of great importance for further activity of the APA, as they enable control (in the name of the State) over the agricultural properties market, as well as intervention during the trade by using national pre-emption (the Civil Code, article 599). In practice, it means that the Agency will be able to make decisions on form and way of managing the lands purchased this way.

3   The Act on Forming Agricultural System from April 11, 2003 (Dz. U. 2003, no 64, pos. 592)
4   Dz. U. from 1997 No 78, pos. 483, from 2001 No 28, pos. 319, from 2006 No 200, pos. 1471, from 2009, No 114, pos. 946.
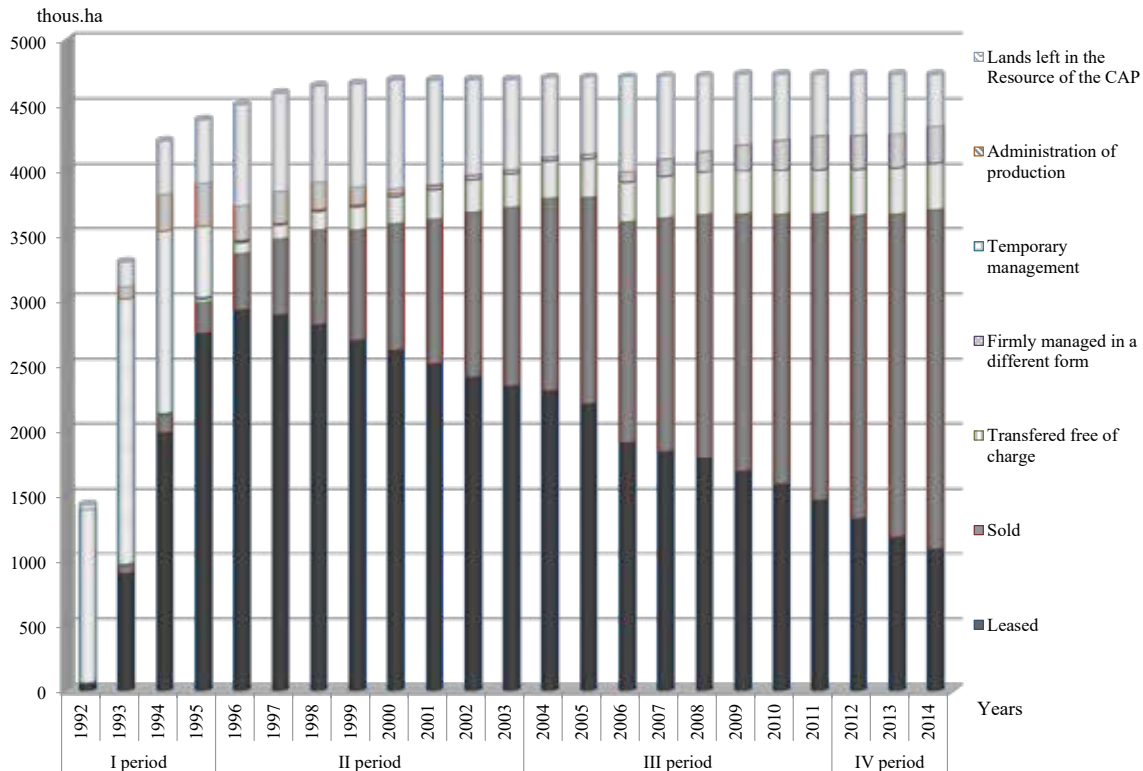
Source: own report on the basis of the data from The reports on activity for years 1992 – 2014.

Figure 1. Management of lands from the Resource of CAP of the State's Treasury in years 1992 – 2014.

Two forms had most important meaning in the process of proprietorial changes: lease (Marks-Bielska, 2014a) and sales. Proprietorial rights are separated from the rights to benefit of using it in case of agricultural lands in lease. Lease enables creation of new farm households or enlarging those already existing without engaging huge amounts of money as it would be required if the lands were to be purchased. The signed contract, according to the Civil Code[5], obliges the landlord to transmit the land to the tenant and thus allow them gaining profit during the specified or unspecified period of time. The tenant is obliged to pay rent for the landlord in a form of money, different type of provision or by sharing a part of profit. The contract specifies rights and obligations of both sides. At the same time the tenant is obliged to use their rights obeying the rules of proper management and should not introduce changes in the contracted land without a permission of the landlord. The level of connection between the sides of the contract determines durability of the lease. Within the analysed period, the development of the institution of lease was influenced by the various socio-economic changes in the country. They were reflected both in lease rents and in land prices. The average lease rent grew by 5 times in natural measures (from 2.4 dt in 1992 to 11.7

dt of wheat per 1 ha of land in 2014) and even 15 times in monetary measures (respectively from 56 PLN ha^{-1} in 1992 to 822 PLN 1ha^{-1} in 2014) within the analysed period. Those changes were parallel to changes in national agricultural policy, which were reflected in changes in legal-formal regulations. They strongly influenced the stability and durability of management in this form. Another factor coming up to treating the lease as a temporary form of management was huge dynamics of changes in agricultural lands' prices. Rapid increase of prices resulted in huge interest in lands (demand), as it started being perceived as a form of investment – it gave the opportunity to augment the invested capital and, after joining the European Union by Poland, it provided the tenant with flowing benefits in form of direct subsidies for using the agricultural lands on the basis of CAP. Another important fact resulting from joining the Union was the agreed transformation period of 12 years which restrained foreigners from buying lands. The period was over on May 1, 2016. The ongoing changes were reflected in systematic growth of prices of farm lands. They grew 51 times higher within 23 years from 0.5 thousand PLN in 1992 to 25.6 thousand PLN in 2014. The biggest growth was noted after Poland joining the Union. The trend might be hold for such reasons as

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5   Section II Lease from art. 693 to art.709 of the Act from April 23, 1964 – Civil Code Dz.U.2014.0.121 t.j.
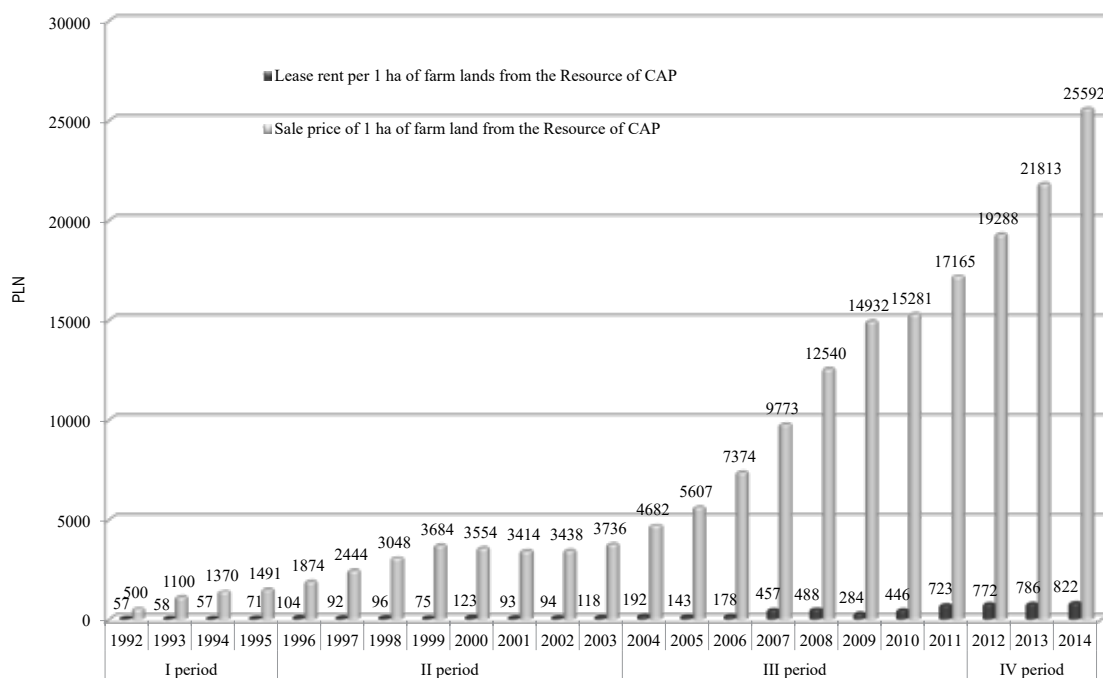
Source: own report on the basis of the data from The report… (2015).

Figure 2. Level of lease rent and sales prices of land from the Resource of CAP in years 1992 – 2014.

smaller supply of lands and relatively high demand for them as well as limitations in trade of agricultural lands after the end of transformation period (Figure 2).

The Agency, in the process of managing the farm lands belonging to the Resource of CAP, creates a plan of land sales and monitors its execution every year. By the end of 2014 a total of over 2.5 MLN ha (more than 53% of the Resource of CAP) of lands were sold in 283 thousands of contracts (an average of 8.6 ha per contract). The analysis of level of land sales according to its territory shows some sort of asymmetry. In the group of over 100 ha contracts were signed with 3194 contractors (an average of 288 ha per contract) and they constituted for 36.6% of total (919 thousands ha). In the group of below 100 ha, 3194 contractors signed contracts for an average of 5.5 ha per contract. Assuming that lands of over 5 ha enlarged the already existing households or were the basis of forming new households, then it referred to merely 5% of country's households. It is characteristic that those contracts of 5 ha and more came up for ¼ of a total number of contracts (around 70.7 thousands), and they referred to 89.6% of sold lands. Such sales structure indicates that the process of proprietary changes helped to improve the territorial structure of agricultural households in Poland only a little. The scale of sold agricultural land to a relatively small group of contractors might cause some doubts and question the point of the changes from the perspective of social interest. At this point, it is crucial to underline that the process of land management caused various problems and a part of

tenants and buyers, as a consequence of changes in economic situation (profitability of production) or wrong investment decisions made, went bankrupt. Therefore, part of land was returned to the Resource of CAP, and it required some costly actions connected with their afresh management. Table 1 presents exact numbers on sold lands grouped by the size of land per contract.

Conclusions

Results of the research indicate that the legal-formal solutions, erecting from agricultural policy in the process of proprietary transformations in the state's agricultural sector, as well as used forms of management of agricultural properties of the States Treasury imposed the scope, paste and dynamics of changes in tasks and in structure of management of the Resource. In the process of reaching the main goal, which was to transfer proprietary rights on the Agency in the process of management of agricultural lands, various legal-formal solutions were created and they shape the current trade of agricultural properties. Several matters had an influence on 'popularity' of forms of management. Such matters are: changes in the socio-economic situation which were reflected in economic conditions connected with the profitability of agricultural production, availability of preferential credits, subsidies and dotation from European Union, legal regulations introducing limitations and other limits. As results of the research and experiences of the process of proprietary transformation in state's

Table 1

Size and a structure of lands sold from the Resource of CAP according to the spatial groups – state at the end of 2014

Size of land in a contract	Total sold land		Size of land				Total number of contracts		Number of contracts				Average land size per contract
			Natural person		Legal entities and others				Natural person		Legal entities and others		
	thous. ha	%	thous. ha	%	tys. ha	%	Number of contracts	%	Number of contracts	%	Number of contracts	%	ha
to 0.99	55.7	2.2	54.8	98.5	0.8	1.5	130 527	44.7	128 660	98.6	1867	1.4	0.4
From 1.0 to 1.99	66.0	2.6	64.8	98.3	1.1	1.7	46 405	15.9	45 612	98.3	793	1.7	1.4
From 2.0 to 4.99	140.7	5.6	137.2	97.5	3.6	2.5	44 331	15.2	43 249	97.6	1082	2.4	3.2
From 5.0 to 9.99	174.1	6.9	168.0	96.5	6.0	3.5	24 541	8.4	23 692	96.5	849	3.5	7.1
From 10.0 to 19.99	276.1	11.0	262.4	95.0	13.8	5.0	19 500	6.7	18 561	95.2	939	4.8	14.2
From 20.0 to 49.99	671.0	26.7	603.7	90.0	67.3	10.0	20 474	7.0	18 599	90.8	1875	9.2	32.8
From 50.0 to 99.99	210.4	8.4	180.2	85.6	30.2	14.4	2 973	1.0	2 563	86.2	410	13.8	70.8
From 100.0 to 499.99	671.9	26.7	453.6	67.5	218.3	32.5	2 864	1.0	2 057	71.8	807	28.2	234.6
From 500.0 to 999.99	186.4	7.4	88.9	47.7	97.5	52.3	293	0.1	142	48.5	151	51.5	636.3
1000.00 and more	60.6	2.4	16.6	27.4	44.0	72.6	37	0.01	12	32.4	25	67.6	1 638.9
Land in total	**2513.0**	**100.0**	**2030.2**	**80.8**	**482.7**	**19.2**	**291945**	**100.0**	**283 147**	**97.0**	**8798**	**3.0**	**8.6**
including:													
to 99.99	1594.0	63.4	1471.1	92.3	122.8	7.7	288751	98.9	280936	97.3	7815	2.7	5.5
100.00 and more	919.0	36.6	559.2	60.8	359.8	39.2	3 194	1.1	2 211	69.2	983	30.8	287.7

*Does not include lands under buildings (also housing properties), separated objects, land of a specific character (with underground deposits, under waters, etc.) as well as non-agricultural lands
Source: own report on the basis of the data from The report… (2015).

agricultural sector show, legal solutions were not always giving equal protection of tenant's interest if compared to the interest of the State Treasury as it was the State Treasury who was prior. In 23 years of transformations more than 3.2 MLN ha (68.5%) of lands acquired by the Resource of CAP were firmly managed. 2.5 MLN ha (53%) out of that were sold and all the obligations towards institutions and contractors were paid. By the end of 2014 only 1.5 MLN ha were kept by the Resource of CAP and 1.1 MLN ha out of it was leased, which combines for 23% of acquired lands although it allows fast temporary management of acquired agricultural properties of the State Treasury, and then, repurchasing them by the current tenants. Scope and structure of areas of farm lands under sales contracts indicates that it was purchased by a relatively small group of contractors. Such a structure of sold lands of the State Treasury might cause specific doubts and question the aim of such transformations from the perspective of social interest and of ethics.

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DISPARITIES IN RURAL DEVELOPMENT OF THE RUSSIAN ARCTIC ZONE REGIONS

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Abstract
The paper provides the study of specific spatial conditions of rural development of Arctic zone regions in Russia during 2000 – 2015. The aim of the paper is to propose the methodology for rural development disparities study in the Russian Arctic. Spatial development of the Arctic is described by a system of indicators, reflecting the system of the resettlement, the level and quality of life: total population size, life expectancy at birth, housing stock etc. The extent and nature of disparities, particularly, social and economic disparities within the rural territories of the Arctic are explained. The assessment has been based on min-max ratio, coefficient of variation as well as Gini index. Eliminating excessive spatial differences in the social development of urban and rural territories of Arctic regions, improving the demographic situation, raising the level and quality of life of the population should be seen as a priority of the state policy in the Arctic in order to make it attractive for living.
Key words: Arctic, disparities, inequality, rural development.

Introduction

The development of northern territories is considered within two opposite approaches: (1) North as a source of natural resources (a raw appendage of the Russian economy) and a strategic interests zone of Russia, (2) as the territory with extreme conditions of activity where the need to increase the quality of life is a more important task than 'sacrificial work on production of resources for the benefit of regions with favorable climatic conditions' (Artobolevsky *et al.*, 2010). The level and quality of life in northern regions do not correspond to the unique natural resources, advantages of geoeconomic and geopolitical character and do not compensate influence of the extreme climatic conditions. Due to the increasing geopolitical and geo-economic importance of the Arctic, it is necessary to pay special attention to problems of sustainable development of the Russian circumpolar zone, the balanced economic and technical development of the polar regions and to the improvement of inhabitant's well-being.

The negative trends associated with an increase in inter-regional and intra-regional differentiation, with a high degree of social disintegration of population, with a decline in human development are marked in Russia as well as in the Arctic. The Arctic zone of Russia with population of 2.4 million people or just 1.7 percent of the country's total produces about 5 percent of national GDP. Taking it into account the per capita product in all the regions is considerably above the Russia's average. But the quality of life of inhabitants does not correspond to high productivity indicators and does not compensate the severe conditions.

Disparities of spatial development in Arctic regions are shown not only in inequality at the mesolevel, but in deeper distinctions in the regions - between the urban and rural areas. Determinants, scales and consequences of intraregional inequality are studied

insufficiently that is explained by the lack of local data. Thus, the main goal of our paper is to reveal the severity of social and economic development problems of urban and rural areas of Arctic regions, to assess spatial development disparities in Russia's Arctic. The paper represents the latest attempt to explore the specific spatial conditions of rural development of Arctic zone regions in Russia. Using a regional-level panel dataset that covers Arctic regions from 2000 to 2015, we explore the variations in development indicators over time.

Introduction

The research of territorial distribution features of the cities on the example of France was given in work (Combes *et al.*, 2008), and factors of spatial inequality were revealed. The explanation labor migration with the salary, but also non-market factors (heterogeneity of preferences of placement in space) is reflected by Tabuchi & Thisse (2001). In later research, Tabuchi, Thisse, & Zhu (2016) analyzed influence of technological progress in manufacturing and transportation together with migration costs for formation of space. The explanation why skill premia is higher in larger cities, how variation in these premia emerges from symmetric fundamentals, and why skilled workers have higher migration rates than unskilled workers when both are fully mobile is presented in research (Davis & Dingel, 2012).

Behrens & Robert-Nikoud (2013, 2014) explained the interrelation between the city size, productivity and inequality and found out that income inequality grows with growth of the cities, and the gain in productivity promotes growth of the cities at the expense of incentives to migration from the rural zone in city. Korchak (2016) analyzed the social stability of regions of the North and defined the main priority directions of the public social policy in

northern regions of Russia. Zubarevich & Safronov (2013) carried out the analysis of social and economic inequality of regions and cities, using the weighed Gini indexes and coefficient of variation. Features of spatial development of the North and the Arctic are reflected in Artobolevsky *et al.* (2010); features of development and problem of agricultural industry in the North (an example of the Komi Republic) are reflected in Ivanov *et al.* (2015). Pilyasov (2009) identified problems of development of the northern periphery, and also a possibility of transition of the North and the Arctic to economy of knowledge that would provide the sustainable development is investigated.

Materials and Methods

According to the Russian President's Decree #296 of 2nd of May 2014, the land areas of the Russian Arctic Zone include the territory of the Murmansk Oblast, Nenets Autonomous Okrug, Yamal-Nenets Autonomous Okrug and Chukotka, as well as some municipality territories of the Komi Republic, Republic of Sakha (Yakutia), Krasnoyarsk Krai and Arkhangelsk Oblast. Since the quality of municipal statistics in Russia is very poor, we will compare the regions as a whole.

We have used data for 2000 – 2015 published by Federal State Statistics Service, reflecting the system of resettlement, the level and quality of life of the population in rural territories of the Arctic as empirical base of a research:

    – total population size is given for resident population covering permanent inhabitants of the given territory, including temporary absentees during the census period. Population comprises urban and rural population according to their place of residence;

    – life expectancy at birth, is a mean number of years to be lived by a person from a hypothetical cohort, assuming the mortality level for every age remains the same as in the years for which the rate is calculated;

    – housing conditions including the share of the housing stock, equipped with heating, hot water, water disposal;

    – education level of able-bodied population – the population having post-graduate professional, higher professional, incomplete higher professional, secondary vocational, primary vocational, secondary (complete) general, basic general, primary general education, and those without education.

The academic literature has suggested a number of different approaches to test the disparities issue, ranging from simple statistical methods (assessment of the dynamics of the standard deviation) to the use of sophisticated econometric models. The cross-regional

dispersion of indicators is usually measured by sample variance, min-max ratio, quartile and percentile ratio, coefficient of variation as well as Gini index.

In our analysis, we use coefficient of variation, which is given by:

$$CV = \sigma / \bar{y}, \tag{1}$$

Where σ is standard deviation of the proposed indicator and $\bar{y}$ is its mean.

The Rural Development of the Russian Arctic

The extensive northern territory is characterized by a combination of adverse factors (such as extreme climatic conditions, backwardness and high cost of infrastructure) and unique natural resource and spiritual, and cultural potentials; weak communication of the regional and republican centers with the rural periphery; the low number of large cities which can carry out a role of a link of the general social and economic system; dispersion of residential and rural locations and the centers of industrial activity, their considerable remoteness from each other and from the developed regions of the country; territorial dispersion of a rural population that creates specific living conditions working in branch; backwardness and inaccessibility of transport system; need to use planes and helicopters of small aircraft and hovercrafts; high transport expenses; worn-out fixed business assets; low level of social arrangement; high illness rate (Pilyasov, 2009; Lazhentsev, 2010; Lazhentsev & Terentyev, 2011; Savelyev & Titov, 2012; Romashkina, 2015; Simonova, Pogodaeva, & Zhaparova, 2015; Tarasova, 2015; Nalimov & Rudenko, 2015).

The dynamics of human development index in Russian Arctic regions over the period from 1999 to 2014 is presented in Figure 1.

Figure 1 indicates that the regional differences have been rapidly decreasing after 2005 due to a weak human development dynamics in the leading Tyumen Oblast and remarkable progress in other Arctic regions during the 2000th. The reason for this convergence is the strong redistributive policy (mainly social) and a profound economic growth. Negative character of a demographic situation is a strong barrier of development of Arctic territories. Demographic development in Russian Arctic is characterized by a decrease in total number of the population; reduction of specific weight of a rural population, high mortality rate, migration outflow. Decrease in demographic potential, especially in the rural areas, promotes a sharpening of social and demographic risks of the region that involves problems with reproduction of population and manpower (Bulayev & Gorina, 2013).

Russia overcame the depopulation phase, which was characterized by high mortality and low birth rates or so called 'Russian cross', only in 2012. The
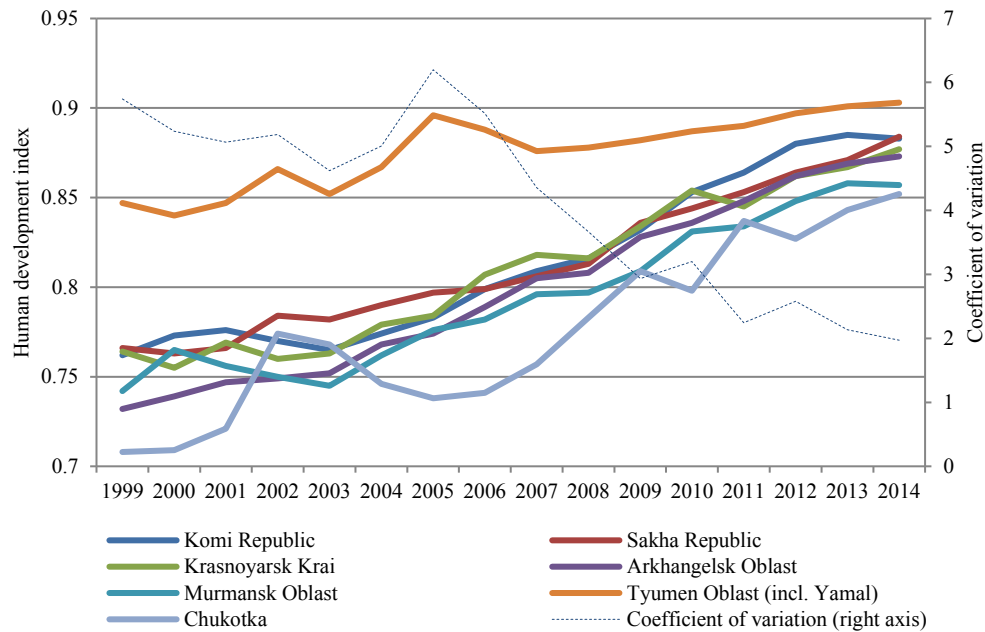
Figure 1. Human development index and its variation in the Russian Arctic zone.

situation in the Russian Arctic remains constant – the population is leaving the Arctic. A slight increase in the number of inhabitants for the last year could be observed only in the most prosperous Nenets and Yamal-Nenets Autonomous Okrugs (Table 1). Russia still has the largest number of Arctic inhabitants, but unlike Canada, the USA and Norway that number is 'melting'.

Negative trends in reproductive processes in the Arctic as well as in Russia sharpened in the 1990s. By the period of 1990 – 1999 the total fertility rate in Russia on average fell from 1.89 to 1.16. Since 2000 a revival began – the birth rate began to rise. Currently, only in the Murmansk region, the birth rate lags behind the Russian average values. However,

the effects of reduced birth rate in the 1990s can be observed right now. First of all, this is expressed in the aging population and the growing shortage of personnel in the economy. The aggravation of the demographic situation in the Arctic was also due to the high level of mortality. The death rate increased from 6.7 per 1000 population in 1990 to 13.4 in 2003 and then gradually began to decline, amounting to 10.4 per 1000 population in 2013. Existing differences in socio-economic, environmental, geographical and other factors of the Arctic regions define different trends in population reproduction processes there. The rate of natural increase and migration increase are the most common characteristics of the intensity of the population reproduction process.

Table 1

The population of the Russian Arctic regions

Region	1 January 2014			1 January 2015		
	total	urban	rural	total	urban	rural
The Arctic zone of Russia	2 400 580	2 143 047	257 533	2 391 631	2 135 359	256 272
Komi Republic	84 707	84 210	497	82 953	82 481	472
Arkhangelsk Oblast	656 624	608 040	48 584	655 100	606 986	48 114
Nenets Autonomous Okrug	43 025	30 478	12 547	43 373	31 118	12 255
Murmansk Oblast	771 058	714 445	56 613	766 281	709 548	56 733
Yamalo-Nenets Autonomous Okrug	539 671	452 569	87 102	539 985	452 570	87 415
Krasnoyarsk Krai	228 493	205 746	22 747	227 205	204 942	22 263
Sakha Republic	26 447	13 449	12 998	26 194	13 192	13 002
Chokotka Autonomous Okrug	50 555	34 110	16 445	50 540	34 522	16 018

During the 2000th the situation with the natural increase in the group of Arctic regions was complicated. All regions had positive dynamics of the indicator, which fully corresponds to the national trends. Three autonomous regions and Sakha Republic (Yakutia) have experienced the population increase for the entire period, while on average in Russia a decrease of the population took place. Only in 2013 the crude birth rate exceeded the crude death rate in Russia. The data indicate that the demographic situation in different regions of the new industrial development, such as Yamal-Nenets, Nenets and Chukotka AO, the prevalence of 'young' population structure and high levels of income provide a steady natural increase.

The weakest component of human development in the Arctic is a very low life expectancy at birth. Only one region, Yamalo-Nenets Autonomous Okrug, has managed to increase life expectancy up to 72 years for both sexes. Although it is higher than the Russian average (71 year in 2014 for both sexes), the potential for growth in life expectancy is enormous comparing it with 78 years in Alaska or 75 years in Canadian territories including Yukon, Northwest Territories and Nunavut. Taking into account the hard situation in Chukotka Autonomous Okrug (62.3 years for both sexes), reserves to increase the life expectancy in the Arctic can be evaluated to more than 15 years – the break for a whole historical period. Analysis in terms of infant mortality shows the same significant differentiation with the gap between leading Yamal and losing Chukotka being 5 times. The indicator of a life expectancy at birth in rural areas is 5.17 years less than in the urban (Fig. 2 and 3) ones.

The very low expectancy of life in Chukotka is explained by the growing suicide rates in the
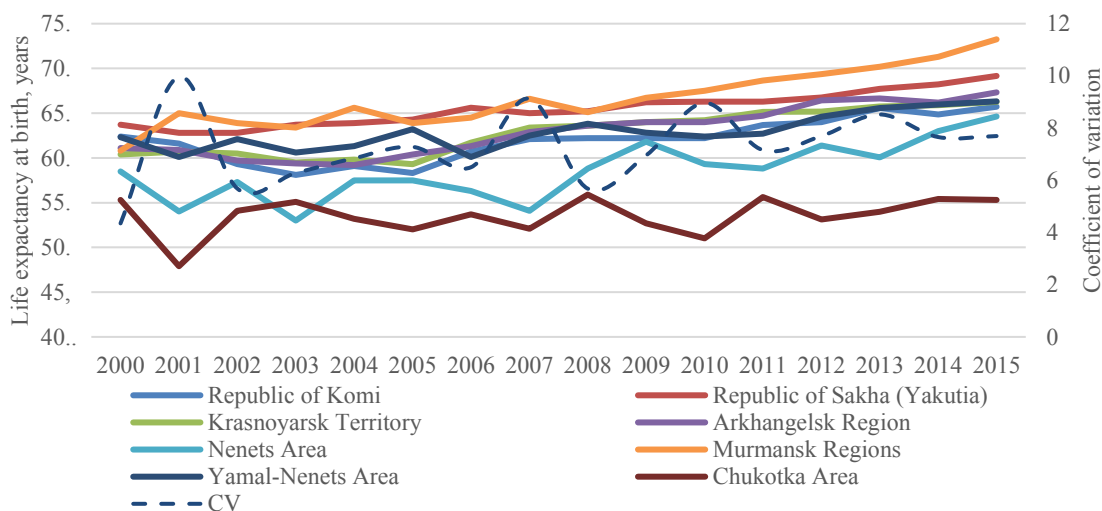

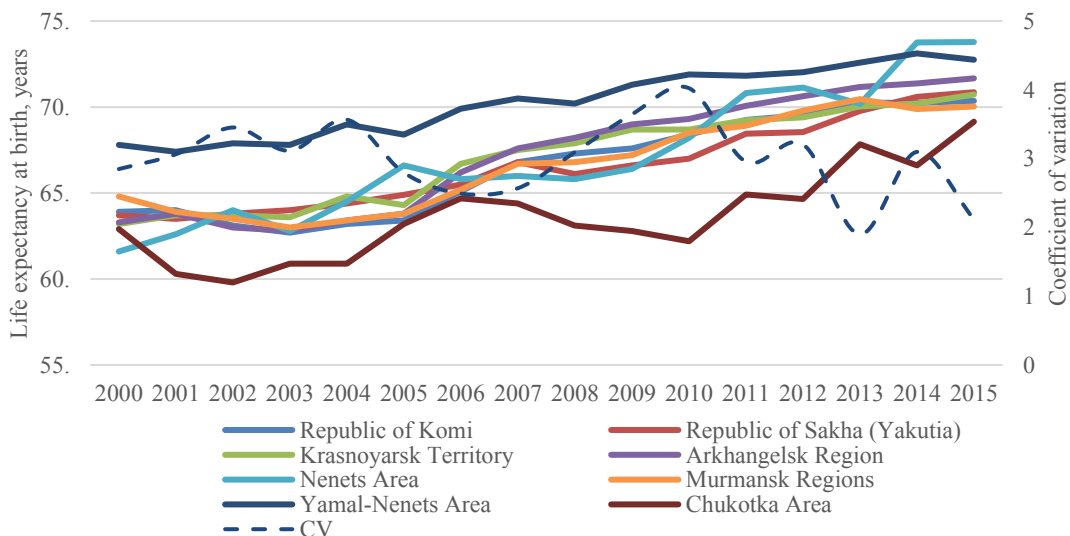Figure 2. Life expectancy at birth (years) and its variation in the Russian Arctic zone (rural areas).

Figure 3. Life expectancy at birth (years) and its variation in the Russian Arctic zone (urban areas).

region. The problem of suicides especially among the young population of Arctic regions arose several decades ago and reached the peak in the second half of the 1990th.

The lack of access to education or healthcare is also a key factor of well-being (Rudenko & Didenko, 2016). The Arctic regions as well as all Russian subjects are characterized by imbalanced development of separate components of the human development index. In the majority of northern regions the social infrastructure is characterized by the high level of unevenness of development, low level of availability of services and their limitation, besides, the remote rural areas are in most cases characterized by lack of objects of a social infrastructure. In development of infrastructure the significant gap between rural and urban areas prevails. In the rural areas of Arctic regions, there is insufficiently high level and availability of social services, insufficient security of inhabitants with doctors, average medical personnel, low level of coverage of children with preschool education (in particular indigenous ethnic groups of the North) due to the lack of incentives, and also low transport availability (Toropushina, 2009; Rudenko & Morosova, 2015). The network of highways with a hard coating averages in the north of 72.1 percent, a gap between maximum (Murmansk region – 94.1 percent) and minimum (Chukotka Autonomous Okrug – 31.4 percent) values of this indicator made 3 times. To compare this area with, other Russian regions, the minimum value of specific weight of roads with a hard coating in the general density of public roads of federal, regional or intermunicipal and local importance constituted 51 percent, in the north of the 2th region (Republic of Sakha – 40.6 percent, the Chukotka Autonomous Okrug – 31.4 percent) are characterized by values on this indicator below minimum on other regions of Russia.

Conclusions

An access to health care, opportunities for education and development of skills, the level of comfort of housing remain low in the Russian Arctic. The paradox of human development in resource-rich regions is the lack of infrastructure, high social inequality (in all its forms – money, property, gender, etc.), which leads to lower social well-being of citizens against the background of high incomes.

Thus, regions wholly or partly related to the Arctic zone of the Russian Federation are characterized by the following specifics: complicated demographic situation with high levels of population loss; the extremely low supply of health infrastructure, especially in rural areas; aging of the population; a high mortality rate, as well as an excess of mortality over births; increased alcohol consumption; the lack of qualified personnel; low level provision of housing and social services (health, education, care for the elderly, etc.); weak development of transport infrastructure, especially in the remote and isolated areas.

The study reported here use official up-to-date data from the whole range of Arctic regions of Russia. The empirical results confirm that the Arctic regions are characterized by sharp disparities of qualitative and quantitative social development parameters between urban and rural areas. The policy implications that follow are to eliminate excessive spatial differences in the social development of urban and rural territories of Arctic regions.

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REGULATIONS OF PUBLIC FOOD PROCUREMENT: OPPORTUNITIES AND CHALLENGES

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Abstract
Public food procurement is a complex system with a large number of participants, and it is regulated by a number of laws and regulations on different sectors, and there is involved a number of controlling bodies. The research aim is to explore and analyze the laws and regulations governing public food procurement in Latvia and to identify the main obstacles to food purchases from local producers. By purchasing food, local governments or authorities have to fulfill the European Union (EU) and the Latvian statutory requirements for both the correct procurement procedures, both on food safety and hygiene norms throughout the whole food product life cycle.
Purchasing food from local producers is a challenge, because on the one hand, the EC Treaty and a number of other documents request the free movement of goods and equal rights for all market participants, on the other – the local community and local government is interested in providing school students with high-quality, natural food and in promoting small local businesses.
The solution is to use green public procurement (GPP) criteria in the public food procurement. However, in the implementation of the GPP there are several disadvantages for both the local government and local food producers. By studying Latvian and other EU countries' experiences, it can be concluded that barriers to local food producers to participate in local government food procurement are related to both competitiveness and production storage and regular supply assurance.
Key words: Local food, public procurement, regulations.

Introduction

There exists the belief that a healthy diet is the basis for sustainable development because it improves both the health of the population and the environment and social justice (Morgan & Sonnino, 2010).

When there is a talk of a market for high quality foods, schools are not usually identified as the target market. However, school food is essential supply chain, in which priority is given to high-quality fresh, locally produced food (Sonnino, 2009).

Healthy and high-quality diet has the decisive role in ensuring and improving health indicators. In order to ensure the mental and physical health, children must have a balanced, natural, healthy and wholesome diet. A large part of the day children are spending in kindergartens or schools, so it is essential that the received meals in the education institutions provide children with the all necessary nutrients. Children who do not receive adequate nutrition or receive it insufficient are unable to concentrate and participate fully in the learning process; they are often sick and quickly get tired.

Catering service in the educational institution is provided by the local authority or by the educational institution to which that function has been delegated. It plans and prepares the food service or food purchase procurement documentation and selects the appropriate tenderers. Quality of prepared procurement documentation and professionalism and knowledge of Procurement Commission affects the quality of provided catering service in the education institution a lot.

Also, in order to supply high-quality food and food products to schools and kindergartens in the planning of procurement, it is essential to ensure appropriate and sufficient funding. Lowest price cannot be put forward as the sole criterion for selecting suppliers of foodstuffs or food service providers, because it does not provide the necessary food quality. It is also important to promote the purchase of local products through the laws and regulations to ensure that fresh, high-quality products from local producers are included in the menu.

In many cases, the main emphasis in school nutrition is on cost reduction rather than on a more comprehensive approach that includes quality, nutritional value and sustainability. This economic focus leads to many difficulties faced by most responsible food service providers in schools. Despite these problems, many local authorities evaluate the food system and, through innovative approaches, seek to ensure that school food quality and sustainability is still high (INNOCAT, 2015). For example, in one of French municipalities it was indicated that 20 percent of school food must be organically grown (European Commision, 2014).

The research aim is to explore and analyze the laws and regulations governing public food procurement in Latvia and to identify the main obstacles to food purchases from local producers. Research tasks: To identify the EU legislation governing procurements and food safety, analyze the Latvian legislation applicable to food purchasers, as well as to explore the burdens and opportunities for procuring local production for educational institutions.

Materials and Methods

The following research methods were employed to carry out the present research: induction and deduction, analysis and synthesis, the monographic method, the analysis of documents and survey method. A study on food procurement legislation was made at the beginning of 2017 (January-February), but the survey was conducted in 2014, from September to December.

The paper employed theoretical findings of scientists, the legal frameworks of Latvia and the EU that set the standards on purchasing food and standards on food safety.

Results and Discussions

Public procurement is important as one of the market instruments to be used to achieve the targets of the EU strategy Europe 2020 (Europe 2020, 2010). In particular, through public procurement, the strategy Europe 2020 encourages to:

- support transition to an economy that saves resources and produces low carbon dioxide emissions, for instance, by encouraging wider use of green public procurement,
- improve the entrepreneurship environment, especially for innovative small and medium enterprises (Green Book, 2011).

The role of the public sector in stimulating sustainable development has been in the spotlight of many researchers. Sustainable procurement is based on the basic principles of sustainable development, that is, it is environmentally friendly as well as promoting a healthy and strong society and social justice (Walker & Brammer, 2009; Rimmington *et al.*,

2006). Public procurement is complex because, on the one hand, it is necessary to ensure competitiveness and free trade criteria, on the other hand, there should be included environmental sustainability and social ideal-providing criteria (Morgan & Sonnino, 2007).

The Operational Strategy 2014 – 2016 of the Ministry of Agriculture of the Republic of Latvia aimed to support agricultural industries producing higher value-added products being demanded in the domestic and foreign markets as one of the priorities in this period (including local food producer quality schemes and organic farming). In this context, one of the most important medium-term tasks is the promotion of production and consumption of local food through implementing measures aimed at increasing the market share of food products produced in Latvia in public procurement and consumption, continuing implementing informative and promotional food programs and improving food quality schemes (Ministry of Agriculture, 2014).

Europe 2020 stresses that public procurement policies have to guarantee as efficient use of public funds as possible as well as procurement markets have to be accessible at EU scale.

Researching regulations of public food procurement, they should be divided into two broad categories:

1. Laws and regulations of the public procurement;
2. Food safety and hygiene laws.

Figure 1 schematically depicts the structure of public food procurement in Latvia, including regulatory hierarchy and structure, as well as food chain controlling authorities.
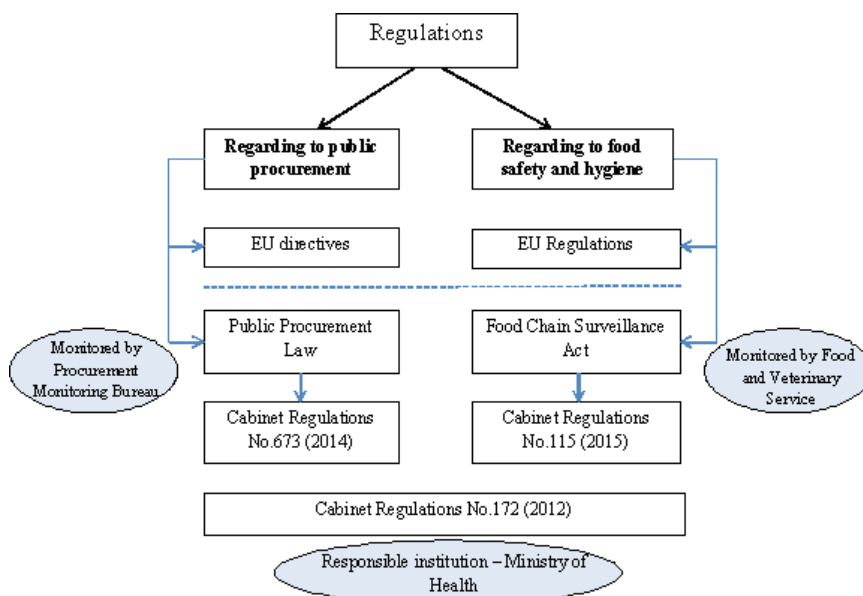

Figure 1. Public food procurement regulatory laws and controlling institutions.
(Source: *Author's scheme*).

As shown in Figure 1, Latvian public food procurement system is a complicated complex monitored by a number of institutions that are responsible both for the procurement procedure observance, both for food safety and hygiene requirements throughout the food chain.

Laws and regulations of the public procurement

The Treaty establishing the European Community in 1957 introduced the principle of a 'single market' and a single Europe for the first time. The Treaty actually sought to ensure a European-scale commitment to free flows of goods among countries and a commitment to economic growth in all the Member States, based on trade among countries. In accordance with this principle regarding the single market, the Treaty, in fact, bans anti-competition in procurement, which would be beneficial to national or local suppliers (Jackson, 2010).

EU regulations, regarding public procurement, are often mentioned as an obstacle to school food reform. The US procurement rules are also interpreted as a barrier for the purchasing of local products in school lunches because they, as well as EU legislation requires that tenders are not allowed to give priority to regional manufacturers. However, compared to Great Britain and France approach to procurements, both of which comply with the rules laid down in the EU, it is clear that this problem is only interpretation. The EU procurement laws and regulations are not barriers to implementation of sustainable procurement, unless the national and local authorities have the competence and confidence to do it under these rules (Morgan & Sonnino, 2007; Garnett, 2007).

The current public procurement Directives 2014/24/EU and 2014/25/EU, which repealed Directive 2004/18/EC and 2004/17/EC, are the latest stage of public procurement development, which began in 1971 with the adoption of Directive 71/305/EEC. The aim of this Directive is mainly to ensure that economic operators benefit fully from the basic freedoms in public procurement by guaranteeing usage of transparent and non-discriminatory procedure. The current Directives also mention a number of objectives with regard to other policies, such as environmental and social standards integration of this system. Directive 2014/24/EU underlines that public procurements must comply with the principles of Treaty on European Union, and in particular the principle of free movement of goods, freedom of establishment and freedom to provide services.

Latvian public procurement system is being developed and improved since the very beginning of the Latvian state. Consequently, with the Latvia's objective – joining the EU – it has been purposefully adapted to the European Union public procurement

process regulatory directives: 92/50/EEC, 93/36/EEC, 93/37/EEC, 93/38/EEC, 97/52/EC, 98/4/EC, but later – 2004/18/EC and 2004/17/EC.

In Latvia, public procurement was regulated by the Public Procurement Law of 2006. From March 1, 2017 it is replaced with a new law. In new law there are significant improvements and amendments to include requirements of Directives 2014/24/EU and 2014/25/EU. Purchases carried out in accordance with the laws and regulations are regulated by the Procurement Monitoring Bureau. Its goal is the implementation of public administration functions under the supervision of the procurement procedure. Its main function is to monitor if the procurement procedures carried out by governments, public service providers, public partners and public partners' representatives are in line with the statutory requirements (Cabinet of Ministers …, 2004).

The purpose of public procurement is to guarantee the transparency of procurement procedures, free competition among suppliers as well as the efficient use of national and local government funding, maximally reducing the commissioning party's risks (Publisko iepirkumu..., 2017).

The Public Procurement Law stipulates that in order to compare and evaluate bids, the commissioning party selects one of the following criteria:

1. bids at the lowest price;
2. the most economically beneficial bid, taking into consideration the terms of delivery of supplies or the contractual deadline; exploitation costs and other costs, their efficiency; quality of goods, services or construction works; esthetical and functional characteristics; compliance with the environmental standards; technical advantages, availability of spare parts, security of supplies; price and other contract-related factors.

Previous experience in Latvia shows that for the purpose of efficient use of funding, mostly the lowest price criterion is employed in evaluating bids in municipal public food procurement.

According to research studies, price is the decisive factor in public catering. Financial pressure is the most important obstacle in implementing sustainable public procurement (Walker & Brammer, 2009). Local producers have the same conditions in public procurement and they must compete with large food manufacturing companies and wholesalers. But the problem is that they cannot win because, on the whole, the costs of local food and therefore the price are higher, given the small production quantities.

For these reasons, local food producers have to be encouraged through various extra conditions, so that they remain competitive in procurement, for

instance, through setting economic benefit criteria for evaluating the offers of bidders.

Preference may be given to the food produced in Latvia if successfully employing the criteria of the most economically beneficial bid. Such criteria can involve, for instance, price, quality, terms of delivery, life cycle cost or environmental values. The Law allows taking into account environmental issues, which enables the purchaser, i.e. the municipality to require short supply chain products.

In recent years, the principle of 'green procurement' has become increasingly important in Latvia. It involves the systematic integration of environmental (and social) criteria into all procurement-related activities for goods and services. It is one of the environmental policy instruments aimed at reducing the effect on the environment, achieving social improvements as well as saving funding (Procurement Monitoring ...., 2015).

GPP has become an environmental policy cornerstone at EU and national levels (Tukker et al., 2008). Since the international conference on the environment and development in Rio de Janeiro in 1992, the understanding of the role of GPP in sustainable consumption and production patterns has significantly improved, and now government institutions use it both as a policy instrument and as a technical tool (Testa *et al.,* 2012).

Green public procurement is an instrument that directly stimulates and ensures increases in sales of local food. Making a public procurement contract in accordance with the GPP principles means that one can be sure that the goods or services purchased make the smallest effect on the environment and a positive social impact. Therefore, the choice of food products plays a significant role in reducing the effect on the environment and maintaining human health.

In Latvia, at the end of 2014, in response to Russia's embargo on the Latvian-produced food products and to promote local food consumption in the country, Cabinet Regulations No 673 'Regulations on the application of environmental criteria and establishment of criteria for selection of for the food supply and food service procurement' were accepted. These Regulations prescribe the requirements for public procurement using environmental criteria, and their application, as well as the applicable tender selection criteria for the food supply and catering contracts. Regulations are related to food supply and catering contracts.

These Regulations emphasize the following principles of GPP in purchasing of food products:

1. The products comply with organic farming or national food quality schemes or its product quality indicators, or integrated production requirements of agricultural products;

2. products which do not contain genetically modified organisms, do not either consist of GMOs or are produced from them;
3. preferred fresh and seasonal foods;
4. The products are purchased by the largest packaging or in packaging that is environmentally friendly or most of which is recyclable, or adopting for re-use;
5. Use of environmentally friendly supplies to reduce environmental pollution by motor exhaust fumes and road infrastructure load.

Similarly, the contracting authority may provide the food supply, the production of which is not used for a certain type of food coloring.

GPP as one of the national priorities is also addressed in other government policy documents and legal acts, which sets high quality standards for food supplies, stating that priority has to be given to the food products complying with the quality standards set in legal acts concerning the national food quality scheme or the organic farming scheme (Cabinet of Ministers, 2012).

After the entry into force of these Regulations GPP criteria in the procurement of food products increased, but still, their share is about 50% of the EU average (Procurement Monitoring …, 2015).

Food safety and hygiene laws
European food safety policy has two objectives:
1. to protect human health and the interests of consumers;
2. to promote the smooth functioning of the EU market.

After the reform of the EU food safety policy approach "from farm to fork" was defined, guaranteeing a high level of safety for all available foods in EU market at all stages of the production and distribution, regardless of whether these products are produced in the EU or imported from third countries. This package consists of a complex and integrated system of rules that covers the whole food chain (European Parliament, 2016).

The general principles of food legislation came into force in 2002 (Regulation (EC) No. 178/2002). In this Regulation, there are general rules for food and feed traceability.

Other EU legislation, depending on the areas in which they govern, is divided into:
1. Food hygiene ((Regulation (EC) No. 852/2004 on the hygiene of foodstuffs, Regulation (EC) No. 853/2004, laying down specific hygiene rules for food of animal origin, and Regulation (EC) No. 854/2004, on which specific provisions relating to fresh meat, shellfish, milk and milk products) lays down.
2. Food contamination

a. Food safety (Council Regulation (EEC) No. 315/93, which ensures that in the market there are not placed foods that contain unacceptable amounts of pollutants. Complementary regulation - Council Regulation (EEC) No. 1881/2006, fixing certain levels for contaminants in food);

b. Maximum residue levels (Regulation (EC) No. 396/2005 on pesticide residue limits in agricultural products, Regulation (EC) No. 37/2010 – on residues in animals);

c. Contamination from materials in contact with food (Regulation (EC) No. 1935/2004 emphasizes the main requirements for all materials and articles in contact with food).

3. Food labeling

a. Food labeling (Regulation (EC) No. 1169/2011 on the labeling, presentation and advertising, as well as on nutrition labeling for foodstuffs);

b. Nutrition and health claims (Regulation (EC) No. 1924/2006 governing the use of nutrition and health claims made on foods).

Food quality and safety in Latvia is regulated by the Food Chain Surveillance Act. Its goal is to provide quality and human health, life and environment-friendly food chain, eliminating the risk and facilitating trade and protecting consumer interests. The law stipulates both requirements for food businesses and food quality and safety requirements.

The Ministry of Health develops and coordinates nutrition policy, approves the recommended nutrition standards and dietary guidelines for Latvian population, approves the nutritional standards for universal primary education, secondary education and vocational training institutions, as well as for pre-school education programs, long-term social care and social rehabilitation institutions clients and inpatients.

Food and Veterinary Service, which is the national regulatory authority under the supervision of the Ministry of Agriculture is responsible for food monitoring and control in Latvia.

The main tasks of Food and Veterinary Service on the supervision of the Food Chain:

- to monitor and control of food products conformity with the regulatory requirements throughout the food chain;
- to recognize and register food business activities, as well as to withdraw their recognition and registration;
- monitoring and control of food businesses and food processes if they are consistent with the statutory requirements throughout the food chain;
- take risk research and analysis throughout the food chain;

- to monitor and control of observation of EU legislation requirements in food chain as well as to provide the necessary information to the European Union institutions;
- to monitor and control food contact materials in the production, processing and distribution processes (Pārtikas aprites …, 2015).

According to the Food Chain Surveillance Act, new Cabinet Regulations No 115 was adopted in 2015 'Requirements for pre-packaged food labeling'. They set out the general requirements for the provision of information on food products; there are included requirements for nutrition and health claims, as well as requirements on indications or marks identifying the food product batch.

Opportunities and challenges

Latvian Rural Advisory and Training Centre, which is the largest consulting provider in Latvia, in 2014 surveyed education authorities in order to identify the situation of local public food procurement in Latvia. In total, there are 110 counties in Latvia. The study surveyed educational institutions in 99 counties (that is 90% of all counties) in which the Latvian Rural Advisory and Training Centre has regional branches.

The 99 districts surveyed have 835 municipal education institutions in total (Central Statistical Bureau, 2014). The survey questionnaire was sent to randomly select 697 educational institutions (to survey at least 80% of all educational institutions). The questionnaire responses provided by 315 educational institutions represented 37.7% of all educational institutions in the surveyed counties. In questionnaire, there were asked questions about the type of procurement (food or food service procurement), supplier selection criteria (lowest price or most economically advantageous tender), and local government willingness to purchase products from local producers.

From the institutions that responded on questionnaire 72% admitted that a key principle of procurement to determine the winner is the lowest price principle, and only 28% used the economically most advantageous tender criteria. The study revealed that only 37% of respondents used green procurement conditions because a large proportion of municipal procurement professionals do not have a clear understanding of exactly what it is. There is a perception - it is a biological production, which raises the costs of it (Rural Advisory …, 2014). This indicates that many local governments and their institutions are still unclear about green procurement, there is lack of information what is included in it. Sometimes there is also an unwillingness to understand how it can be successfully applied in favor of local producers.

The positive trend is that in the survey 91% of the institutions expressed readiness to choose local food in procurement and implement GPP criteria if there would be given different types of support, such as information of experience of other local government in buying local food, suppliers identification, as well as training on development of GPP.

The main obstacles that make it difficult for local small-scale producers to participate in local government procurement are following:

- small producers are not competitive to participate in the public procurement of food, where the lowest price is still the main criterion rather than the most economically advantageous tender because local producers cannot compete with wholesalers;
- Purchases basically are announced in the summer, when the harvest is already growing and the owners have already found purchasers for it;
- small producers do not have sufficient and high-quality space for vegetable storage until the next harvesting season;
- Complications are often in intended product range in procurement parts and delivery terms. It is being dealt with by dividing the lots in such a way that products that can be grown in Latvia and supplied by local farmers are separated from exotic fruits.
- This in turn leads to greater administrative burdens for school representatives, so not always procurement dividing in parts is introduced;
- It would be easier for suppliers to offer their products through the cooperation. However, it is difficult for the small farm owners to find leaders who would take the lead, and they must also deal with a relatively large distances to be taken by providing the product supply (Rural Advisory …, 2014).

Exploring other EU countries' experiences, it can be concluded that there also has similar barriers to successful implementation of GPP. In addition, other countries have been identified other encumbrances of local entrepreneurs to participate in public food procurement:

- The price paid by the institutions is low;

- The quantity of products required by the body is inadequate for manufacturer (too big or too small);
- Expensive insurance premiums for the tender;
- Smaller companies have uncertainties with regard to access to procurement and tendering process by itself can be a burden;
- Lack of knowledge on how to sell their products to schools and other local authorities (Rosenberg *et al.*, 2014; Pinard *et al.*, 2013; Conner *et al.*, 2012; Scottish Government, 2009).

Thus, studying the experience of other countries and actions to reduce these barriers, there is a possibility to incorporate requirements that promote the effective implementation of GPP in the Latvian laws and procurement regulations.

Conclusions and Proposals

Healthy and high-quality diet has the decisive role in ensuring and improving health indicators. Catering service in the educational institution is provided by the local authority or by the educational institution to which that function has been delegated. Quality of prepared procurement greatly affects the quality of provided catering service in the education institution.

Latvian public food procurement system is a complicated complex monitored by a number of institutions that are responsible for the procurement procedure observance, both for food safety and hygiene requirements throughout the food chain.

Purchasing food from local producers is a challenge because, on the one hand, the EC Treaty and a number of other documents request free movement of goods and equal rights for all market participants, on the other hand, the local community and local government is interested in providing school students with high-quality, natural food and promoting small local businesses. The solution is to use GPP criteria in the public food procurement.

Exploring Latvia's and other EU countries' experiences, it can be concluded that there are identified several burdens of local food producers to participate in local government organized food procurement that are related to both competitiveness and production storage and regular supply assurance.

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CUSTOMER LOYALTY TO A GROCERY RETAILER: DIFFERENCES BETWEEN URBAN AND RURAL AREAS OF LITHUANIA

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Abstract
Given the intensive competition in almost all the business sectors, customer loyalty research is gaining its popularity among marketers as well as among scholars. The aim of this research was to determine the differences in loyalty to grocery retailer between urban and rural consumers. In order to reveal the differences, questionnaire research was provided and differences between Lithuanian urban and rural customer loyalties were determined. The research results indicated the existence of statistically significant differences between the loyalties of Lithuanian urban and rural regarding their mostly visited grocery retailers in terms of their attitudes and repeat patronage behaviour. Moreover, based on the neo-behaviouristic approach, considering attitudinal and behavioural measures, all kinds of loyalties were observed stronger in the urban areas of Lithuania. The assumption was made that there might be an effect of limited-choice condition. Affected by the latter condition, rural citizens tend to seek for variety more than the urban ones. Consequently, considering the rural citizens' evaluations, it can be stated that their loyalty is undermanaged, resulting in a very low amounts of truly loyal customers. Therefore, for the grocery retailers it was recommended to revise their customer loyalty schemes based on the point of residence of their consumers. In such a way the higher possibility of meeting consumer needs might be achieved.
Key words: attitudinal loyalty, behavioural loyalty, customer loyalty, grocery retailer, Lithuania.

Introduction

Modern competitive business environment makes it more and more difficult to gain and retain competitive advantage. Gaining and retaining customer loyalty is considered to be one of the crucial goals for companies that lead to successful competition in ever-changing business word. The customer has become the central focus for most companies (Makanyeza, 2015; Boohene & Agayapong, 2011). It is becoming a regular assessment of successful businesses to place customer loyalty at the centre of their marketing strategy. Different authors acknowledge benefits of long-term customer relationship and loyalty for the companies (O'Malley, 1998; Nordman, 2004; Rust & Oliver, 1994; Reinartz & Kumar, 2000). The following arguments are suggested: decline of customer retention rates by several per cents determines significant decrease in profitability of the company (Reichheld & Sasser, 1990); attraction of new customers costs much more for the company than retention of the existent ones, and customer loyalty increases growth potential of the company (Hesket, 2002; Nordman, 2004). Loyal customers purchase significantly more products / services 'related' to the main product or service (Little & Marandi, 2003) and contribute to the reduction of marketing costs (Nordman, 2004). Costs of loyal customer service are lower, companies receive price premiums as loyal customers are less sensitive to prices, and word-of-mouth by loyal customers reduces costs of new customer acquisition (Nordman, 2004; Černiauskienė & Stankevičienė, 2007).

Marketing theory gives a high emphasis on customer loyalty construct. However, the antecedents, participating in the formation of customer loyalty, have generated a lot of discussion and debate. Analysing the process of customer loyalty formation, researchers mention different tools for loyalty building; distinguish various factors, affecting customer loyalty formation. Special attention in today's rapidly changing business environment attracts some nonessential factors influencing relationships between organizations and customers such as market structure or insufficient number of available alternatives, which can serve as a limitation for customer switching behaviour, and it is particularly likely that if customers do not notice or other alternatives simply do not exist in the market, they will tend to continue relationship with the current organization (Storbacka, Strandvik, & Grönroos, 1994; Bendapudi & Berry, 1997; Colgate & Lang, 2001). According to the market structure or insufficient number of available alternatives, as an antecedent in customer loyalty formation process, different areas in counties – mostly urban and rural, can generate different amount of loyal customers, just because of the customers' ability to have greater variety of choices. Dick & Basu (1994) argue that even formation of different loyalty categories (according to Dick & Basu (1994) model) is dependent on customers' opportunity to have sufficient number of available alternatives. According to these theoretical insights, it could be stated that people, living in rural places, tend to be more loyal than those living in urban, just because of market structure or insufficient number of available alternatives.

Little research has been done about customers' loyalty differences between rural and urban areas in grocery retailing, though research shows that the biggest interest in loyalty formation in retail sector is in the grocery retailing (Ott, 2011). Authors of this article have chosen to analyse Lithuanian grocery

retailing, because grocery retailers act in fast moving consumer goods (FMCG) sector, where competition is very high, many customers use grocery retailers' loyalty cards, and even rural areas of the country have at least one grocery retailer.

Research problem in this article is formulated as a question: what are the differences in customer loyalty to grocery retailer between urban and rural areas of Lithuania?

The aim of the paper is to determine the differences in loyalty to grocery retailer between urban and rural consumers.

In order to reach the aim of the article, questionnaire research will be provided.

The paper consists of both theoretical and empirical analysis. After the presentation of theoretical insights, research methodology is outlined, following with research findings. Finally, conclusions are stated.

Materials and Methods

Loyalty construct. Customer loyalty construct is as an integral part of consumer behaviour theory and has evolved over the years (Boohene & Agayapong, 2011; Makanyeza, 2015). Having much attention in both academic and business word, nowadays customer loyalty focuses on brands, stores, services and activities (Makanyeza, 2015). The concept of customer loyalty has changed over the decades, too. Previous research on the conception of relationship marketing (see Zikiene & Pileliene, 2011) enabled to distinguish two basic customer loyalty conceptions: behaviouristic and neo-behaviouristic. The behaviouristic customer loyalty conception dominated in the sixth decade of the twentieth century; the basic idea of the concept was that customer loyalty is reflected by permanent purchases of the same brand or at the same point-of-purchase (Zikiene & Pileliene, 2011). Yim & Kannan (1999), emphasizing behaviouristic approach mention an exclusive or a hard-core loyal customer; hard-core loyal consumers are loyal to a single alternative despite many choice possibilities. The topic of identity between repeat purchases and customer loyalty was considered early. Cunningham in 1956 based on empiric research identified factors affecting purchase behaviour; latter factors were not considered by the behaviouristic loyalty conception (Zikienė & Prėskienė, 2013). The neo-behaviouristic customer loyalty conception is based on Day's (1969) conceptual attitude that customer loyalty is a two-dimensional construct, accordingly, both aspects have to be considered. Day's customer loyalty conception encompassing behavioural and attitudinal measures is applicable till nowadays. Many authors (Jacoby & Kyner, 1973; Jacoby & Chesnut, 1978; Backman & Crompton, 1991; Pritchard, Havitz, & Howard, 1999; *et al.*) provide their own modifications of the concept;

however, the modifications do not vary much from Day's (1969) conception. The most widely analysed neo-behaviouristic conception of customer loyalty can be found at Dick & Basu's (1994) scientific researches (Zikienė & Prėskienė, 2013). According to the neo-behaviouristic customer loyalty conception, customer loyalty is expressed by:

1. Behavioural loyalty, which is reflected by actual amount of product/services purchases in a concrete period of time;
2. Attitudinal loyalty, which is represented by preferences for a certain brand's product or service, satisfaction with a product or a service, commitment, the likelihood of repeat purchase, advocacy activities (positive word-of-mouth, recommendations).

Despite the scientific opinion about appropriateness of the behaviouristic loyalty conception, the authors of this article accept a neo-behaviouristic approach; both, attitudinal and behavioural measures have to be considered while measuring customer loyalty.

The neo-behaviouristic customer loyalty conception is based on identification of customer loyalty categories. Dick & Basu (1994) define customer loyalty as a combination of repeat patronage and object-related attitude. Accordingly, four categories of customer loyalty can be identified:

1. True loyalty, expressed by positive reviews and attitude (attitudinal loyalty), and repeat purchases (behavioural loyalty);
2. Latent loyalty, related to positive attitude (attitudinal loyalty), but not to repeat purchases (behavioural loyalty);
3. Spurious loyalty, expressed by a low level of positive reviews (attitudinal loyalty), but huge repeat purchases (behavioural loyalty);
4. No loyalty, expressed by a low level of positive reviews (attitudinal loyalty) and a low level of repeat purchases (behavioural loyalty).

Based on the two-dimensional construct of customer loyalty, Dick & Basu determined four levels of loyalty. They are illustrated in Figure 1.

It is acknowledged that consumers representing true loyalty have strong attitudes and high repeat purchase intentions toward a product or brand. In most situations these customers purchase a particular brand or encourage a particular service provider (Makanyeza, 2015). In true loyalty, a conscious decision to continue purchasing a particular product or from particular provider must be accompanied by the positive attitude and commitment toward that product (Boohene & Agayapong, 2011).

Latent loyalty is characterized by strong attitudinal commitment and low purchase behaviour. O'Malley (1998) points out that this is most likely a result of situational influences – including inconvenient store

Behaviour (Repeat Patronage)

		High	Low
Relative attitude	High	**True Loyalty**	**Latent Loyalty**
	Low	**Spurious Loyalty**	**No Loyalty**

Source: Dick and Basu (1994).

Figure 1. Four levels of customer loyalty.

locations, out-of-stock situations, and/or the influence of other people. In the situations of latent loyalty, Dick & Basu (1994) remark that managerial efforts are best focused on removing the interferences to patronage, for example, by extending the branch network.

Customers representing spurious loyalty are not emotionally attached to the brand or product even though they may frequently purchase it. In such situations, repeat purchase may be based on the availability of deals, special offers, convenience or inconvenience or the influence of other people (O'Malley, 1998; Schiffman & Kanuk, 2004; Makanyeza, 2015). Schiffman & Kanuk (2004) suggest that consumers representing spurious loyalty can continue to purchase products or brands even they really may not like them (Makanyeza, 2015). By the way, Assael (2004) confirms that an uncommitted customer may continue shopping in a particular store because he/she does not have enough time and it is easier to shop in one place. This indicates inertia rather than true loyalty. According to these insights, the authors of this study emphasize that normally rural areas have a smaller number of grocery retailers than urban areas, so it can serve as a limitation for customer switching behaviour and tend to continue relationship with the current grocery retailer.

Customers with low loyalty represent no loyalty at all. Their attitudinal loyalty is low as well as their behaviour is not accompanied by any repeat purchases. According to O'Malley (1998), no loyalty situations are common in markets where the product has low rates of differentiation, and its selling strategy is not supported by any sales promotion or loyalty building program.

Loyalty measurement. Customers may express their loyalty in many different ways, reflecting their attitudes of resulting in purchase patterns. It is recognised that segmenting loyal customers can assist in developing an understanding of the nature of loyalty orientation and can inform appropriate marketing actions (Rowley, 2005). Previous research (Bakanauskas & Pilelienė, 2008; Pilelienė, 2010) enabled the elaboration of the model for

the determination loyalty stages; moreover, it was concluded that different managerial actions have to be taken based on the state of customer loyalty. However, the scientific literature mostly provides Dick & Basu's (1994) model of loyalty assessment and segmentation. The authors argue that loyalty is determined by the strength of the relationship between relative attitude and repeat patronage, and that it has both attitudinal and behavioural elements.

Based on the two-dimensional construct of customer loyalty, Dick and Basu determined four levels of loyalty (true, latent, spurious and low (no) loyalty) as already explained. The behavioural loyalty leads the customer to repeat purchases. It denotes a brand or product preference over time. The attitudinal loyalty explains the customer's intention to purchase again and to recommend the product to others (Kandampully & Suhartanto, 2000, Makanyeza, 2015). To conclude, customer loyalty is to be measured in the context of attitudinal and behavioural loyalty. These approaches are not contradictory, but complementary. Different customers have different attitude, leading to differences in behaviour. Accordingly, organizations focus to customer loyalty must be aligned with customer loyalty categories.

Questionnaire design. The design of the questionnaire was established to reflect the two dimensions of customer loyalty (latent variables): 'relative attitude' and 'repeat purchase behaviour'. Ten manifest variables (five items for the attitudinal, and five items for the behavioural components) were used to assess customer loyalty based on previous researches by Makanyeza (2015), Lewis & Soureli (2006), Söderlund (2006). Table 1 illustrates the items used to measure customer loyalty; each item was given a code. Respondents were asked to provide their evaluations of agreement or disagreement with the statements based on a 5-point Likert scale that ranged from 1 'strongly disagree' to 5 'strong agree'.

The questionnaire survey was provided in Lithuania in December 2016. The total sample was 350 respondents (209 female); 175 respondents (94 female) were rural and 175 respondents (115 female)

Table 1

Items used to measure customer loyalty

Item	Code
The shopping centre I used to shop is good	ATT1
The shopping centre I used to shop ensures a high quality of products	ATT2
The shopping centre I used to shop is my favourite	ATT3
The shopping centre I used to shop is welcoming	ATT4
I trust the shopping centre I used to shop	ATT5
Next time I will go back shopping to this shopping centre	BEH1
Mostly I just do my shopping in this shopping centre	BEH2
I spend the most money doing my shopping in this shopping centre	BEH3
I have a positive contribution and recommend this shopping centre to my relatives and friends	BEH4
When I have other alternatives to do my shopping rather the usual shopping centre, anyway I choose to do my shopping in the usual one	BEH5

Source: adapted from Makanyeza (2015); Lewis and Soureli (2006); Söderlund (2006).

were urban citizens. All the respondents were over 18 years old.

Data distribution was tested using the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test and reliability analysis were performed to substantiate the suitability of data for further analysis. The p values of all the results were below 0.05, meaning that data were not distributed normally. The Cronbach's Alphas were obtained 0.798 for the construct 'relative attitude' and 0.771 for the construct 'repeat purchase behaviour'.

Results and Discussion

In order to analyse the differences between loyalty of urban and rural customers, the evaluation means for each latent variable ('relative attitude' and 'repeat purchase behaviour') were calculated. As the evaluation of manifest variables (five to reflect each manifest variable) was provided in 5-point Likert scale, where '1' indicates absolute disagreement with the statement, and '5' – total agreement with the statement, the breaking point was decided to be '4'. The evaluation '4' means that the respondent agrees with the statement; however, his / her opinion is not extremely strong. Therefore, all the evaluation means which were obtained below '4' were considered as indicating low attitude or intended behaviour. Similarly, all the evaluation means of '4' and higher were considered as indicating high respondent's attitude to the grocery retailer or intended behaviour in terms of future purchases. After calculating the means of evaluations, respondents were divided into four categories, based on the Dick's and Basu's (1994) classification. Respondent distribution according to the level of their loyalty is provided in Figure 2.

As it can be seen in Figure 2, the evaluation differences between urban and rural customers are
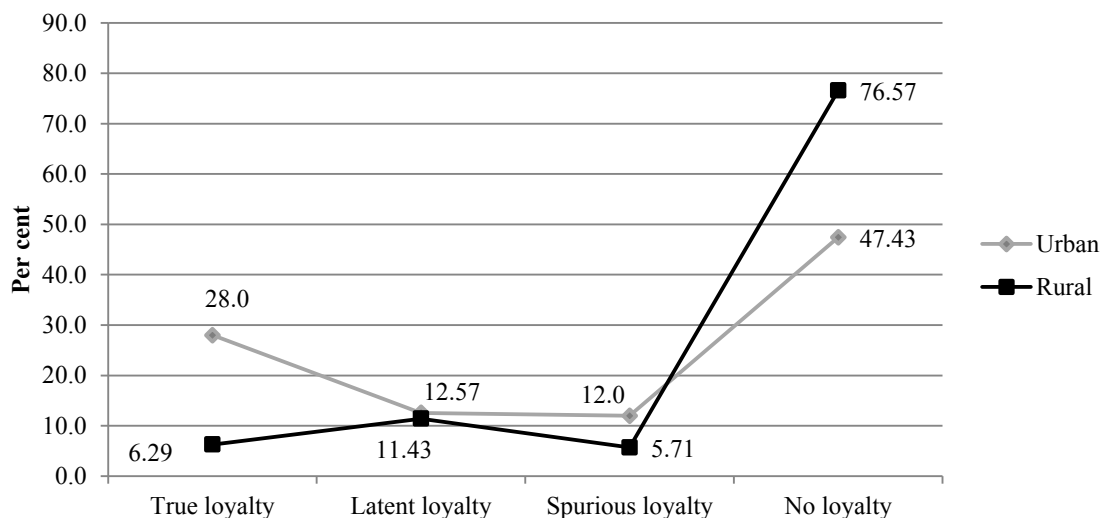

Figure 2. The levels of Lithuania customer loyalty to grocery retailers, N = 350.

Table 2

Differences between urban and rural customer attitudinal loyalty to grocery retailers in Lithuania

Parameter		ATT1	ATT2	ATT3	ATT4	ATT5
Urban citizens	Mean	4.08	3.83	3.53	3.85	3.79
Rural citizens	Mean	3.62	3.09	2.84	3.39	3.35
Total	Mean	3.85	3.46	3.18	3.62	3.57
Mann-Whitney U		11244.000	8777.500	9670.500	11839.000	11904.500
Wilcoxon W		26644.000	24177.500	25070.500	27239.000	27304.500
Z		-4.991	-7.581	-6.180	-4.127	-3.993
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000

obvious. The smallest difference was obtained in the category 'Latent loyalty'; however in the extremes differences are enormous. The results indicate that customer loyalty to a grocery retailer is much higher in urban areas of a country even though 47.43 per cent of urban respondents' were described as having 'no loyalty' to their regularly visited shopping centre. The category of non-loyal customers among rural citizens was also the largest one – it comprised more than three-quarters of rural respondents. Moreover, only 6.29 per cent of rural respondents were attached to the category of 'true loyalists'. Latter results indicate the necessity of customer loyalty and relationship management in Lithuania, primarily in rural country areas.

However, if considering customers which were attached to the categories of 'latent loyalty' and 'spurious loyalty' as loyal, the situation in the urban areas of Lithuania can be called satisfactory. Even 28 per cent of urban respondents exhibited 'true loyalty', 12.57 per cent – 'latent loyalty', and 12 per cent – 'spurious loyalty'. Altogether somehow loyal customers comprised 52.57 per cent of the sample.

The determined differences in the structure of customer loyalty to a grocery retailer between urban and rural citizens imply that different loyalty-related aspects have to be managed in particular areas. Therefore, it is necessary to determine the undermanaged aspects; moreover, it is necessary to determine the area-specific undermanaged aspects.

Achieving to determine the main differences between urban and rural citizen evaluations, means were calculated for each statement of the questionnaire in three ways: statement's evaluation mean by rural respondents, statement's evaluation mean by urban respondents and statement's general evaluation mean. Also, mean differences between the evaluations provided by urban and rural citizens were calculated and Mann-Whitney U test was applied to determine the statistically significant differences between evaluations.

The analysis of the research results indicates that there are evident statistically significant differences between urban and rural customer attitudinal loyalty to a grocery retailer – the evaluation means were found to be statistically significantly different for all the five evaluated statements. The research results indicate that urban customers are statistically significantly more loyal that the rural ones (see Table 2).

All the evaluation means reflecting general evaluations means as well as urban customers' evaluations were obtained above '3'. In a 5-point Likert scale '3' is often a breaking point, indicating indifference or a lack of opinion. Therefore, all the evaluations above '3' are considered as being positive. Moreover, the mean of evaluations provided by urban customers for a statement that the shopping centre was good were obtained above '4'; such a high evaluation mean indicates that customers are satisfied with their regular shopping centre. Analysing the results provided by the rural respondents, the situation changes. The statement ATT3 indicating that the shopping centre was respondent's favourite was evaluated negatively – the evaluation mean was obtained below '3'. The negative evaluation of the statement indicates the low consumer choice possibility. The lack of shopping centres in rural area creates the situation when consumers are choosing the closest, not the preferred one even though all the other attitudinal aspects were evaluated positively by rural customers, indicating quite high quality standards in an industry of grocery retailing in Lithuania.

During the further analysis of the research results, the evaluations of behavioural loyalty reflecting statements were analysed. All the evaluation means were found to be statistically significantly different for all the five evaluated statements as it was for attitudinal loyalty reflecting statements (see Table 3).

As it can be observed in Table 3, all the general evaluation means for each statement were obtained positive (in a range between '3' and '4'). Therefore, it can be argued that general situation can be considered as positive in terms of customer behavioural loyalty. However, the mean differences between urban and rural respondents' evaluations indicate the lack of behavioural loyalty in rural areas. The situation is

Table 3

Differences between urban and rural customer behavioural loyalty to grocery retailers in Lithuania

Parameter		BEH1	BEH2	BEH3	BEH4	BEH5
Urban citizens	Mean	4.04	3.72	3.78	3.51	3.40
Rural citizens	Mean	3.46	3.33	3.25	3.07	2.90
Total	Mean	3.75	3.53	3.51	3.29	3.15
Mann-Whitney U		10189.500	11837.000	10799.000	11404.500	11101.500
Wilcoxon W		25589.500	27237.000	26199.000	26804.500	26501.500
Z		-5.906	-3.997	-5.003	-4.350	-4.635
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000

best described by the negative evaluation of the statement that in case of a choice, a consumer will choose the usual shopping centre – the statement's evaluation mean was obtained 2.90 meaning that rural consumers are variety seeking, regardless of the positive evaluations of centre's quality. Moreover, the statement reflecting consumers' intentions to recommend the shopping centre to their relatives and friends was evaluated very low by rural respondents; the evaluation mean was obtained 3.07. Despite being evaluated above '3', consumer recommendations are often considered as one of the principal indicators of customer loyalty; therefore, the statement's evaluation can be considered as negative.

Conclusions

In the conditions of tough competition, loyal consumers can be considered as a valuable asset of any company. Therefore, customer loyalty assessment is a field of discussions not only for managers, but for scientists as well. During the century of the evolution of marketing thought, many typologies of customer loyalty have been elaborated. However, many of them have been based on the neo-behaviouristic approach, incorporating both: attitudinal and behavioural measures.

The business of grocery retailing is one the most overcrowded industries, where keeping loyal customers is vital. However, the customer relationship situation in this industry is different depending on the area: rural or urban. In rural areas consumer choice is often limited because of smaller number of alternatives. Therefore, the competition among grocery retailers in rural area is mellower. Having limited choice possibilities, rural consumers often visit the same (often closest) shopping centre. However, calling such a forced shopping behaviour as 'loyalty' would be myopic.

The research provided with two samples of respondents (urban and rural citizens) enables the initiation of discussion on the effect of limited-choice condition on consumer loyalty. Research results indicate the existence of higher customer loyalty in urban areas of the country; namely, in those areas where customers have a free choice possibility. Considering the evaluations provided by the rural citizens, it can be stated that customer loyalty is undermanaged, resulting in a very low amounts of truly loyal customers. Therefore, for the grocery retailers it can be recommended to revise their customer loyalty schemes according to consumer point of residence.

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HOW DO BRAND ASSOCIATIONS AFFECT PURCHASE INTENTIONS?
A CASE OF ORGANIC PRODUCTS

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Abstract
The aim of the research is to determine the influence of brand associations on purchase intentions in the framework of organic products. In order to determine the influence of brand associations on purchase intentions in the organic product category, the organic yogurt was chosen as a product. The brands' criteria grid was elaborated for the selection of the specific yogurt brands and three different yogurt brands were chosen for the research. Nine associations directly or indirectly associated with ecology were generated and approved by experts of marketing and advertising; namely: 'organic', 'natural', 'ecological', 'healthy', 'nutritious', 'Lithuanian', 'tasty', 'regular', and 'expensive'. The empirical research with the selected brands and generated associations was composed of two parts: experiment and questionnaire survey. The research results revealed that brand associations have a huge impact on consumer purchase intentions in a framework of organic products. Proper and positive association development positively and directly influences consumer purchase intentions. Positioning of the brand as providing organic products is extremely important when seeking to develop brand associations with organic products; the naturalness, ecology of the product should be emphasised in marketing communication; a brand name should be meaningful and visual marketing communication should expose the ecology. For the future research, the analysis of the influence of brand associations on the conative consumer response in the frameworks of the remaining products categories is necessary.
Key words: brand associations, consumer behaviour, purchase intentions, organic products, brand equity.

Introduction

Framed by the conditions of market economy and a tough competition in the sector, the producers of fast-moving-consumer-goods are facing the situation where the determination of factors affecting consumer purchase intentions becomes vital. Achieving to respond effectively to the ever-changing business environment, brand managers are elaborating new strategies to strengthen brand association which connects images and symbols with a specific brand or its benefits (Virutamasen, Wongpreedee, & Kumnungwut, 2015). Considering the variety of brands of the same products competing for the customer attention and share of wallet, knowing the keywords for consumer attraction might result in a measurable competitive advantage among the rivals. The previous research (see Liesionis & Pilelienė, 2009; Pilelienė & Liesionis, 2014) enabled the determination of product attributes influencing milk consumer's choice in Lithuania. The results of the research showed that the key determinants of the milk product's choice are such factors as naturalness and the country-of-origin (Lithuanian milk consumers strictly prefer local producers' goods). Therefore, considering latter results it might be assumed that naturalness and local origination can also affect the choice of other products representing fast-moving-consumer-goods sector in Lithuania. Moreover, the trend for the ecology and organic production has been obvious in Lithuania in recent years. On the other hand, the producers of organic agricultural and food products often face grater expenditures and the final price for consumer increases. Therefore,

ecology is related to expensiveness. Analysing the effect of country-of-origin on consumers' choice (see Šontaitė-Petkevičienė & Pilelienė, 2013; Pilelienė & Šontaitė-Petkevičienė, 2014), it was determined that despite being a shortage in other sectors, in a food product sector 'made in Lithuania' can be used as a promotional tool. Considering latter results, an assumption is made that associating a brand with ecology and a proper country-of-origin might lead to a better consumers' opinion and brand valuations in terms of increased purchase intentions. The other previous research (Pilelienė, Grigaliūnaitė, & Stakauskaitė, 2016) indicated that colours might have an influence on consumer perception, valuation of a product, and purchase intentions. Therefore, another premise for this research is that brand associations are colour-related.

Considering all the discussed insights, the **object** of this research is brand associations, which influence purchase intentions of organic products. The **scientific problem** analyzed in the article is formulated by a question: how and what brand associations influence purchase intentions for organic products? The **aim** of the research is to determine the influence of brand associations on purchase intentions in the framework of organic products. Accordingly, this research fills the gap in the scientific literature by determining the influence of brand associations on purchase intentions in the framework of organic products. Moreover, the findings of this study have specific practical implications of how to position brands in the market in order to enhance the possibility of higher sales of organic products.

Materials and Methods

For the analysis of the influence of brand associations on purchase intentions in the case of organic products, the specific product – organic yogurt was chosen for the experiment as it represents the category of fast-moving-consumer-goods, hence the analysis of purchase intentions becomes more reliable. Authors made the yogurt brands' criteria grid (see Table 1) for the selection of the specific brands. After the selection, three different yogurt brands remained for the experiment. As it can be seen, the first yogurt brand A is foreign, with foreign brand name is associated with health. The dominating colours in the logotype are green and white and fruits are presented on the packaging. Brand A yogurts are sold in Lithuania with the average price when compared to the competitors and latter brand is positioned in the market as healthy, nutritious, and superior quality. The second brand B is Lithuanian with Lithuanian brand name meaning the native herb. It is sold in Lithuania with the high price when compared to the competitors. The dominating colours in the logotype are green and white and Lithuanian herb corresponding to the brand name is incorporated in the logotype. The latter brand is positioned in the market as organic, natural, healthy, and nutritious. The third brand C is Lithuanian with Lithuanian brand name corresponding to the generic company name. It is sold in Lithuania with the low price when compared to the competitors. Many pastel colours and colourful fruits are presented on the packaging. The latter brand is positioned in the market as Lithuanian, healthy, nutritious, tasty, and natural. Consequently, all three chosen organic yogurt brands are generally known for the consumers in the experiment holding country.

To reach the aim of the article, nine associations at some level directly or indirectly associated with ecology were generated and approved by experts of marketing and advertising. The generated associations for the experiment are 'organic', 'natural', 'ecological', healthy', 'nutritious', 'Lithuanian', 'tasty', 'regular', 'expensive'.

The empirical research with selected yogurt brands and generated associations was composed of two parts: experiment and questionnaire research.

The aim of the experiment was to determine the implicit associations with each of the selected brands. In this research for the measurement of implicit associations Inquisit's Brand Association Reaction Time Task by Millisecond Software was applied. Latter Task measures reaction time of judgments whether words (generated associations) are associated with the selected brands. Till *et al.* (2011) stated that strength of association is defined as the intensity of the connection between the association and the brand node, and it is measured by the response latency. Hence, faster response latency indicates stronger association.

Participants viewed brand names in the computer screen (diameter – 58 cm) and shortly thereafter were presented a possible association with that brand. They were asked to decide as fast as possible whether the association belongs to the brand (yes) or not (no) by pressing the response buttons (left/right). The assignment of yes/no to left and right response button was counterbalanced by an assigned group number. The experimental procedure contained 1 practice block of 8 trials (2 practice brands x 4 associations) and 1 experimental block of 27 trials (3 brands x 9 associations). All brands were tested

Table 1

Criteria of chosen yogurt brands

Brand	Criteria						
	Country of origin	Name	Meaning of name	Logotype	Positioning	Price	Sold in Lithuania
A	Foreign	Foreign	Foreign, but associated with health	• Dominating colours: green and white • Fruits are presented on the packaging	• Healthy • Nutritious • Superior quality	Average	Yes
B	Lithuanian	Lithuanian	Lithuanian herb name	• Dominating colours: green and white • Picture of Lithuanian herb is incorporated in the logotype	• Organic • Natural • Healthy • Nutritious	High	Yes
C	Lithuanian	Lithuanian	Generic Lithuanian company name	• Many pastel colours • Fruits are presented on the packaging	• Healthy • Nutritious • Tasty • Natural • Lithuanian	Low	Yes

in a mixed format, the order of brands was randomly selected; moreover, the order of associations within the brands was randomly selected as well. For the analysis of the experiment results, we applied the results' categorization procedure as described in Till *et al.* (2011): categorized each brand/association pair as either 'strong' (top 25 percent of response times), 'medium' (middle 50 percent of response times) or 'weak' (bottom 25 percent of response times).

After the experiment, each of the participants' filled the questionnaire (second part of the research). The questionnaire was composed of the measures of explicit associations, purchase intentions, and demographic part. Explicit associations regarding each of the brands were measured with the same associations used in the experiment by applying the scale of semantic differential. Moreover, respondents had to evaluate the level of purchase intentions of each brand in two conditions: 1) when choosing to buy an organic product; 2) when choosing to buy any product (not specifically organic). Finally, respondents had to indicate their age and gender.

The empirical research was held in Lithuania, Vytautas Magnus University, February 2017. 23 participants' (13 females) data appropriate for the analysis were obtained. IBM SPSS Statistics v.20 and XLSTAT 2014 software packages were applied for the statistical analysis of the results.

Results and Discussion

As the data of Brand Association Reaction Time Test reveal, brand A is strongly associated with 'tasty' and 'nutritious'; has medium association with 'expensive', 'Lithuanian', 'ecological', 'healthy', and 'organic'; and is weakly associated with 'natural' and 'regular' (see Fig. 1). As it can be seen, brand B is strongly associated with 'ecological' and 'natural'; has medium association with 'expensive', 'nutritious', 'organic', 'tasty', and 'regular'; and is weakly associated with 'Lithuanian' and 'healthy'. Brand C is strongly associated with 'Lithuanian' and 'regular'; has medium association with 'expensive', 'ecological', 'organic', 'natural', and 'healthy'; and is weakly associated with 'tasty' and 'nutritious'. Consequently, based on the implicit associations, brand A is associated with good taste and nutrition; brand B is associated with ecology and natural products, while brand C is associated with homeland products.

The strength of explicit associations measured by the questionnaire is visualized in Figure 2. As it can be seen, brand A is strongly associated with 'tasty', 'nutritious', and 'expensive'; has medium association with 'ecological', 'regular', 'healthy', and 'organic'; and is weakly associated with 'natural' and 'Lithuanian'. Brand B is strongly associated with 'ecological', 'natural', 'nutritious', 'healthy', and 'Lithuanian'; has medium association with 'expensive', 'organic'; and is weakly associated with 'tasty' and 'regular'. Brand C is strongly associated with 'Lithuanian', 'tasty' and 'healthy'; has medium association with 'expensive', 'nutritious', 'ecological', and 'natural'; and is weakly associated with 'organic' and 'regular'. Consequently, based on the explicit associations, brand A is associated with good taste, nutrition, and high price. Hence, in the
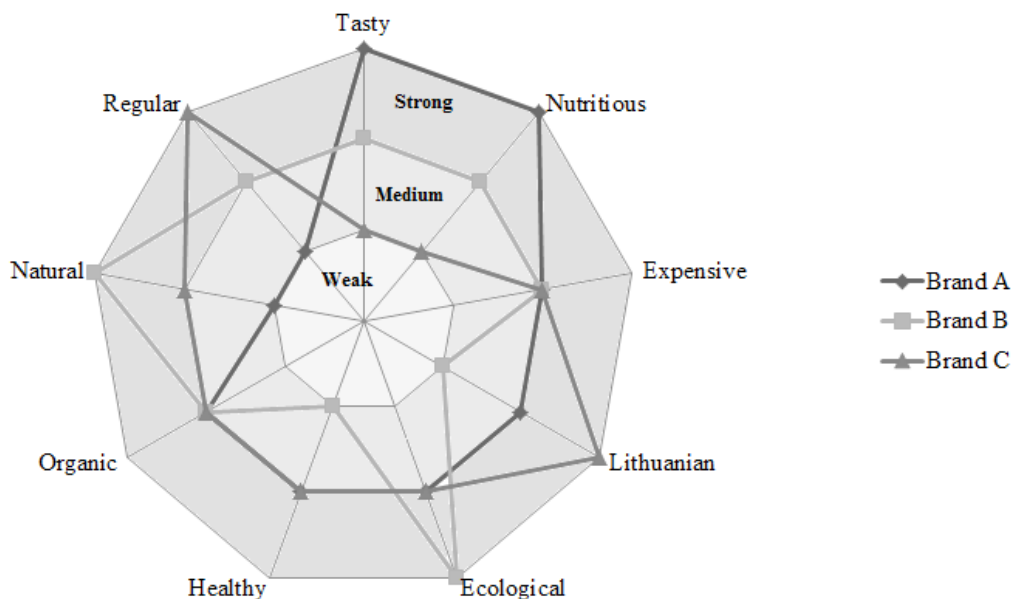
Figure 1. Strength of implicit associations.
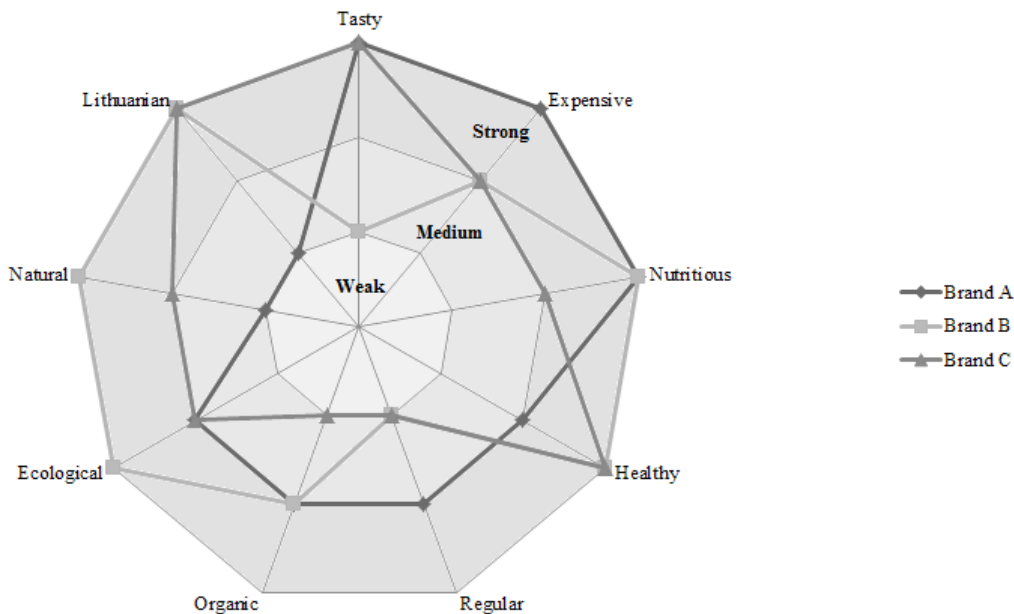
Figure 2. Strength of explicit associations.

case of brand A, implicit associations correspond to the explicit associations. Based on the explicit associations, brand B is associated with ecology and natural products, thus in the case of brand B, implicit associations correspond to the explicit associations as well. Finally, based on the explicit associations, brand C is associated with healthy homeland products, which also correspond to the implicit associations. It could be stated that the obtained results of the strength of associations are reliable as the results of response latency and the results of the questionnaire research complement each other.

The analysis of the research results revealed that purchase intentions when choosing to buy an organic product are the highest for the brand B. Hence, the brand that is associated with ecology and natural products is also the most likely to be bought when choosing the organic product. Nevertheless, when choosing to buy any product, not specifically organic, then purchase intentions are the highest for the brand C, which is associated with healthy homeland products. Purchase intentions for the brand A, which is associated with good taste, nutrition, and high price, are the lowest regarding both cases, when choosing organic product and when choosing any product.

As the object of this research is brand associations, which influence purchase intentions of organic products and the questionnaire data are non-normally distributed, the Friedman test is applied (three dependent samples) in order to evaluate whether there are significant differences in purchase intentions when choosing an organic product. As the test revealed, there are significant differences in purchase intentions when choosing an organic product. To examine where the differences actually occur, Wilcoxon Signed Ranks Test with the Bonferroni adjustment (significance

Figure 3. Evaluations of purchase intentions.

Table 2

Wilcoxon Signed Ranks Test

Statistics	Organic A – Organic B	Organic C – Organic B	Organic C – Organic A
Z	3.020	1.205	3.037
p value	0.003	0.228	0.002

Table 3

Standardized Regression Coefficients

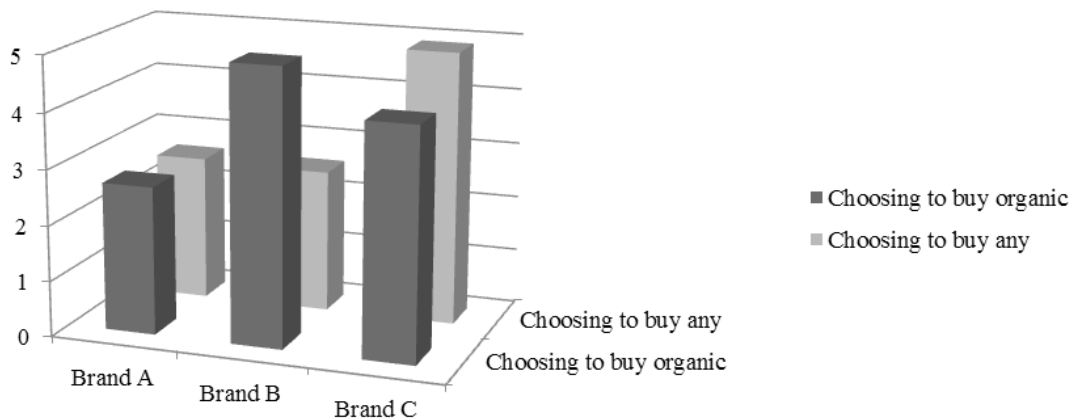| Source	Value	Standard error	t	p value	Lower bound (95%)	Upper bound (95%)
Associations of Brand B –> Choosing to buy organic product	0.615	0.181	3.396	0.003	0.236	0.993
Associations of Brand C –> Choosing to buy organic product	0.643	0.176	3.658	0.002	0.275	1.000

level equals to 0.017) is applied as the Post-Hoc test (see Table 2). Purchase intentions when choosing organic product differ statistically significantly for brand B and for brand A ($p < 0.01$) as well as for brand C and for brand A ($p < 0.01$). Consequently, when choosing organic product, brand B or brand C are statistically significantly more likely to be bought when compared to the brand A. On the other hand, the difference in purchase intentions when choosing organic product of brand B and brand C is statistically non-significant, even though purchase intentions for the brand B are a little higher. Based on these results, brand A is eliminated from the further analysis as purchase intentions for latter brand are statistically significantly lower.

In order to determine the influence of brand associations on purchase intentions in the case of organic products, simple linear regression analysis is conducted and the results are provided in the Table 3 below. As it can be seen, associations of brand B have positive statistically significant ($p < 0.01$) influence on the purchase intentions when choosing to buy an organic product. Moreover, associations of brand C have positive statistically significant ($p < 0.01$) influence on the purchase intentions when choosing to buy an organic product as well.

The visualized regression line of organic product purchase intentions by associations in the case of brand B is presented in the Figure 4 below. When analyzing brand B, it can be seen that the value of the determination coefficient is 37.8 percent. Hence, the explained variance of brand B related purchase intentions is considered as moderate. The visualized regression line reflects the trend of growing purchase intentions of brand B with the growing level of positive associations with the brand B. The analysis of the influence of all the specific associations on the brand B purchase intentions reveals that the most

important associations of the brand B that influence purchase intentions are 'ecological', 'natural', 'healthy', 'expensive', and 'organic'.

The visualized regression line of organic product purchase intentions by associations in the case of brand C is presented in the Figure 5 below. When analyzing brand C, it can be seen that the value of the determination coefficient is 41.3 percent. Thus, the explained variance of brand C related purchase intentions is considered as moderate to high. The visualized regression line reflects the trend of growing purchase intentions of brand C with the growing level of positive associations with the brand C as well. The analysis of the influence of all the specific associations on the brand C purchase intentions reveals that the most important associations of the brand C that influence purchase intentions are 'Lithuanian', 'natural', 'healthy', 'ecological', and 'nutritious'.

The analysis of the research results reveals that brand B is associated with ecology and healthy natural products and these associations influence consumer purchase intentions when choosing an organic product. The assumption can be made that despite the fact that brand B is Lithuanian, it is not strongly associated as being such. Nevertheless, the positioning of the brand as organic, natural, healthy, and nutritious, showing green and white colours together with green native herbs in the logotype and the brand name itself being of native herb leads to the improved associations of an organic product.

Brand C is associated with healthy and ecological homeland products and these associations influence consumer purchase intentions when choosing either organic or any product. Brand C is positioned as Lithuanian, tasty, healthy and nutritious due to the natural ingredients from the homeland. The name of the brand C is generic Lithuanian company name; there are many pastel colours and many colourful
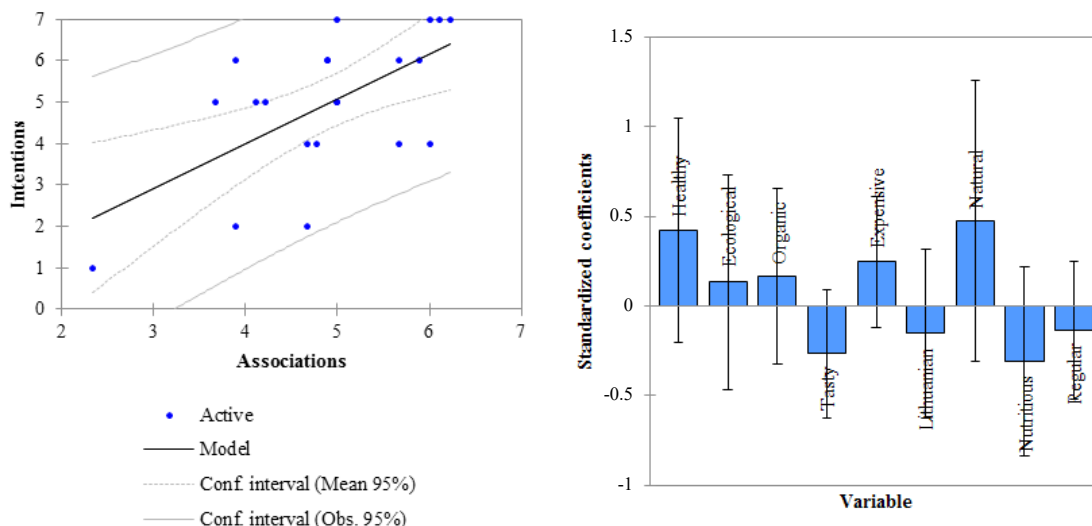
Figure 4. Regression of organic product Purchase Intentions by Associations in a case of brand B (R² = 0.378).
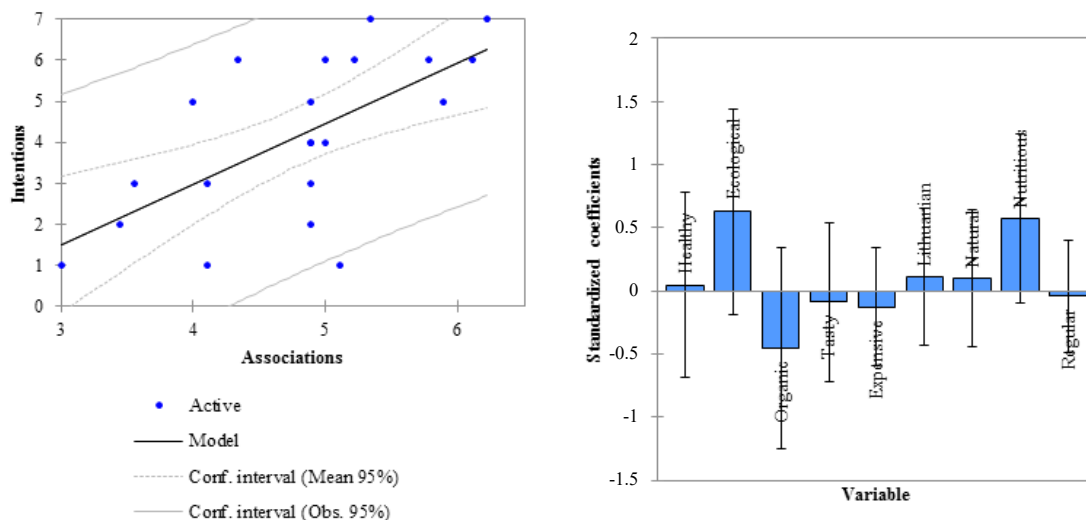
Figure 5. Regression of organic product Purchase Intentions by Associations in a case of brand C (R² = 0.413).

fruits presented on the packaging. Hence, the emphasis in the positioning regarding brand C is on the natural ingredients from the homeland. Consequently, this leads to the strong brand C associations with healthy homeland products, and despite this brand has no strong direct associations with organic products, its associations indirectly create the impression of an organic product, thus leading to enhanced purchase intentions when choosing an organic product.

Conclusions

The producers of fast-moving-consumer-goods are facing the intensifying competition in the sector; therefore, the determination and assessment of factors affecting consumer purchase intentions might lead to the improved marketing communication as well as better results in terms of revenues and profits. Many

brands of similar products compete for the customer attention and share of wallet; therefore, formation of the right brand associations becomes a necessary task of brand management.

Brand associations have a huge impact on consumer purchase intentions in a framework of organic product category. Developing proper and positive associations positively and directly influence consumer purchase intentions. Contrarily, the assumption can be made that developed negative or improper associations can negatively influence consumer purchase intentions.

Based on the analysis of research results, it could be stated that positioning of the brand as providing organic products is extremely important when seeking to develop brand associations with organic products. The naturalness, ecology of the product should be emphasised in marketing communication. Moreover,

brand name should be meaningful and visual marketing communication should expose the ecology. Such means can enhance the possibility to develop a brand associated with certainly organic products.

Nevertheless, the analysis of the research results leads to the conclusion that in the positioning process, strong emphasis of the natural ingredients, precisely from the homeland stimulates consumers to believe consciously or unconsciously that a product is more likely to be organic. Hence, the combination of the arguments about nationality and ecology in the positioning of the brand leads to the higher possibility of purchase intentions of two types of consumers: those who choose organic product, and those who do not prefer organic products.

The results of this research enhance understanding of the holistic view of brand associations' effect on consumer behaviour. In such a way, the findings of this investigation complement those of earlier studies by revealing the influence of brand associations on purchase intentions in the case of organic products. Furthermore, this research of the effect of brand associations on purchase intentions contributes to the literature by integrating both traditional marketing research methods, i.e. questionnaire research and neuromarketing research methods, i.e. response latency measure in order to objectively analyse and evaluate consumer behaviour. Hence, the framework of this research will serve as a base for future studies.

Moreover, the findings of this study have specific practical implications: by following research results, organizations can improve their brand equity by enhancing effective positioning possibility, which in turn can enhance brand value resulting in the improved sales. Directions for the future research are the analysis of the influence of brand associations on the conative consumer response in the frameworks of the products of remaining categories.

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WINTER PRICES FOR SUMMER PRODUCTS ON THE EXAMPLE OF APPLES IN SPAIN, POLAND AND LATVIA

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Abstract
Apple trees are the most common fruit tree type in the EU covering 450 000 ha. At the global scale, the largest apple exporters are EU-27, China, Chile and the USA, but the largest importers – the EU-27 and Russia. In the EU and Russia, large volumes of apples are imported during the cold time of the year. The market for fresh fruit has traditionally been driven by price, but today's market has become even more dynamic and consumers – more fastidious. The aim of the article is to identify the main determinants influencing prices of fresh fruits and indicate a range of differences between winter and summer prices of fruits based on the example of apples. The current research should be regarded as a 'work in progress', as it will be a part of more extensive research conducted in several EU countries and different times of the year. In the present research, the authors have used comparative analysis, which was based on theoretical literature studies, publications and statistical data available in EUROSTAT databases as well as statistical data aggregated by Spanish, Polish and Latvian market research institutions.
Key words: price, fruit, apples, Poland, Spain, Latvia.

Introduction

Fresh fruits play an important role in our daily diet, because they provide the body with the necessary biologically active substances – vitamins, minerals, organic acids and fibres. Recently, consumption of fresh fruits significantly increases (Juhnevica-Radenkova, 2015). One of the most popular fruit is apple. Apples, and their healing properties, were already known approx. 6500 years BC in the region located between the Black Sea and the Caspian Sea, where they come from. These fruits, rich in many vitamins, were a delicacy of the ancient Romans and Greeks (Vieira, 1999). Scientists believe that apples, which is the most common fruit type in European latitudes, is the fruit that is both rich in antioxidants and full of a fibre called pectin, as a medium-sized apple contains about 4 grams of fibre. Pectin is classed as a soluble, fermentable and viscous fibre, a combination that gives it a huge list of health benefits. The proverb 'An apple a day keeps the doctor away', addressing the health effects of the fruit, dates from 19th century Wales, according to Caroline Taggart, author of 'An Apple a Day: Old-Fashioned Proverbs and Why They Still Work' (Pollan, 2001).

During warm period of the year, a lot of fresh fruits and berries are available in the markets of the EU countries, whereas during wintertime their supply dramatically decreases, especially in colder climate countries, such as Poland and Latvia.

There are many studies supporting a relation between income level and fruit intake, concluding that low-income groups tend to consume lower amounts of fruit and vegetables than higher income groups (Pearson *et al.*, 2009). Moreover, high costs may negatively impact on fruit and vegetable intake levels, too (World Health Organization, 2005). And finally, even people with higher incomes can perceive price as a barrier to consumption of these foods (Kamphuis *et al.*, 2007). The current research is a part of several related research projects that will be devoted to analysis of fruit prices in various EU Member States during different times of the year. The ***aim*** of the article is to develop a list of main determinants influencing prices of fresh fruits and indicate a range of differences between winter and summer prices of fruits based on the example of apples. This fruit was selected because nowadays apple trees are the most common fruit tree type in the EU, covering 450 000 ha.

The ***specific research tasks*** were: 1) to study theoretical aspects of price as an economic category; 2) to characterize Spain, Poland and Latvia as apple producers; 3) to conduct a comparative analysis of apple prices in winter in Spain, Poland and Latvia. In scope of the research, the authors have employed the following methods: theoretical literature studies, analysis and synthesis, comparative analysis method. A graphical method was used for statistical display of research data.

1. Price as an economic category

Price, as the value of a product, is debatable. In Roman times (VI-I c. BC) judges, in case of a dispute about the value of goods, were supposed to determine the value regardless of the market price. The judge put himself on one side and on the other side, and then suggested amicable price. This way the concept of just price arose, so the price fair to both parties involved in the transaction. At the time of Diocletian (III-IV c.) fixed prices on all products were introduced and also the death penalty for asserting a higher price. It was thought that in the best interest of the country is to reduce prices in order to provide better living

conditions for citizens deprived of work and a steady income. Whereas at the period of Thomas Aquinas (XIII c.), fair price included a cost of used materials and a cost of manufacturer's work. Unjustified rising of the price was treated as an unholy fraud. At the end of the Middle Ages, the market became a place for exchange goods but not for getting rich; therefore, prices were set by guilds in an agreement with authorities of cities (Holowka, 2002).

The approach to price has been changed thanks to works of Adam Smith, who introduced the concept of exchange value of goods, which is defined as the quantity of another good, we can get in the process of exchange. If this 'another good' will be a specific sum of money, then we are talking about the price. So, the price is the value of a product expressed in money (Adam Smith Theory of Value, s.a.).

Keynes, in turn, stressed that prices depend on supply and demand. It turns out, however, to be incomplete true, because prices also depend on quantity of money in the market, the willingness of people to save, inflation and deflation, as well as the cost of production, and perhaps even other factors (Keynes, 1946). Nevertheless, certainly supply, demand and price are dynamic elements of the market, and, therefore, are subject to constant change. It should be noted, however, that they do not change spontaneously, but under the influence of market operators activities.

We can agree that the price usually is understood as the value expressed in monetary units, which a buyer is obliged to pay to an entrepreneur for goods or services. It includes the value-added tax and excise tax, if such goods are subjects to such a tax. Price also is defined, as mentioned already, as value of a good, but can also be understood as exchange value, or as a cost that a buyer has to pay, if he/she wants to possess the product (Hernik, 2011). From market point of view, price can encourage or discourage a customer to a purchase. Despite the fact that customers are often not able to determine the value of products, especially in case of a new product without a substitute on the market, the price is a major factor shaping customers' behavior. M. van der Pol, M. Ryan proved that this is true also in case of fruits and vegetables (1996). Table 1 gives evidence to this assumption.

Table 1

Main factors influencing consumption of vegetables and fruits

Factors	Total responders (in %)
Price	42
Taste and family preference	39
Freshness	32

Quality	27
Availability	17
Season	14

Source: M. van der Pol, Ryan, 1996.

In practice of companies' activity, the most often used pricing strategies are the price based on costs, the price set at a level that is acceptable to a customer, and the market price based on decisions of competition.

It is worth noting that the method of pricing also significantly depends on the type and length of distribution channel, so – that is logical – on the product's country (place) of origin.

2. Spain, Poland and Latvia as apples producers

The EU fruit sector offers a large number of different products (Eurostat, 2016). The most important fruits in terms of the volume of harvested products are apples (12.7 million tons), oranges (6 million tons) and peaches (2.5 million tons).

Today apple trees are the most common fruit tree type in the EU covering 450 000 ha. Poland is the biggest apple growing country with nearly one third of the EU total apple tree area. Italy and Romania follow with each a share of over 11%. France (8%), Germany (7%), Spain (6%) and Hungary (nearly 6%) are also major apple producing countries. Together these seven EU Member States cover more than 80% of the total EU area under apple trees (Eurostat, 2016).

Spain, Italy, Greece and Portugal are the EU's largest citrus fruit (oranges, small citrus fruits and lemons) producing countries. After apple and citrus fruit trees, peaches (including nectarines) is the most important fruit tree species in the EU with 200 000 ha. Spain has the largest producing area for peaches followed by Italy and Greece.

Three European countries: Poland, France and Italy, provide 60% of the apples' production. Against this background, Latvia is an insignificant manufacturer, because its production covers only 0.1% of the European market of apples, with production volume of 7800 tons (Table 2, Figure 1).

As it is revealed in Figure 1, Poland occupies the largest market share and the fourth part of the total production is grown exactly in Poland. Remarkable market share leaders are also Italy and France with the market share of 16% and 19% accordingly.

The apple orchard farmers admit that apple producing is not a fast and easy business, besides consumers are very sensitive to price increases (Lauku bizness, 2014). **In Latvia**, the proportion of imported apples constitutes 30-65% depending on the yield in the current year. Harvested production and average yields of apples during 2010-2014 have been very instable: from 7 501 tonnes in 2011 to 14 751 tonnes in 2013 (Statistical Yearbook of Latvia, 2015). While

Table 2

Production of apples in chosen EU Member States* (in 2015)

Specification	Harvested production (in 1000 tons)	Share of EU total harvested production (in %)
EU	*12 685.4*	*100.0*
Belgium	284.2	2.2
Czech Republic	155.4	1.2
Germany	973.5	7.7
Greece	281.8	2.2
Spain	593.6	4.7
France	**1967.1**	**15.5**
Italy	**2441.6**	**19.2**
Hungary	500.0	3.9
Netherlands	335.9	2.6
Austria	287.6	2.3
Poland	**3168.8**	**25.0**
Portugal	328.2	2.6
Romania	459.6	3.6
United Kingdom	460.0	3.6
Latvia	*7.8*	*0.1*

* – countries which produce more than 100 000 tons.
Source: Production of fruit and vegetables. Eurostat news release, 126, 2016.

in Poland the trend of apple production is growing – from 1 878 000 tonnes in 2010 to 3 169 000 tonnes in 2015 (Concise Statistical Yearbook of Poland, 2016).

The most popular apple breeds in Latvia are Auksis, Antej, Belorusskoje Malinovoje, Sinap Orlovskij, Lobo. In Poland, most popular breeds are Antonowka, Papierowka, Lobo and Cortland. In Spain: Royal Gala, Granny Smith, Golden Smoothee, Golden Delicious. Generally, in Latvia fruit (including apples) trade balance is distinctively negative, thus the imported products' value is almost three times larger than exported products value (Ministry of Agriculture of the Republic of Latvia, 2016). In Poland, fruit trade balance is almost equable, with slightly bigger import than export. Since Polish fruit producers are struggling with low prices and declining domestic demand, they are looking for new markets outside the EU. In Spain, in 2013, the trade surplus of fruits reached over 5 billion euros. Although Spain produces less than 5% of apples in EU, this country is the world's third
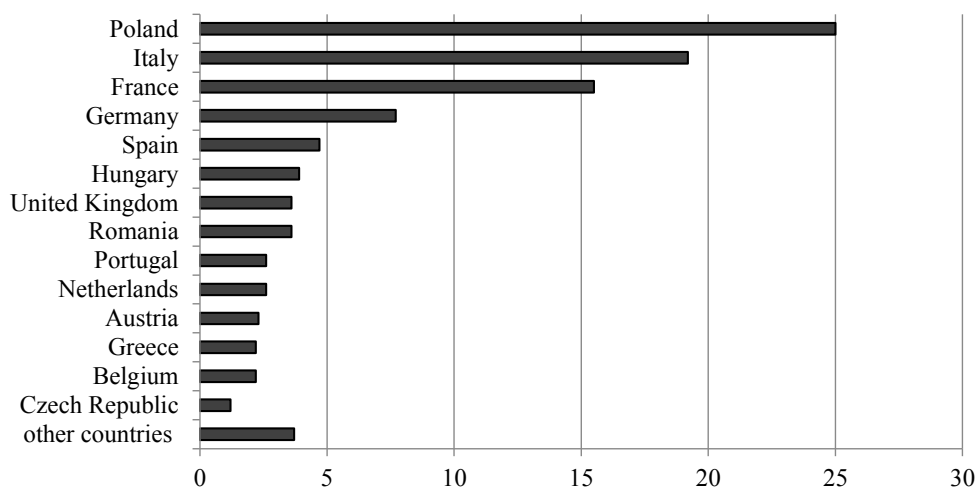
Source: 'Agricultural production - orchards', Eurostat, 2016.

Figure 1. Share of EU total harvested production of apples, %.

largest exporter of wine, other fruits and vegetables (Spain Exports, s.a.). The European Union accounts for 70% of Spain's exports.

3. Apples on the market - comparative analysis

Apples, of course, can be found in any grocery store in any country (Table 3). But, at the same time, consumers can buy a lot of other fruits (Tab. 4). In Spain, there will be: papaya from Brazil; grenade, mango or chirimoya from Spain; kiwi from Chile or bananas from Costa De Marfil (the offer in DIA supermarket in Jaen, Spain, February 2017). In Poland, there can be mango from Brazil, mandarins and oranges from Spain, pineapple from Costa Rica, or pears from Italy (hypermarket Auchan Szczecin, Poland). While in Latvia's largest network of supermarkets RIMI consumers can buy such exotic fruits as pomelo from China, mango from Peru, strawberries from Egypt, or granadilla and pepino from Columbia.

As it is seen in Table 3, the cheaper fruits in February have been in Poland (except oranges and pears), but the most expensive – in Spain (except oranges and pears). The data in Table 3 and 4 show that, in general, prices of fruit in Poland are lower by 11% compared to Spain, and by 17.5% compared to Latvia. In case of apples, prices are also significantly lower in Poland: in Span this fruit costs 259% more; in Latvia – 207% more, compared to Poland.

4. Some conditions of agricultural production: climate and seasonality

Agriculture uses natural resources; therefore, to a large extent, it dependents on natural environment. The biggest influence on the development of agriculture, among the natural conditions, are climate, water resources, soil, and landform.

Territory of **Poland** is 312.685 sq km. Of this territory, 48.2% are used for agriculture and 30.6% consists of forests. Population of Poland surpasses 38 million, and 15.5% of economically active population is active in agriculture, although much more (39.5%) lives in rural areas (FAO, s.a.). The climate is humid continental, with cold, cloudy, moderately severe winters with frequent precipitation, and mild summers with frequent showers. The average summer temperature is between 16.5 and 22 °C; in the winter between -6 and 0 °C. Winter is the longest in the east of the country, where minimum temperatures may

Table 3

Selling prices of apples in EUR per 100 kg (in 2015)

Country	Price	Country	Price	Comment
Czech Republic	34.61	Hungary	25.80	
Belgium	39.42	Spain		no data
Greece	60.33	Germany		no data
Austria	39.04	France		no data
Netherlands	48.21	Italy	44.58	
Portugal	59.12	Poland	**18.59**	
Romania	60.06	Latvia	33.35	
United Kingdom	**91.67**	*Average*	*46.23*	

Source: 'Agricultural production – crops', Eurostat, 2016.

Table 4

Prices of selected fruits and apples (February 2017)

	Name	Poland	Spain	Latvia
		Price in euro kg^{-1}		
1	mandarins	1.5	1.89	1.75
2	kiwi	1.6	1.99	1.79
3	bananas	1.0	1.26	1.15
4	oranges	0.9	0.78	0.85
5	pears	1.74	0.89	1.99
6	**apples**	**0.46**	**1.19**	**0.95**
	average	*1.2*	*1.33*	*1.41*

Source: authors' research.

reach -20 °C. The average rainfall comes to 600 mm, but a distribution of rainfall during the year is uneven – 2/3 of annual precipitation appears in the summer (mainly July and August), so summers in Poland are rainy. Poland mainly produces potatoes, fruits, and vegetables, when it comes to plant agriculture products. The total area of **Spain** is 505.370 sq km, with mean elevation of 660 m (Latvia, for example, has 87 m of elevation). 54.1% of the territory is used for agriculture, and 36.8% as forests. Population of Spain exceeds 48.5 million; 20% of citizens live in rural areas, but only 4.2% work in agriculture. Spain produces mainly grain, vegetables, olives, wine grapes, sugar beets, citrus (World Factbook, s.a.). Spanish climate, due to the terrain, varies from cool and rainy in the north-west, after a hot and dry in the plains of Andalusia. Average temperatures are 12 °C in January and 25 °C in July, annual rainfall reaches 250 mm. The area of the east and south coast of the country presents characteristics of Mediterranean climate with influence of maritime climate – the more to the south, the hotter is the climate. The average temperatures in July, August and September are 30 °C. In Spain, one can enjoy more than 3,000 hours of sunshine per year. In many regions of this country, it snows in winter, especially in the north, despite the fact that an average temperature in January and February is 10 – 12 °C. The total area of **Latvia** is 64 589 sq km, of which 38% is considered agricultural land and 44% forests. Latvia`s population is almost 2 million, and 8.8% works in agriculture. For its latitude, Latvia has a peculiar temperature regime since the maritime temperate climate in the western part is transitional to a more continental one in the eastern part. The climate is characterized by moderately cold winters, while summers are moderately hot. Latvian summers are cool and rainy. The mean July temperature rises to 16 – 17 °C. Mean annual winter temperatures range from +5 to -5 °C in coastal regions; in eastern regions temperatures do not exceed –15 °C in winter, and rise to +30 °C in summer. Should be noted that

over 90% of the agricultural land in Latvia can only be intensively cultivated if drained. Latvia produces mainly grain, rapeseed, potatoes, and vegetables (Country pasture profiles. FAO, s.a.). When analyzing data on the climate, it can be stated that Poland and Latvia have relatively short and wet summers. In Spain, however, summers are long and warm. This fundamental dissimilarity (Figure 2) forming the seasonality in agriculture makes the production of fruit, including apples, significantly different.

Latvia appears to be in a more difficult situation than Poland, because average temperatures in spring and autumn are lower. Thus, the duration of growing season is similar, but climate for agriculture in Latvia is worse.

Latvian fruit producers face not only the climate – among other difficulties in the public survey they have claimed psychological problems of pricing, which still exist in Latvia due to euro adaption in Latvia in 2014. Another threat is cheap and vast supply of Polish apples in Latvia. Finally, the lack of labour force in rural areas, which is very necessary for such industry as apple producing. Moreover, cultivating of apple trees and ensuring their productivity is only one side of this business. The second one, which is even more important, is to find export markets for Latvian apples. Consequently, local market in Latvia is not yet saturated with strong and mature local market players. According to the estimates of the industry specialists, Latvian apples produce constitutes approximately 20% of all apples supplied to super markets in Latvia. Unlike Poland that has announced an ambitious motivation '*each Pole should eat 15kg of apples per year'*, Latvia does not specially motivate its population to eat more apples and support local apple producers, which would be nationally important in today's geo-political circumstances.

Results and Discussion

Certainly, product quality, price, the reputation or trademark, the freshness and guarantee are some
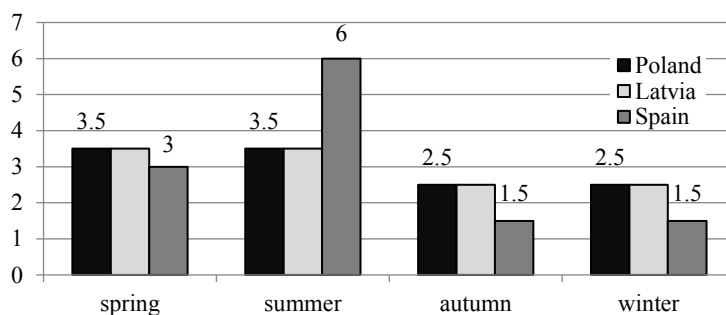
Source: author's design based on internet sources *'Pogoda i klimat w Hiszpanii', 'Pory roku', 'Temperatury i pogoda w Hiszpanii'.*

Figure 2. Seasons in Poland, Latvia and Spain (in months).

of the most important criteria used by European consumers for the general selection of foodstuffs. Of course, consumer penchant for differentiated products is dependent on individual buyer characteristics and of product traits. For example, Rolfe (Rofle *et al.*, 2006) writes that males were more likely to pay higher prices for fruit than females, people who shopped several times a week were more likely to pay higher prices, and people from shared accommodation households and family households were more likely to pay higher prices.

Without doubt, personal characteristics and consumers` style of life play an important role. However, the goal of this article is to agree on a list of main determinants influencing prices of fresh fruits and indicate a range of differences between winter and summer prices, taking price of apples as a starting point. So, in the beginning we can consider (the list definitely is not finished):

1. average salaries;
2. availability of substitute products;
3. climate and geographical location;
4. traditions in consumption.
5. socio-political determinants.

The dynamics of salary changes should be analysed in a close connection with consumption, which provides a more comprehensive overview of the population's welfare. Any household by its consumption expenditure chooses a particular consumption model, which is characterized by particular regularities depending on the household's consumption priorities. One of such regularities was discovered by the German statistician Ernst Engel – the regularity between the household's income and food and non-alcoholic beverages' consumption proportion against the total expenditure. According to modern requirements, the Engel's regularity suggests that alongside with the growth of households' prosperity,

their expenditure on food and non-alcoholic beverages increase in absolute numbers and their proportion against the disposable income amount envisaged for consumption decreases (Ciemina, 2009). Average median salary has increased for about 2.39% in the European Union in 2016, resulting in average EUR 1508 monthly up from EUR 1469 in 2015 (Table 5).

The data aggregated in Table 5 show that the sharpest salary increase in 2016 compared to 2014 has been in Latvia (16.11%) followed by Romania (14.03%) and Bulgaria (12.82%). However, the standard of living in Latvia, compared to developed European countries is much lower and the average salary comparatively is not competitive. Spain and Poland indicate a moderate increase (accordingly, 7.92% and 6.22%), which is also characteristic to Estonia and Belgium.

The households' consumption structure in the European Union Member States in 2016 suggests that Latvia cannot be brought in line with the welfare standards of highly developed countries, as for e.g. Luxemburg, in which according to the Eurostat data of households' budget survey, the expenditures on food and non-alcoholic beverages of the total consumption expenditure was just 3.3%, while in Latvia they exceed 11% exceed 15%. Although these indicators are slightly better in Poland and Spain (accordingly, 9.8% and 8%), they significantly lag behind such welfare countries as Luxemburg, Denmark, Germany, the Netherlands and the UK.

Conclusions

1. The theoretical literature studies give evidence that supply, demand and price are dynamic elements of the market, and, therefore, are subject to constant change. In practice of companies' activity, the most often used pricing strategies are the price based on costs, the price set at a level that

Table 5

Changes in the average salaries in the European Union between 2014 and 2016

Rank in EU	Country	Population	2014	2016
		Mil	EUR Net	EUR Net
5	Germany	80.60	2,054	**2,225**
10	United Kingdom	64.10	2,597	**2,113**
13	Spain	46.70	1,615	**1,754**
18	Portugal	10.40	985	**1,001**
20	Czech Republic	10.50	701	**793**
22	Poland	38.50	678	**723**
24	Latvia	2.00	557	**664**
25	Lithuania	2.90	524	**585**
	EU	505.90	1,489.43	**1,508.61**

Source: Average Salary in EU 2016, s.a.

is acceptable to a customer, and the market price based on decisions of competition. The method of pricing also significantly depends on the type and length of distribution channel, thus it depends on the product's country of origin. Price may also depend on the geographic location. For example, the UK – firstly, it is an island; secondly, there are high salaries in the UK; consequently – these factors lead to limited supply and high wage costs, which causes high prices.

2. Although climate in Spain favors the production of citrus, but not apples, Spain is still the fifth largest producer of apples after Poland (the 1st place in the EU), Italy, France and Germany. Whereas, Latvia is an insignificant manufacturer, because its production covers only 0.1% of the European market of apples. So, it seems that the volume of domestic production has an impact on a given product price.

3. Price may vary depending on the size and structure of the market; therefore, in Latvia the prices are higher (big market means lowers costs and prices owing to the economy of scale).

4. The cheapest apples are available in Poland, because of a large supply, big market, big individual consumption (patriotic reasons against the embargo of Russia), and vast supply of other fruits. Thus, availability of other fruits from South America, Africa and Asia, can cause low apple prices as well.

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A COMPARATIVE ANALYSIS OF ON-FARM GREENHOUSE GAS EMISSIONS FROM FAMILY FARMS IN LITHUANIA

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Abstract
The aim of paper is a comparative analysis of on-farm greenhouse gas emissions across family farm types and farm size classes using FADN data in Lithuania. To achieve this, Lithuanian FADN data of 2014 were used for the analysis. The research draws on a sample of 1304 family farms. The methodology is based on an adaptation of the IPCC guidelines using Lithuanian emission factors from Lithuania's National Inventory Report and the activity data of family farms derived from Lithuanian FADN. The GHG emissions were analysed per farm (t CO_{2eq} farm^{-1}) and per hectare (CO_{2eq} ha^{-1} of UAA). The research found out that the major sources of GHG emissions are related to the use of chemical fertilizers on farms comprising 52.6% of the total emissions from family farms. The performed analysis shows that GHG emissions per farm depended on the farm size and ranged from 63.3 t CO_{2eq} farm^{-1} to 479.6 t CO_{2eq} farm^{-1}, on farm size class less than 30 ha UAA and from 500 ha UAA or over, respectively. The GHG emissions on family farms totalled 184.2 t CO_{2eq} farm^{-1} and ranged from 5.8 t CO_{2eq} farm^{-1} to 234.6 t CO_{2eq} farm^{-1}, in the permanent crops farms and in the specialist dairying farms, respectively.
Key words: GHG emissions, FADN, farming type, family farms.

Introduction

At the Paris climate conference in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal (EC, 2017). The agreement aims at holding global warming to well below 2 degrees Celsius and to 'pursue efforts' to limit it to 1.5 degrees Celsius. To accomplish this, countries have submitted Intended Nationally Determined Contributions outlining their post-2020 climate action (Rogelj *et al.*, 2016). The European Commission in a Communication 'Roadmap for moving to a competitive low-carbon economy in 2050' has set a target to cut domestic greenhouse gas (further in text – GHG) emissions by at least 80% by 2050 compared to 1990. According to the Intergovernmental Panel on Climate Change (further in text – IPCC) data, Agriculture, Forestry and Other Land Use sector accounts for about a quarter of net anthropogenic GHG emissions (IPCC, 2014). Therefore, it is important emitter of global emissions of GHG as agricultural sector is both a source and a sink of GHGs (Syp *et al.*, 2015; Gocht *et al.*, 2016). According to European Environmental Agency (further in text – EEA) data of 2014 in the structure of GHG emissions of the European Union (further in the text – EU) agriculture, the dominant sources are CH_4 emissions from enteric fermentation in livestock and N_2O emissions resulting from a number of processes on agricultural soils, 42.9% and 38.0%, respectively. In the period of 2004 – 2014 the emissions from enteric fermentation decreased by 2.4% and from agricultural soils by 1.5% in the EU.

The Common Agricultural Policy (further in text – CAP) plays an important role in achieving environmentally and climate friendly agricultural sector. In the period of 2014 – 2020 greening instruments were added to the first CAP pillar. In addition, agricultural policy encourages to implement such measures as efficient fertiliser use, bio-gasification of organic manure, improved manure management, better fodder, improved livestock productivity, local diversification and commercialisation of production, maximising the benefits of extensive farming, which are expected to reduce GHG emissions by between 42.0% and 49.0% (IEEP, 2011).

As Lynch, Donnellan & Hanrahan (2016) noticed, GHG emissions share that arises from agricultural sector varies greatly by the EU member state. Brizga, Feng, & Hubacek (2014) stated that Lithuania has significantly managed to reduce their total GHG emissions (from all the sectors) since the early 1990s as total GHG emissions decreased by 55.2% in 2004. The same tendency was observed in agricultural sector, the emissions in considered period decreased by 53.7%. Such results are not explained just by the adoption of the United Nations Framework Convention on Climate Change (signed in 1992) and the Kyoto Protocol (signed in 1997), but are more likely related to significant economic and political changes in Lithuania. In 2004, Lithuania became a member of the EU and Lithuanian legislation has to comply with the EU regulations and plans. According to EEA data, in 2014 as compared to 2004, the total emissions of Lithuania decreased by 9.1%, though from agricultural sector it increased by 5.8%. In Lithuania, emissions from agricultural sector comprised 20.1% in 2014. As compared to EU-28 agriculture sector average, it was two times higher. The enteric fermentation is responsible for 42.1% and agricultural soils for 46.4% of agricultural emissions. During the period of 2004 – 2014 the emissions from enteric fermentation decreased by 1.5%. On contrary, the emissions from agricultural soils increased by 18.2% in considered

period (EEA, 2016). It should be noticed that during the period of 2004 – 2015 the number of cattle decreased by 8.8% in Lithuania (Central Statistical Office of Lithuania, 2017). Obviously this trend limits the consumption of organic fertilizers and causes higher inputs of chemical fertilizers. Vitunskienė & Vinciūnienė (2014) calculated GHG emissions intensity indicators for the whole economy and agricultural sector in Lithuania. The research results revealed that in the period of 1995–2010 the GHG emissions intensity decreased by 2.6 times in the whole economy, whereas in agriculture, it increased by 1.4 times. Moreover, the GHG emissions intensity in Lithuanian agriculture was greater than the EU-27 average, which showed the higher GHG emissions performed per value added unit.

In line with the increased awareness of the environmental impacts from agricultural sector and the importance of farmers' decision making towards the implementation of environmentally friendly practices on farms, the GHG calculators have been developed (Hillier, 2012; Tuomisto et al., 2015). Colomb et al. (2012) assessed the developed GHG calculators for agricultural and forestry sector. The authors identified four main types of GHG calculators, those designed to raise awareness, to report, to evaluate projects and to assess products. Accordingly, the end-users of carbon calculators' tools mostly are farmers, projects evaluators and certification organizations. Though the farm-level GHG calculators are usually used at the individual farm level and are not sufficient for larger scale assessment, in order to inform decision-makers (Keller et al., 2014) and do not encourage farmers for changes as the consumers are getting more conscious about GHGs (Maraseni et al., 2010). GHG emissions assessment on farm is one of indicators measuring farms' environmental sustainability (Reidsma et al., 2015; Dillon et al., 2016). Regarding the end-user of calculator, each author tries to find the best

compromise between output accuracy, data correctness and availability, user-friendliness, compatibility, transparency, and complexity (Colomb et al., 2012). Therefore, recently available databases as information sources such as the EU Farm Accountancy Data Network (further in text – FADN) have been employed for farms sustainability assessment (Longhitano et al., 2012; Dillon et al., 2016) and even calculating GHG emissions (Coderoni & Esposti, 2014). In Lithuanian FADN the collection of information on the quantities of chemical fertilizers applied on farms was launched on 1 January 2014 under the framework of the European Council Regulation (EU) No. 1320/2013. The lack of data limited research and scientific discussion regarding fertilizers consumed and emitted GHGs on farms (Vitunskienė & Dabkienė, 2016). In order to cover this gap, the paper's aim is a comparative analysis of on-farm greenhouse gas emissions across family farm types and farm size classes using FADN data in Lithuania.

Materials and Methods

The methodology proposed for this paper is based on an adaptation of the IPCC methodology (IPCC, 2006) using Lithuanian emission factors from Lithuania's National Inventory Report (further in the text – LNIR) (Lithuania, N. I. R., 2015) and family farms activity data derived from Lithuanian FADN. Considering the main GHG emission sources of agricultural sector and the availability of farms activity data in FADN, the emissions from enteric fermentation of domestic livestock, direct and indirect emissions from manure management and direct and indirect N_2O emissions from managed soils in the study were calculated (Table 1).

The data related to manure management system on farms is not available in Lithuanian FADN. Therefore, the manure management methane emission factors for 'other system' were used for calculation. GHG

Table 1

GHG emission sources accounted in the paper

Emission sources	FADN activity data	Source in IPCC, 2006
N_2O manure management	Animal numbers	Equation 10.25, 10.26, Annex 10A.2, Tables 10A-4 to 10A-8
CH_4 manure management	Animal numbers	Equation 10.22
CH_4 enteric fermentation	Animal numbers	Equation 10.19, 10.20
N_2O agricultural soils		
Direct emissions		
Use of synthetic fertilizers	N fertilizers	Equation 11.11, Table 11.1
Indirect emissions		
Atmospheric deposition	N fertilizers, animal numbers	Equation 11.9, Table 11.3
Leaching and run-off	N fertilizers, animal numbers	Equation 11.10, Table 11.3

emissions at different levels were calculated by summing up CO_2, CH_4 and N_2O emissions based on their equivalence factor in terms of CO_2 (100-year time horizon): 1 for CO_2, 25 for CH_4, and 298 for N_2O.

Lithuanian FADN data of 2014 were obtained for the analysis of GHG emissions on farms. For calculations individual farm records of 1304 family farms were used. This paper focuses on eight groups of farms depending on their production specialisation based on the EU standard classification of 'Type of Farming'. The analysis was carried out for the after-mentioned farming types: specialist cereals, oilseeds and protein crops (further in text – COP), general field cropping and mixed cropping, horticulture, various permanent crops combined, specialist dairying, grazing livestock, specialist granivores and field crops-grazing livestock combined. Alongside, the differences across farm size classes expressed in utilized agricultural area (further in the text – UAA) were estimated. As any sample of size class or farm type has to be large enough (it is advisable to present the results for a group of at least 15 farms) to comply with FADN confidentiality restrictions the number of farm size classes across farm types differs and the analysis by farm size classes for the specialist granivores, horticultural and permanent crops farms was not estimated. ANOVA test was used to measure statistical significance of the difference in the GHG emission values between the farm size classes. The coefficient of variation (further in the text – CV) was calculated to CV: (SD/Mean) x 100. The statistical package for social science (SPSS 21) was employed for processing and analysis of the data.

Results and Discussion

Table 2 reports the structure of GHG emissions across farm size classes expressed in hectare of UAA.

The GHG emissions averaged 184.2 t CO_{2eq} farm[-1] in Lithuanian family farms. The emitted GHG emissions differ significantly at six considered farm size classes. In small-sized farms, the lowest level was estimated, but in the large-sized farms - the highest level of GHG emissions, 63.3 t CO_{2eq} farm[-1] and 479.6 t CO_{2eq} farm[-1], respectively. The major sources of GHG emissions are related to the use of chemical fertilizers on farms comprising 52.6% of the total emissions from family farms. The differences across considered farm size classes are significantly higher in relation to chemical fertilizers consumption on farms as compared to CH_4 emissions, as the highest emissions observed were by 11.3 and 3.8 times higher in large-sized farms than in small-sized farms, respectively. It should be noted that even small reduce in chemical fertilizers consumption has positive effect on the total GHG emissions on farms because of the high N_2O global warming potential. The performed analysis shows that GHG emissions per farm depend on the farm size and this finding is in consistence with some other studies (Coderoni & Esposti, 2014).

With regard to small sample of permanent crops, horticultural and specialist granivores farms in FADN, the results of GHG emissions are presented in the average values for the total farms (Table 3). The permanent crop farms have the lowest GHG emissions with emission value of 5.8 t CO_{2eq} farm[-1]. Alongside, the lowest emissions were achieved per farm area unit, i.e. 98.9 kg CO_{2eq} ha^{-1} of UAA. The value of 29.0 t CO_{2eq} farm[-1] was observed for horticultural farms and this value made 15.7% of the average value of the total farms. In terms of the emissions per area unit, horticultural farms averaged at 843.4 kg CO_{2eq} ha^{-1} of UAA. The specialist granivores GHG emissions per farm comprised 91.6% of total emissions per family farm. The emissions per

Table 2

GHG emissions structure across farm size classes (ha UAA), t CO_{2eq} farm[-1]

The GHG emission sources	Less than 30 ha	From 30 to 50 ha	From 50 to 100 ha	From 100 to 200 ha	From 200 to 500 ha	500 ha or over	Total
CH_4 emissions from enteric fermentation and manure management	30.9	51.4	72.7	123.1	125.4	118.5	87.0
Direct N_2O emissions from manure management systems	0.2	0.1	0.1	0.3	0.2	0.2	0.2
Indirect N_2O emissions from manure management	0.1	0.0	0.1	0.2	0.1	0.1	0.1
Direct and indirect N_2O emissions from managed soils	32.0	33.0	57.6	78.9	150.9	360.8	96.9
Total	63.3	84.5	130.5	202.4	276.7	479.6	184.2

Source: own calculation based on Lithuanian FADN data.

Table 3

GHG emissions of permanent crops, horticulture and specialist granivores farms

Farm type	Number of farms	Average farm size (ha UAA)	t CO_{2eq} farm^{-1}	kg CO_{2eq} ha^{-1}
Horticultural farms	39	37.5	29.0	843.4
Permanent crop farms	25	52.0	5.8	98.9
Specialist granivores farms	8	82.5	168.8	5,082.7
Total	1,304	159.8	184.2	1,200.3
Index (total on farms = 100)				
Horticultural farms	3.0	23.5	15.7	70.3
Permanent crop farms	1.9	32.5	3.1	8.2
Specialist granivores farms	0.6	51.6	91.6	423.5

Source: own calculation based on Lithuanian FADN data.

area unit recorded to 5,082.7 kg CO_{2eq} ha^{-1} of UAA, and it is rather obvious as livestock density is high in specialist granivores farms.

Table 4 provides average values of GHG emissions on the COP farms expressed by total emissions on farms (t CO_{2eq} farm^{-1}) and by an intensity indicator expressed in kg CO_{2eq} ha^{-1} of UAA. Six size classes were used to examine differences for the COP farms. GHG emissions from the use of synthetic fertilizer contributed 96.4% of the total emissions on farms. The lowest share is observed in small-sized farms whereas the largest share - in large-sized farms, 67.9% and 96.4%, respectively. In addition, it shows the higher

diversification of small-sized COP farm activity. The emissions of farms of 500 ha UAA or over amounted to 715.8 t CO_{2eq} farm^{-1}. Moreover, the GHG emission gap between the observed farm size classes is large as the lowest level of GHG emissions per farm observed on small-sized farms generated only 7.2 t CO_{2eq} farm^{-1}. CV value indicates much higher variation level for the total GHG emissions per farm than measuring differences among intensity values on farms (147.5% and 32.3%, respectively).

Table 5 presents the average values of the GHG emissions of the field cropping farms in identified three size classes. The GHG emissions per farm

Table 4

GHG emissions of COP farms by farm size classes

Farm size classes of UAA	Number of farms	t CO_{2eq} farm^{-1}	kg CO_{2eq} ha^{-1}
Less than 30 ha	39	7.2	381.7
From 30 to 50 ha	39	16.4	416.8
From 50 to 100 ha	103	43.8	599.6
From 100 to 200 ha	87	88.5	604.2
From 200 to 500 ha	126	240.8	757.7
500 ha or over	59	715.8	897.8
Total	453	189.2	648.8
$F_{(5,447)}$	-	120.3	9.5
Significance	-	***	***
Coefficient of variation	-	147.5	32.3
	Average farm size (ha UAA)	Index (total GHG on COP farms = 100)	
Less than 30 ha	20.6	3.8	58.8
From 30 to 50 ha	38.5	8.7	64.2
From 50 to 100 ha	72.4	23.1	92.4
From 100 to 200 ha	145.8	46.8	93.1
From 200 to 500 ha	309.6	127.3	116.8
500 ha or over	798.7	378.4	138.4

Note: *** Indicates significance at 1% level, ** at 5% level, * at 10% level.
Source: own calculation based on Lithuanian FADN data.

Table 5

GHG emissions of field cropping farms by farm size classes

Farm size classes of UAA	Number of farms	t CO_{2eq} farm^{-1}	kg CO_{2eq} ha^{-1}
Less than 50 ha	35	12.9	487.6
From 50 to 200 ha	52	80.1	744.9
200 ha or over	38	523.4	1,094.8
Total	125	196.0	779.2
$F_{(2,122)}$	-	49.0	15.5
Significance	-	***	***
Coefficient of variation	-	135.0	39.3
	Average farm size (ha UAA)	Index (total GHG on field cropping farms=100)	
Less than 50 ha	25.7	6.6	62.6
From 50 to 200 ha	101.7	40.9	95.6
200 ha or over	465.1	267.0	140.5

Note: *** Indicates significance at 1% level, ** at 5% level, * at 10% level.
Source: own calculation based on Lithuanian FADN data.

averaged 196.0 t CO_{2eq} farm^{-1} and ranged from 12.9 t CO_{2eq} farm^{-1} to 523.4 t CO_{2eq} farm^{-1}, in small-sized and large sized farms, respectively. The GHG emissions related to soils management comprise 91.0% of the total emissions on farms and ranged from 73.3% in small-sized farms to 91.6% in large-sized farms. The large differences were observed in GHG emissions per farm as index values varied from 6.6% to 267.0%. The same tendency of CV as in the COP farms was assessed, i.e. very large value of the CV in terms of

emissions on farms and large in case of measuring GHG intensity per hectare of UAA, 135.0% and 39.3%, respectively.

Five size classes were established for the specialist dairying farms (Table 6). The methane (CH_4) emissions from livestock farming are the dominant source of emissions in dairying and averaged 91.5%. The largest share was for methane in emission structure of small-sized farms and the smallest share was observed on large-sized farms, 95.6% and 90.1%,

Table 6

GHG emissions of specialist dairying farms by farm size classes

Farm size classes of UAA	Number of farms	t CO_{2eq} farm^{-1}	kg CO_{2eq} ha^{-1}
Less than 30 ha	64	32.0	2,386.6
From 30 to 50 ha	57	83.2	2,025.0
From 50 to 100 ha	74	148.4	2,021.3
From 100 to 200 ha	66	313.0	2,293.3
From 200 or over	42	777.6	2,301.4
Total	303	234.6	2,197.2
$F_{(4,298)}$	-	105.7	1.3
Significance	-	***	ns
Coefficient of variation	-	111.7	7.7
	Average farm size (ha UAA)	Index (total GHG on dairying farms=100)	
Less than 30 ha	16.0	13.6	108.6
From 30 to 50 ha	41.2	35.5	92.2
From 50 to 100 ha	72.6	63.3	92.0
From 100 to 200 ha	137.0	133.4	104.4
From 200 or over	337.1	331.5	104.7

Note: *** Indicates significance at 1% level, ** at 5% level, * at 10% level and ns (not significant)
Source: own calculation based on Lithuanian FADN data.

GHG emissions of grazing livestock farms by farm size classes

Farm size classes of UAA	Number of farms	t CO_{2eq} farm^{-1}	kg CO_{2eq} ha^{-1}
Less than 50 ha	25	51.1	1,763.9
From 50 to 100 ha	34	96.1	1,472.3
100 ha or over	33	256.7	1,447.0
Total	92	141.5	1,542.4
$F_{(2,89)}$	-	35.5	2.0
Significance	-	***	ns
Coefficient of variation	-	80.3	11.3
	Average farm size (ha UAA)	Index (total GHG on grazing livestock farms=100)	
Less than 50 ha	29.9	36.1	114.4
From 50 to 100 ha	66.0	67.9	95.5
100 ha or over	175.6	181.4	93.8

Note: *** Indicates significance at 1% level, ** at 5% level, * at 10% level and ns (not significant)
Source: own calculation based on Lithuanian FADN data.

respectively. Opposite to the results gained from the COP and the field cropping farms, the large-sized dairying farms are more engaged in their activity diversification. The GHG emissions per farm differ considerably across the farm size classes, particularly between small-sized and large-size farms. The highest level of emissions per farm was achieved on farm size class of 200 ha UAA or over and this was 3.3 times more than average emissions on dairy farms whereas the differences across farm size classes in terms of GHG emissions per unit area (expressed as emissions per hectare of UAA) were not significant and minor. This is evidenced by low calculated CV value which equalled to 7.7%.

Table 7 summarizes the results of the GHG emissions on grazing livestock farms in examined three size classes. The methane (CH_4) emissions from livestock farming are the dominant source of emission in grazing livestock farms the same as in dairying farms and averaged 95.4% ranging from 97.0% and 95.4%, in size class less than 50 ha UAA and from 100 ha UAA or over, respectively. The total emissions per farm differ considerably by farm size classes as CV equalled 80.3% whereas the differences of emissions values expressed as intensity indicator kg CO_{2eq} ha^{-1} of UAA were moderate (CV value was 11.3%) and were not statistically significant.

GHG emissions of field crops-grazing livestock combined farms by farm size classes

Farm size classes of UAA	Number of farms	t CO_{2eq} farm^{-1}	kg CO_{2eq} ha^{-1}
Less than 50 ha	61	26.9	964.8
From 50 to 200 ha	99	130.8	1,186.6
200 ha or over	49	504.3	1,496.3
Total	209	188.1	1,194.5
$F_{(2,206)}$	-	161.4	12.4
Significance	-	***	***
Coefficient of variation	-	113.8	22.0
	Average farm size (ha UAA)	Index (total GHG on field crops-grazing livestock combined farms=100)	
Less than 50 ha	29.6	14.3	80.8
From 50 to 200 ha	104.1	69.5	99.3
200 ha or over	332.4	268.1	125.3

Note: *** Indicates significance at 1% level, ** at 5% level, * at 10% level.
Source: own calculation based on Lithuanian FADN data.

The average GHG emission values per farm and per area unit across three established farm size classes for field crops-grazing livestock combined farms are presented in Table 8. The methane emissions in these farms averaged 72.1%, and the lowest share was established on small-sized farms (less than 50 ha UAA).

Farms of 200 ha UAA or over were the biggest source of GHG emissions both in terms of emissions per farm and per area unit. The gap between farm size class less than 50 ha UAA and from 200 ha UAA or over is large, as the emissions in the largest size farm class were 18.7 times higher than in small-sized farms class. Additionally, the CV value of about 113.8% indicated very large differences regarding emissions per farm. The variation of GHG emissions per unit area (kg CO_{2eq} ha^{-1}) was found significant among different farm size classes with CV value of 22.0%.

Conclusions

1. The assessment of GHG emissions on farms revealed that:
   - major sources of GHG emissions are related to the use of chemical fertilizers on farms comprising 52.6% of the total emissions from family farms. Therefore, chemical fertilizer application planning on farms should be taken into account in achieving environmentally and climate friendly agricultural sector;
   - the GHG emissions on farms averaged 184.2 t CO_{2eq} farm^{-1} and ranged from 5.8 t CO_{2eq} farm^{-1} to 234.6 t CO_{2eq} farm^{-1}, on the permanent crop farms and on the specialist dairying farms, respectively;
   - the GHG emissions differ significantly across farm size classes. In small-sized farms, the lowest level was estimated, but in the large-sized farms - the highest level of the GHG emissions, 63.3 t CO_{2eq} farm^{-1} and 479.6 t CO_{2eq} farm^{-1}, respectively;
   - the GHG emissions intensity averaged 1,200.3 kg CO_{2eq} ha^{-1} of UAA on family farms and varied from 98.9 kg CO_{2eq} ha^{-1} of UAA to 5,082.7 kg CO_{2eq} ha^{-1} of UAA on the permanent crop farms and on specialist granivores farms, respectively.

2. The GHG assessment across different farming types and farm size classes provides insights for farmers and policy makers about the source and magnitude of GHG emissions in the agricultural sector. Alongside, the indicator related to the GHG emissions on farm can contribute to the continued development of sustainability assessment tool at a farm level.

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INFLUENCING FACTORS OF SMALL BREWERIES IN LATVIA

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Abstract

Europe is the number two producer of beer worldwide. However, the quantity of beer sold in Latvia in the last decade did not increase considerably, and the average quantity of beer consumed per capita rose very slowly. Even though beer consumption was stable in Latvia, the quantity of beer supplied to the market was approximately three times greater than the quantity of the other kinds of alcoholic beverages combined, totalling about 15 million dekalitres. Besides, in recent years in Latvia the segment of craft beers tended to increase, which became increasingly popular in Western Europe and the number of small breweries sharply increased there. In Latvia, the number of small breweries increased at a slower pace, therefore, the research aim was to examine the factors influencing the development of small breweries in Latvia. The research found that most of the breweries in Latvia qualified for the status of small brewery, the output of which did not exceed 50 000 dekalitres per year. Although small breweries produced craft beers, yet their performance and development were considerably influenced by the activity of the large breweries and the purchasing power of consumers. Small breweries positively influence the beer drinking traditions of Latvians, which can contribute to the stable development of the small breweries. Small breweries have their competitive advantages in the market, which is due to the quality and assortment of their products, as well as they perform extra economic activities that contribute to their recognition.

Key words: brewing industry, beer, factors, PEST, case study.

Introduction

In the alcoholic beverage domain, beer plays an important economic role, accounting for 78% of the worldwide alcoholic beverage market share (Euromonitor International, 2009, 2014). Therefore, the brewing industry and beer as a mass consumption product has been researched in the scientific literature from various aspects – from the consumer perspective (Aquilani *et al*., 2015; Giacalone *et al*., 2015; Donadini *et al*., 2016; Harasym & Podeszwa, 2015), as an economic category (Nield & Peacock, 1995), as a symbolic meaning (Mejlholm & Martens, 2006) and in a functional sense (Guinard *et al*., 1998).

The beer category has been dominated for a long time by a single beer style: lager beer. But in the last decade a growing interest for craft and specialized beers has been noticed in several countries, including Latvia. In the past years craft beer sales have been growing faster than the dominant lager-style in countries with different beer tradition (Gomez-Corona *et al*., 2016a; Fastigi *et al*., 2015; Assobirra, 2014). In recent years in Latvia too, particularly the market of exclusive beers or the craft segment has been one of the fastest-growing ones. It is expected that this beer segment is going to expend until 2018, yet its growth pace will not be so fast (Does beer industry…, 2015). The growing interest in craft beers is strongly linked with small breweries because craft beer is usually made in small breweries, which is the research object of the paper.

In recent years in Latvia, the number of small breweries has considerably increased, and four large and 34 small breweries operated in the country in 2016. However, only approximately 30% of the total employees of the brewing industry were employed by small breweries, as most of them were employed by three largest breweries in Latvia (Aldaris, Cēsu alus and the Cido group's Lāčplēsis Brewery), which paid in taxes EUR 50 million a year (Does beer industry…, 2015). Even though a number of researchers have pointed out that it is not correct to compare large breweries with small ones, yet they are engaged in the same industry and the activities of large breweries affect the whole brewing industry, which was proved by a decrease in the market share of Aldaris in Latvia in 2014 that resulted in a considerable increase in the number of small breweries. In general, small breweries are affected by diverse political, social, economic and technological factors. The research aim is to examine the factors influencing the development of small breweries in Latvia. To achieve the aim, the following specific research tasks were set: 1) to determine the factors influencing small breweries in Latvia; 2) to analyse the performance of small breweries in Latvia.

Materials and Methods

The main research methods applied: monographic, descriptive, logical, comparative analysis, analysis and synthesis, induction and deduction. The methods of analysis and synthesis were used to study the problem elements and to synthesize coherence. The induction method was used for summarising individual facts in general statements, while the deduction method – for theoretical explanations and a logical synthesis of the empirical study. A graphical method was used for the statistical display of data.

A PEST analysis was performed to characterise the factors influencing small breweries. A PEST analysis can be used to survey a product, a company, an industry or a sector, a region or a country (Iglinski *et al*., 2016).

This analysis provides more information about the political, economic, social and technological situation of the small breweries. Using a PEST analysis helps to understand various macro environmental factors that need to be taken into consideration when determining the decline or growth of a particular market.

To examine the experience of small breweries in Latvia, a case study was employed, as this method ensured a detailed examination of the situation (Stake, 1995; Yin, 2013; Bryman, 2008), including the performance of the small breweries.

A statistical data analysis was performed for the period 2010 – 2015, while a case study employed data for 2015. The research was based on the analysis of information published by the State Revenue Service's reports on trade in excised goods, Lursoft data and the scientific literature.

Results and Discussion
PEST analysis of the factors influencing small breweries
Political factors. In Latvia, the status of small brewery is granted in accordance with Cabinet Regulation No 956 'Procedures by which the Status of an Independent Small Brewery is Granted and the Rate of Excise Duty is Applied to Beer Produced by Independent Small Breweries' (adopted on 13 December 2005). After an application is submitted to the State Revenue Service, a small brewery is granted the status of an independent small brewery and a relevant certificate if its output of beer in the previous calendar year was less than 50 000 hectolitres. Small breweries are taxed at a two times lower excise tax rate only for their first million litres of beer produced. Based on this criterion, almost all the breweries in Latvia are small ones; there are a number of breweries whose products are seen on the shelves of supermarkets, as the minimum quantity to be supplied is very large. This means that both those breweries whose output is actually low and those whose products are broadly available on the shelves of supermarkets qualify for the status of small brewery. It signifies that the term small brewery has a broad interpretation, and it is useful to introduce the status of micro-brewery in Latvia. This may be justified by the fact that those home breweries that want to enter the market and produce interesting products in respect to taste and sell the products in small quantities have to undergo the same bureaucratic procedures as those breweries whose products are available on the shelves of almost all supermarkets.

In view of the fact that beer is a food product, the operation of breweries is regulated by legal acts on food production, food safety and the handling of food: the Law on the Safety of Goods and Services (adopted on 7 April 2004), the Requirements for Food Quality Schemes and the Procedures of their Introduction, Operation, Supervision and Control (adopted on 12 August 2004), the Law on the Supervision of the Handling of Food (adopted on 19 February 1998) and the Procedure of Training Persons Engaged in the Handling of Food in Food Hygiene (adopted on 29 September 2015). The measures prescribed by the legal acts often hinder production, as the risks referred to in the acts are not attributable to beer production.

As regards the effects of the legal acts on breweries, one has to note that the breweries are significantly influenced by the legal acts that regulate the promotion of a product in the market, including the Law on Electronic Mass Media (adopted on 12 July 2010), which sets restrictions on audio and visual commercial advertising with regard to alcoholic beverages. Section 5 of the Advertising Law (adopted on 20 December 1999) provides that it is prohibited to use children in advertising alcoholic beverages as well as address such advertisements to children. However, the greatest restrictions on advertising and promoting alcoholic beverages are set by Sections 10 and 11 of the Handling of Alcoholic Beverages Law (adopted on 22 April 2004), which strictly limit the information included in alcoholic beverage advertisements and set general restrictions on advertising.

Economic factors. The brewing industry is considerably influenced by the number of competitors and their activity in the market. Four large breweries prevail in Latvia's brewing industry, and there are 34 breweries that are granted the status of small brewery. According to the State Revenue Service reports on trade in excised goods, the largest numbers of founded small breweries (since 1992 when the first brewery was founded in Latvia) have been reported in 2014 and 2015, which was affected by the fact that the facility of Aldaris in Latvia was partially closed in 2014. Before it, Aldaris had a domestic market share of more than 30%, yet in 2014 the enterprise changed its strategy and moved the production of the cheapest beers to other Carlsberg Group facilities, retaining the production of exclusive beers in Latvia. Consequently, the market was entered by a number of new small breweries, thereby increasing the production and consumption of exclusive sorts of beer.

One can conclude that competition in the brewing industry may be viewed as positive, as it contributes to the diversity and quality of the products. In terms of quantity, small breweries cannot and directly do not compete with large ones, yet they seek to focus on unusual tastes and high quality, which is an essential determinant factor for consumers. According to scientific research studies too, consumers are paying more attention to quality and local production (Mejlholm & Martens, 2006).

According to the State Revenue Service reports on trade in excised goods, almost half of small breweries were concentrated in Riga region (12), which may be explained by the fact that the purchasing power of Riga region residents was higher as well as tourism was more developed in Riga. This means that the purchasing power and standard of living of the population can significantly influence the situation in the brewing industry, as the price of products produced by small breweries, compared with large ones, is higher. A market study conducted by the brewery Aldaris and independent experts "Does the beer industry have a future in Latvia" forecasts that in the nearest years the beer industry in Latvia is going to stagnate with the market size decreasing by 2.6% until 2018; however, if the standard of living rises, consumers increasingly prefer higher quality beers (Does beer industry…, 2015).

At the initial phase of development of small breweries, their availability of finances is limited, as equipment for beer production is not cheap, and banks are reluctant to finance this segment and it is difficult for alcohol producers compared with other food sector participants to acquire European funding.

Social factors. Although food choices do not change fast (Riet *et al.*, 2011), food habits can evolve (Gomez-Corona *et al.*, 2016). Nowadays, individuals improve their understanding of the culture of tasting beers, traditions as well as matching beer to food. Individuals increasingly comprehend and appreciate new and interesting tastes. Such a trend stimulates beer makers to experiment with new tastes and create new, exclusive products. This may be considered to be an advantage of small breweries, compared with large ones, as the small breweries can offer an exclusive beer produced in small quantities, creating a feeling that there is no overproduction in the market. Besides, as found by scientists, individuals aged 21-30 are interested in exploring new beer tastes and willing to pay higher prices (Ascher, 2012; Brager & Greco,

2011). It means that the demand for beer is affected by beer tastes and quality, which become a more essential factor than the price. At the same time, however, there are opposite opinions, i.e. the market study of the brewery Aldaris and independent experts found that in Latvia only 17% of all craft beer consumers were ready to try anything new, sometimes even something untypical of the classical understanding of beer. In Latvia's segment of classical craft beers, approximately 90 sorts of beers intensively compete for a quite small number of beer enjoyers. The market study showed that in the nearest three years, in terms of value, the segment of economic and strong beers would considerably decrease (-11.5%), the segment of Premium beers would slightly decrease or remain the same (-1%), while the segment of medium price category (+15.5%) and craft beers (+12%) would considerably increase, which would be affected by consumer behaviours and consumption traditions (Does beer industry…, 2015).

One can conclude that beer traditions and beer drinking culture and the diversity of beer tastes, in general, contribute to the demand for products of small breweries (Gomez-Corona *et al.*, 2016a; Gomez-Corona *et al.*, 2016b). It is evidenced by the fact that beer is the most produced and consumed alcoholic beverage in Latvia. The quantity of beer supplied to the market is about three times greater than the quantity of all the other alcoholic beverages combined. In the period 2011 – 2015, the consumption of alcoholic beverages has not considerably changed, totalling about 15 million dekalitres a year (Figure 1).

The indicator 'beer supplied to the market in Latvia' shows the quantity of beer produced in Latvia and imported from other countries that was supplied to the market in Latvia after the excise tax being paid. One can find that beer accounts for about 75% of the total consumption of alcoholic beverages in Latvia. Even though the quantity of beer supplied to the
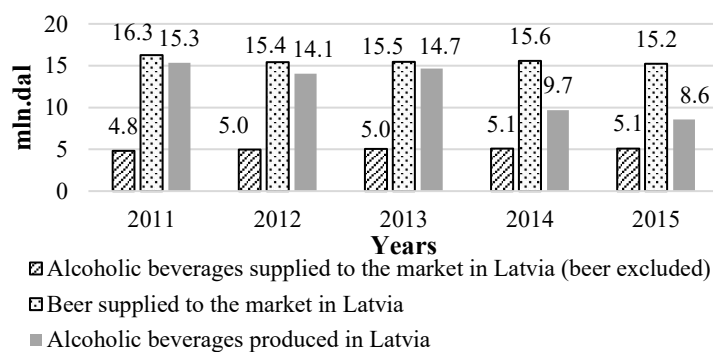
Source: authors' construction based on SRS reports on trade in excised goods.

Figure 1. Alcoholic beverages consumed in Latvia in 2011 – 2015, mln. Dal.

market in Latvia has not significantly changed, due to the above-mentioned situation with Aldaris the output of beer has considerably changed in Latvia, which once more confirms the large market share of Aldaris in Latvia. Compared with 2013, the output of beer in Latvia in 2014 declined by 4.99 million dekalitres or 34.01%. In 2015 compared with 2014, too, the output of beer decreased in Latvia – by 1.12 million dekalitres or 11.57%. During two years after Aldaris partially closed its facility in Latvia, the output of beer in the country decreased by approximately 45% or 6.11 million dekalitres.

The development of small breweries was affected by the trend, which was observed in recent years, to support domestically produced products, which could positively contribute to the turnover of small breweries.

Technological factors. Technological progress as a whole positively affects the common environment in which small breweries operate. The technological development of beer production at large breweries means that it is possible to modernise the production process even more and produce the beer in larger quantities as well as to provide an expected quality of the product. Such a way of development, on the one hand, would increase the difference between industrially produced beer and the beer produced by small breweries, which would, in the eyes of consumers, assign an even higher value to the latter, as the beer produced by small breweries reminds and, in relation to production, is very similar to home-made beer. However, on the other hand, technological development and the introduction of innovations at small breweries promote the creation of new products

Table 1

PEST analysis of the beer industry in Latvia

Factors		Factor effects on the situation		Effects created by factors
		+ (positive)	- (negative)	
Political and legal	Acquiring the status of small brewery	effects		• The term small brewery is widely interpreted in Latvia, as those home producers that want to enter the market and sell their products in small quantities have to undergo the same bureaucratic procedures as the breweries supplying their products to the market in large quantities. • Excise tax relief is applied to small breweries. • Advertising and distributing alcoholic beverages are limited.
	Excise tax	effect		
	Legal documents limiting the promotion of products		effect	
Economic	Competition	significant effects		• The more large breweries are in the market, the more saturated the market is. However, at the same time, competition is viewed as positive, as it contributes to the diversity and quality of products. • The price of products of small breweries is higher than that of large breweries. Therefore, with the standard of living rising, consumers will increasingly prefer higher quality beer.
	Purchasing power and standard of living of the population	significant effects		
	Availability of finances		effect	The availability of finances to buy equipment is limited, as banks are reluctant to finance this segment and it is difficult for alcohol producers to acquire European funding.
Social and cultural	Beer drinking tradition	effect		• Strong beer drinking traditions in summer and during the midsummer festivities increase the consumption of beer. • The wish of consumers to taste new products encourages producers to consider expansion and broadening the assortment. However, a lot of consumers are not ready to experiment with beer tastes. • Support for domestic products can positively influence the sales of small breweries.
	Demand for new tastes	significant effects		
	Support for products produced in Latvia	effect		
Technological	Progress in production technology and innovation	effect		Technological progress and innovations introduced by small breweries contribute to the development of new products.

Source: authors' construction.

Table 2

Economic performance characteristics of the enterprises selected for the case study in 2015

Indicators	'ECOS' Ltd	'Odzienas Pilsbrūzis' Ltd	'Madonas Alus Darītava' Ltd	'Raiskuma labumu darītava' Ltd
Net turnover, EUR	29973.00	6427.00	30331.00	42774.00
Excise tax paid, EUR	1825.00	126.00	2062.00	1216.00
Net revenue, EUR	-4235.00	39308.00	-26359.00	4735.00
Total tax revenue paid into the consolidated government budget, thou. EUR	2.59	-3.21	2.81	-5.98
Lursoft rating	1.3	2.9	2.2	2.7

Source: authors' construction based on Lursoft data and enterprise annual reports.

that would allow fulfilling the wishes of other consumers.

A PEST analysis of the factors influencing the performance of small breweries is presented in Table 1.

Performance of small breweries in Latvia

In Latvia, every small brewery has a different history and production technology, different product specifics and packaging. Some small breweries produce also other kinds of products or services. A case study was done to better understand the experience of small breweries in Latvia. The case study selected four small breweries: 'Odzienas Pilsbrūzis' Ltd, 'Madonas Alus Darītava' Ltd, 'ECOS' Ltd and 'Raiskuma labumu darītava' Ltd to compare them according to the same criteria.

'Odzienas Pilsbrūzis' Ltd is a producer of beer and kvass located by the Odziena manor house in Plavinas municipality. Its advantage, compared with many other small breweries, is that it offers a number of halls for holding social events in the adjacent manor complex and a guest house with nine rooms for staying overnight. The enterprise is engaged in the production of a non-alcoholic beverage – kvass.

'ECOS' Ltd was registered in 2006 and was a wholesale intermediary for a broad assortment of goods until the brewery was built in 2014. The brewery produces 'Bursh' beer, which has become popular and has been in demand in Plavinas municipality, in its vicinity and in Riga region within two years after being on the market.

'Madonas Alus Darītava' Ltd produces 'Baudalu' beer in the centre of Madona town, and earned appreciation from industry professionals for the successful entry into the market and recognition in the brewing industry in 2016. At many shopping places, 'Baudalu' beer is placed along with 'Bursh' beer. The products of both 'ECOS' Ltd and 'Madonas Alus Darītava' Ltd took part in the project Latvian Craft Beer.

'Raiskuma labumu darītava' Ltd began producing its product in February of 2015, yet its recognition was earned within a short time. 'Raiskuma labumu darītava' Ltd also produces bread baked in an oven and smoked meat.

To perform an in-depth examination of the brewing industry, it is important to analyse the economic performance indicators of the enterprises selected for the case study. Since the first year for which data are available for all the breweries is 2015, the authors particularly analysed the indicators for this year in order to better comprehend the financial situation in the small breweries (Table 2).

In 2015, the largest net turnover was reported by 'Raiskuma labumu darītava' Ltd, which may be explained by the diverse activity of the enterprise, as it produced three different products. The smallest net turnover was posted by 'Odzienas Pilsbrūzis' Ltd, which may be explained by the specifics of the enterprise – it was less engaged in the production of products, as its key occupation was associated with the rental of premises. Even though 'Raiskuma labumu darītava' Ltd began selling its products only in 2015, its net turnover was 142% higher than that of 'ECOS' Ltd, which may be explained by its broader assortment.

The excise tax paid is one of the indicators that indicates the output of beer by an enterprise, as all the breweries are granted the status of an independent small brewery, and their payments for every 100 l of beer are equal. Based on this indicator, one can identify which breweries focus on beer production ('Madonas Alus Darītava' Ltd and 'ECOS' Ltd) and which are engaged in extra economic activities ('Odzienas Pilsbrūzis' Ltd and 'Raiskuma labumu darītava' Ltd). Their extra economic activities are indicated by the fact that they have a high net turnover ('Raiskuma labumu darītava' Ltd) and net revenue ('Odzienas Pilsbrūzis' Ltd and 'Raiskuma labumu darītava' Ltd) despite their small amounts of excise tax paid (i.e. a small quantity of beer produced). As told in an interview with the manager of

the 'Bursh' brewery, Mārtiņš Daģis, 'even though the number of breweries has considerably risen in recent years, this niche is still free and there would be a place for at least the same number of small breweries. The most important thing is to create a tasty product; maybe there is no big need to seek differences from other products. At present, we produce only two sorts of beer and do not intend to expand the assortment'. He noted that they plan to engage in tourism activities too in future, using the potential of the location of the brewery – a nice farmstead. This may be justified by economic considerations, i.e. it is possible to enhance the competitiveness of small breweries by engaging in an extra economic activity.

The case study showed that 'Madonas Alus Darītava' Ltd and 'ECOS' Ltd suffered losses. Their financial reports revealed that 'ECOS' Ltd succeeded in reducing its losses, compared with 2014, by 43%, whereas 'Madonas Alus Darītava' Ltd had a 30% increase in its losses, compared with the previous year. The analysis of the increasing losses showed that the other production costs considerably rose during that year, which was due to selling its fixed assets. That is why the losses of 'ECOS' Ltd may be considered a positive fact, whereas the increasing losses of 'Madonas Alus Darītava' Ltd may not be linked with a deterioration in its economic performance.

A Lursoft rating is calculated employing six financial performance indicators: solvency, profit before taxes, liquidity, increase in turnover, return on equity and liabilities. The overall rating of an enterprise is an arithmetic mean between a rating in its industry and a rating among all the enterprises in the country. According to Lursoft, 'ECOS' Ltd had the lowest rating, which may be explained by the financial performance indicators that were not taken

into account in the calculations done by Lursoft, as a high weight in a rating was assigned to the enterprise's solvency, profit before taxes and liquidity ratio. Given all the financial performance indicators of the enterprise, one can conclude that none of the above-mentioned indicators included in the rating was positive for 'ECOS' Ltd, and the economic activity of the enterprise was unprofitable; therefore, the rating score was low. In contrast, 'Odzienas Pilsbrūzis' Ltd and 'Raiskuma labumu darītava' Ltd had the highest Lursoft ratings, which indicated the positive effects of their extra economic activities on their financial performance.

Given the enterprise analysis performed within the case study, further in the research, the competitiveness of the small breweries was compared according to subjectively selected key factors and their significance (Table 3). Only the factors with a weight ranging from 0.15 (less significant) to 0.3 (the most significant) were selected from the distribution of the key factors by significance. The factors of enterprise competitiveness were rated on a scale from 1 (very weak) to 9 (very strong). In the result, a brewery, the sum of whose scores was the highest, had the best position.

The diversity of products is the most significant key factor, as diverse products cover a more numerous target audience; consequently, it is possible to increase the number of customers. According to the competitiveness criterion, 'Raiskuma labumu darītava' Ltd had the highest rating score, as it produced diverse products there. The small brewery introduced a new product – a cherry beer cocktail, which was unique and none of the other breweries had anything like this; it also could reach another segment customers by own smoked meat and own baked bread, thereby popularising its products and

Table 3

Competitiveness ratings of small breweries selected for the case study

Key factors of competitiveness	Weight of key factors	'ECOS' Ltd		'Odzienas Pilsbrūzis' Ltd		'Madonas Alus Darītava' Ltd		'Raiskuma labumu darītava' Ltd	
		Score	2*3	Score	2*5	Score	2*7	Score	2*9
1.	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*
Diversity of products	0.3	5	1.5	7	2.1	5	1.5	9	2.7
Tourism opportunities	0.15	8	1.2	9	1.35	1	0.15	5	0.75
Extra services	0.2	7	1.4	9	1.8	1	0.2	1	0.2
Financial situation	0.2	5	1	9	1.8	2	0.4	9	1.8
Recognition	0.15	7	1.05	9	1.35	3	0.45	1	0.15
Total	**1**	**32**	**6.15**	**70**	**8.4**	**12**	**2.7**	**25**	**5.6**

Source: authors' compilation.

contributing to the recognition of the enterprise. 'Odzienas Pilsbrūzis' Ltd produced both alcoholic and non-alcoholic beverages. The beer production technology at 'Odzienas Pilsbrūzis' Ltd was different, as it used more hops that created a bitter taste; for this reason, this beer was popular among those consumers who preferred a bitter taste. The other small breweries dealt only with beer production – 'Madonas Alus Darītava' Ltd made the classical, light 'Baudala' beer, while 'ECOS' Ltd – the light and dark 'Bursh' beer.

Mostly those breweries that were located outside urban areas had opportunities for tourism services. For example, 'Odzienas Pilsbrūzis' Ltd attracted tourists by means of the adjacent manor house, while 'ECOS' Ltd – by means of the River Aiviekste and nature. 'Raiskuma labumu darītava' Ltd was also located outside urban areas, yet it should develop tourism services.

A guest house belonging to 'Odzienas Pilsbrūzis' Ltd and the potential rental of premises in the case of 'ECOS' Ltd, as well as the vicinity of the manor house belonging to 'Odzienas Pilsbrūzis' Ltd and a tradition established by the enterprise – the celebration of the winter and summer solstices and Easter – may be attributed to extra services.

An essential factor influencing competitiveness is the recognition of small breweries in Latvia, which is affected by marketing activities implemented. According to this criterion, 'Raiskuma labumu darītava' Ltd had the lowest score, as it had no enterprise website, while 'Madonas Alus Darītava' Ltd made insignificant activity in social network accounts, which did not contribute to its recognition.

The competitiveness ratings shown in Table 3 allow concluding that 'Madonas Alus Darītava' Ltd had low scores for almost all the key factors of competiveness, which indicated the need to enhance its assortment of products and marketing communication as well as to consider introducing extra services, including tourism.

The products produced by 'Odzienas Pilsbrūzis' Ltd do not directly compete with the products of the randomly selected breweries owing to their taste specifics – the beers have a specific, bitter taste that is preferred by a certain target audience. At the same time, the beer produced by 'ECOS' Ltd has taste nuances, yet, in general, it has the conventional taste of beer. The products and economic performance of 'Madonas Alus Darītava' Ltd and 'ECOS' Ltd are similar. 'Raiskuma labumu darītava' Ltd has developed and enhanced its assortment of products, which gives it advantages in comparison with other breweries.

Conclusions

1. Most breweries in Latvia qualify for the status of small brewery, including home breweries, the output of which is considerably lower. This means that it is urgent to introduce the status of micro-brewery in Latvia, as those home breweries that wish to enter the market and sell their products in small quantities have to undergo the same bureaucratic procedures as larger ones.

2. Even though small breweries operate in the craft segment and their operation differs from that of large ones, yet the small breweries are influenced by the activity of large breweries in the market, which was proved by the decrease in the market share of Aldaris in Latvia in 2014; in the result, the number of new small breweries increased.

3. The brewing industry in Latvia is positively affected by beer drinking traditions, which can contribute to the stable operation and development of small breweries in future.

4. Small breweries have competitive advantages, which contribute to the promotion of their products in the market. It is due to the quality and assortment of their products, as well as extra economic activities, which contribute to the recognition of the enterprises.

5. It is advisable to make further research to determine demand for the craft beers in Latvia, as it can affect the development of small breweries.

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HIGH-TECHNOLOGY INDUSTRIES COMPETITIVENESS AND REGIONAL ALLOCATION BY NUTS 3 REGIONS IN LATVIA

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Abstract
Competitiveness is the key factor in order to reach the economic transformation, smart growth, governance and legal framework for the state and society for sustainable development that are stated as the major goals in the current planning period in Latvia. High-technology industries are the main drivers of economic activity in developed economies. To ensure data comparability, the official definition of the high-technology industries by Eurostat is applied in this research including two industries: manufacture of basic pharmaceutical products and pharmaceutical preparations and manufacture of computer, electronic and optical products. The research aims to analyse high-technology industries in Latvia taking into account the competitiveness and the regional allocation using a set of several indicators. According to NUTS 3, Latvia is subdivided into 6 regions; however, the high-technology industries are regionally allocated mainly in two regions, Riga and Pieriga regions. Manufacture of basic pharmaceutical products etc. employs 99% of employees in these two regions, manufacture of computer etc. products – 81% despite the fact that only 54% of employees reside in these two regions. The research confirms that the high-technology regional allocation depends on available labour resources and also education and professional training facilities in the region. We conclude that the high-technology industries are competitive in the global market as the share of the high-tech products in total exports is several times higher than the share of these industries in the manufacturing sector or in total economy. The global competitiveness of Latvia's high-tech industries is stable and gradually rising.
Key words: high-technology industries, competitiveness, regional allocation, NUTS 3 regions.

Introduction

High-technology industries are anticipated as the main economic development drivers of developed economies. Researchers (Brown, Martinsson, & Petersen, 2015) argue that the countries with larger high-tech sectors exhibit faster future rates of economic growth. However, numerous problems are observable regarding both theoretical and practical application issues related to the high-technology industries.

High-technology industries are slightly differently defined by various authors and institutions; however, in order to maintain data comparability and ensure data availability, the official definition of Eurostat is applied in this research. According to the Eurostat (Eurostat, 2016a), high-tech classification of manufacturing industries based on NACE Rev.2 2-digit level high-technology industries are the following: manufacture of basic pharmaceutical products and pharmaceutical preparations (NACE Rev.2 2-digit level code: C21) and manufacture of computer, electronic and optical products (C26). If more detailed (or disaggregated) data are available and NACE Rev.2 3-digit level is applied, then in addition, manufacture of air and spacecraft and related machinery (C30.3) is also included into high-technology industries.

Some authors define the high-technology industries even more precisely. For example, (Kenney & Patton, 2005) defined these three high-technology industries: semiconductors, telecommunications equipment, and biotechnology researching the entrepreneurial support network for start-up companies in high-technology industries in the USA. However, analysis in such a detail is not possible in Latvia due to the lack of the data.

The research aims to analyse the high-technology industries in Latvia taking into account the competitiveness and the regional allocation. The aim is achieved by:

1. Analysing the theoretical and practical background;
2. Defining the indicators and the data sources, as well as by examining the data availability and comparability;
3. Performing the analysis and comparison of the selected indicators;
4. Elaborating conclusions and recommendations in order to improve the high-technology industries competitiveness taking into account the regional allocation.

The research focuses on the current situation and latest trends, hence the appropriate research period is selected. It should be stressed that regarding competitiveness it is significant to analyse dynamics and tendencies rather than focus on figures in a certain time period (for example, in a certain year) if it is possible.

High-technology companies in regions demand a variety of high-skilled professionals and engineers as in any major high-tech city. Hence the availability and quality of the labour resources available in the region where the company operates is very important and should be analysed as well.

The results of the research on the regional knowledge production as a determinant of the high-technology entrepreneurship in Germany (Huelsbeck

& Pickave, 2014) clearly show that the high-technology entrepreneurship is highly dependent on regional knowledge production by industry and university, while technology entrepreneurship does not largely depend on these factors. Moreover, research in the South European countries (Fernández López, Pérez Astray, Rodeiro Pazos, & Calvo, 2015) indicate that more innovative enterprises (which include also high-technology enterprises) are more interested in collaborating with the universities. Other author (Castro, 2015) stresses that knowledge and technological innovation are the key sources to sustain competitive advantage and survive in the high-technology industries and that external relationships and networks are necessary to develop better and faster innovations.

Some authors have examined the contribution of regional universities for regional development in Latvia and they emphasize that GDP per capita in cities with regional universities is higher than in other cities in Latvia (Sloka & Vilcina, 2009). However, the findings argue that the regional knowledge and training have significant impact on the regional development and regional allocation of the high-technology companies.

The evidence of the authors examining the wages in high-tech companies in high-tech cities and in other cities in the USA (Echeverri-Carroll & Ayala, 2009) argues that employees earn raw wages that are on average 17% higher than the wages of the employees in other cities, and it is a result of the high-tech cities actually making employees more productive. These findings stress the need and importance of self-assessment and self-declaration of cities and also regions (whether to attract high-tech companies and create appropriate business environment) and constant high-tech policy.

In scientific literature, relatively many authors have examined the regional development and regional differences in Latvia (including NUTS 3 regions) by various aspects, as the EU funds allocation by regions (Latviete, 2010), endogenous factors in regional development (Abeltiņa, Zvirgzdiņa, & Ozols, 2016), regional policy and readiness for structural change (Šipilova, 2014), the role of universities (including regional universities) in lifelong learning process (Jurgelane, Grizane, & Jankova, 2016) etc. The above-mentioned authors and researchers represent a wide variety of institutions, and it emphasizes that regional aspects are important to wide scientific and professional audience. However, there are no notable studies devoted to the high-technology industries and their regional allocation in Latvia. Hence this research is topical and needed for economists and scientists, government, policy makers, business and non-government institutions and associations etc.

Materials and Methods

The data sources for the statistical data used in the research are the Central Statistical Bureau of Latvia and Eurostat. The use of the indicators from the Eurostat data ensures a unified methodology for all selected countries and thus the data comparability (comparability across countries and time periods).

The research is focused on Latvia. In addition, the average values of the EU countries' indicators and data on several EU countries are used for comparisons and analysis. In this research, the EU is a union of 28 member states.

But some authors use other type of data and data sources. The authors (Huelsbeck & Pickave, 2014) in the research used hand-collected data from multiple sources; however, this method is not applicable for Latvia due to the data incomparability in multiple sources (data collected by institutions, associations, non-government institutions etc.) as in most cases there are statistical methodological problems and inconsistencies.

The NUTS classification used in the research is Nomenclature of territorial units for statistics applied by Eurostat (Eurostat, 2017) that is a hierarchical system for dividing up the economic territory of the EU for the purpose of:
1. Collection, development and harmonisation of European regional statistics
2. Socio-economic analyses of the regions
   - NUTS 1: major socio-economic regions
   - NUTS 2: basic regions for the application of regional policies
   - NUTS 3: small regions for specific diagnoses
3. Framing of EU regional policies.
   - Regions eligible for support from cohesion policy have been defined at NUTS 2 level.
   - By far the Cohesion report has generally been made at NUTS 2 level.

The NUTS classification has regular amendments adopted by Commission Regulation. The fourth, extraordinary amendment to the annexes was adopted by Commission Regulation (EU) No 868/2014. It entered into force on 8 August 2014 and had to be applied in Eurostat from 1 January 2016. The Fifth Amendment to the annexes was a regular one adopted by Commission Regulation (EU) 2016/2066. It entered into force on 19 December 2016 and will be applied in Eurostat from 1 January 2018 (Eurostat, 2017).

The current NUTS classification lists 98 regions at NUTS 1, 276 regions at NUTS 2 and 1342 regions at NUTS 3 level (Eurostat, 2017). Latvia is split into 1 region (Latvia) at NUTS 1, 1 region at NUTS 2 and 6 regions (Kurzeme (NUTS code: LV003), Latgale (LV005), Riga (LV006), Pieriga (LV007), Vidzeme (LV008), Zemgale (LV009)) at NUTS 3 level.

As the research focuses on the regional aspects of the high-technology industries in Latvia, NUTS 3 level is applied in the research.

Both quantitative and qualitative data analysis methods and analytic method have been used in the research. Several indicators for evaluation of the dynamics of the high-technology industries have been selected and are used in the research.

The following indicators have been selected:

1. Exports of high technology products as a share of total exports – Eurostat (Eurostat, 2016c) is selected as the appropriate data source;
2. Values added by regions in Latvia – data source is Eurostat (Eurostat, 2016b);
3. Economically active population and the number of employed persons by regions – data source is CSB (Centrālā Statistiskas pārvalde, 2017b)
4. High-tech industries value added by regions – data source is CSB (Centrālā Statistikas pārvalde, 2016);
5. High-tech employment (number of employed persons) by regions – data source is CSB (Centrālā Statistikas pārvalde, 2016);
6. Gross average monthly wages and salaries in high-technology industries – data source is CSB (Centrālā Statistikas pārvalde, 2017a).

The research covers the time period from 2004 to 2015. It can be divided into three periods – 2004-2008 (pre-crisis), 2008-2010 (crisis) and starting from 2011 (post-crisis) according to (Auzina-Emsina, 2014) in order to analyse the trends and correlations. For some indicators data were available for shorter time period. These data have been used in the research anyway as the research aims to include the maximum available data. It is specified in the text if the time series of the indicators are not available for the whole period.

Results and Discussion

General regional development trends in Latvia

In the EU, Eurostat has been gathering and publishing the data on trade and exports of the high technology products as a share of total exports since 2007. The data is published in section 'statistics on high-tech industry and knowledge-intensive services' that is sometimes referred to as simply 'high-tech statistics' (Eurostat, 2016d). The data cover all member states of the EU as well as candidate countries and European Free Trade Association (EFTA) countries.

In 2015, exports of the high-technology products as a share of total exports accounts for 9.8% in Latvia. This share has doubled in recent years form 4.6% in 2007 to 9.8% in 2015 (see Figure 1).
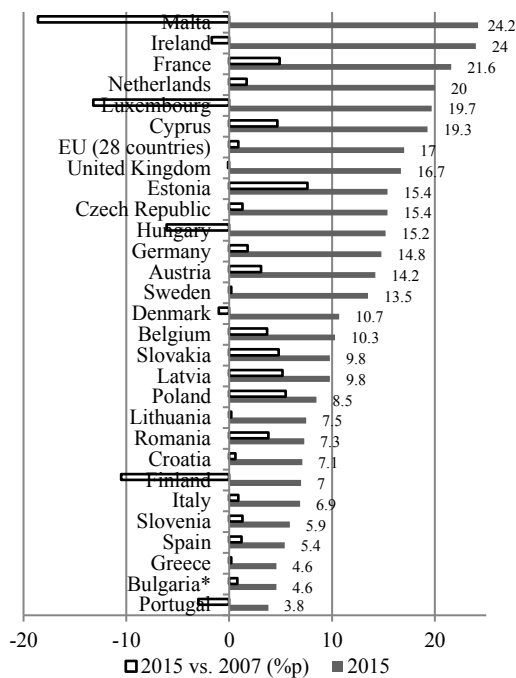

Figure 1. Exports of high-technology products as a share of total exports in 2015 (%) and change since 2007 (%p).

Economic activity is allocated unequally in country's territory. It is a common observation and it is not an abnormal situation in Latvia or neighbouring countries and countries in the region (as Estonia, Lithuania, Russia, Belarus, Sweden, Poland, Finland etc.). This is observable in both small and large countries by territory, also in both economically highly developed and developing countries etc.

Regional statistics takes time to be gathered, processed and published by the statistical offices hence a significant time delay is observed. According to the latest published data regarding the economic activity by regions (NUTS 3), in 2013, Riga region is the outstanding leader as it accounted for 53% of the gross value added, Pieriga region accounted for 15%, Kurzeme – 10%, Latgale – 8%, Zemgale – 8%, and Vidzeme – 6%.

Economic activity in Riga region correlates with the general economic well-being and economic trends in export market, hence Riga region had slightly lost the share in the final years compared to the fast economic development period (in 2006-2007; Riga region accounted for 56% of the gross value added in Latvia) and also during the economic crisis period (2008 – 2010). The lowest point was in 2011 (51%). When the export markets and also the domestic economy started to recover, it resulted in faster economic development in Riga region in comparison with the rest of Latvia (see Figure 2).
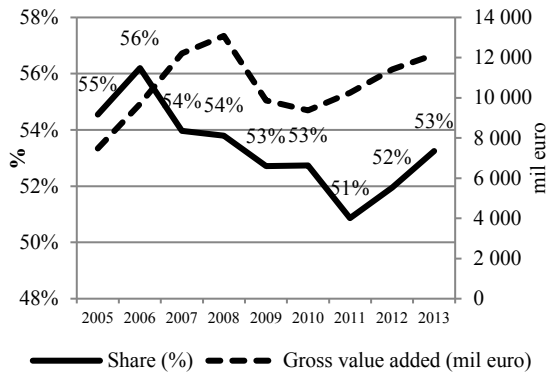
Figure 2. Gross value added at basic prices in Riga region and its share in 2005 – 2013 (mil euro; %).

As all the other regions have significantly smaller share in the economy, these regions are illustrated separately (see Figure 3). Pieriga region is the second largest region by gross value added produced, however, it significantly lags behind the leading region (Riga region) with the share of 15% in 2013. A specific characteristic regarding Pieriga region is that it has gradually increased its share in economy despite the economic fluctuations (fast economic growth, crisis, recovery) – from 12% in 2005 to 15% in 2013. The rest of the regions have a stable share in the economy, and the fluctuation interval of their shares mainly does not exceed one percentage point. Thus, stable and notable trends are not observable.
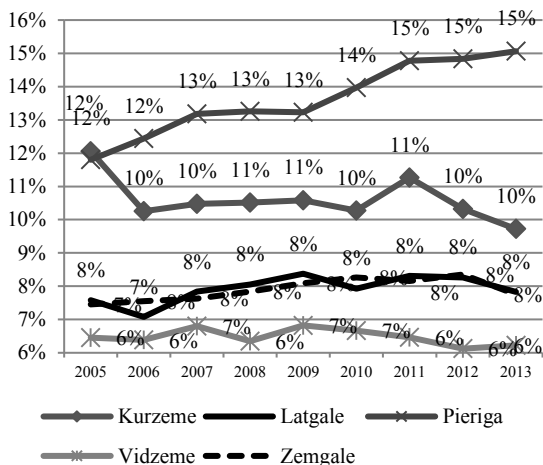
Figure 3. Share of gross value added at basic prices in Pieriga region, Kurzeme, Latgale, Zemgale, Vidzeme in 2005 – 2013 (%).

The number of the economically active population shows the amount of potentially available labour force, but the number of employed persons shows the amount of actually available and used labour force in the region. The structure of the economically

active population and employed persons by regions are considerably different from the structure of the gross value added. Riga regions holds its leading position but the share is notably lower – 34% of the economic active population and 35% of the total number of employed persons lived in Riga region in 2015 and accordingly 34% and 34% in 2013 (for data comparability with the value added data) (see Figure 4).
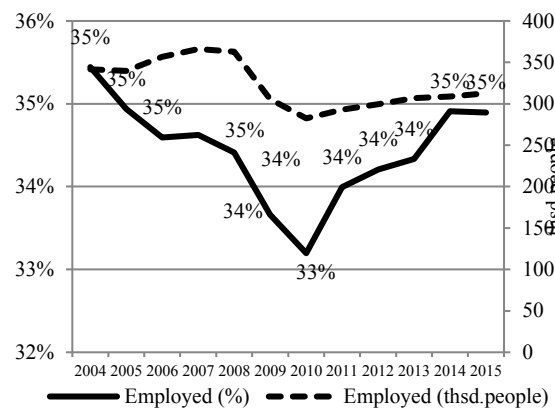
Figure 4. Employed persons in Riga region in 2004 – 2015 (%; thsd. people).

According to the methodology of CSB, the territorial breakdown is obtained by the place of the residence of the respondent, so economically active persons actually live in particular regions, but the employees can be employed is any region.

In the period analysed, the share of employed persons with a place of residence in Pieriga region has gradually increased from 17% in 2004 to 20% in 2015 (see Figure 5).
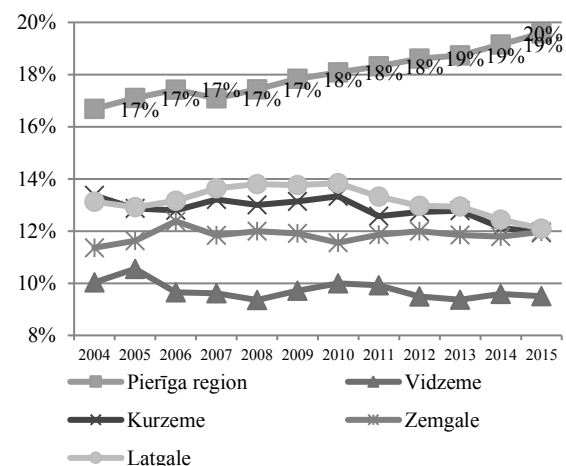
Figure 5. Number of employed persons in Pieriga region, Kurzeme, Latgale, Zemgale, Vidzeme in 2004 – 2015 (%).

The rest of the regions have stable positions and only some changes within 2 percentage points can be detected.

Regional development of the high-technology industries in Latvia

The latest data on the high-tech industries by regions in Latvia (by CSB) of 2014 have significant limitation due to the obligations to ensure the confidentiality of data. In practice, if one or only some companies are in a certain industry, the data are not published, but included in total number and overall computations. According to CSB data, in 2014 the high-technology industries created the gross value added 151 mil euro or 0.7% of the total gross value added or 5.8% of value added in manufacturing sector. The dynamics of the share of the high-technology industries in total gross value added are presented in Figure 6.

Figure 6. Share of High-technology industries in total gross value added in 2004 – 2014 (%).

Due to the data confidentiality obligations, data on the value added of the manufacture of basic pharmaceutical products and pharmaceutical preparations (C21) by regions are published only regarding Zemgale; but - Manufacture of computer, electronic and optical products (C26) by regions are published on Riga region, Kurzeme and Zemgale.

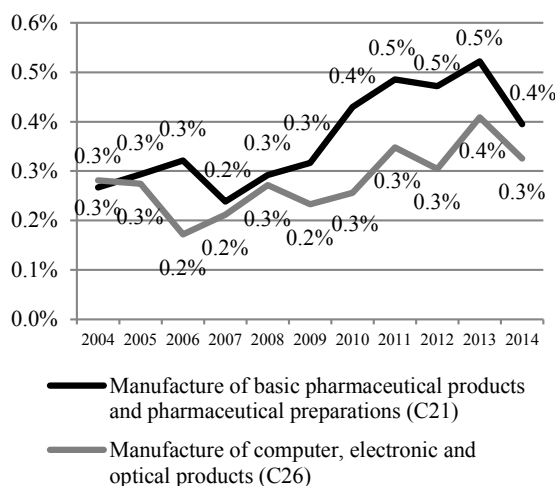Employment data contain more information and give solid background for conclusions and recommendations for the government policy.

The analysis of persons employed shows that the place of residence of the employed persons in manufacture of basic pharmaceutical products and pharmaceutical preparations (C21) are dominantly only in two regions – Pieriga region (56%) and Riga region (43%) (see Table 1). There are two leading companies in the industry in Latvia – AS 'Grindeks'

(that is located in Riga) and AS 'Olainfarm' (located in Olaine that is in Pieriga region). Only one per cent of persons employed in this high-technology industry have a place of residence in other regions. In total, the industry employs 0.2% of all persons employed in 2014.

Table 1

Employment of manufacture of basic pharmaceutical products and pharmaceutical preparations in Latvia in 2014

Region	Manufacture of basic pharmaceutical products and pharmaceutical preparations (C21)	
	Persons	*Structure*
Riga region	810	*43%*
Pieriga region	1045	*56%*
Vidzeme	2	*0%*
Kurzeme	x	x
Zemgale	6	*0%*
Latgale	x	x
TOTAL	**1863**	*100%*

x – no data

The analysis of persons employed in the manufacture of computer, electronic and optical products (C26) by region shows that Riga region is the absolute leader with 65% of persons employed in the industry in 2014 (see Table 2). Pieriga region is the next most significant region where employed persons live – 16%. Both regions – Riga and Pieriga regions together have dominant position as they account for 81%. In total, the industry employs 0.2% of all persons employed in 2014.

Table 2

Employment of Manufacture of computer, electronic and optical products in Latvia in 2014

Region	Manufacture of computer, electronic and optical products (C26)	
	Persons	*Structure*
Riga region	963	*65%*
Pieriga region	239	*16%*
Vidzeme	25	*2%*
Kurzeme	152	*10%*
Zemgale	15	*1%*
Latgale	81	*5%*
TOTAL	**1475**	*100%*

Table 3

Gross average monthly wages and salaries in high-technology industries in 2015 (in euro)

	Total economy (average)	Manufacture of basic pharmaceutical products and pharmaceutical preparations	*Above the average (%)*	Manufacture of computer, electronic and optical products	*Above the average (%)*
Total in the industry	818	1181	*44%*	1079	*32%*
total, excluding private sector enterprises with number of employees < 50	883	1194	*35%*	1214	*37%*
Public sector	853	x	x	x	x
Private sector	799	1181	*48%*	1079	*35%*
private enterprises with number of employees >=50	916	1194	*30%*	1214	*33%*

x – no data in the source (magnitude zero).

The analysis of the value added by industry and persons employed by industry shows that the high-technology industries in Latvia are economic drivers – with fewer resources they produce larger value added than on average in the economy. Manufacture of basic pharmaceutical products and pharmaceutical preparations employs only 0.2% but creates 0.5% of the value added.

Similar results are obtained regarding the manufacture of computer, electronic and optical products – the industry employs 0.2% of persons employed in the economy, but it creates 0.3% of the value added.

The analysis of the wages and salaries in the high-technology industries and the comparison with the average level in the economy shows that wages are significantly higher in the high-technology industries than on average in the economy. The average gross monthly salary in manufacture of basic pharmaceutical products and pharmaceutical preparations was by 44% higher in 2015 (see Table 3), but in Manufacture of computer, electronic and optical products – by 32% higher.

Definitely, high-technology industries demand employees with specific education, training, knowledge and skills. And in most cases for new employees that moved or shifted from other industries (even medium-high technology industries as manufacture of chemicals and chemical products (C20), manufacture of electrical equipment (C27) etc. that are alike to some extent to high-technology industries) at least additional training at companies (at company level) is needed.

Regional professional and higher education institutions can be helpful in this process to ensure both companies needs for qualified employees and potential employees with the necessary skills and training.

It means that any local government should take into account that the high-technology industry companies (production plants) have high labour productivity and pay higher wages to employees that leads to the higher personal income tax payments in local budgets etc. High productivity is one of the key factors that ensures and maintains industry's competitiveness in the national and global market.

Currently, the competitiveness issues are taken seriously by the economic policy makers including technology improvement and upgrade programs, supporting innovation activity, high-tech start-up companies etc. supported or partly financed by the government and the EU funds.

Conclusions

We conclude that high-technology industries are competitive in the global market as the share of high-tech products exports of total exports are several times higher than the share of these industries in manufacturing sector or in total economy. The global competitiveness of Latvia's high-tech industries is stable and gradually rising. Also, the high-technology companies offer significantly higher wages and salaries that forms relative advantage over other industries in Latvia.

We conclude that regional allocation of high-technology industries in Latvia is stable and notable changes or shifts are not observable or even foreseeable in the nearest future. The research confirms that the high-technology regional location depends on available labour resources and also education and professional training facilities in the region.

Recommendations for government and policy makers: 1) Any local government should take into account that the high-technology industry companies have high labour productivity and pay higher wages to employees that leads to the higher

personal income tax payments in local budgets etc.; 2) policy makers should be aware of the fact that high-technology companies demand employees with specific education, training, knowledge and skills. And in most cases for new employees that shifted from even alike industries at least additional training is needed; 3) Competitiveness of high-technology industries is sensitive to legislation changes (especially regarding employment and taxation), hence the changes should be predictable.

Unexpected changes may hinder the development of these industries.

Acknowledgements

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CONSUMERS' WILLINGNESS TO PAY FOR AGRICULTURAL LANDSCAPE IMPROVEMENTS IN LITHUANIA: ESTIMATION FRAMEWORK

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Abstract
Agriculture not only supplies food and fibre to the society, but also provides other services, which are not revealed in the market prices. The role of agricultural activities is essential in forming and improving the landscape, in particular, for Lithuanian case study. Therefore, the paper focuses on development of the framework for estimation of consumers' willingness to pay for agricultural landscape improvements. The objectives of this paper are to present construction of the estimation framework for eliciting willingness to pay (WTP) for non-market agricultural landscape goods through choice experiments (CE) in Lithuania; then, to show the results of framework pre-test, and identify applicability of the framework designed. CE is a survey-based method implying creation of repetitive choice situations about alternatives of agri-environmental schemes for revealing how inhabitants of Lithuania value public goods from agricultural landscape (scenic views, variety of flora and fauna species, recreational infrastructure and services, the objects of cultural heritage), enabling to estimate Lithuanian residents' WTP and the demand for improvements of agricultural landscape. The results of the pilot survey have shown that the questionnaire was comprehensible and interesting to the respondents, revealing that the valuation of agricultural landscape is in demand by the society. The results of modelling, applying conditional logit, have shown a good model fit, allowing the usage of the estimation framework for the main survey and an estimation of consumers' willingness to pay for public goods/improvements from agricultural landscape.
Key words: agricultural landscape, choice experiments, willingness to pay, Lithuania, public goods.

Introduction

Agricultural activity is special, because during the production process not only private benefit is created (i.e. food and fibre), but it also gives benefits to society in the form of aesthetic value of the landscape, the space for recreation and other (Fleischer & Tsur, 2009). Agriculture has essential impact on the landscape. Paracchini *et al*. (2016) describe the agricultural landscape as a cultural landscape composed of spatial units characterized by interrelation of different, yet identifiable, components such as natural conditions, farming systems, cultural heritage, and those who manage the land. In this context, Jones *et al*. (2016) affirm that in recognition of the cultural services that agricultural landscapes provide, these landscapes are now being defined both as physical structures managed for the purposes of agriculture and forestry and as cultural entities characterised by systems of land use and cultural practices. Landscape plays an important role in cultural, environmental and social spheres, and is a favorable resource to economy, because protection, management and planning of the cultural landscape may contribute to job creation in rural areas (Santos *et al*., 2016). Therefore, the positive role of agriculture, good farming practices have the potential to significantly increase the value of landscape, while the negative role may lead to impoverishment of landscape. Agri-environmental public goods and services as aesthetic value of agricultural landscape or preservation of biodiversity are created as by-products during production of market output. Farmers' reaction

to agri-food price changes and changes in agricultural policy could influence the supply of these public goods and services (Santos *et al*., 2016).

The agrarian component has a considerable effect on the Lithuanian landscape. For hundreds of years, agriculture has been shaping the Lithuanian rural environment. At present, it also has an exclusive role in creation of agri-environmental public goods. According to data by the Lithuanian Land Fund (2016), 53.11% of the surface land feature agricultural land, and arable land covers 49.67%. The second pillar of the European Common Agricultural Policy is also focused on the agricultural landscape; moreover, the Landscape Stewardship Scheme was provided under the Lithuanian Rural Development programme during the 2007 – 2013 period. Nevertheless, Lithuanian residents' opinion is not taken into the account, even though they contribute to implementation of the agricultural policy. It is therefore important to assess Lithuanian rural residents' and visitors' attitudes towards landscape management, in particular, towards the role of agriculture in shaping the cultural landscape and its elements, and to assess the value of such public goods for society in view of the absence/lack of the market for them. This analysis could be useful for development of agri-environmental measures, their better adaptation to the expectations of society.

Choice experiments (CE) are widely applied to evaluation of environmental public goods as well as analysis of the attributes of agricultural landscape. Research has been conducted from the demand

perspective, analysing consumers' willingness to pay for the agricultural landscapes' goods (for example, Takatsuka *et al.*, 2006; Campbell, 2007; Rodríguez-Ortega, Bernués, & Alfnes, 2016) as well as the supply perspective (for example, Christensen *et al.*, 2011; Goibov *et al.*, 2012; Villanueva *et al.*, 2015). However, only few studies were done in Lithuania. Therefore, this paper focuses on evaluation of significance of the main attributes of agricultural landscape (scenic views, variety of flora and fauna species, recreational infrastructure and services, objects of cultural heritage) for Lithuanian residents, and, in particular, on development of the framework for estimation of consumers' willingness to pay for agricultural landscape improvements. The main aim of this paper is to present construction of the framework for estimation of consumers' willingness to pay for agricultural landscape through choice experiments in Lithuania; then, to show the results of framework pre-test and identify applicability of the framework designed. The pilot survey was conducted in February 2017. The paper is structured as follows: first, main aspects of the chosen CE method are presented; second, the survey and questionnaire design, focusing on the selection of attributes, construction and aims of the CE survey are shown; the results and discussion part presents the empirical research findings revealing suitability of the framework designed. Conclusions are drawn in the last section of the paper, highlighting main points for further research.

Materials and Methods
Framework modelling

CE is one of the stated preference techniques frequently used in agri-environmental valuation (Arriaza *et al.*, 2008; Dominguez-Torreiro & Soliño, 2011; Rodriguez-Entrena *et al.*, 2012; Jianjun, 2013; Vivithkeyoonvong & Jourdain, 2017). It allows consumers to express their preferences and choose between alternative hypothetical scenarios that differ in the magnitude of their effects (Lancaster, 1966; Bennett, 2001; Dominguez-Torreiro & Soliño, 2011). Lancaster's Theory of Value (Lancaster, 1966) and Random Utility Theory (RUT) (Thurstone, 1927) are the main foundations of CE. Arriaza *et al.* (2008) affirms that the Theory of Value proposes that utilities for goods can be decomposed into individual utilities by their characteristics or attributes. Jianjun *et al.* (2013) adds that consumers' choices can be modelled as a function of attributes of the alternatives specific to a given choice problem. The RUT explains diversity of the opinions choosing the offered combinations (Thurstone, 1927). Econometric basis for current choice modelling theory stems from McFadden (1974) who later extended RUT to multiple comparisons and choices (McFadden and Train, 2000).

According to Lancaster (1966), consumers gain their utility not from the whole good, but rather from the attributes the good renders. According to the RUT, the subject chooses the alternative which gives the highest utility. Within this theoretical framework, subjects choose among alternatives according to the utility function with two components: systematic (i.e. observable) component plus random term (non-observable by the researcher) (McFadden, 1974). Mathematically:

$$U_{in} = V_{in}(Z_i, S_n) + \varepsilon_{in} \qquad (1)$$

where U_{in} is the utility provided by alternative i to subject n, V_{in} is the systematic component of the utility, Z_i is the vector of attributes of alternative i, S_n is the vector of socio-economic characteristics of respondent n, and ε is the random term.

Conditional logit (CL) model is one of the available probabilistic choice models, mostly used in CE (McFadden, 1974; Ben-Akiva & Lerman 1985; Arriaza *et al.*, 2008; Grammatikopolou *et al.*, 2012). The condition of independent and identically distributed (IID) errors according to Gumbel distribution must be met using this model specification. This distribution in the error terms allows for verification of independence of irrelevant alternatives (IIA) property, known as Luce's axiom (Luce 1959). The axiom implies that the ratio of probabilities of choosing any pair of alternatives i and j ($P(_i/C_n)/P(_j/C_n)$) is not dependent on systematic utility of any other alternative within set of alternatives C_n. According to CL model, the probability that an individual n will choose alternative i (P_{in}) among other alternatives j ($j = 1...J$) of set C_n is expressed by equation (McFadden, 1974):

$$P_{in} = \frac{\exp(\mu V_{in})}{\sum_{j \in C} \exp(\mu V_{jn})} \qquad (2)$$

where V_{in} is the systematic component of the utility provided by alternative i, and μ is a scale parameter which is inversely proportional to standard deviation of the error terms and usually is assumed to be equal to one (Ben-Akiva & Lerman, 1985).

Survey and questionnaire design

Survey-based CE method, where hypothetical choice situations about alternatives of agri-environmental programs pertaining to agricultural landscape are developed, have been employed in this paper. This allows revealing how residents in Lithuania value public goods from agricultural landscape to identify their attitudes concerning maintenance and improvements of these environmental public goods in the rural areas. One of the most important objectives for this research is selection of the attributes for the

survey. As a result, the framework for estimation of consumers' willingness to pay for agricultural landscape improvements in Lithuania has covered the landscape elements, which might be largely affected by certain policy measures. Identification of these elements has been implemented according to the scientific literature analysis. This has enabled the authors of this paper to identify four attributes for implementation of the CE:

1. scenic views;
2. variety of flora and fauna species;
3. recreational infrastructure and services;
4. objects of cultural heritage.

The CE questionnaire has been designed to contain multiple choice questions (choice cards) about alternative policies for improvements of agricultural landscape in Lithuania. The CE questionnaire consists of three parts. The first part contains questions pertaining to respondents' opinions and their awareness of impacts caused by agriculture on the landscape. This part also presents the aim of the survey. The second part of the survey presents the role of agriculture in creation of public environmental goods on the agricultural landscape and contains choice situation questions. Consequently, this part of the questionnaire is focused on determining public view regarding the role of agriculture in terms of sustaining and improving scenic views of the agricultural landscape, preserving the flora and fauna, improving recreational infrastructure and services, and safeguarding the objects of cultural heritage. The following attributes of agricultural landscape have been presented to the respondents:

- *Scenic views* – extensive farming could enhance aesthetic value of the landscape. Environmentally-friendly farming practices (depending on the agricultural land use, crop structure, farming intensity, greening and other measures implementing the agri-environmental scheme) could create open and various mosaic landscape. Such landscape is very attractive to visitors of rural areas.
- *Variety of flora and fauna species* – extensive farming could have very positive role in preserving biodiversity and enhancing it. Different breeds of domestic animals and plant species could be valuable in the context of agricultural landscape, shaping active/ productive view of the landscape. Nonetheless, intensive farming leads to reduction of the areas of natural meadows, pastures and swamps, and, consequently, the landscape becomes monotonic. Rare and preserved plant species are disappearing due to the use of fertilisers. Mostly by food chain relations,

this has a negative impact on other animals like birds and mammals.

- *Recreational infrastructure and services* – recreational value could be understood as providing possibilities to use the goods from agricultural landscape. Roads, bicycle paths, resting fields and sleeping places, beaches, parks, avenues, information stands as well as rental of specific leisure services (bicycles, boats, ski) are needed for this purpose.
- *Objects of cultural heritage.* Maintenance of agricultural activities in rural areas determines the condition of heritage. Farmers are usually unique persons who are the conservators of valuable architecture, buildings, and objects of cultural heritage. It should be stressed that the remains of farm buildings, neglected objects of cultural heritage (manors, castles) spoil the landscape.

In the choice cards, the respondents were asked to select the combination they favour most out of two alternatives or the status quo provided. Status quo situation means current situation, i.e. non-application of any additional agri-environmental policies. Each option contains different combinations and levels of attributes as well as the cost of respective additional agri-environmental policy. The cost attribute is annual personal contribution for sustaining public goods from agricultural landscape. Each respondent was given four cards with choice situations, where he/she had to choose one alternative out of three. Three follow up questions are proposed after the choice situations. The first question is aimed at identifying whether or not the respondent has lexicographic preferences, for example, systemically ignoring certain attribute. The second question focuses on collection of information about general demand for suggested attributes, which are proposed as separate services of agricultural landscape. The last follow up question is aimed at identifying the motives of protesters not to pay for environmental public goods from agricultural landscape.

The third part contains questions about the respondent's economic and social status. This part of the questionnaire is set to collect the socio-economic data about the respondents such as age, gender, education, occupation and income. Wang *et al*. (2007), Arriaza *et al*. (2008) have noted that the differences between respondents' socio-economic characteristics influence their willingness to pay for suggested attributes of agricultural landscape.

Upon the review of recent studies, the following socio-economic characteristics were selected: gender, age, area of residence, purposes of visits to rural areas, relation to agricultural activities, size of the household, and monthly net income per capita. The

Table 1

Example of a choice card in the questionnaire

Attributes	Program A	Program A	No program
Scenic views, aesthetic value	greater variety	greater variety	
Variety of flora and fauna species	improvement 50%	No changes	
Recreational infrastructure and services	No changes	No changes	
Objects of cultural heritage	Recovery	Improvement	
Personal contribution (EUR per year for the next 5 years)	24 EUR	12 EUR	0 EUR
Your choice	☐	☐	☐

interest and difficulty of the questionnaire have also been included in the last part of the questionnaire in order to understand the interest and importance of the current topic for the respondents, which is highly important for construction of the framework.

Results and Discussion

Pre-test of the estimation framework is the crucial point in application of choice experiments for estimation of willingness to pay for improvements in agricultural landscape. It has been stressed in recent studies (Hensher *et al*., 2005) that an untested questionnaire may cause considerable imperfections and errors during data modelling. Therefore, a choice experiment questionnaire has been tested using a pilot survey to check and, as may be required, improve the efficiency and appeal of the framework prior to conducting the main research.

The pilot survey was carried out in February, 2017. Four attributes of agricultural landscape, such as scenic views, variety of flora and fauna species, recreational infrastructure, services, and objects of cultural heritage, and the cost attribute were included during this pre-test. These covered 324 combinations ($3^4 \times 4^1$) in the full factorial design, resulting in excessive number of combinations to be presented to the respondents. Therefore, orthogonal experimental design of the survey has been developed using the SPSS program. As a result, 12 choice cards have been developed and divided randomly into three blocks, each consisting of four sets. These contain four attributes delivered at three levels and the cost attribute delivered at four levels. Table 1 illustrates an example of a choice card in the questionnaire.

57 questionnaires were distributed, 48 questionnaires were filled in, 3 questionnaires were eliminated due to incorrect completion, data of 45 questionnaires was analysed. The survey was implemented randomly by selecting respondents during seminars and other events. A total of 45 valid questionnaires has been obtained, delivering 540 choice observations. Two cases of non-willingness to

pay for improvement in agricultural landscape have been identified on the basis of the status quo option chosen in all cards. Pre-test of the questionnaire has indicated that the questionnaire was comprehensible and interesting to the respondents. More than 70% of them stated that the topic is really interesting and 65% – that it was absolutely clear. The results of the pilot survey have implied that personal contribution to agricultural policy could be reduced.

Approximately 55% respondents of the pilot survey are women; mean age of the respondents is approximately 35 years old. More than 70% respondents live in urban areas. Majority of the households are comprised of 2 members. Average family size is 2.98 persons. Majority of the respondents were earning about 650 – 800 EUR monthly net income per person, and the minority – less than 200 EUR. More than 80% of the respondents think that agriculture has a positive impact on the landscape and about 14% – negative. Respondents' opinions concerning the impact of agri-environment elements on landscape are different. Mostly, the respondents have expressed support to the land use, crop structure and protection of water bodies, they think that these elements have the greatest effect on landscape aesthetics, scenic diversity and biodiversity.

In order to check applicability of the framework created for the analysis of consumer preferences towards agri-environmental public goods, two conditional logit (CL) models were run with STATA 13. The first model, named model I, was the basic specification that included only one independent variable – personal contribution or price. It is the base model or its basic specification. The decision to add only the price variable into the base model was based on the existing knowledge that consumers first always analysed the price before making any choice, with other determinants analysed further. The second model, named model II, showed the importance of the choice attributes in explaining consumer preferences towards different options of agri-environmental public goods (i.e. scenic views; variety of flora and

Table 2

Results obtained from CL model I and model II

Variables	Model I			Model II		
	Coefficients	S.E.	p-Value	Coefficients	S.E.	p-Value
PRICE	.0087718	.0058183	0.132	-.0153785	.008404	0.067
VIEWS				.0262318	.0136219	0.054
WILD_L				.0417575	.0135015	0.002
RECR				.0573690	.0133361	0.000
CULT				.0298947	.0150012	0.046
Model fit statistics						
Log-likelihood	-278.07686			-253.77891		
χ^2	2.26			50.85		
(p-Value)	0.1331			0.000		
Pseudo-R^2	0.0040			0.0911		
Observations	540			540		

fauna species; recreational infrastructure and services; objects of cultural heritage). In model II, utility was determined by the levels of five attributes (scenic views, variety of flora and fauna species, recreational infrastructure and services, objects of cultural heritage, personal contribution) in the choice sets (Table 2).

The results of model I show bad model fit: first, there is no negative sign by the price coefficient; second, its p-value is too high (0.132). This means that using the price variable to explain consumers' choices is not enough. Consequently, more variables need to be included into the model. Model II was run to identify whether or not new variables improve the model. In other words, to prove that model II is actually more appropriate that model I. Comparison of the Log-likelihood of model II with that of model I suggests that model II is more statistically significant, because its likelihood value is closer to zero (-253.779). The test to compare the LL function of an estimate, i.e. model II, against its related base model (model I) is referred to as the LL ratio-test. Comparing model II and model I, four additional variables are included (i.e. scenic views, aesthetic value, variety of flora and fauna species, recreational infrastructure and services, objects of cultural heritage). As a result, critical χ^2 value is 9.5 (χ^2(4)d.f.= 9.4877) at α = 0.05. Here, χ^2 value is 50.85, which is higher than critical χ^2 value. Therefore, model II is more statistically significant than the base model (model I). Despite the small number of observations, the results of model II show that almost all variables are statistically significant at 0.05 level. The price coefficient is significant at 0.07 level. It should be noted that all coefficients of the attributes are positive and the price coefficient is negative, suggesting that people are likely to accept an agri-environmental policy with lower personal

monetary contribution. Also, it shows a good fit of model II.

In addition, it should be noted that the variables used in model II are correct and statistically significant, and the conditional logit model could be used for modelling of data generated by main surveys and estimation of respondents' willingness to pay for public goods from agricultural landscape. At this stage, inclusion of respondents' socio-economics characteristics into the modelling process and estimation of willingness to pay for public goods from agricultural landscape would be unreasonable due to scarce data. It will be estimated after the main survey.

Conclusions

Agriculture not only supplies society with food and fibre, but also provides other services, which are not revealed in the market prices. Positive role of agriculture, good farming practices can significantly increase the value of landscape, while their negative role might lead to landscape impoverishment. Agri-environmental public goods and services as aesthetic value of agricultural landscape or preservation of biodiversity are created as by-products during production of market output. Agricultural policy makes essential contribution into provision of such goods and services. As they are not measured in the market, special valuation techniques, such as CE, should be applied to assess the value of agri-environmental public goods.

The main finding of this paper is creation and testing of the framework for estimation of consumers' willingness to pay for agricultural landscape improvements in Lithuania for further application and main survey. The results of the pilot survey have demonstrated the relevance and significance of the

topic selected, which is substantiated by respondents' answers that it was interesting and comprehensible. They have also shown that all attributes have been selected properly and should be included into the framework. However, the pre-test has also shown that some improvements could be made, such as minor reduction in the value of personal contribution and inclusion of an additional price combination.

Modelling results have shown a good model fit, including all attributes (scenic views, variety of flora and fauna species, recreational infrastructure and services, objects of cultural heritage, personal contribution) and its suitability for the main survey. The tested CL could be selected as an appropriate model for further research.

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IMPACT OF THE FACTORS OF THE SOCIAL CAPITAL OF ZEMGALE REGION ON THE DEVELOPMENT

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Abstract
In the regions of Latvia there still exists a large unused resource – social capital (SC). Ineffectively implemented development policies, population's alienation from the state democratic institutions, a low level of non-governmental engagement and SC, lack of resources in the local government sector, increased emigration, civic cynicism, low conditions of the prestige of the political profession have facilitated the development differences among territories. The research goal: comparison of the social capital of Zemgale region, towns and districts. Monographic analysis and method of synthesis, data statistical research methods – grouping, comparison, the processing and interpretation of statistical data – the method for analyzing aggregate indicators, was used in the article. The research discovers the SC at the micro-level – the collaboration and attitudes between citizens and the state as well as in-between the individuals themselves, along with the macro-level – interaction of social groups as a part of a network which helps create trust to local government bodies as well as the state. The study indicates that the development of the Zemgale region is impacted not only by such social capital factors as the population density in the districts (0.37), the number of population until the working age (0.55), but also by the factor education level of the deputies (2009-2013) between the districts (0.12), towns (0.41), and the whole region (0.14). This verified the assumption that higher education level implies higher social potential and more active social inclusion. The authors suggest the local-governments to devote increased funding to the NGOs as it is the most active form of social capital, thus ensuring a long-term development of such initiative groups.
Key words: regional development, social capital, influencing factors.

Introduction

The social and economic differences between the regions are significant (NAP, 2012). E. Šumilo, T. Subbotina (2002), V. Locāne, R. Spāde, P. Šķiņķis (2007) and B. Bela *et al.* (2013) define regional inequality explaining it as the access of individuals and groups to education, health care, social security, material welfare and political engagement. The reasons for arising differences are an ineffectively implemented development policy, alienation between the population and the state structures and a low level of social capital (SC). The phenomenon has negative consequences – increased emigration, development impediment, civic cynicism and low prestige of the political profession.

In Latvia, there are few publications and little research on SC, and even less about its use in evaluating the use of SC in fostering regional development (Garleja, 2006; Igaune, 2010), but this research could facilitate benefits at both local government and regional level. The **research goal:** comparison of the social capital of Zemgale region, towns and districts.

To attain the research goal, the following **objectives** were set: 1) to establish the essence of SC from the regional aspect; 2) to compare SC influencing factors.

Materials and Methods

The research analysed the indicators of Zemgale region, its 20 districts and two largest towns – Jelgava and Jekabpils: the number and the density of the permanent residents; the proportion of the population until the working age, at the working age and over the working age; the number of economically active businesses; gross salary; revenues of the consolidated budget of Latvia and local governments; the number of non-governmental organizations; the population's activity during the elections of local governments, the level of education of the deputies of towns and districts.

The research considered changes in the number of societies and foundations, using the term 'non-governmental organizations' (NGOs).

The data of the Central Statistical Bureau (CSB) of the Republic of Latvia, the information available on the webpage of the Central Election Commission (CEC) of Latvia and the publicly available information about the budgets of the local governments of districts and the two largest towns (SRDA, 2017) were used as informative basis to conduct the research. The data available from the CEC about the education level of the deputies elected during the elections of 2009 – 2013 in Zemgale region were analysed.

Research methods: Content analysis of literature and internet resources was conducted to prepare this scientific paper; the selected data were processed and interpreted applying statistical data processing and interpretation – aggregated indicator analysis method. The analysed period was the years 2009 – 2016.

Research limitations: To compare, the average indicators of Latvia were used: the number and density

of the permanent residents; the proportion of the population until the working age, at the working age and over the working age; the number of economically active businesses; gross salary; revenues of the consolidated budget of Latvia and local governments; the number of non-governmental organizations; the population's activity during the elections of local governments.

Results and Discussion

The essence of social capital

To evaluate the development nowadays the 'Model of Three Capitals' – human, financial and natural resources – is applied. V. Locāne, R. Spāde, P. Šiņķis (2007), E. Šumilo, T. Subbotina (2002), M. Pelše (2007), G. Becker (1998), E. Igaune (2010) and R. Garleja (2006) divide human resources into human capital and social capital. SC comprises the quality of human life – education, health care, culture, social integration – engagement of social groups into public, non-governmental and political organizations, civic initiatives. Both capitals supplement each other, interact and accumulate. L. Zīverte, I. Austers, Dz. Zilinska (2003), R. Putnam (1995), and F. Fukuyama (2001) define SC as the development of contacts between people and groups, or as to socially organize trust.

SC possesses the significant advantages given to an individual, a family or a group by better contacts (Zīverte, Austers, & Zilinska, 2003). In other words, it is a private and a social benefit and it can also be defined as a unified approach.

The authors' research emphasises the approach of social benefit. At the public level, SC is the people's ability to work together in groups and organizations to attain shared goals. SC refers to the characteristics of social organizations, such as trust (Putnam, 1995; Fukuyama, 2001).

These conclusions correspond to what is defined in the National Development Plan of Latvia 2014-2020 (NDP) – people who feel belonging to Latvia, who willingly live, work and establish families in their country and support their country through engaging in civic activities (NAP, 2012).

SC allows grouping it by the impact and the potential of the collaboration levels. The SC structure is divided in three groups: private, social and public. The levels of SC analysis are national, regional and local, out of which this research deals with all three: national, regional and local (district) levels.

Summarizing the opinions of the theoreticians J. Coleman (1988), S. Knack, P. Knifer (1997), G. Becker (1998), M. Woolcock, D. Narayan (2000), J. Moseley (2001), J. Manza (2006), M. Pelše (2007), E. Igaune (2010), J. Stiglitz (2012), P. Šķiņķis (2015), I. Vilka (2016) and R. Cimdiņa (2015), the authors

divided them based on similar SC characteristics which express the essence of SC, separating them into micro and macro levels, into SC impact and potential:

- at the micro level – individuals' collaboration as a result of personal contacts, cooperation, formal and informal networks, trust in other individuals, businessmen, country and governance;
- at the macro level – the result of social groups: engagement in public, non-governmental and political organizations and civic activities; trust in the government and local governance; responsiveness of social groups when establishing a strong mutually related network of groups.
- SC impacts: increase of public tolerance, public consolidation, economic development of territories, development and implementation of the action policy of the state and local governments, increase of the level of life of society.
- SC potential is the competences, skills and abilities possessed by an individual and groups. A correlation exists: the higher the level of knowledge, the higher social potential and the more active social engagement (Iyer, Kitson & Toh, 2005).

Researchers P. Šķiņķis *et al.* (2015), I. Vilka (2016), R. Cimdiņš (2015), V. Locāne, R. Spāde, P. Šiņķis (2007) and M. Pelše (2007) have used indicators to compare SC, dividing them into directly influencing and subordinate.

SC core indicators are: participation in various civic and social activities, political parties or groups, professional societies, unions and associations, public and religious organizations, work groups; participation in local governance; engagement in attracting funding; education indicators; ability to trust.

Indicators subordinated to SC impact are: the number of population, its changes, population density, the proportion of the population until the working age, unemployment rate, revenues of the local governments, economically active businesses, people's gross income, education of the decision-making and the executive authority of local governments, civic activity during elections, the number of NGOs.

Factors affecting social capital

Analysing the SC subordinate indicators, the authors support the opinion of M. Bērziņš (2011) and E. Kļave, Šūpule (2015) that less developed regions are losing inhabitants, especially the young and the educated because workplaces are not offered (Bērziņš, 2011; Kļave & Šūpule, 2015).

The reduction of the population number and density may affect negatively the social capital of the

Table 1

Number and density of permanent residents in Latvia, Zemgale region and districts in 2010 – 2016

Indicators/ territories	Year	Districts	Towns	Region	Latvia
Number of population (thous.)	2010	169	82	251	2 044
	2016	159	79	238	1 968
Base increase, %		-6	-4	-5	-4
Population density (people per km²)	2010	20	969	23	32
	2016	19	930	22	30
Base increase, %		-5	-4	-4	-6
Number of population until the working age (0-14), %	2011	14.4	14.4	16.5	14.2
	2016	16.1	16.2	14.9	15.3
Base increase, %		0.01	1.10	0.55	1.10
Working-age population (15-64), %	2011	63.5	65.0	61.8	64.2
	2016	62.3	64.3	62.1	61.5
Base increase, %		-1.2	-3.2	-2.2	-2.7
Number of enterprises (thous.)	2012	10.4	4.5	14.8	116
	2015	11.7	5.6	17.3	123
Base increase, %		12	24	18	6
Gross salary (EUR)	2012	612	605	608	685
	2015	744	707	725	818
Base increase, %		21	16	19	19

Source: authors' calculations, based on CSB.

territory, the attractiveness of the place of residence, the revenue of the local governments and the investors' interest. According to the CSB data (Table 1), since 2010 the number of permanent residents in Latvia has decreased by 4%. The largest reduction in the number of population in Zemgale districts was observed in Auce district – 14%, Jekabpils district – 12% and Pļaviņas district – 11%. In the future, it can create lack of labour force in establishing new enterprises or developing the existing ones. The population density in the districts of Zemgale region is by 37% lower than the average in Latvia, and it indicates the unactractiveness of the territories and low SC.

The age structure of the population characterises the potential of social and economic development, the employment development perspective, where SC is the influencer of the mentioned factors. The number of economically active population (Table 1) at the working age has reduced by 2.7% in total in Latvia. A faster reduction was observed in the towns of the region – Jelgava and Jekabpils. In districts, it was twice lower. The changes in the number of the working-age population are related to the population aging and emigration.

The number of population until the working age (Table 1) is the social potential of the future of the territory. In Latvia, Jelgava and Jekabpils it has increased on average by 1.1%, in Zemgale region – on

average by 0.55%. In the districts, the increase is very small – 0.01%.

In the NDP 2014 – 2020, the development of entrepreneurship is linked with a sustainable growth of the territory and enhancing of SC and economic activity (NAP, 2012). SC is not used fully as a resource for promoting entrepreneurship. This corresponds with G. Ciemleja and N. Lāce's (2012) opinion, who associates SC with active management of businesses, competitiveness and sustainable development (Ciemleja & Lāce, 2012). High SC determines intercompany collaboration in the future, which should result in strong partner relationships.

The increase of the number of businesses (Table 1) in towns is related to the population number and density, which has allowed for the accumulation of larger SC, for the existence and development of entrepreneurs. In the districts, the number of businesses has increased by 18%, which exceeds the average indicators in Latvia three times. That indicates to the presence of SC, but not to sufficient SC in establishing new enterprises and workplaces.

An indicator of SC impact is gross salary (Table 1). The largest changes were observed in the districts of Zemgale region – 21%, and they indicate to a faster SC development than it is in the rest of Latvia. The business environment, workplaces, gross salary and budget revenues of local governments

Table 2

Revenues of the consolidated budget of Latvia and local governments in 2008 – 2015

Year/ indicator	Revenue of the state consolidated budget, bill. EUR	Base increase (%)	Revenue of the consolidated budget of local governments, bill. EUR	Base increase (%)	Proportion of the revenues of local governments in the state budget (%)
2008	8.15	100	2.39	100	29.4
2009	6.72	83	1.89	79	28.2
2010	6.55	80	1.87	78	28.7
2011	7.24	89	1.92	80	26.6
2012	7.93	97	2.12	89	26.8
2013	8.21	101	2.22	93	27.0
2014	8.48	104	2.31	96	27.2
2015	8.71	107	2.34	98	26.9

Source: authors' calculations, based on CSB.

are associated with the SC of state institutions. This corresponds with J. Grizāns' (2015) opinion that the competence and the capability of state and municipality institutions is important nowadays, and it is directly linked with the SC of regional and municipality governments.

The state and the local governments should provide a developed, reachable and attractive territory for their inhabitants. For a country and local governments to perform their functions, they possess a total of funds – budgets of local governments.

The total SC of Latvia has fostered the revenues of the state consolidated budget (Table 2), with the average annual income of 6%. The revenues of the consolidated budgets of local governments are insufficient. In 2015 they did not reach the level of the base year (2008). Their proportion in the total national budget is decreasing, which indicates inactive and poorly governed local SC.

The authors' observations coincide with J. Grizāns' (2015) opinion that the revenues of local governments are directly linked with the business environment in the territory, with enterprises capable of operation, the development of the NGO sector and the SC possessed by the local government.

In the research of other authors, the development of a continuous dialogue between local governments and NGOs that would be present at all stages of the development of the action policy and would facilitate the development of the territory, is emphasised (Marsden, Eklund, & Franklin, 2004; Moseley, Cherrett, & Cawley, 2001; Kovách, 2000; Woolcock & Narayan, 2000).

The number of NGOs per 1000 inhabitants in Zemgale region and districts (Table 3) has increased 2.2-2.3 times. On average, in Latvia it has decreased by 20%. The authors consider that the increase of the NGO number is partly related to the offer of the EU Funds in 2014 – 2020. It coincides with the conclusion of B. Bela *et al*. (2013) that NGOs depend financially not on the membership fees, but on attracting resources of various Latvian and foreign funds, and when the funding is terminated, the organizations either limit or stop their operation (Bela, 2013).

Table 3

Non-governmental organizations, population's civic activity during the elections of local governments in Latvia, Zemgale region and districts in 2009 – 2016

Indicators	Public organizations per 1000 inhabitants		Base increase (%)	Population's civic activity (%)		Base increase (%)
	2010	2016		2009	2013	
Districts	2.89	6.67	231	51	42	-8.8
Towns	2.80	6.45	230	52	41	-10.7
Region	2.86	6.52	228	51	42	-8.9
Latvia	1634	1316	-20	46	46	-0.1

Source: authors' calculations, based on ER, CEC.

Table 4

Comparison of the indices of the education level of the deputies of Zemgale region, towns and districts in 2009 – 2013

Indicators	Index (year)		Difference in the period
	2009	2013	
Districts	1.46	1.58	0.12
Towns	1.51	1.92	0.41
Region	1.47	1.64	0.14
Average	1.48	1.71	0.23

Source: authors' calculations, based on CEC.

The voter activity approves the civic activity and the population's belief that when they go to elections, it is in their power to change something. The population's engagement in the elections of local governments in 2009 and 2013 (Table 3) has decreased between 8.8 – 8.9%; in towns it is 10.7%. The lowest voter proportion was observed in 2013 elections of local governments in Bauska – 33%, the largest was in 2009 elections in Skriveri – 55.3%. The level of the voter activity characterises a poor presence of SC, distrust in the local power and feebleness in influencing decisions. Comparing the number of programmes submitted for the election of local governments, a decrease between 18 – 20% was observed, which approves of insufficient population's engagement and low SC.

M. Pelše (2007) considers that territorial development is directly linked with the SC possessed by the executives and the administration. The authors agree with the opinion that it is exactly the decision-making and the executive authority that have to understand the importance of SC and have to enhance it. Whereas, the SC potential is directly linked with education, and in the research the SC possessed by the decision-making authority of the local governments was compared.

The index of the total SC potential or the index of the education level was calculated for the decision-making authority of Zemgale region, towns and local governments. According to Likert scale (Nachmias, 2005), 100% will be achieved if the characterising value is 2. The weight coefficient of the component indicators of the index is 1 for secondary and secondary vocational education and 2 for higher education.

The model of the standardization method for the territorial development index designed by the Latvian Statistical Institute (Cimdiņš, 2015) was applied in the calculation. It determines that the values characterising the education level of the decision-making authority standardised with particular weight coefficients are aggregated according to the formula (Formula (1):

$$t = \frac{x - \acute{x}}{s} \qquad (1)$$

Jelgava and Jekabpils towns demonstrated a faster increase of the SC potential – level of education – of the decision-making authority (Table 4) – 0.41.

The situation differs in the districts where the average increase is 0.12 and changes can be evaluated as insignificant, and they characterise the SC potential of the elected deputies. None of the local governments demonstrated the highest level of SC potential, i.e. 2. There is a need for new local leaders who possess a competence to solve socially important issues. The SC quality of the decision-making authority threatens the local territorial development. There is a need for the increase of SC potential.

Conclusions
1. The essence of SC is related to private and social benefits: 1) at the individual level – better mutual contacts; 2) at the public level – people's ability to work in a group and in organizations to attain their goals.
2. SC potential is the competences, knowledge and skills possessed by an individual and groups. High social engagement is directly linked with SC, which depends on the level of education.
3. Core indicators and subordinate indicators are used to measure SC. Core indicators demonstrate the presence of SC, subordinate – the impact of SC.
4. The lack of SC influences the income of local governments and households, social differences and changes in the population number, weakens the governance of municipalities and fosters crime.
5. The observed SC factors: 1) The decrease of the population number and density in towns and districts has affected negatively SC of the territory, which in the future can reduce the overall attractiveness of the territory, budget revenues of the local governments and investors' interest, create lack of labour force; 2) the decreasing number of the working-age population reduces: the total SC of the territory, the number of choices for regional and local leaders; 3) the little increase of the number of population until the working

age can create even more significant lack of SC and can foster development differences among districts and towns in the future; 4) the increase of the number of enterprises in the towns and districts of Zemgale region is between 18 – 24%, and it has allowed SC to accumulate, the businesses to exist and develop. SC is not fully used in the development of new enterprises; 5) the average population's engagement in the election of local governments in Zemgale region, towns and districts has decreased and points to an insufficient and poor presence of SC; 6) NGOs depend financially not on the membership fees, but on attracting resources of various Latvian and foreign funds. When funding is terminated, the organizations either limit or stop their operation; 7) the SC quality of the decision-making authority

threatens the local territorial development. There is a need for the increase of SC potential.

6. The authors suggest local governments of districts should more actively support NGOs, allocate municipality or state funding to the sustainable operation of NGOs, similarly as it currently happens when financing political parties.

7. Summarising and comparing statistical indicators about SC core and subordinate indicators, it is concluded that in particular analysed categories the indicators are insufficient. Local governments should foster the dialogue with the social groups of society, should improve the population's engagement in making decisions required for society and should enhance SC potential and activity. Results beneficial for development can be reached only through working collaboratively.

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IMPROVEMENT OF CUSTOMS AND TAX ADMINISTRATION ICT SYSTEM PERFORMANCE

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Abstract

Nowadays ICT has a significant role in public administration by creating opportunities to automate a lot of manual operations. ICT plays an important role both in improving customer service in public administrations as well as internal and inter-institutional co-operation processes in public administrations that promote access to services and service quality, facilitate administrative processes for citizens and businesses and contribute to the accessibility of information. Public authority daily faces a major challenge – on the one hand to reduce labour costs and on the other hand to introduce innovations. In the implementation of both these objectives public administrations deal with a serious problem – to operate in a connected environment by involving stakeholders and at the same time to solve problems by using new working methods, tools and management models. One of the strategic objectives of tax and customs administrations is to increase resource use efficiency and effectiveness; therefore, they continuously search solutions to simplify administrative procedures, to improve and develop the quality of services provided and the business environment in general, and how to automate internal work processes and significantly reduce manual workload. This study aims to examine the structure affecting the efficiency indicators, to point out the factors which have the biggest impact on increasing effectiveness of institutions.

Key words: Tax and customs administrations, information and telecommunication systems, productivity, efficiency, manual work.

Introduction

One of the strategic objectives of tax and customs administrations is to increase resource use efficiency and effectiveness; therefore, they continuously search solutions to simplify administrative procedures, to improve and develop the quality of services provided and the business environment in general, and how to automate internal work processes and significantly reduce manual workload.

In the OECD and non-OECD countries one commonly used performance indicator for tax administrations is their total revenue body expenditure as a percentage of GDP and the cost of collection ratio, which compares the aggregate tax administration cost per 100 units of net tax revenue collected (OECD, 2014). When calculating the cost of one euro collected, in most cases three categories of costs – administrative expenses, remuneration costs, and Information and communications technology (ICT) costs are taken into account, as they play a key role in smooth functioning of the public administration.

With the development of modern technologies and new working methods, the existing work processes are revised from the perspective of innovations, replacing the historic and traditional working methods with new and advanced ones, thus making work processes more efficient. It is generally believed that such replacement is important from a resource use perspective, allowing more efficient use of the means of production. While preserving the old system and adding new elements and tasks, it will still be necessary to maintain both the old resources for performing standard functions and continually adding new resources to ensure that new activities are implemented. In this formation, a lack of resources and the need for new employees will always be felt.

The authors agree to Pang's *et al.* opinion that 'the majority of studies in the information systems (IS) discipline have focused on discovering IT business value in for-profit organizations, the performance effects of IT in the public sector have not been extensively studied neither in the IS nor the public administration literature' (Pang *et al.*, 2014).

The authors put forward the argument that the increase of the role of information and communication technology and decrease of manual work in public administration ensures that efficiency indicators will increase. This study aims to examine the structure affecting the performance indicators, to point out the factors which have the biggest impact on increasing the effectiveness of institutions. ICT efficiency and effectiveness having impact on the performance indicator are the target of current research. To achieve the aim, the following objectives are pursued:

- to determine the types of expenditures affecting the SRS performance indicator;
- to analyze the existing ICT expenditure, recovery costs and structure of labour force in the Latvian State Revenue Service (SRS);
- to propose improvements of the mechanism for calculating resource savings by replacing manual workflows with ICTs.

The information compiled by SRS statistic, scientific publications of foreign and local researchers, and other materials have been used for the purpose

of the study. The research is mainly based on the monographic descriptive method as well as the methods of analysis and synthesis.

Problem Statement

Nowadays ICT has a significant role in public administration by creating opportunities to automate a lot of manual operations. ICT plays an important role both in improving customer service in public administrations, as well as internal and inter-institutional co-operation processes in public administrations that promote access to services and service quality, facilitate administrative processes for citizens and businesses and contribute to the accessibility of information. Public authority daily faces a major challenge – on the one hand to reduce labour costs and on the other hand to introduce innovations. In the implementation of both these objectives public administrations deal with a serious problem – to operate in a connected environment by involving stakeholders and at the same time to solve problems by using new working methods, tools and management models.

'The scale of society's evolving challenges gradually surpasses the capacity of the public sector to address them. Coping with these challenges requires budget-short governments to look for innovative ways to transform and improve their operations and service provisioning models while in many cases transformation starts from the inside-out (based on policy goals) and focuses on reorganization through ICTs' (Klievink *et al*., 2016).

Scientists studying the role of ICT in public authority stress its positive effects on a range of the organization's internal performance determinants – efficiency, effectiveness, accountability, management quality, simplified government procedures and external factors such as improved interaction with citizens, connectivity, openness (Sun, 2011; Nugroho, 2014; Ibrahim *et al*., 2015; Ochara-Muganda & Van Belle, 2010; Bonina & Cordella, 2009).

The authors completely agree with Dečman and Klun that tax administration gains from ICT use, however, tax administration systems are among the most complex ones (Dečman & Klun, 2009). Janssen and Estevez point to the fact that in the foreseeable future public authorities will have to shift from the 'traditional approaches – like electronic government (e-Government) and transformational government (t-Government) to 'lean government' (l-Government) – a new wave which is appearing as a response to and aims at reducing the complexity of the public sector by simplifying and streamlining organizational structures and processes, at the same time at stimulating innovation by mobilizing stakeholders' (Janssen & Estevez, 2013).

Tax and customs administrations, and any other public administrations whose operations to a great extent are based on intellectual and manual work, possess the ability to absorb a virtually unlimited number of employees and the only limiting element is the allocated funding. The human factor determines that resources allocated to work are never sufficient. The existence of such a factor determines the fact that the management of the institution has to perform regular assessment of the workload and optimal resource allocation for human resources and ICT.

The leader in the use of information technology among the Baltic States is Estonia because, as shown by the Global Information Technology Report data of the World Economic Forum (WEF) 2015, Latvia ranks 33 in the field of ICT in the world, whereas Lithuania has maintained the 31st place and Estonia ranks 22. It has developed historically, because since 2000 the institutions in Estonia have focused on their core functions and outsourcing IT services, while the Latvian and Lithuanian authorities have mainly relied on their own internal resources to provide ICT services. WEF points out that Estonia's powerful performance and constant growth of Latvian ICT which is approaching the Lithuanian position allow the Baltic countries 'slowly but surely close the gap with the Nordic countries, which is a considerable achievement for the three former Soviet republics' (Dutta, Geiger, & Lanvin, 2013).

Administrative costs increase due to manual document circulation between the public administrations and the Latvian SRS and also between the public administrations and taxpayers. Despite the government's decisions on the circulation of documents between the public administrations with a secure electronic signature, not all Latvian public administrations implement the decisions adopted by the government. For example, insolvency applications still cannot be submitted electronically. In addition, in Latvia the proportion of physical persons who choose to settle their obligations to the state in person is still large. In 2015, in Latvia 41% of physical persons submitted their annual income declarations in paper form in person, while in Estonia, 95% of physical persons submitted their annual income declarations electronically. Already in 2013, 96% of Lithuanian residents submitted their annual income declarations electronically. In Estonia, electronic submission of annual income declaration of physical persons started in 2000, in Lithuania in 2004, but in Latvia only in 2008. In all three countries, the situation is very similar with the corporate income tax and VAT annual income declarations, which are submitted electronically in 98% of cases.

Data analysis

Authors agree with Coste & Tudor (2013) 'Service performance in public sector entities should provide high quality information, the way funds should be allocated should be transparent, efficient resource use without raising questions about resource use and eliminate uncertainty in the quality of services'. In this context, exactly the replacement of manual work with ICT should lead to the improvement of the whole organization's performance. Considering that the performance indicator in most cases takes into account the three types of expenditures – administrative, remuneration and Information and Communications Technology (ICT) expenditures, the research will examine the remuneration and ICT expenditures because the proportion of administrative expenditures is relatively small compared to the other two types of expenditures.

Taking into consideration the increasing amount of data to be accumulated and processed by the tax and customs administrations, the role of ICT in tax administration processes is growing. In Latvia, 2011 was a milestone in the communication between the SRS and taxpayers, when a mandatory requirement was introduced for the majority of taxpayers (legal entities and separate groups of physical persons) to submit tax reports only in an electronic form using the Electronic Declaration System (EDS) (see Figure 1).

Figure 1 illustrates that taxpayers – legal entities and separate groups of persons who were identified as obliged to submit documents to the SRS in electronic form – have started to submit the most significant and most extensive part of the reports which were meant to be entered by SRS officers manually in the SRS IT systems before the SRS electronisation in 2011. Figure 1 demonstrates that the number of documents transmitted electronically grew rapidly in 2010. This is due to the fact that some groups of SRS clients, who regularly submit their reports and declarations with intent to prepare themselves to this requirement, started to do it in the electronic form already in 2010. 2010 was a transition period of the SRS electronicization. Figure 1 demonstrates that within the period of eight years the proportion of documents submitted to the SRS on paper and in electronic format has changed totally opposite.

In search for solutions to reduce manual work, Latvian SRS has gained significant resource savings by introducing submission of the most important taxpayers' reports – value added tax return, annual corporate income tax declaration, report on state social insurance mandatory contributions (SSC) from the income for work of the employees, company's annual report and the personal income tax (PIT) as well as business risk-related state duty in the reference month – in the electronic declaration system (EDS).

In addition to the improvement of the EDS, the Latvian SRS also works on the development of its other information and telecommunication systems on the basis of changes in the national and EU legislation and by optimizing internal processes when manual work is replaced with automatic control. The electronic customs data processing system (EMDAS) and its subsystems provide the opportunity to electronically submit such customs declarations and documents as entry summary declaration, import declaration, export declaration, export declaration with the exit summary data, re-export notification, exit summary declaration, transit declaration, TIR declaration, transit and TIR declaration with the summary declaration data, manifests/temporary storage module – (air transport) manifest, temporary storage declaration, information related to stock control of goods in temporary storage. According to the requirements of the EU legislation, economic operators and other persons involved in customs formalities use unique economic operators registration and identification number – EORI number when dealing with customs authorities throughout the
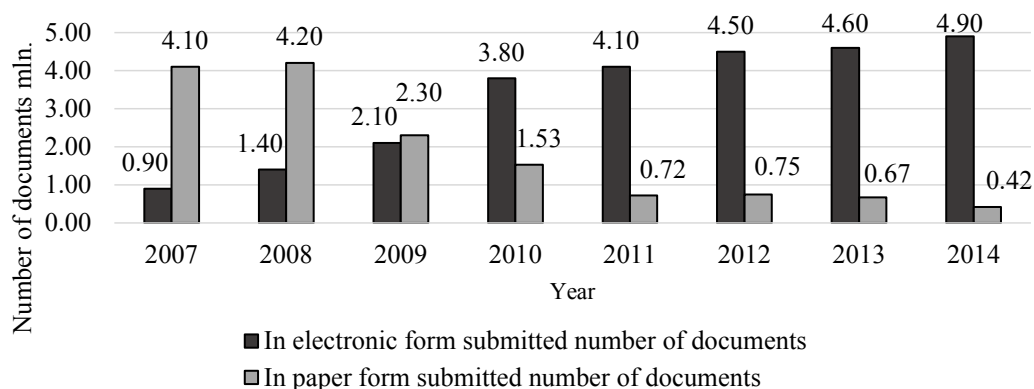

Figure 1. The proportion of documents sent in electronic and paper form in the SRS
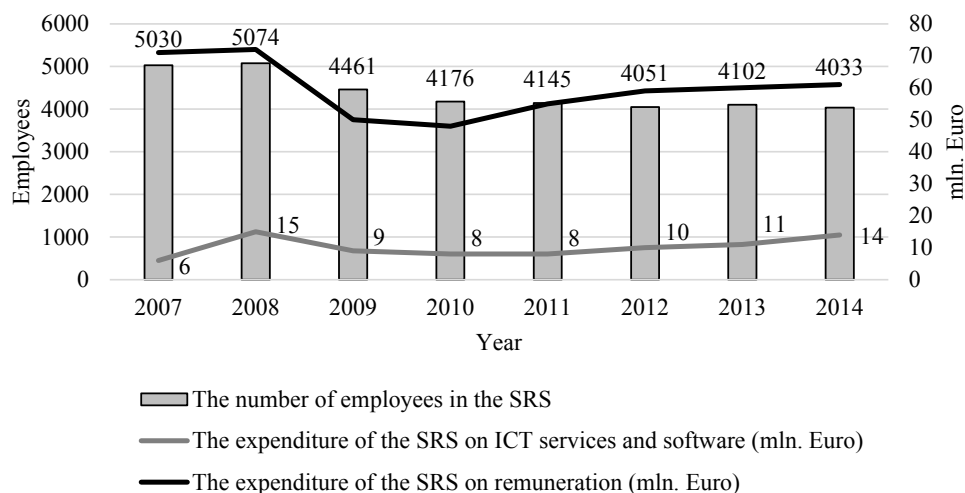(The State Audit Office of the Republic of Latvia, 2015).

Figure 2. The expenditure of the Latvian SRS on ICT, remuneration and the number of employees.

EU. Like all EU states, Latvia uses Excise Movement and Control System (EMCS).

When comparing the SRS expenses for remuneration and ICT services, it is observed that ICT services costs increase in proportion to remuneration expenses. ICT and remuneration expenses showed a rapid reduction in 2009, which is attributed to the consolidation measures during the crisis, whereas starting from 2012 expenses for ICT and remuneration have been gradually increasing (see Figure 2).

Figure 1 demonstrates that electronic document submission has reduced manual work in the Latvian SRS that was used for transferring the data submitted by the taxpayers to the ICT systems; however (see Figure 2), electronic document submission actually has not influenced the number of employees. The total increase of the Latvian SRS remuneration may be due to the overall increase in funding for public administration after the economic crisis of 2009. Expenditures for ICT and software in 2014 were almost equal to the 2008 level (pre-crisis), unlike the remuneration part. Due to the accounting peculiarities in the Latvian SRS, it is not possible to obtain reliable and valid data on the Latvian SRS savings after introducing electronic document submission process because the Latvian SRS does not gather such data; though according to expert estimates, more than ten workloads have been saved.

Although the number of employees since 2010 has been slowly increasing, development of the EDS functions not only has led to a cascading effect of reductions in manual work in the Latvian SRS, but has also influenced issues such as the quality of the Latvian SRS data information systems and decrease in the number of errors in the submitted documents. The quality of the Latvian SRS data in the information systems has grown, the number of errors in the submitted documents has decreased resulting

in the decrease in the amount of work needed for the examination of the quality of declarations. Starting to use the EDS for mutual communication with taxpayers has resulted in savings on office supplies and postage expenses.

Results and Discussion

National governments, following the New Public Management (NPM) guidelines, introduced private principles and instruments in the public field to improve the efficiency, effectiveness and financial stability of state enterprise (Calogero, 2010). This means that in order to achieve the strategic objectives of public authorities, it is necessary to assess two vitally important factors – human resources and ICT and their interaction required for reaching strategic goals and performance indicators. Gershon believes that 'Government policy-making emphasis worldwide is moving increasingly to how IT can be used to achieve efficiency savings' (Gershon, 2004).

However, in order to calculate what effect can be achieved by modernizing the work process, it is crucial to have accurate understanding of the existing work processes and the time consumed when the already existing work methods are applied.

Work estimating methods are work process research and design techniques aimed at defining the workload. The Latvian SRS has chosen to introduce the analytical work estimating method (Кибанов, 1998), which is based on process management (Pētersone & Ketners, 2016b).

In order to objectively evaluate the resource savings due to the replacement of manually performed work processes with ICT, it would be necessary to perform analysis of all core activities. International experience shows that the evaluation procedure (identifying work processes, recording times necessary for each task, abandoning unnecessary activities) performance

helps tax administrations in work optimization, more efficient operation and resource use. For example, the Estonian tax administration devoted two years for the identification of each process, measurements, etc., including setting the necessary amount of human resources for each process, and it allowed the Estonian Tax and Customs Board to reduce resource consumption in 2013 by 2.3% and in 2014 by another 3.9%. Due to the development of Estonia's electronic environment, already for a long period of time the Estonian Tax and Customs Board has worked on partial or even full automatization of functions or performing them without unnecessary bureaucracy. For example, one of the most important tax administration processes for which the SRS annually allocates significant resources is the refunding of overpaid personal income tax on the basis of annual income declarations submitted by the residents. Annual income declaration submission in both countries is possible by electronic means, but it is still manually inspected in Latvia. In Estonia, this resource-intensive process has been fully automated for several years due to the electronic data flow from employers, banks and other public authorities. Thus, submission of annual income declarations does not need accompanying supporting documents. In Estonia, the amount of expenditure for which residents can receive refunding is also smaller due to different national legislation, for example, the exemptions are not applied to medical and dental charges.

The SRS has ensured the quality of performance measurements by linking it to the process control systems creating a SRS results matrix, where each indicator is attributed to one of the processes and process steps (Pētersone, Krastiņš, & Ketners, 2015). However, together with the idea about the process and function identification, it would be necessary to begin developing work time tracking, in order to obtain comprehensive information on the number of resource-intensive and time-consuming tasks and processes thus providing information and support for determining the necessary resources. To implement work time tracking, it would be necessary to:

- assess the tasks, processes, performance indicators and human resource allocation for each process according to the competence of the institution;
- provide time tracking for each process, determining the time spent and performance outcomes;
- estimate costs (both direct and indirect) for each process (Pētersone & Ketners, 2016a);
- assess the available data on the time consumed and cost of the processes by determining the optimal human resource consumption and reducing this consumption or replacing it by process automation.

'An investment in IT that only achieves an improvement of PA internal efficiency through increased productivity and a reduction in production costs will be halfway through the achievement of its objective, as that internal efficiency does not help to increase the taxpayer's satisfaction with the public service received' (Bigliardi & Dormio, 2009).

Before initiating the process of replacing manual work with ICT solutions, the Latvian SRS has to evaluate such strategic questions as:

- whether all the functions performed by the SRS correspond to the aims of the Latvian SRS;
- the enforcement of legislation, which increases the work process costs;
- the probability of duplication of delegated tasks and processes with other public administrations;
- the increase of the number of employees involved in support processes;
- the absence of internal work estimating standards.

However, the most significant factor determining the efficiency of tax and customs administration is the human factor. Fakhrutdinova *et al*. stress that 'among a set of problems of increasing the efficiency of public civil service, it is necessary to underline the following: replenishment of administrative staff with highly professional and competent experts and an increase of a professional level of the public civil servants in the process of performance of their functional duties (Fakhrutdinova *et al*., 2015)' Chlivickas points out: 'the main focus should be laid on improvement of state structures efficiency and increment of professionalism and accountability of human resources in state institutions' (Chlivickas, 2015).

Conclusions

1. Taking into consideration the increasing amount of data to be accumulated and processed by the tax and customs administrations, the role of ICT in tax administration processes is growing. In the communication between the SRS and taxpayers a mandatory requirement has been introduced for the majority of taxpayers and the clients of the customs administration to submit tax reports and customs documents only in an electronic form using the Electronic Declaration System (EDS).

2. Due to the accounting peculiarities in the Latvian SRS, it is not possible to obtain reliable data on the Latvian SRS savings after introducing electronic document submission process because the Latvian SRS does not gather such data. Electronic document submission has reduced manual work in the SRS; however, it actually has not influenced the

number of employees. Any mechanical reduction of personnel without deep investigation of the processes may create a threat when the amount of work in different workplaces may sharply rise or drop.

3. When comparing the Latvian SRS expenses for remuneration and ICT services, it is observed that ICT services costs increase in proportion to remuneration expenses. Submission of electronic documents has reduced the SRS's manual work; however, the electronic submission of documents did not actually affect the number of employees. The SRS, whose work is based mostly on intellectual and manual work, has the capacity to absorb practically unlimited numbers of people and the only one restrictive element is just the funding which has steadily increased since the crisis in 2009, but has not achieved the level of 2008.

4. The Latvian SRS has chosen to introduce the analytical work estimating method, which is based on process management. However, in order to calculate what effect can be achieved by replacing manual work processes with ICT solutions, it is crucial to have accurate understanding of the existing work processes and appropriate accounting and estimating.

5. Before initiating the process of replacing manual work with ICT solutions, the SRS has to evaluate such strategic questions as whether all the functions performed by the SRS correspond to the aims of the Latvian SRS, the enforcement of legislation, which increases the work process costs, the probability of duplication of delegated tasks and processes with other public administrations, the increase of the number of employees involved in support processes and the absence of internal work estimating standards.

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ECONOMIC COSTS OF YOUTH UNEMPLOYMENT IN LATVIA

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Abstract

In foreign studies Latvia is positioned as a 'depressive' region in the year 2030, which will have an insufficient population of young people. Thus, Latvia as a country with a business-friendly environment will not be able to be competitive relative to other European countries and the flow of investment will be at risk, as well as passed on other, more competitive and better developed regions in demographic terms (Grinevica *et al.*, 2016). It is one of the main reasons to deal with the youth unemployment problem and to realize the actuality and consequences. Also, one of the EU's priorities of development is to reduce youth unemployment. National labour force surveys (Hoffman, 2011) show that since 2008 the youth unemployment rate has risen in all the EU countries (Hjūza & Borbējs-Pece, 2012). The current economic instability in the context of youth's prospects and opportunities in the labour market is uncertain (Balan, 2014). Youth unemployment has also a negative effect on economic growth and productivity.

The aim of the paper is to identify the importance of unemployed youths and draw the society's attention to the consequences. The paper presents a brief analysis of importance of unemployment costs as well as the calculation of an economic loss from youth unemployment in Latvia. The result was calculated using Okun's Law concept.

Key words: youth into the labour market, costs of youth unemployment, Okun's Law, gross domestic product (GDP).

Introduction

Youth unemployment has created particular concerns because individuals who have become unemployed in the first years of their employment can become detrimental to the society. Youth who are unable to find a job after completing education can be perceived as inefficient human capital with the possibility of deterioration in employment, which could contribute to an individual's social exclusion. At the same time, youth unemployment is problematic not only for the person being unemployed but also for the economy as a whole (Salvador & Leiner-Killinger, 2008).

The transition from education to making money is becoming increasingly problematic (Keep, 2012). Increasingly diverse youth (including those who have had good school results) do not obtain education or undergo training and are not in employment, the labour supply is lower, including proper jobs (as opposed to unskilled temporary jobs), and the skills of youth are not very much demanded by employers (Global Unemployment Trends..., 2010).

Youth unemployment makes serious consequences to young people's future as well as to the state's economic income.

Various authors in their studies discuss the unemployment impact on youth's future and the country's economic situation.

Authors Novak and Darmo believe that unemployment is considered as a broad macroeconomic problem that is associated with job absorption, the wasting of human resources, the performance of the labour market, the success of economic policies and even with the risk of inflationary pressures. Unemployment itself has hidden potential to become a significant and serious social problem of the society (Novak & Darmo, 2015).

Blanchflower and Freeman have found that youth unemployment affects social exclusion and in the case of long-term inability of young people to find a job, it has negative consequences for future working lives in terms of lower incomes and wages (Fares & Tiongson, 2007; O'Higgins, 2001).

The European Union (EU) is facing a new challenge oriented to the so-called 'lost generation' and solving the status of this generation in global aspect. The role of youth is undeniable and countries have to revise political positions related to the young generation because the discontent of youth can become a major force for changing political regimes. If there are no attempts to solve the problem of youth unemployment, we might expect economic and political instability in the EU in future, as well as globally (Novak & Darmo, 2015).

Youth unemployment rates are generally much higher, even double or more than double than unemployment rates for all ages. As for the rate for the total population, the youth unemployment rate in the EU-28 sharply declined between 2005 and 2007, reaching its minimum value (15.1%) in the first quarter of 2008. The economic crisis, however, severely hit the young. From the second quarter of 2008, the youth unemployment rate has taken an upward trend, peaking at 23.9% in the first quarter of 2013, before receding to 18.7% at the end of 2016 (Unemployment Statistics, 2017).

Latvia had the highest youth unemployment among the three Baltic States in the year 2016, according to Eurostat.

The Eurostat figures show that 17.3% of young people aged 15-24 years were jobless in Latvia in 2016, growing by 1 percentage point from 2015.

In Lithuania, this rate was 14.5% in contrast to 16.3% a year ago, while in Estonia 13.4% of youngsters were unemployed, up 0.3 percentage points from 2015.

At the same time, the EU average for youth unemployment in 2013 was 18.7% of young people between 15 and 24 years of age, down 1.6 percentage points from 2015 (Youth unemployment in..., 2017).

As stated above, in foreign studies Latvia is mentioned as a region with an insufficient population in the year 2030, which is one of the main reasons why there is the need to identify the amount of losses from youth unemployment and find the way how to deal with it.

The paper's aim was not to solve all problems associated with youth unemployment. In this case, the authors would like to introduce readers to the youth unemployment problem, economic costs of youth unemployment and the calculation of economic losses from unemployed youth's in Latvia.

The main aim of the research is to calculate the lost GDP from youth unemployment in Latvia.

The following tasks are set to achieve the aim:

1. To describe the main trends in youth unemployment;
2. To evaluate the theoretical findings on economic costs of unemployment by different authors;
3. To calculate the lost GDP by using Okun's Law from youth unemployment in the period from 2008 to 2015 in Latvia.

Novelty of the research: the lost GDP due to youth unemployment in Latvia in the period from 2008 to 2015 was calculated.

Materials and Methods

Research methodology: the monographic and descriptive method, statistical research methods, the graphic method, synthesis and analysis, the logical construction method, Okun's Law concept using GDP calculations to calculate the lost GDP from youth unemployment in the period from 2008 to 2015 in Latvia.

Theoretical framework of the research: the research elaboration is based on other scientific researches and findings in the economic field, statistical information provided by the Central Statistical Bureau of Latvia and Eurostat.

Results and Discussion

Analysis of Unemployment

The crisis that hit Europe in 2008 significantly and constantly more affects youth: in August 2015, youth (including aged up to 25 years) unemployment in the EU-28 was 20.1%, while the overall unemployment rate was 9.4%. Youth unemployment is more than twice as high as unemployment among adults in the EU-28. In addition to the immediate impact of the crisis, the education system and labour market structural problems in the transition from school to work has become lengthy and complicated. Youth unemployment can leave a lasting negative impact. In addition to a higher risk of unemployment, youth are also at a higher risk of poverty and exclusion and encounter more health problems in the future. A report by the European Commission 'Communication from the Commission to the European Parliament, the Council of Europe, the European Economic and Social Committee and the Committee of the Regions' (2012) highlights that there is an urgent need for effective solutions for youth in their transition to employment (Komisijas paziņojums Eiropas..., 2012).
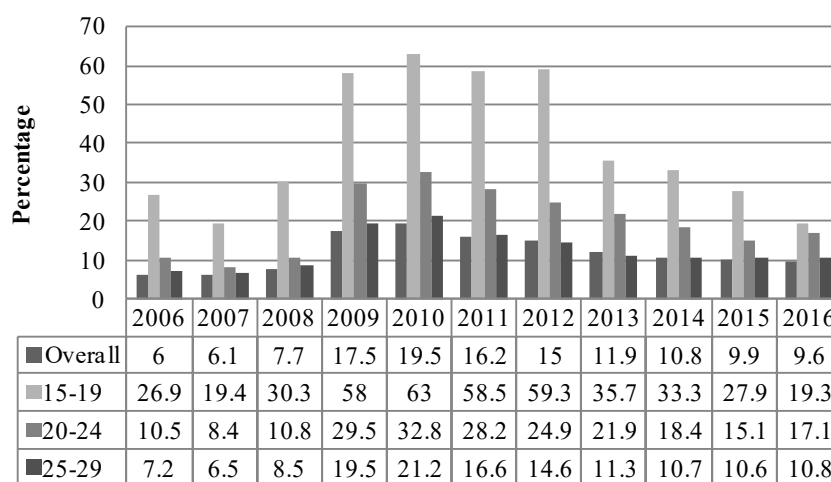
In Latvia, Figure 1 shows that in 2009 compared with 2008 the overall unemployment rate was 9.8 percentage points higher. In 2010, the overall unemployment rate reached the highest level (19.5%), assessing the period of time from 2006 to 2015. In 2010, both overall and for young people in the age groups of 15-29 years, the unemployment rate reached the highest values – among young people aged between 15-19 years – 63%, 20-24 years – 32.8%, 25-29 years – 21.2%, exceeding the average overall unemployment rate. In 2015, unemployment in total has fallen by 0.9 percentage points compared with 2014. In 2015, the overall unemployment rate was 9.9%, for young people aged 15-19 years – 27.9%, young people between 20-24 years old – 15.1%, and young people between 25-29 years old – 10.6%.

In 2016, youth unemployment aged 15-19 was fallen by 8.6 percentage points compared with 2015. The overall unemployment rate was 9.6%. Youth unemployment aged 20-24 increased by 2 percentage points – 17.1% compared with 2015, for young people aged 25-29 increased by 0.2 percentage points – 10.8% compared with 2015.

Economic costs of unemployed youth

Unemployment leads to significant losses both for the unemployed and for society as a whole, the damage increases with the length of unemployment (Dao & Loungani, 2010).

Costs of unemployed include loss of income, loss of skills and qualifications, negative impacts on health, etc. For society it is the fall in tax revenue and increases of fiscal cost are due to unemployment benefits, income inequality and poverty increase, weakening of social cohesion (e.g., less trust to the state power) and the loss of human capital. Structural unemployment causes (e.g., skills and geographical

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
■ Overall	6	6.1	7.7	17.5	19.5	16.2	15	11.9	10.8	9.9	9.6
▨ 15-19	26.9	19.4	30.3	58	63	58.5	59.3	35.7	33.3	27.9	19.3
■ 20-24	10.5	8.4	10.8	29.5	32.8	28.2	24.9	21.9	18.4	15.1	17.1
■ 25-29	7.2	6.5	8.5	19.5	21.2	16.6	14.6	11.3	10.7	10.6	10.8

Source: data from the Central Statistical Bureau of Latvia.

Figure 1. Unemployment rate among young people for different age groups and overall in Latvia
from 2006 to 2016 (%).

mobility) mismatch between labour supply and demand. One of the reasons is an ongoing price and wage rigidities. Unemployment creates significant losses to person and to the whole community (Augsts bezdarbs Latvijā...., 2010).

The costs of youth unemployment for individuals and the communities they live in is enormous. But youth unemployment also results in significant costs to the public purse. For all of the reasons above, youth unemployment translates into higher spending on benefits, lost income to the exchequer through tax receipts forgone, and higher spending on services such as the criminal justice system. For example, in England in 2012 research for the Commission found that youth unemployment is likely to cost the Exchequer approximately £ 4.8 billion (more than the 2011-2012 budget for further education for 16- to 19-year-olds), and the wider economy £ 10.7 billion in lost output:

- the total benefit bill for youth unemployment at its current levels is likely to be just under £ 4.2 billion;
- the total cost of youth unemployment at its current levels in terms of taxes foregone is likely to be just over £ 600 million;
- the total cost to the economy of youth unemployment at its current levels in terms of lost output is likely to be £ 10.7 billion (Youth Unemployment: the..., 2012).

However, because youth unemployment has a negative impact on young people's future prospects, its costs include not just those current costs outlined above, but future costs too (Youth Unemployment: the..., 2012).

In 2010, the Swedbank experts estimated that in Latvia case emigration would have very painful consequences of structural unemployment. This would mean the increase of burden to the remaining labour force of Latvia, and the threat of social protection and the sustainability of the pension system - balance of the budget in such a case would be required in order to reduce social spending and/ or increase taxes. It might reduce the motivation to pay taxes and evasion of tax payment. Consequences of structural unemployment and emigration (especially highly skilled manpower drain) are slowdown of the potential impacts of economy. Labour resource is being depleted – if entrepreneurs want to increase production volume, they will be confronted with the labour shortages and the inability to find qualified employees (Augsts bezdarbs Latvijā...., 2010).

Losses for the state of unemployed young people can be approximated by calculating the unmanufactured volume of gross domestic product (GDP) (in the given year) by taking into account the proportion of the unemployed youth in number of employees.

The GDP is total volume of final products and services in the territory during the year. It is calculated using data of domestic production (at current and constant prices), expenditure (current and constant prices) and income (only current prices) (Iekšzemes kopprodukts Latvijā..., 2015).

Economic costs arise because economic resources are not fully exploited due to unemployment. The consequences are a decrease of the goods and services production, personal income and state budget revenues. However, the expenditure of the state budget is growing. Economic growth will be faster if employment will grow and unemployment will fall. However, in order to ensure a reduction of unemployment rate, it must comply with any other

relevant relationship -economic growth rate must be greater than the growth rate of annual potential GDP. The decline in unemployment is possible when the real GDP annual growth rate is higher than the potential growth rate of GDP (studies have shown that it represents average 3% per year). This means that real GDP will be greater than 3% (Bikse, 2015).

Real GDP growth of 2% above potential GDP provides a reduction in the unemployment rate by 1%. By contrast, real GDP decrease of 2% and increase unemployment level by 1% (Bikse, 2015).

If the actual unemployment rate compared with the previous year is constant, the real GDP growth rate is 3% per year. The following GDP growth is provided with population growth, capital accumulation and technological progress. If the unemployment rate compared with the previous year will increase of 1%, the real GDP will decrease per 2%. The economic losses resulting from the cyclical unemployment is the additional production, which could produce every unemployed person if he was employed. Economists believe that because of unemployment or loses of unmanufactured actual output is the amount that should be produced to meet potential production if in the economy is natural unemployment. It shall be calculated as the difference between the potential GDP (which could produce) and real GDP – the actual output (the amount that is produced). In order to calculate the unmanufactured real GDP of unemployed, in the 1960s US economist Arthur Okun discovered the difference between the level of unemployment and the real GDP – 1:2 (Bikse, 2015).

The coherence between the level of unemployment and unmanufactured GDP is expressed with Okun's Law: if the actual unemployment rate exceeds the natural unemployment rate of 1%, then produced GDP lags behind potential GDP about 2 – 3%. Coefficient 2 is determined empirically and for each country is different. This difference is in the interval 2-3 (Bikse, 2003; Adam etc., 1987).

In accordance with the Okun's Law, the unmanufactured GDP as a result of the impact of unemployment, is calculated as a percentage of actual unemployment and percentage of natural unemployment in the country and the difference between these indicators are multiplied by 2 (in the range of 2 – 3%). The size shall be multiplied by the annual potential GDP (Bikse, 2003).

Okun's Law can be expressed in the form that reflects the relationship between GDP and unemployment dynamics. If the actual unemployment rate against the previous year's unemployment level remains constant, then real gross domestic product will increase by 3% per year. Such increment rate of GDP growth is ensured by population growth, capital

accumulation, and scientific and technical progress (Bikse, 2003).

Arthur Okun has discovered the relationship between GDP and unemployment dynamics, as reflected in the formula:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} 100 = 3 - 2(u_t - u_{t-1}) \qquad (1)$$

After which:
Y_t – The actual production volume in a given year,
Y_{t-1} – The actual production volume for the previous year,
u_t – The actual unemployment rate in a given year,
u_{t-1} – The actual unemployment rate in the previous year (Bikse, 2003).

Calculation of youth unemployment economic losses

To calculate the economic costs of youth unemployment, there was defined the base year when Latvia reached the full employment of resources, i.e., the potential level of production. It takes into account the year 2007 when the real GDP was 22'557.0 million EUR and full employment was reached.

According to calculations, the average annual real GDP (GDP calculation used 2010 constant prices) growth should reach 3% (the calculation used a 3% rate) (Bikse, 2005; Bikse, 2015).

There was a calculated potential GDP in 2008 - 2015, for example, in 2013 compared with 2007, the potential GDP should increase by 19.41% and in 2015 compared with 2007 it should increase by 26.67%.

Using the data from the Central Statistical Bureau of Latvia, the overall unemployment rate from 2008 – 2015 in Latvia was calculated as the difference between the actual and the natural unemployment rate.

For example, in 2013 the real unemployment rate was 11.9%.

Natural unemployment (an assumed rate) was 6%, based on the real GDP.

The difference between the real unemployment rate and the natural rate of unemployment:
11.9% – 6% = 5.9%

The lost GDP due to unemployment: 5.9% * 2% = 11.8%

The lost GDP due to unemployment was calculated (11.8% * potential GDP), which was 11.8% * EUR 26934.23 million = EUR 3172.85 million.

Finally, there was calculated the proportion of unemployed young people (from 15 to 24 years old) in 2013, which was 17.9% (according to data of the Central Statistical Bureau of Latvia). The calculation assumed that youth contribution to the growth of GDP was not different from adult's contribution.

It was calculated what part of the GDP was not produced by youth.

Table 1

**Calculated data on the lost GDP due to youth unemployment from
2008 to 2015**

Year	Proportion of unemployed youth (from 15 to 24 years old), %	Potential GDP with 3% growth per year, million EUR	Potential GDP growth from 2007, %	GDP growth from 2007, million EUR	Lost GDP due to unemploy-ment, million EUR	Lost GDP due to youth unemploy-ment, million EUR	Lost GDP due to youth unemploy-ment compared with potential GDP, %
2007	-	22557.00	-	-	-	-	-
2008	22	23233.71	3.00	676.71	1758.79	386.93	1.67
2009	22.6	23930.72	5.91	1373.72	4159.16	939.97	3.93
2010	20.6	24648.64	8.74	2091.64	4776.91	984.04	3.99
2011	19.1	25388.10	11.49	2831.10	4082.41	779.74	3.07
2012	18.6	26149.75	14.15	3592.75	3891.08	723.74	2.77
2013	17.9	26934.24	19.41	4377.24	3172.85	567.94	2.11
2014	15.7	27742.26	22.99	5185.26	2962.87	465.17	1.68
2015	13.8	28574.53	26.68	6017.53	2794.59	385.65	1.35

Source: authors' construction based on data from the Central Statistical Bureau of Latvia.

For example, in 2013 the lost GDP due to youth unemployment was EUR 567.94 million, which was 11.2% of the potential GDP in 2013 (see Table 1).

As shown in Table 5, according to the above mentioned methodology, the greatest lost GDP due to youth unemployment was in 2010 – EUR 984.04 million and in 2009 – EUR 939.97 million.

In 2014, the lost GDP due to youth unemployment was estimated at EUR 465.17 million, and in 2015 it was smaller - EUR 385.65 million.

Conclusions

Youth unemployment has a negative impact on youth development, health and professional career as well as on economic growth, productivity, the gross domestic product, and it increases economic costs for state, because there is more money to be paid on social benefits and less money coming in from taxes.

Based on the theoretical base, losses from unemployed youth were calculated as the lost GDP of Latvia from 2008 to 2015. The losses in the above mentioned period were estimated at EUR 5233.18 billion.

Higher losses from youth unemployment were in 2010 – 990.14 million EUR and in 2009 – 946.46 million EUR.

In 2014 losses from youth unemployment decreased to 470.40 million EUR and in 2015 to 390.39 million EUR.

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NON-BANK CONSUMER CREDITING TRENDS IN LATVIA

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Abstract
Non-bank crediting has become popular in Latvia as well as in other European countries due to various economic and social factors. Since the banks in recent years have introduced much stricter lending conditions, non-bank crediting sector has experienced a significant increase not only in Latvia but also in other European and world countries. Non-bank crediting market actively began to develop through a wide promotion of consumer credits in the major mass media; thus, creating human interest in the availability of fast and easy processable credits. Non-bank credit companies without customer deposits have transformed the present credit market, since a number of new players entered the market testing new business and crediting models and providing solutions to credit-challenged customers. The research aim is to study the non-bank consumer crediting trends in Latvia and it employs a monographic descriptive method as well as the methods of analysis and synthesis and graphics. The research results demonstrate that the popularity of non-bank credits is still growing among consumers, since the total amounts of non-bank credits disbursed for the first time have increased by EUR 116.61 million or 33.18% for the period 2012-2015 with distance credits being the most demanded credit type accounting for approximately 40% of all non-bank credits. Non-bank credit market is saturated and there is a fierce competition between non-bank crediting companies in terms of interest rates, crediting conditions and other factors.
Key words: non-bank credits, consumers, annual percentage rate of charge.

Introduction

Non-bank consumer crediting is a relatively new type of crediting in Latvia, since the first short-term loans have been disbursed right before the financial crisis in 2008. Simultaneously with the rapid development of Internet and changing habits of the people in the use of financial services, the non-bank crediting sector has experienced both a fast growth and high demand as well as it has faced many challenges related with the government intention to control the operation of non-bank services. In 2007, the first companies started to offer first distance credits. The service gained great popularity and new market players appeared to offer new and new types of crediting. The fact that the sector was not specifically regulated and any company with the minimum share capital of EUR 2845.6 might become a non-bank creditor facilitated the expansion of primarily distance crediting among the population. After the financial crisis, some researchers admitted that non-bank crediting sector called for wider and more intensive financial supervision (Gambacort & Marques-Ibanez, 2011). Also, Romanian scientists Mirea and Aivaz (Mirea & Aivaz 2014) have expressed a similar opinion that 'the economic crisis has led to a major shift in thinking, i.e. the habit of an accelerated loan growth has been replaced by an accelerated decrease and by the decline of confidence in the banking system'. The resumption of growth in 2013 has led to the need for the banking system in Romania and other countries to find, as soon as possible, an appropriate structure of loans, in order to continue without worries the crediting of reliable customers (households and economic agents) (Mirea & Aivaz 2014). Such researchers as Reifner, Clerc-Renaud, Knobloch and Robert Scott, Glennon have also studied different aspects related with interest rate restrictions and commercial lending distance issues (Reifner *et al.*, 2010; Robert *et al.*, 2008).

At present, the situation has changed – consumers recognise that the non-bank crediting is a modern tool and solution for receiving small loans. In addition, it is simpler and faster compared with bank crediting. The market is harmonised, and the companies operating in the non-bank crediting sector not only initiate new measures directed at the protection of customers but through various self-regulation mechanisms they contribute to a credible, socially responsible and long-term cooperation aimed lending practice; thus, improving the provision of credit services. Similar experience is observed also in other countries as Jagtiani and Lemieux (Jagtiani & Lemieux, 2016) analysing small business lending in the USA emphasise that 'nonbank and alternative creditors have begun to compete with banks by introducing sophisticated technologies and new underwriting methods'.

The still existing high demand for non-bank consumer credits has determined the research **hypothesis**: non-bank consumer crediting is a demanded crediting instrument in Latvia; consequently the research **aim** is to study the non-bank consumer crediting trends in Latvia. The following research **tasks** are advanced to reach the set aim: 1) to give a brief insight into the regulatory requirements for non-bank crediting sector; 2) to analyse types and dynamics of non-bank crediting trends; and 3) to describe the calculation and essence of the annual percentage rate of charge. The analysis covers the period of 2012 – 2015, in some cases the years 2013 – 2015, since the Consumer Rights Protection Centre of

Latvia has started to compile information on non-bank consumer credits only from 2013.

Materials and Methods

The information compiled by the European Commission, the Consumer Rights Protection Centre of Latvia, regulatory enactments of the Republic of Latvia, scientific publications of foreign and national researchers, and other materials have been used for the purpose of the study. The research is mainly based on the monographic descriptive method as well as the methods of analysis and synthesis are used to study the problem elements and synthesise coherencies or formulate regularities.

Results and Discussion

Regulation of non-bank crediting sector

Way to a legislatively aligned business environment started in 2011 after the introduction of the requirement for licensing of non-bank crediting companies. The amendments to the "Consumer Rights Protection Law" prescribed that only capital companies having received a special permit (licence) may provide credit services to consumers (Parliament..., 1999). The licence is issued by the Consumer Rights Protection Centre for one year. The companies which did not receive a licence were not allowed to enter into new contracts with consumers; they could only continue serving the existing contracts. Therefore, a high standard for the entry into business was determined along with the introduction of licensing, so companies not being oriented towards a long-term business dropped out. The amount of the state fee for the issuance of a licence is EUR 71 140, while for the re-registration it is EUR 14 225 (Cabinet Regulation, 2011). In addition, the license can be obtained only by companies whose paid-up share capital is at least EUR 425 000. Certain other requirements, such as not suspicious laundering, compliance with the Consumer Rights Protection Law, monitoring of credit allocation and data protection, are prescribed for consumer crediting companies. Before the introduction of the license fee and surveillance measures the market comprised about 77 non-bank consumer crediting companies; yet in 2015 only 55 capital companies hold a valid license. A major role in the market self-regulation is played by Latvian Association of Alternative Financial Services (former Latvian Association of Non-bank Creditors). The association unites non-bank crediting companies providing various financial services to the population. In early 2013, the association members signed the Best Practice Standard with a commitment to take additional measures to protect borrowers. The agreement also provides the promotion of responsible long-term business environment.

One of the recent amendments to the enactments regulating the non-bank crediting sector prescribes that it is prohibited to enter into a consumer credit contract in the time period from 23.00 o'clock to 7.00 o'clock, unless more strict restrictions for provisions of the consumer credit service are provided for in the laws and regulations regarding consumer credit (Cabinet Regulation, 2016).

Types and dynamics of non-bank crediting trends

Nowadays, non-bank credit companies without customer deposits are transforming the credit market. A number of new players have entered the market testing new business and crediting models and providing solutions to credit-challenged customers. In Latvia, non-bank lenders offer five types of non-bank credits:

- **mortgage non-bank loans** - loans for purchasing of real estate or loans the repayments of which are secured by a mortgage on immovable property. Non-bank mortgage loans are mainly provided for the purchase, improvement, repair or construction of housing premises as well as larger procurements. Loan repayment period can range from a few months to several decades. Loan amount depends on the collateral and the customer's ability to make monthly loan payments;

- **leasing and another loan secured with a vehicle or other property (except real estate)** - financial leases for the purchase of a vehicle or another object (excluding real estate) or lease (operating lease) or credit agreements, the repayment of which is secured by the collateral of purchased vehicle or another object (excluding real estate); this type of crediting includes also a reverse lease and credit agreements secured with a commercial pledge of a car;

- **consumption credits** - credit agreements under which a credit is granted for the financing of consumption and which are concluded at the presence of both parties, for example, credits for the purchase of certain goods and services, and other credits;

- **distance credits** - credit agreements under which the credit is granted for the financing of consumption and which are concluded via the Internet, telecommunications or other types of distance communication means (referred to as *fast credit*), no collateral required;

- **loans against pledge of movable property** - credit agreements under which the loan is issued to finance consumption and which are disbursed against a movable collateral, the consumer's liability is limited only to the
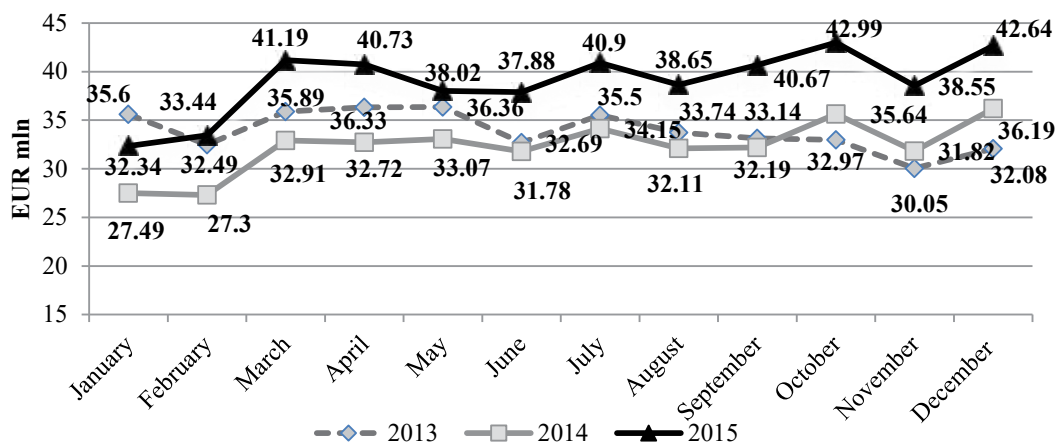
Source: author's construction based on Patērētāju tiesību ..., 2016.

Figure 1. Total amounts of credits disbursed for the first time by non-bank credit companies of Latvia
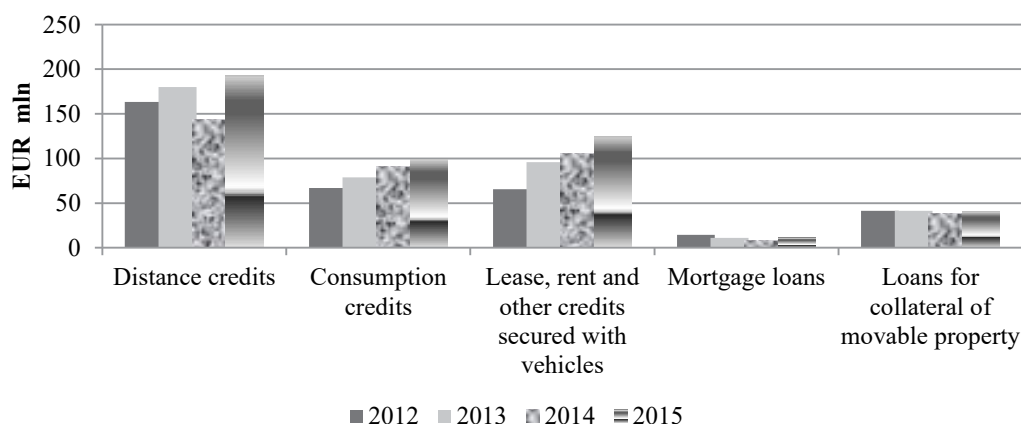between 2013 and 2015, EUR mln.

mortgaged property and loan amount depends on the collateral value (pawn loans).

The general tendencies show that non-bank credits still earn popularity among consumers, since the total amounts of non-bank credits disbursed for the first time have increased for the period 2013 – 2015 (Figure 1).

The largest amounts of credits are disbursed in 2015, when they amounted to EUR 468.01 million; credit amounts have grown by EUR 80.63 million or 20.81% compared with the previous year. Figure 1 reflects credit amount fluctuations by months allowing to conclude that cyclical trends are similar for the years 2014 and 2015 contrary to 2013. This means that the largest amounts in 2014 and 2015 were disbursed in December (EUR 36.19 mln and EUR 42.64 mln respectively), while the smallest ones in January (EUR 27.49 mln and EUR 32.34 mln respectively). The necessity for additional and easily

receivable financial resources to cover the expenses for Christmas and New Year's holidays may explain such tendencies. The smallest amounts required in January may signal on the precaution of consumers at the beginning of the year. However, the year 2013 displays a different scene, i.e. the largest amounts are received in May (EUR 36.36 mln) and the smallest ones in November (EUR 30.05 mln). Here, the explanation may be related with the upcoming introduction of euro currency in 2014. The breakdown of disbursed credits by their types (Figure 2) demonstrates the preferences of consumers.

According to Figure 2, distance credits are the most demanded credit type accounting for approximately 40% of all non-bank credits. In 2015, the amounts of distance credits have grown by EUR 29.41 mln or 18.02% compared with 2012 with a considerable decrease in 2014 by 19.84% compared with the previous year. In general, the amounts of

Source: author's construction based on Patērētāju tiesību ..., 2016.

Figure 2. Breakdown of non-bank credits disbursed for the first time in Latvia
between 2013 and 2015, EUR mln.
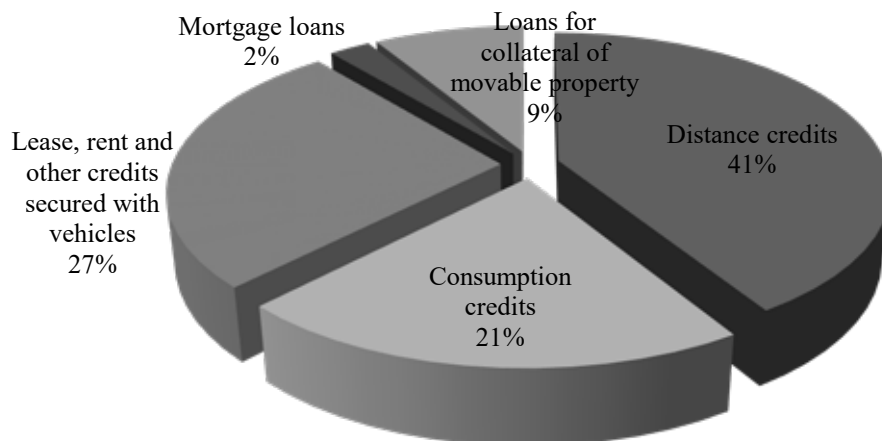
Source: author's construction based on Patērētāju tiesību ..., 2016.

Figure 3. Proportion of non-bank credits disbursed for the first time in Latvia in 2015, %.

disbursed distance credits have fluctuated during the analysed period. Steady growing trends between 2012 and 2015 are demonstrated by consumption credits and lease, rent and other credits secured with vehicles, where the credit amounts have increased by 47.99% and 89.79% respectively. Minor changes are observed for mortgage loans and loans for collateral of movable property.

In 2015, distance credits govern in all non-bank credits disbursed for the first time, since their share is 41%, followed by lease, rent and other credits secured with vehicles (27%), consumption credits (21%) and loans for collateral of movable property (9%). The smallest share is taken by mortgage loans (2%). The shares of mortgage loans and lease, rent and other credits secured with vehicles in total non-bank credits have not changed in 2015 compared with the previous year; however changes relate with other types of credits, i.e. the share of distance credits has increased by 4 percentage points, while the shares of consumption credits and loans for collateral of movable property have decreased by 3 and 1 percentage points respectively (Figure 3).

In general, according to the Consumer Protection Rights Centre, demand for non-bank credits has not changed significantly; though, the increase goes for the number of rejected applications. The primarily reasons for rejections include incompliability of consumers with the criteria for crediting, for example, members of Latvian Association of Alternative Financial Services disburse credits only to people older than 20 years (Patērētāju tiesību..., 2016). There is a requirement to submit a proof of income if a credit amount exceeds EUR 427 or the maximum credit amount is not disbursed if a person borrows for the first time. The average credit amount has declined by approximately 10% and it is about EUR 160 due

to the introduced requirements for the evaluation of consumers' solvency.

Annual percentage rate of charge (APR)

The annual percentage rate of charge (APR) is a very disputable issue when determining the price of non-bank credits, thus, it requires a more detailed study and interpretation. Historically, the formula for calculating the annual percentage rate of charge was introduced to facilitate the transparency and comparability of credit market and to increase the awareness of customers both consistent with the EU and national regulatory enactments. The necessity for the APR formula was based on long-term banking services and it has not been adjusted for short-term credits (up to one year). Therefore, the APR formula might be applied to compare traditional bank services; yet it may not be applied to draw a comparison between non-bank and traditional bank services. This instrument is inappropriate for the comparison of crediting products with the repayment term exceeding one year and those up to one year. Frequently, the APR for short-term credits is higher than for the long-term credits; though, in reality it may turn to be a cheaper credit instrument for a consumer. According to the PricewaterhouseCoopers, the APR is not an indicator to reflect the profitability for a customer in an individual situation (PricewaterhouseCoopers, 2013).

From the beginning of the harmonization process, it was considered that the total cost of credit should include all the costs that the consumer has to pay, including interest and other charges, and that these costs should be expressed in terms of an annual percentage rate of charge. It is this rate which provides consumers with a means of comparing credit across the EU. Hence, the APR are total credit costs expressed as annul interest of the total credit amount consistent

Table 1

The comparison between traditional bank and non-bank consumption credits based on the APR calculation

Type of credit / Expense	Traditional bank consumption credit	Non-bank consumption credit – 12 months	Non-bank consumption credit – 6 months	Non-bank consumption credit – 1 month	Non-bank consumption credit – 1 day
Principal credit amount, EUR	1000	1000	1000	1000	1000
Repayment period, months	36	12	6	1	1/30
Interest rate per annum, %	10	10	10	10	10
Advance payment of administrative costs, EUR	100	100	100	100	100
APR,%	16.68	28.41	44.04	131.00	251.74
Contributions, EUR	35.49	96.71	188.72	1109.17	1104.71
Total amount to be repaid, EUR	1277.78	1160.49	1132.31	1109.17	1104.71
Total overpaid amount, EUR	277.78	160.49	132.31	109.17	104.71

Source: PricewaterhouseCoopers, 2013.

with the Directive 2008/48/EC requirements. The equation expressing the APR and the equivalence for a year's period between the existing credit and total value of the remaining credit and costs is as follows: (Cabinet Regulation…, 2016).

$$\sum_{k=1}^{m} C_k (1+X)^{-t_k} = \sum_{l=1}^{m'} D_l (1+X)^{-s_l} \text{, where} \quad (1)$$

X – annual percentage rate of charge; m – number of the last drawdown; k – number of a drawdown, thus, $1 \le k \le m$; C_k – amount of drawdown k; t_k – interval, expressed in years and fractions of a year, between the date of the first drawdown and the date of each subsequent drawdown, thus t1=0; m' – number of the last repayment or payment of charges; l – number of a repayment or payment of charges; D_l – amount of a repayment or payment of charges; s_l – interval, expressed in years and fractions of a year, between the date of the first drawdown and the date of each repayment or payment of charges (European Commission, 2013).

The APR formula is envisaged for credits with the repayment term being expressed in years or parts of the year (t_k and s_l), which is the basis for interest rates on consumption credits issued by banks. The formula allows expressing the repayment term in days, for example, 14 days are expressed as part of the year – 14/365; however, the formula is not specifically applicable for consumption credits with short repayment period. The APR includes total cost of the credit to the consumer such as interest, commissions, taxes and any other kind of fees which the consumer is required to pay in connection with the credit agreement and which are known to the creditor, except for notarial costs; costs in respect of ancillary services relating to the credit agreement, in particular insurance premiums, are also included if, in addition, the conclusion of a service contract is compulsory in order to obtain the credit or to obtain it on the terms and conditions marketed (Cabinet Regulation…, 2016). The APR does not reflect the actual amount of overcharge or the credit price – a credit with a high APR may cost cheaper for a consumer. Table 1 depicts the comparison between the traditional bank and non-bank consumption credit prices to show the inappropriateness of such comparison.

The audit company PricewaterhouseCoopers has developed this comparison to prove that the APR is not a desirable instrument to compare bank and non-bank credit services, since the APR amount differs for identical credit amounts with identical interest rate and advance payment but various repayment periods. The research author draws attention to the total overpaid amount, which is the highest for traditional bank consumption credits (EUR 277.78) with a repayment period of 36 months, while a similar non-bank consumer credit with the repayment term 1/30 of a month requires overpayment of EUR 104.71. This comparison is illogic, as in accordance with the data provided in Table 1, a credit with the highest APR costs much less for a consumer than a credit with the lowest APR. The basic determining factor is the period of credit repayment.

Table 2

The average weighted fixed interest rates (AWF) and annual percentage rates (APR) for non-bank credits in Latvia for the period 2013 – 2015, in December, %

	2013		2014		2015	
	AWF	**APR**	**AWF**	**APR**	**AWF**	**APR**
Mortgage non-bank loans	14.61	-	16.12	-	14.30	-
Leasing and another loan secured with a vehicle or other property	32.54	41.71	40.54	50.87	31.87	43.20
Consumption credits						
repayment terms – 1 payment with a period up to 14 days	378.85	789.37	396.24	857.40	245.92	234.80
repayment terms – 1 payment with a period more than 14 days	266.29		396.24		99.76	
repayment schedule and/or credit line	35.29	90.59	41.96	102.88	31.93	64.68
Distance credits						
repayment terms – 1 payment with a period up to 14 days	248.98	255.30	240.94	228.09	230.26	210.50
repayment terms – 1 payment with a period more than 14 days	115.56		110.39		112.43	
repayment schedule and/or credit line	76.61	162.87	82.43	162.24	77.77	123.20
Loans against pledge of movable property	176.56	-	180.37	-	185.26	-

Source: author's construction based on Patērētāju tiesību..., 2016.

Non-bank credit market is saturated and there is a fierce competition between non-bank crediting companies in terms of interest rates, crediting conditions and other factors. Non-bank credit companies apply two types of interest rates for their services: the average weighted interest rates (fixed and variable) and the annual percentage rate of charge. The average weighted fixed interest rates are considerably higher compared with the variable rates. The significant difference between the low interest rates on contracts with variable interest rate with the repayment period up to 1 year and the high interest rates on contracts with the fixed interest rate is determined by factors that the first type of contracts in most cases is concluded between consumers and non-bank crediting companies that have access to cheaper financial resources, in turn the second type of contracts is concluded between consumers and non-bank creditors to which financial resources are limited (they have to buy them for higher prices) and who, when concluding transactions, undertake greater risks, which later are featured in the borrowers' interest rates and credit amounts. Table 2 reflects the comparison between the average weighted fixed interest rates (AWF) and annual percentage rates (APR) for all types of non-bank credits in Latvia. The analysed period covers only 3 years, since the information on non-bank credit companies and services provided by them are gathered only from 2013. The rates are compared for December following the principle that

financial information is summarised at the end of the year; however, interest rates fluctuate throughout the year.

The highest interest rates both the average weighted interest rates and the annual percentage rates are observed for consumption credits and distance credits, followed by loans against pledge of movable property; while the lowest rates are for mortgage non-bank loans and leasing and another loans secured with a vehicle or other property. Interest rates for mortgage non-bank loans issued for the first time have declined to 14.30% in December 2015; the decline is by 1.82 percentage points compared with the respective period in 2014. The highest rate was observed in August 2014 (21.18%), while the lowest one in August 2015 (14.26%). The weighted average interest rate on mortgage loans with a variable rate is not evaluated because only one company disburses these loans for small amounts. Interest rates on loans against pledge of movable property have increased by 8.7 percentage points. In general, these credits gradually become more expensive at the almost constant number of new credit agreements and the balance of credit portfolio. The average weighted fixed interest rates for consumption credits with the repayment terms – 1 payment with a period up to 14 days have decreased by 132.93 percentage points, these interest rates have experienced historically highest values (402.70% in February 2015) and historically lowest values (245.92% in December 2015). Consumption credits

with the repayment terms – 1 payment with a period more than 14 days produce similar fluctuations; yet the decrease is more considerable compared with the credits to be repaid up to 14 days, i.e. 166.53 percentage points. According to the Consumer Protection Rights Centre, such a decrease may be related with the introduction of stricter restrictions for the operation of non-bank credit companies from 2016 (Patērētāju tiesību..., 2016); thus, companies ensured their crediting activities through offering much lower interest rates. Consumption credits with the repayment schedule or credit line are subject to the smallest fluctuations. The annual percentage rates for consumption credits show dramatic differences; here, rates are reflected for the repayment term more than 14 days. This group of credits has traditionally high interest rates and sensitivity towards periodic increases (additional costs etc.); thus the highest rate of 3400.52% was in July 2015, while the lowest one – 234.80% in December 2015. Distance credits reflect the most moderate fluctuations through the whole analysed period with a decreasing trend till December 2015. It is impossible to unanimously interpret the reason for fluctuations and difference, since there are more than 50 non-bank credit companies providing alternative credits and each of them follow their own business terms and application of particular interest rates.

Conclusions

1. Non-bank credit companies without customer deposits have transformed the present credit market, since a number of new players entered the market testing new business and crediting models and providing solutions to credit-challenged customers.

2. The popularity of non-bank credits is still growing among consumers, since the total amounts of non-bank credits disbursed for the first time have increased by EUR 116.61 million or 33.18% for the period 2012 – 2015 with distance credits being the most demanded credit type accounting for approximately 40% of all non-bank credits.

3. The annual percentage rate of charge (APR) is not a desirable instrument to compare bank and non-bank credit services, since the APR amount differs for identical credit amounts with identical interest rates and advance payments but various repayment periods, as a credit with the highest APR may cost much less for a consumer than a credit with the lowest APR. The basic determining factor is the period of credit repayment.

4. The APR is higher as it includes total cost of the credit to the consumer such as interest, commissions, taxes and any other kind of fees which the consumer is required to pay in connection with the credit agreement and which are known to the creditor, except for notarial costs.

5. The comparison of the average weighted interest rates (AWF) and the annual percentage rates of charge (APR) demonstrates that the highest rates are observed for consumption and distance credits with the repayment terms – 1 payment with a period up to and more than 14 days; while the lowest rates are determined for the mortgage non-bank loans.

6. Non-bank credit market is saturated and there is a fierce competition between non-bank crediting companies in terms of interest rates, crediting conditions and other factors; thus, the terms for licensing non-bank companies should envisage more detailed procedure for those companies which apply unfair treatment of consumers.

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ENTREPRENEURSHIP EDUCATION AT UNIVERSITY: INNOVATIVE MODELS AND CURRENT TRENDS

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Abstract
Entrepreneurship education is a relevant topic in today's study programs of higher education at two levels: as research object and as development of skills while preparing students. In fact, the latter is one of the most important objectives in Lithuanian universities aiming together with other disciplines at developing students' entrepreneurial skills. The main aim of the article is to analyze theoretical and practical models of entrepreneurship education applied in universities and introduce development trends. Teaching process involves various methods, internships, consultation and instruction, but usually all activities are not systematically applied. From the behavioral perspective, this study analyses students towards entrepreneurship through the opportunity identification, motivational factors, information source, resources impact and entrepreneurial ability. Hypothetical deductive approach was used through a population sample of 194 students of Aleksandras Stulginskis University Faculty of Economics and management. The research summarized in this paper students attitude toward motives, factors encouraging and preventing entrepreneurship and information sources in the higher education institutions. The gap between teaching methods and student attitude towards at entrepreneurship educations can be reduced supplementing collaboration among stakeholders in the entrepreneurship education. In final part of the article, trends of entrepreneurship education in university enabling to assess dimensions of the development of entrepreneurship education are presented.
Key words: entrepreneurship, higher education institutions, entrepreneurship, models and methods of entrepreneurship education.

Introduction

In Lithuania promotion and development of youth entrepreneurship are based on provisions determined by the European Union (Resolutions of the Government of the Republic of Lithuania, 2012). Entrepreneurship of young person is highly prioritized, because young people have a great potential and are able to create new job opportunities as well as to ensure overall economic growth (Youth Opportunities Marketing, 2015). Also, promotion of entrepreneurship and establishment of new ventures is one of the most important objectives of Lithuanian economic policy – in the third part of the first point of National Progress Program 2014 – 2020 the following objective is determined 'To promote leadership, youth and children entrepreneurship and preparation for the labor market' (Resolutions of the Government of the Republic of Lithuania, 2012). Entrepreneurship is a key factor for economic growth therefore, it is necessary to prioritize initiatives raising public awareness and development of entrepreneurial competences. Entrepreneurship education is implemented while using various methods, theories, models and measures. All applied Lithuanian measures (Youth Entrepreneurship Valuation Toolkit, 2013) promoting youth entrepreneurship can be classified into two large groups: development of entrepreneurial competences ('soft elements') and assistance for business development ('hard elements'). 'Soft elements' – teaching, motivation, education, consultation and other activities of a similar nature. 'Hard elements' –

measures, which directly or indirectly subsidy business ('start-up' finance, various tax concessions for business development, credits, etc.)

Despite the fact that entrepreneurship education is prioritized in Lithuanian economic policy (Resolutions of the Government of the Republic of Lithuania, 2012), ways and measures to promote youth entrepreneurship are often still to be searched. Gegieckienė & Grikšienė (2009) stated that entrepreneurship is innate and acquired human quality allowing person to operate actively and be not afraid to risk. However, after analyzing theoretical literature related to entrepreneurship, it can be concluded that the issue regarding personal qualities promoting entrepreneurship is relevant. Driessen & Zwart (2010) distinguishes 4 main elements regarding entrepreneurship: knowledge, skills, motivation, personal qualities.

There are many different views in scientific literature how entrepreneurship education should be organized and which methods are most effective. According to Ansari *et al.* (2014), it is important to select what kind of education programs should be applied, that they would develop thinking and encourage them to take actions as well. The essence of this theory is to connect knowledge and experience in the way that these elements would become a clear base for further development or, in other words, there would not be necessity to start again from the beginning. One of the most important ideas is that entrepreneurship can be taught (Rae, 2014); however, it must be applied to specific economic situations and

circumstances. While organizing learning process it is important to use knowledge regarding innovations, technologies and best practical examples. Lahm & Rader (2014) states that technological platforms, social networks play an important role in strategy of entrepreneurship education. Ji & Zhao (2014) distinguished main components of entrepreneurship education in educational institutions. The system is composed of: (a) students, (b) teachers, (c) 'carrier' and (d) environment.

Saeed, Muffatto & Yousafzai (2014) after researches with 805 students in various universities in Pakistan have proved that practical entrepreneurial activities at university made a positive influence towards the process of entrepreneurship education. This process should involve students in those tasks, which promote self-efficacy, risk-taking propensity and innovation development. Täks *el al.* (2014) after qualitative research performed with engineering students, described four categories of entrepreneurship education directions: (a) first step toward self-directed learning, (b) preparation for work life, (c) path to self-employment and (d) context for developing leadership and responsibility for team achievement. Ortega *et al.* (2014) analyze entrepreneurship education while paying attention to the implementation of various projects, trainings, examples of prominent persons and knowledge creation. Sánchez (2011) raises several important questions related to relations between entrepreneurship and education: what is the meaning of entrepreneurship education? Is entrepreneurship education the same as training for enterprise establishment? How it differs from gaining business education? What relation is between teaching business peculiarities and learning in business enterprise? Do the programs of entrepreneurship education influence entrepreneurial activities?

Entrepreneurship education begins from the development of human creativity, learning to plan and organize, goal achievement, problem solution and innovations (Gamez, 2013). Entrepreneurship education enables students to adapt more easily in dynamic business world and they can become employees who help enterprises compete in the world (Singh & Magee, 2001). This can be achieved while using such measures as trade games, imitations, business conferences, consultations on business examples, forums, seminars, business platforms and laboratories (Herrera, 2010). In the phase of primary education, the objective of entrepreneurship education would be to strengthen the capacity for creativity; help to understand risk and planning. In secondary school – to develop business thinking, which would help to establish and control enterprise starting from small steps. In colleges and universities, the important factors are interdisciplinarity, work with others and

development of various business forms: business, social business, public sector, entrepreneurship, etc. It is important to develop the capacity to analyze economic, social, cultural, technological environment and suggest new ideas. Personal competences: social sensitivity, goal achievement, self-confidence, perception amplitude, empathy, conceptual thinking, decision making and action orientation. Entrepreneurship education involves four stages: entrepreneurship on theoretical level – early stage of academic programs, generation of creativity and ideas – middle stage, business – social plan and support – final stage. Entrepreneurship is a learning process, which continues throughout life; it begins at home while watching examples of parents and other persons, continues in primary and secondary schools, university and even after graduation of continuing education (Pérez, 2014). Higher education can develop human capacity to control, move from ideas to actions, identify possible problems. Businessman as the founder and manager of enterprise seeks to ensure stability while using various methods and styles for making decisions.

University assesses the educational process throughout interaction with students while analyzing their reactions, imitativeness and desire for continuous improvement. Model of entrepreneurship education at university includes three stages (see Figure 1). Traditional methods for entrepreneurship education such as seminars, trainings, lectures, events and etc., form the first stage of model in economic based on knowledge. In order to stimulate behavioral changes and development of psychological characteristics necessary for entrepreneurship, other stages of the model are oriented towards actions and practical tasks. Tools for simulating the development of new business, for instance, business plans, creating and thinking about them together with mentors and consultants, allows to go successfully to the third stage. Students have to be encouraged to participate in national and international contests for developing ideas, broaden their professional horizons and create partnership of business projects. Entrepreneurship promotion and support is prepared quite well at school level in Lithuania; however, it is almost not applied in institutions of higher education. It is a significant gap while paying attention to the role of universities in organizing education and transferring knowledge and scientific researches to the business community and preparing students for labor market. Opportunities to acquire basics of entrepreneurship in institutions of higher education for students are not coherent and not compatible with efforts to organize entrepreneurship education in secondary school. Thus, despite the fact that the educational institutions are autonomous, politicians have a task to convince Lithuanian

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                    ┌─────────────────────────────────┐
                    │       Academic programs         │
                    └─────────────────────────────────┘
                                    ⇩
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                 │  Centre for Entrepreneurship Development  │
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         ┌──────────────────────────────────────────────────────┐
         │                      Stage 1                         │
         │   Seminars, training, lectures, events, conference   │
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    │          Stage 2.1          │   │            Stage 2.2            │
    │  Practice of enterprise     │   │  Business idea- social project  │
    │          training           │   │          competitions           │
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         │                      Stage 3                         │
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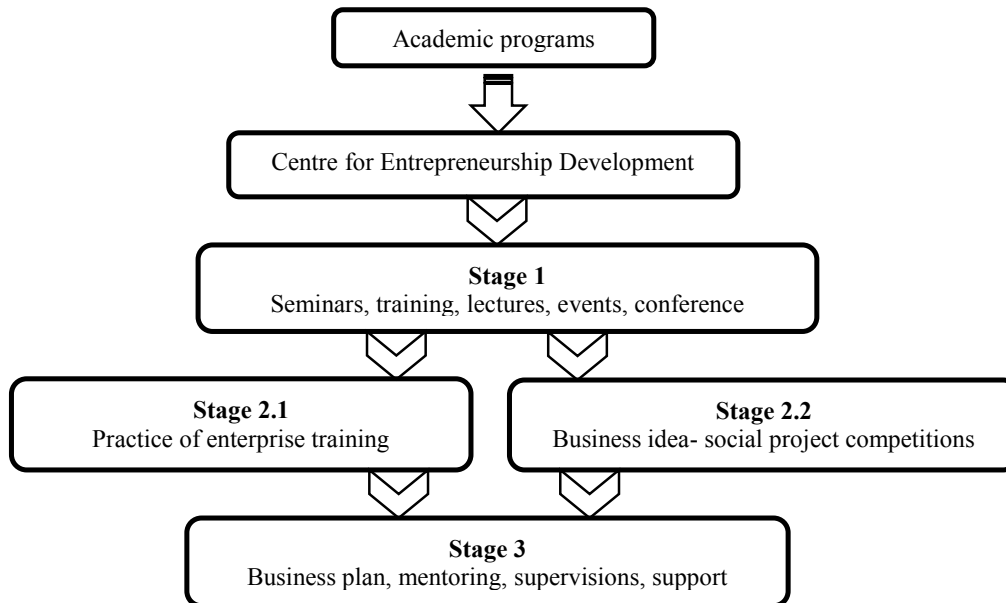
Figure 1. Model of Entrepreneurship Education at University (developed by the authors).

institutions of higher education that entrepreneurship promotion and support are necessary and useful for students and educational institutions as well.

It is necessary to pay attention to the fact that all measures, programs and suggestions for entrepreneurship education have to encourage people to start their own business. However, general scientific researches show that business establishment raises a number of fears and has an evident connection between acquired knowledge and motivation to become businessman. Thus, it can be stated that, in order to conduct research, the main priority was to identify students' motivation to connect their lives with business world. If the students have a low need to become businessmen, measures of entrepreneurship education can be ineffective. However, the suggested general model can help for each student to find out his or her value. Therefore, specific models can be applied only in that case if students believe in what they are doing. Clear framework and informatively presented entrepreneurship opportunities can motivate students to participate actively and become involved in certain activities promoting entrepreneurship.

Research problem – practical models of entrepreneurship education applied in universities while educating students.

The research task – to determine the tendencies of development of entrepreneurial competences in universities and application of their principal patterns among students.

Materials and Methods

In order to estimate entrepreneurship education at university, students of the Faculty of Economics and Management of Aleksandras Stulginskis University were chosen. In addition, two researches were conducted. Firstly, case analysis was performed for the sake of identification of activities related to promotion of students' entrepreneurship at the faculty. The analysis covered period running from 2014 to 2016 inclusive (three years). Case analysis helped to indicate initiatives and performed actions in relation to promotion of students' entrepreneurship. This method helps to analyze situation and identify necessary factors for further research, because it is appropriate to complement data with quantitative research (Žydžiūnaitė & Sabaliauskas, 2017). During the second research, students of the first cycle full-time studies were interviewed. The goal of interviews was to find out whether activities and initiatives carried out influence students' entrepreneurship. It is necessary to pay attention to the fact that questions in questionnaire are generalized and let to analyze the situation. Sample survey include 194 students (Kardelis, 2016), 375 students in total are studying in the first cycle full-time studies, research bias 5%, sample survey was calculated according to Kasnauskienė (2010). Questionnaire was established while following researches conducted by the scientists in the field of entrepreneurship education. The conducted research and presented results can be called the first research which is aimed to learn students' attitude. It is appropriate to analyze each component included in the model of entrepreneurship education separately in further research.

Method of case analysis was used to analyze measures of entrepreneurship education applied in the first and second cycles full-time studies at

the Faculty of Economics and Management of Aleksandras Stulginskis University. After the analysis, it was determined that measures of entrepreneurship education can be classified into several groups:

- Seminars. 35 seminars on the promotion of entrepreneurship have been organized since 2014. The main tendency of these seminars: the main focus is on invited guests, who tell about their business experience. Today's business leaders participate in these seminars. Also, seminars are organized around certain topics – from generation of business ideas to commercialization of produced products. After the analysis of the lists of the participants, it can be stated that there were averagely 50 students participating in each event.

- Business idea competitions. Business idea competitions are organized annually. In 2014 – 1 competition, 2015 – 1 competition, 2016 – 2 competitions. Average number of received ideas – 12. Not only students but as well as pupils are invited to participate in business idea competitions. Competitions are closely connected with seminars – firstly, thematically seminars are suggested, later participants of competitions are registered and finalists make presentations to the panel. Participants of the business idea competitions have already prepared business plans, their products are already developed or in the process of development. This indicates a high level of entrepreneurship of students participating in these competitions.

- Programs of business education integrated in studies. Students of the first and cycle full-time studies have already a subject "Entrepreneurship"; later, business studies and analysis continue in other subjects. During the last study years, students use their entrepreneurial knowledge in the subject Practice of Entrepreneurship Education. While studying this subject, students work in enterprise simulation, get acquainted with finance management and production management. Also, all students wanting to try themselves can run the company.

After performed case analysis it can be stated that in the Faculty of Economics and Management of Aleksandras Stulginskis University entrepreneurship education is being implemented in coherent and intensive way (i.e., business idea competitions are included in annual action plan, subjects and entrepreneurship practice are included in study program, function of seminars and other organized events on the topic of entrepreneurship is appointed

to the Entrepreneurship Development Center) and it involves up to 500 students every year.

The second research is aimed to estimate students' motivation for being businessman and analyze their information channels, which provide them with information regarding programs of entrepreneurship development; in this way, the first element of the model of entrepreneurship education is analyzed and students' need for entrepreneurship is assessed. To present quantitative descriptions in a manageable form was used Descriptive Statistic method. The first group of questions was composed of respondents' demographical data. In the research participated 108 females and 86 males. Respondents' age 19 – 25 years old. The study uses Likert-type five-point scale. The second group of questions was composed of 9 statements – respondents were asked to estimate statements from 1 (totally disagree) to 5 (totally agree). Statements represent the following question: what kind of motives would encourage respondents to establish their own business?

Results and Discussion

Respondents estimated every statement; in order to assess the value of statements, point averages were calculated. Students defined a possibility to earn money as the most important motive for business establishment (4.2 points). The statement about financial success is in the second place (4.1 points).

Also, the respondents relate entrepreneurship to carrier possibilities in business world (4.0 points – respondents agree with this statement). The most evident negative evaluation is related to business establishment for solving societal problems (2.2 points). As a result, it can be concluded that a possibility to solve societal problems is not relevant to this group of respondents. However, if the respondents would establish their business, they would act while following their values (3.9 points). Answers related to business oriented towards a solution of a specific problem or changing standing practice were estimated similarly – averagely 3 points and in grading scale this means neither 'I agree' nor 'I do not agree'. In scientific literature it is emphasized that motivation for entrepreneurship can be realization of personal competences; thus, respondents were able to share their opinion regarding this statement. However, the respondents' opinions were different – the majority of respondents agreed with this statement. According to the theoretical overview, entrepreneurship has to be oriented towards a solution of a specific problem; however, this research shows that respondents are not sure about the reliability of this statement and answers distributed between positive and negative evaluations.

In addition, other questions related to the measures, which have to be taken in business, also provided
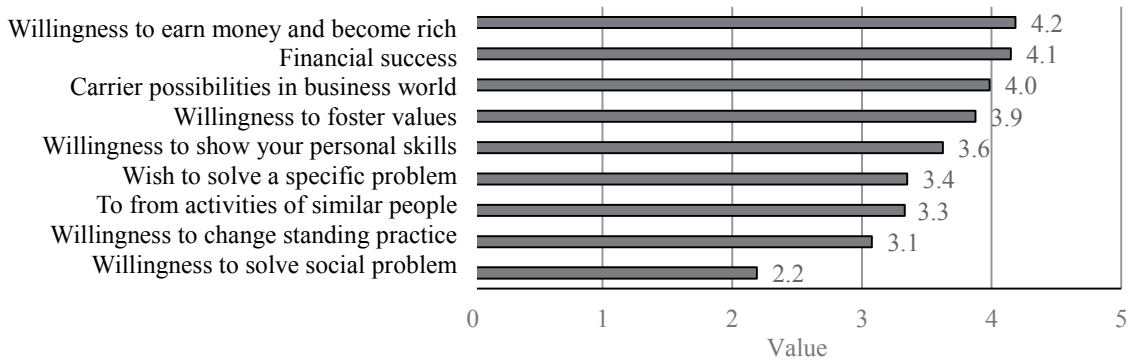
Figure 2. Students' Attitude towards Motives Encouraging Entrepreneurship.

a lot of information. The main goal was to find out respondents' opinion. 8 statements were presented, they were estimated from 1 (totally disagree) to 5 (totally agree).

After analyzing respondents' answers, it can be stated that motivation for business establishment is a very important factor – average of respondents' estimation is 4.7 points. Also, according to the respondents, it is very important to have a good business idea for business establishment (4.7 points). The third important factor is a good team (4.4 points). In theoretical analysis, it was emphasized that knowledge is very important for business establishment. The conducted research has shown that respondents put this statement in the fourth place (4.3 points), and in the fifth place is a need to consult with experienced businessmen (4 points). The aim of this group of questions was to estimate what is more important for respondents: support from family or support from friends. The research revealed that respondents appreciate more support from family (3.6 points) than from friends (3.1 points). However, it can be noted that the statement about money relates to the statement presented the first group of questions – money is an important factor for business establishment, according to the respondents (3.7 points).

In the theoretical part of the article and case analysis, various events, seminars and other knowledge

sources were defined as important elements in entrepreneurship education. Thus, respondents were asked to estimate 10 information sources from 1 (totally disagree) to 5 (totally agree) while answering the questions from the fourth group.

Respondents define the internet as the most important information source (4.2 points), also, as a more specific information source for entrepreneurship, social networks can be identified (4.0 points). Moreover, they stated that a lot of information related to business is transmitted by the teachers during the lectures (4.1 points). Case analysis has shown that many events related to entrepreneurship education are organized at university and respondents defined them as information source for entrepreneurship (3.8 points). Summarized research results show that newspapers (2.3 points), magazines (2.4 points), books (2.3 points), teachers (2.2 points) and school events (2.3 points) are not supported by respondents. Information sources estimated by 2 points or less correspond to the statement 'I do not agree'. To sum up, respondents use internet and information provided by the teachers during lectures.

In the last question respondents were asked to estimate 16 statements and those statements, which were estimated by outstanding points, are discussed further. As the main statement respondents excluded knowledge – if they would have enough knowledge,
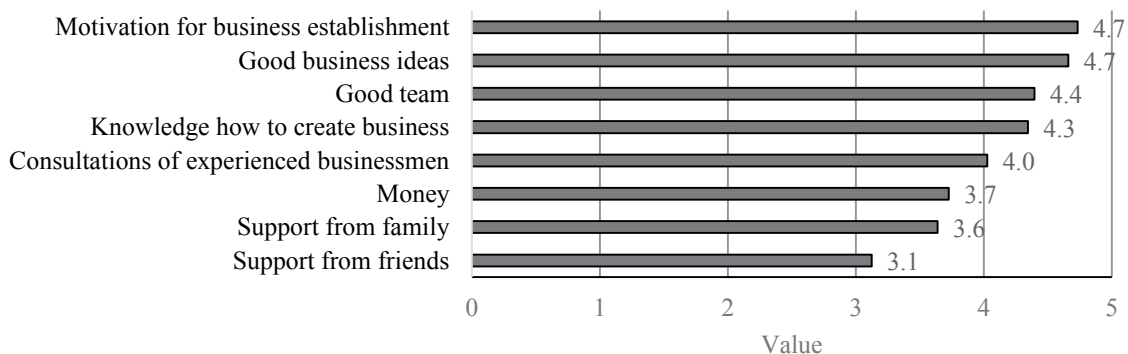

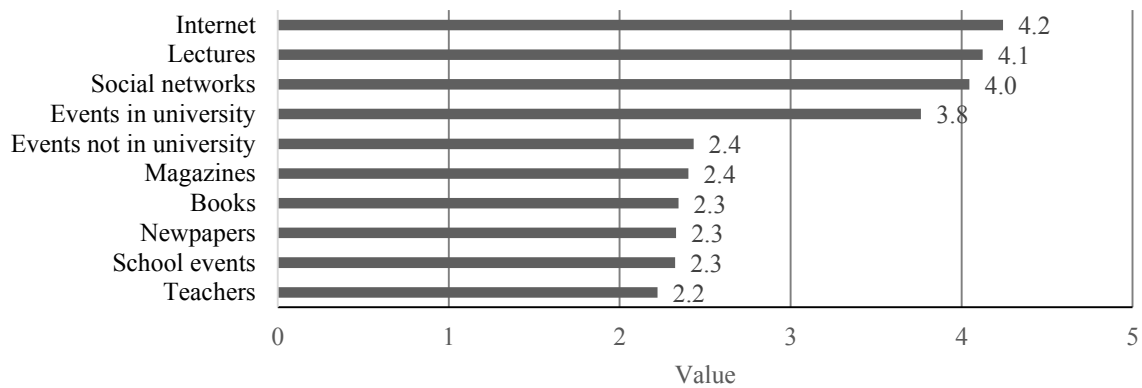Figure 3. Factors Encouraging and Preventing Entrepreneurship.

Figure 4. Information Sources Related to Entrepreneurship.

they will establish their own business (4.2 points). Respondents participating in research agree with the statement that your own business means a lot of work, little time; however, business carrier is attractive to respondents. In the theoretical part a factor of motivation was distinguished – the fact that this is an important factor is confirmed by the respondents – they think that they are motivated and try to fulfill their objectives. Also, it can be noted that respondents are determined to establish their own business in the future (4 points). The research data shows that respondents would be determined to establish their own business and put all efforts (4 points). However, it should be concluded that a good idea is necessary for business (this is stated by the respondents while answering the question presented earlier), but in this section, they state that they do not have business idea which they are willing to implement (2.2 points). The last question helped to determine the most important factors describing respondents' motivation to have business; however, the analysis has shown that many respondents do not have business idea, but they would like to have their own business.

The propose of the study is to assess the determinant factors and motives that influence students' entrepreneurial readiness. This is important for constructing success Entrepreneurship education model at university. This paper represents one of the few empirical analyses of the on-going debate how entrepreneurs can be developed. There are various factors that can influence readiness of young people towards entrepreneurial activities. As show Macke & Markley (2003) entrepreneurs may want to create new venture due self-sufficiency, lifestyle, necessity or desire for wealth, some of them may be ready for new start-up business due ability to explore new area, attractiveness of business idea, entrepreneurship program, willingness to invest and ability to create entrepreneurial team. There are various components of entrepreneurial motivation. Woo, Cooper and Dunkelberg (2000) found that ability to obtain high

profit and create successful new venture will generate higher motivation towards new business start-up. In addition to analyzing the use of various information sources the research question is formulated as follows: what kind of information sources can be used in the Entrepreneurship education model at university, that students can get information in the best way. The training should be more practical that theoretical. The entrepreneurship programmes should be more of real world activities. Students can get more useful knowledge and gain from success entrepreneurs' experiences if the training is more extensive. This may be done by allowing the students to do innovative business as practical. Entrepreneurship education model should assess the entrepreneurial capacity; discover the inner skills of the prospective entrepreneurs.

Conclusions

Entrepreneurship education in higher education institutions is considered to be a relevant area of research focus since on a theoretical level entrepreneurship education is treated as priority among various activities of educational bodies that encourages youth to establish their own business. Entrepreneurship education is often defined in the key institutional documents, however, problems arise in implementing goals. The major measures applied are study subjects integrated into the study process, seminars, events and conferences as well as mentoring and training. However, the performed theoretical analysis shows that although different measures are adopted by universities, the motivation of the target group (e.g. students') to have a specific mind-set of an entrepreneur and be eager to start a business is of the paramount significance. According to the theoretical analysis entrepreneurship becomes experienced and practical process. This type requires structural changes in educational system and new teaching methods.

The offered model demonstrates the constituent elements of entrepreneurship education at universities, however, the applicability and benefits of the model

should be thoroughly explored as well. A special attention should be paid to identify the opportunities for students to come closer to the real business environment. The investigated students showed that their motives and factor encouraging entrepreneurship are good examples. To improve entrepreneurship education model for the future training we should conduct a teaching methods on how business can be set-up. This can be achieved by inviting successful entrepreneurs to share entrepreneurial knowledge. This research need to be continued in order to investigate the best ways and methods how success to share successful entrepreneurs experience to students. Further investigation should focus on the effectiveness of entrepreneurship education programs and the impact on motivating students to establish their own business.

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STUDENTS' OPINIONS ABOUT THE PROSPECTIVE HOSPITALITY MANAGER'S COMPETITIVENESS DURING PEDAGOGICAL EXPERIMENT

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Abstract
Academic staff of higher education institutions has to extend students' vision and promote their variability of views on competitiveness in order to promote prospective hospitality managers' competitiveness. The aim and goal of academic activities of the university teaching staff is to search for appropriate or relevant means and provide the necessary conditions to foster the students' thinking and understanding of the concept of 'competitiveness' according to a new paradigm of this notion. The pedagogical experiment was carried out at the Latvia University of Agriculture. The aim of the study was to promote the opinions' change regarding the notion of prospective hospitality managers' competitiveness; the developed competitiveness self-assessment method was used as a pedagogical tool. The results of the research (the concluding statistics of the Wilcoxon test and the Sign Test) show that the students' opinions regarding the notion of prospective hospitality managers' competitiveness have significantly changed before and after their competitiveness self-assessment. Thus the theoretically grounded method of competitiveness self-assessment approved by students and experts, including a questionnaire of the students' survey, significantly extended the students' vision as a pedagogical tool influencing the opinions regarding competitiveness notion among representatives of the prospective hospitality managers' profession.
Key words: competitiveness, essays content analysis, competitiveness self-assessment method, pedagogical experiment, prospective hospitality managers.

Introduction

The notion competitiveness in modern educational space is used to denote the combination of personal and professional qualities of a prospective specialist based on the experience acquired during the life time, including education process which to a great extent characterizes one's flexibility and vitality in the time of dynamic and changeable environment. The human adaptation abilities to changeable conditions are both a prerequisite and a result of competitiveness development (Katane & Iriste, 2013). Members of academic staff during the study process at the university have to foster the broadening of prospective hospitality managers' vision and changeability of opinions regarding competitiveness so that they can become competitive specialists. In order to ensure the competitiveness of students of any speciality, updated study plans have to be: flexible, they should comprise study courses demanded in both the market of education services and labour market, they should provide training of specialists in strategic directions, as well as, according to the current requirements, combine fundamental and innovative training. The aim and goal of academic activities of the university teaching staff is to search for appropriate or relevant means and provide the necessary conditions to foster the students' thinking and understanding of the concept of 'competitiveness' according to a new paradigm of this notion (Katane & Kalniņa, 2010).

Currently not only a paradigm of personality's/ specialist's competitiveness is changing but also a paradigm of higher education in order to maintain sustainability of the society. The focus has shifted from the 'teacher-centred' approach to 'student-centred' approach or from teaching to learning (Гребнев, 2004), because prospective specialists not only have to learn to acquire ready knowledge but they have to search answers to questions and solve problems by themselves during the study process. Globalisation process, the rapid development of science and introduction of innovation into our lives have led to an increase of new information flow at the huge scale and pace; information quickly is becoming obsolete. Therefore, the transition from factual learning to problem-based learning occurs promoting critical thinking, when prospective specialists have to develop judgment and decision-making abilities, creativity, media competence, including the ability to quickly find, evaluate and select the valid information they need.

The aim of the study was to promote the opinions' change regarding the notion of prospective hospitality managers' competitiveness.

Materials and Methods

The **pedagogical experiment** was carried out at the Latvia University of Agriculture and was one of several research stages. The developed competitiveness self-assessment method was used as a pedagogical tool.

The research took place at the Latvia University of Agriculture, Institute of Education and Home Economics, where prospective hospitality managers' competitiveness assessment method was developed, and at the Faculty of Food Technology, the Nutrition Department, where the experiment took place. The

22 4th year undergraduate students of the study programme Catering and Hotel Management were invited to participate in the experiment.

The pedagogical experiment was held in 2015/2016 and comprised several stages (Fig. 1) described below:

- In March of 2016, the 22 4th year undergraduate students of the study programme Catering and Hotel Management wrote an essay 'Describe a competitive hospitality manager!'.
- In April of 2016, the 22 4th year undergraduate students of the study programme Catering and Hotel Management performed competitiveness self-assessment of themselves as prospective hospitality managers applying the competitiveness self-assessment method worked out by the authors.
- In May 2016, the 22 4th year undergraduate students of the study programme Catering and Hotel Management wrote a repeated essay 'Describe a competitive hospitality manager!'.

The following **research hypothesis** was put forward: if competitiveness self-assessment method worked out by the authors of the article is applied as a pedagogical tool during the pedagogical experiment, it is possible to extend the prospective hospitality managers vision and promote the change of opinions regarding the notion of competitiveness in the context of the new paradigm.

The requirements for the essay 'Describe a competitive hospitality manager!' both before and after prospective hospitality managers completing the questionnaires were the following: 1) the size of an essay: 1 page, 2) the deadline of the submission into LLU e-learning environment: 2 weeks; 3) characters (with spaces) 5000.

The essays 'Describe a competitive hospitality manager!' were submitted by each of 22 4th year students of study programme Catering and Hotel Management.

In order to find out if the students' opinion has changed regarding the notion of prospective hospitality managers competitiveness, students performed self-assessment of their competitiveness between the 1st and the 2nd essay 'Describe a competitive hospitality manager!'. The research used the competitiveness self-assessment method theoretically grounded, approved by students and specialists-experts, including a questionnaire of the survey, as a pedagogical tool of the experiment in order to promote changes in students' opinions regarding the competitiveness of representatives of their profession.

The completion of the questionnaire took 35 minutes at the presence of the authors in the premises of the Nutrition Department.

The research data were obtained by analysing and evaluating essays using the method of content analysis.

The origins of the method of content analysis dates back to the beginning of the previous century; it has been included in the Webster's Dictionary since 1961 (according to Prasad, 2008). The founders of the content analysis are considered to be H. Lasswell (Lasswell, 1948), an American sociologist, who suggested to use statistical analysis for abstract linguistic units, and French journalist J. Kayser (Kayser & Renouvin, 1963), who in the 60s of the 20th century worked out the system for the analysis of long texts on the basis of statistical analysis.

Content analysis is the method in which verbal information is being translated into more objective nonverbal form (Пашинян, 2012) with the help of which:

1. the content of communication undergoes objective, systematic and qualitative analysis (Berelson, 1952) to measure variables (Kerlinger, 1986);
2. the obtained conclusions exceeds a specific character of a concrete document and are obtained on the basis of any data analysis of the meaning of its constituent elements (Kroplijs & Raščevska, 2010);
3. documents are compressed and categorized in order to classify, systematize, tabulate their content (Дмитриев, 2005), discover or measure different facts and trends reflected
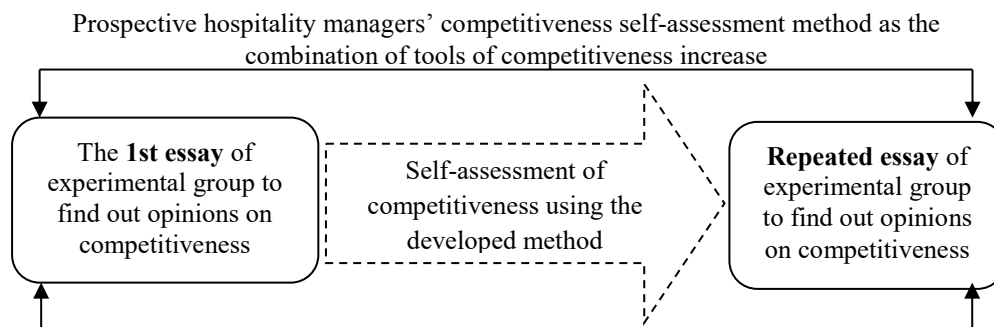

Figure 1. Procedure of the experiment (Source: constructed by the authors).

in the social context of these documents (Семёнова & Корсунская, 2010).

The analysis of definitions of content analysis shows that the emphasis is placed on such aspects as regularity, objectivity, quantification, context and validity – with reference to the conclusions resulting from communication content of a message sender, message receiver.

Researchers distinguish between two levels of content analysis (Geske & Grīnfelds, 2006): 1) manifest level is a descriptive account of the data without going into details of its meaning; 2) interpretive level reveals the meaning of content and conclusions that can be implied.

There are also two approaches of content analysis which often are combined (Kroplijs & Raščevska, 2010).

- Inductive content analysis. It starts without previous theories, assumptions. The data are viewed as diffused, disorganized groups of separate pieces of information, each of which is worthy of attention. A researcher's task is to see the overlapping topics covered by these groups and provide some clarification on the issue under consideration.

- Deductive approach. It is based on clear assumptions which are based on theories. A researcher's task is to discover qualitative differences which reveal constructions of respondents' realities in a specific theme, instead of searching quantitative differences between an experimental and control group on some issue.

The content analysis contains several steps or stages of the analysis procedure (Josselson & Lieblich, 1993; Дмитриев, 2005; Манекин, 1991; Семёнова & Корсунская, 2010).

- A research question(s), objectives are set which a researcher desires to find out with the help of the content analysis.

- Selection of communication content and samples.

- Division of communication content into extracts or content units revealing a respondent's statements which characterise/interpret his/her experience.

- The meaning of content units is explained and grouped in analytical categories. Thus experiences of individual respondents are combined building 'a bridge to another real-life situation'. The researcher expresses categories in the terms of psychology or education (abstract and general), otherwise the analysis will not generalize what respondents said and will be just a repetition of his/her words.

- Encoding and analysis of the obtained data.

- Fitting notions in a structure, i.e., a model or theory which could explain notions, scale, dynamics of phenomena, restrictions of existing theories or discovery of specific cases as well as formation of new theories.

The concept of content analysis is revealed by moving from a statement of a single respondent to a generalized scientific overlapping account of many statements.

With the help of content analysis it is possible to determine attitudes, trends of changes in opinions by analyzing texts of one or many authors of one subject field in the time period, as well as discover differences that characterize the content of texts of different authors.

Analysis of the research data. On the basis of developed and scientifically grounded structural competitiveness model of prospective hospitality managers, which include four components: self-conception, personality/professional direction, self-management and competence of environment of professional activity, the system of 203 indicators for competitiveness self-assessment was worked out with four indicators' groups which students filled in before writing the 1st essay 'Describe a competitive hospitality manager!'.

All 44 submitted essays were read for several times. Each essay was divided into extracts or content units which characterize/interpret the authors' of an essay experience regarding competitive hospitality manager. Initially these content units were written out, grouped in analytical categories, expressed in psychological terms and inserted in the table where all competitiveness indicators corresponded to the hospitality manager competitiveness self-assessment method worked out by the authors. The qualitative analysis was carried out comparing the data of the analysis of the 1st and 2nd essay. Furthermore, the results of the qualitative research were transformed into quantitative values, determining a frequency of collocations, phrases in relation to each competitiveness indicator. **Mathematical analysis of data** was carried out in the last stage in order to obtain descriptive statistics and concluding statistics using the Wilcoxon and the Sign test SPSS (21.0) software.

Results and Discussion

The analysis of the opinions' change in relation to structure components showed a significant difference in indicators of competitiveness **component of competence** of the repeated essays.

- In **the Social and Cultural Competence** these indicators were related to the ability to give a professional advise to colleagues, customers, importance of client-oriented thinking, such

indicators as: an ability to include in unknown social environment and communication skills, also the knowledge of several languages. The significant extension of vision is related to the traineeship time (Management practice) which occurred between two essays, i.e., an opportunity to link theory (hospitality managers' competitiveness self-assessment questionnaire) with the environment of professional activity. It should be noted that an indicator of the knowledge of other and one's own culture was not mentioned in essays neither before nor after completion of hospitality managers' competitiveness self-assessment questionnaire. It is possible that such an erroneous opinion is caused by the idea that it is enough to know a foreign language to be aware of traditions of other cultures. However if the participants of intercultural communication process do not take into account the 'language code', traditions, norms, manifestations of social behaviour, there are possible communications failures that have more negative consequences than language mistakes (Гальскова & Гез, 2006). In addition, an indicator of tolerance to sexual minorities was not related to competitiveness even though tolerance to ethnic minorities and knowledge of one's own culture and patriotism were mentioned. Accordingly, only a person who loves one's own country is active and responsible to become competitive hospitality manager.

- As regards 11 indicators of **technology environment competence**, only 3 indicators were mentioned in essays before completion of prospective hospitality managers' competitiveness self-assessment questionnaire: two students mentioned that competitive hospitality manager must be able to work with various computer software professionally, as well as they have to know cooking technologies. The hospitality managers' ability to transfer information (using modern and various technologies) quickly and qualitatively in real time shows their efficiency and competitiveness in the hospitality business (Щербаков, 2012). A significant increase of indicators after completion of prospective hospitality managers' competitiveness self-assessment questionnaire signifies that knowledge of different technologies and the ability to apply them is a significant competitive hospitality managers' indicator.
- Many indicators of **informative environment competence** mentioned in the essays after

completion of prospective hospitality managers' competitiveness self-assessment questionnaire proves the fact that students, prospective hospitality managers, understand the importance of this competence in their future professional activities, however, it seems that they fail to completely distance themselves from unnecessary and even harmful information, which could adversely affect the professional activities, as well as it is necessary to work on information processing for the purpose of analysis of economic activities of a hospitality company.

- Students' opinions regarding indicators of **business environment competence** after completion of prospective hospitality managers' competitiveness self-assessment questionnaire have changed in the following way: the indicators 'wish and ability to promote one's own country's economic growth, competitiveness and sustainability by professional activities'; students wrote in the essays about the feeling of responsibility for their decisions, an ability to prepare descriptions of various procedures, the ability to analyse and evaluate technological processes of hotels and restaurants and business activities. The essays reflect an issue of food ingredients, which is a topical issue of catering business mostly regarding food allergens which should be identified in menus of catering companies and hospitality manager is directly responsible for food safety and its implementation (European Parliament and the Council, 2011). According to students' opinion, an important indicator is an ability to develop a hospitality product according to a profile of a company and the market demands since a hospitality company has to compete not only in its own country but also internationally, as the hospitality industry becomes one of the world's largest employers (World Tourism Organization, 2017). Only an innovative and different product is able to attract new and keep existing customers. Knowing what people want, delighting the customers by fully meeting their needs and expectations and creating memorable experiences consistently is key for successfull business (Melissen *et al.*, 2014). Even though essays lack a range of indicators, these indicators have been highly evaluated in prospective hospitality managers' competitiveness self-assessment questionnaires therefore the authors make a conclusion that it is impossible to mention all indicators in essays but they are certainly

important in competitive hospitality managers' professional activities.

- Any industry including hospitality area is influenced by state policy, its legislation – by developing or braking business activities (Praude, 2011). Hospitality is one of the most intensely regulated industries in the world as it involves various risks to the health of clients. Statistics show that more than 80% of hospitality managers' professional activities are of a legal nature (Маноляк, 2007). As regards **political and legal competence**, only three out of ten indicators were mentioned before completion of prospective hospitality managers' competitiveness self-assessment questionnaire, but after its completion students mentioned seven indicators. However, such issues as labour security and legal knowledge are not reflected in the essays.

- **The Component of Personality and Professional Direction**. According to several scholars 'core' of personality is personality direction (Vanderbeeken & Weber, 2002; Асмолов, 2002; Божович, 1968; Мерлин, 1996), which manifests itself in various spheres of human activity, including in the professional field (Ананьев, 1968; Леонтьев, 1977; Прангишвили, 1967; Рубинштейн, 1957). It is noteworthy that mentioning of such an indicator as love to work has increased significantly in the repeated essays. Students write that the work should be a hobby that prospective hospitality managers should be interested in everything related to hospitality, have a desire to improve professional knowledge, skills and competence in order to become a high-level professional and that prospective hospitality manager would be ready to improve business skills. In addition, students mention that it is necessary that other people, customers, staff members, relatives would respect and admire prospective hospitality managers for his/her success which is possible to achieve by providing products of high quality, by being able to adjust one's interests and aims to the interests and aims of other people, for example, customers, and a company. Prospective hospitality managers should feel a desire to help other people. Several studies (Hjalager, 2003; Teng, 2008) have emphasized the importance of this prospective hospitality managers' personality trait. Students' essays express an opinion that no one is perfect, even a manager, but everyone has to be psychologically ready to strive and achieve the goal by determining methods how

to do that. Competitive, smart, strategically thinking entrepreneurs are able to transfer competitors into cooperation partners if they will be ready for a fair competition among other professionals. In spite of the fact that the authors of essays have a positive attitude towards the work in hospitality business and entrepreneurship, they do not consider this work to be prestigious. The authors of the paper emphasize that university lecturers working with prospective hospitality managers play an important role in the education process, they have to remind students that nothing can be more prestigious that to serve others by offering high quality products.

- **The Component of Self-Conception**. Self-conception is influenced by time, significant people and events from the past (Reece, 2013), it is mental picture of one's personality (Swann, Chang-Schneider, & Larsen McClarty, 2007). Students' essays before and after completion of prospective hospitality managers' competitiveness self-assessment questionnaire contained an opinion that it is necessary for competitive hospitality manager to have a high level of knowledge, skills and competence in the area of hospitality. However, as regards the repeated essays, students increasingly mention high level of the knowledge in entrepreneurship. Hospitality manager has to be aware of his/ her physical, intellectual features, features of character, social maturity, they have to be able to objectively evaluate their knowledge and skills level in hospitality business. In addition, it is important to have self-respect, then others will evaluate correspondingly. Professor A.J. DuBrin (DuBrin, 2007) points out that employees who have ability to examine themselves and adapt their behavior receive better performance ratings, become leaders in the organizations. Competitive hospitality manager has to be a leader with a good sense of humour, negative experience should inspire to become a good specialist, generates internal defiance and determination to overcome one's weakness, inability and shortcomings. The job should be done in the best possible way.

- **The Component of Self-Management**. As regards self-management component indicators, only seven were mentioned out of thirty three indicators in the students' essays before the completion of prospective hospitality managers' competitiveness self-assessment questionnaire. The vision has significantly extended after the completion of the questionnaire: students think that

competitive hospitality manager should be flexible in thinking, decisions and actions, they have to be able to implement innovations simultaneously working according to certain standards even if they fully do not agree with them due to the fact that hospitality business is being strictly regulated by the law. Scientist D. Kryukov (Крюков, 2012) points out that the prospective hospitality managers can knowingly change not only the external conditions of existence and life activities, but also own inner world, himself, personality properties and character; can widen the range of their potential (to develop their career) thanks to the understanding and transformation of those own qualities, which hinder or promote competitiveness. The work with people creates many various unexpected situations which should be dealt with immediately; therefore people engaged in hospitality business should be particularly stress-persistent; it is possible when one takes care of one's health.

As it was mentioned before, after encoding the data of competitiveness indicators found in the prospective hospitality managers' essays and the primary statistical analysis of the data, the secondary statistical analysis was carried out for obtaining concluding statistics. Two tests were used for this purpose: the Wilcoxon and the Sign test SPSS (21.0) software.

Two hypotheses were put forward:

H_0: students' opinions have not changed on the competitive hospitality managers after self-assessment of their competitiveness during the pedagogical experiment:

1st essay results = 2nd essay results.

H_1: students' opinions have changed on the competitive hospitality managers after self-assessment of their competitiveness during the pedagogical experiment:

1st essay results ≠ 2nd essay results.

The Wilcoxon test results were obtained which gave evidence that changes have occurred in 135 indicators and only 68 indicators have not changed.

Concluding statistics of the Wilcoxon test results show that: p–value = 0.000 < α = 0.001, which means that changes in students' opinions on competitive hospitality managers during the experiment are *distinctly significant.*

The Sign test results did not differ from the Wilcoxon test results.

Conclusions

1. With the help of content analysis it is possible to determine prospective hospitality managers attitudes, trends of opinion changes, analyzing one text or texts of many authors of the same subject field in time, as well as to reveal differences which characterize the content of texts of many authors.

2. The results of both the Wilcoxon test and the Sign Test show positive changes in 118 indicators out of 203 indicators. The concluding statistics of the Wilcoxon test and the Sign Test give evidence that the students' opinion on the notion of competitiveness and competitive hospitality managers have significantly changed during the pedagogical experiment, because p-value = 0.000 < α = 0.001.

3. The proposed hypothesis was tested during the pedagogical experiment. It is possible to extend students' vision significantly if the developed, scientifically grounded method worked out by the authors and approved by students and specialists-experts, including a questionnaire of the survey, as a pedagogical tool of the experiment in order to promote changes in students' opinions regarding the competitiveness of representatives of their profession, is applied.

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