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STUDENTS ON THEIR WAY TO SCIENCE
(undergraduate, graduate, post-graduate students)
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The conference is aimed at dissemination of scientific research results, sharing of experience, improvement of foreign language and cross-cultural communication skills, and establishing of international contacts.

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AGRICULTURE

THE EFFECTS OF SPILOCAEA OLEAGINEA IN OLIVE PLANT

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The olive tree (Olea europaea L.), native to the Mediterranean basin and parts of Asia, is now widely cultivated in many other parts of the world for production of olive oil and table olives. Olives are a rich source of valuable nutrients and bioactives of medicinal and therapeutic interest. Olives and olive oil may have a role in the prevention of coronary heart disease and certain cancers because of their high levels of monosaturated fatty acids and phenolic compounds. In addition, olives (Olea europaea L.) and olive oils provide sources of natural antioxidants.

Spilocaea oleagina is one of the most serious fungal diseases of olives, which can cause the loss of yield by more than 10-20%. Moist weather conditions favour fungus sporulation, conidia germination and infection, and young leaves are more susceptible to infection than older ones. Conidia germination and infection required continuous moisture for 12-24 h and temperatures ranging from 5 to 25 °C, 98% humidity. The pathogen can survive in extreme conditions like dry and hot weather, in fallen leaves etc. Infected leaves in the tree canopy were important for pathogen survival and conidia production. The number of conidia per square centimetre of scab lesion and their viability varied greatly throughout the seasons and between years. The pathogen did not form new conidia in scab lesions, although some pseudothecia-like structures and chlamydospores were detected on fallen leaves. Conidia were mainly rain-splash dispersed. In the late spring, dark spots appear on the upper surface of leaf cuticles in the low canopy. Symptoms may also appear on the stem and fruit, but are most commonly found on the leaf surface. The control of disease depends on chemical application of copper containing fungicides which are sprayed directly after harvest.

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DEVELOPMENT OF FABA BEAN DISEASES DEPENDING ON THE SOWING TIME

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Faba beans (also called field beans, broad beans, fava beans) are a protein-rich legume seed well-adapted to most climatic areas of Europe and widely used for feed and food [2]. The faba bean also plays an important agronomical role being able to fix atmospheric nitrogen and to act positively as a break crop in intensive cereal-dominated crop rotations [3].

Chocolate spot caused by *Botrytis* spp. is the dominant faba bean disease in Latvia. Leaf spots caused by *Alternaria*/*Stemphylium* complex and *Didymella fabae,* and rust caused by *Uromyces viciae-fabae* are also observed almost every year [1].

The aim of the present study was to investigate the development of faba bean diseases depending on varieties ('Laura', 'Boxer', 'Isabell') and sowing time (April 21, April 29, May 8). Observations were carried out at the research and study farm "Peterlauki" of the Latvia University of Life Sciences and Technologies in 2018. The study was conducted in a pre-arranged trial that carried out several studies on faba beans. [4]. The incidence and severity of faba bean diseases were assessed in plots where fungicides were not used. From each plot, 20 plants were randomly selected, and disease severity was evaluated with a 0–9 point scale, where 0 meant no disease symptoms observed but 9 meant leaves were completely covered with blotches. Disease severity on leaves was observed after the appearance of the first symptoms until the end of vegetation season, and the values of AUDPC were calculated.

The first symptoms of chocolate spot caused by *Botrytis* spp. and leaf spot caused by *Alternaria*/*Stemphylium* complex were observed on June 13. In 2018, chocolate spot was the dominant disease and was observed in all trial plots. The AUDPC value was calculated and it proved that *Botrytis* spp. development depends on varieties and the sowing time ($p < 0.001$). The leaf spot caused by *Alternaria*/*Stemphylium* complex was also observed in almost all trial plots, but disease severity was low and did not exceed 2 points. Rust was observed only at the end of growing season (BBCH 80) on beans sown in May. The symptoms were observed only on some plants, and disease severity was low and did not affect faba bean development and growth.

The obtained results are in line with the results of studies already carried out in previous years that the development of the disease is significantly dependent on the variety [1]. It is important to continue the study because the dry summer of 2018 affected the faba bean growth, development, vegetation length, and development of faba bean diseases was affected as well.

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WINTER WHEAT GRAIN QUALITY IN LATGALE

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Winter wheat (*Triticum aestivum* L.) is the third most grown cereal crop in the world after corn and rice [1]. Protein, gluten content and sedimentation value are primary quality components that influence most wheat grain baking quality characteristics [2]. The aim of this investigation was to clarify variation of protein, gluten content and sedimentation value of winter wheat grain cultivars. Field experiments with winter wheat varieties 'Edvins', 'Brencis', 'Talsis', 'Fredis' (all from LV) 'Skagen' (DK), and 'Olivin' (UK) were conducted at the "Agriculture Science Center of Latgale" in 2017/2018. Winter wheat was sown on 27 September after black fallow in four replications (rate of 500 germinating seeds per m^2) field layout – randomised. Winter wheat was harvested at tge optimal time when the growth stage GS 88-91 was reached. The quality indicators were evaluated using grain analyser "Infratec NOVA". Experimental data evaluation was done using single–factor analysis of variance by Fisher's criteria. In the experiment, average protein content in wheat grains was 12.0% (from 11.2% ('Olivin') to 12.6% ('Talsis')). Grains with protein content 11–14% are suitable for making bread [3]. Gluten content in grain was from 22.1% ('Olivin') to 25.7% ('Edvins'). Winter wheat sedimentation value was from 33.4 mL ('Olivin') to 42.6 ('Talsis'). The content of protein and gluten content and sedimentation value reached the requirements of the food grain (bread baking). The data show that cultivar significantly ($p<0.05$) affected protein, gluten content and sedimentation value. A statistically significant positive correlation was found between protein content and gluten content $r=0.887$ ($n=6$, $r_{005}=0.811$) and also between protein content and sedimentation value $r=0.858$, similar dependences were confirmed by the study of Skudra and Ruza [4]. If protein content in wheat grain was higher, gluten content and sedimentation value were higher. In conclusion, grain protein and gluten content and sedimentation value significantly varied depending on the differences among varieties. The cultivars 'Talsis' and 'Edvins' showed the highest grain quality indices.

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GROUND BEETLES (*COLEOPTERA: CARABIDAE*) AS INDICATORS OF MANAGEMENT OF NATURAL GRASSLAND HABITATS

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Natural meadow habitats are important feed resource and hideout elements for ground beetles. These bioindicators are known for their good ability to indicate disturbances in environment and to change along with a habitat disturbance gradient. They are used to indicate digestate application influence on natural meadow habitats. Currently in Europe, including Latvia, there is still insufficient knowledge on the use of digestate and its consequences in EU-protected meadow habitats. Previous research data shows that the impact of digestate on the ground beetle dominance structure and species diversity was not clearly evaluated [1].

The main goal of this research was to determine how digestate application affects species composition and biodiversity of ground beetles in three EU-protected meadow habitats: 1) semi-natural dry grasslands and scrubland facies on calcareous substrates (Natura 2000 code: 6210), 2) Fennoscandia lowland species-rich dry to mesic grasslands (6270*), 3) lowland hay meadows (6510). The research was carried out in six stations: Sigulda (Lat: 57.147, Lon: 24.084; 6510; digestate application: 15 April, 2016), Allaži (Lat: 57.047, Lon: 24.833; 6270*; 18 April, 2016), Allažmuiža (Lat: 57.022, Lon: 24.757; 6210; 18 April, 2016), More (Lat: 57.068, Lon: 25.091; 6270*; 15 April, 2016), Ludza (Lat: 56.551, Lon: 27.706; 6210; 8 April, 2016), Vecslabada (Lat: 56.269, Lon: 27.998; 6210; 8 April, 2016). In each one, four sample plots (220–380 m^2) were established, and the digestate was applied in two of them. Ten pit-fall traps placed in one or two cornerwise transects were exposed in each sample plot from 20 May to 17 June, 2016 and 17 May to 14 June, 2017. Ground beetle species composition was analyzed by calculating dominance structure [2], but the biodiversity was expressed as reciprocal Simpson's index.

In total, 91 ground beetle species were observed in all stations (2016, 2017). In both years, *Poecilus versicolor* dominated over other species in all sample plots in all stations except Vecslabada. Other dominant and subdominant species and their percentages noticeably differed between differently managed sample plots in stations: Allaži, Allažmuiža, and Vecslabada in 2016, and Sigulda, Allaži, and More in 2017. Digestate application did not cause noticeable changes of ground beetle species assemblage in Sigulda (2016) and Vecslabada (2017). In 2016, digestate application promoted significantly higher biodiversity of ground beetles in three stations (Sigulda, Allažmuiža, and Vecslabada). But in 2017, significantly higher biodiversity of ground beetles was observed in Sigulda, Allaži and Allažmuiža in the treated sample plots. Effect of digestate application was insignificant in other stations.

The main conclusion is that digestate application affects fauna and diversity of ground beetles inhabiting natural grassland habitats. It is necessary to continue research over the longer term to assess the effect of digestate application on fauna and biodiversity of ground beetles.

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BOTRYTIS CINEREA MORPHOLOGICAL DIVERSITY AND PATHOGENICITY IN FABA BEANS

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The area sown with faba beans in Latvia has significantly increased recently, which is the result of EU regulations on farmland area greening – from 2800 ha in 2010 to 42 500 ha in 2017. With this, the importance of faba bean fungal diseases has grown. Chocolate spot is one of the most economically-significant diseases, caused by different species of *Botrytis*, including *B.cinerea* [1]. *B.cinerea* is a non-specialized pathogen, which can infect more than 235 plant species [2]. The aim of the present study was to evaluate the level of *B. cinerea* diversity and pathogenicity in faba beans.

The samples of infected tissues were gathered from different plants and plant organs: – faba bean leaves and seeds, pea seeds, rose flowers, grape-fruit, cabbage leaves, onion bulbs, strawberry leaves, and quince leaves. Purified isolates of *B. cinerea* were sown on a sterile Petri plate with potato-dextrose agar (PDA), and incubated at 20 °C in the dark for seven days. After a week, the color, type of the growth and structure of mycelium, and the presence of sclerotia were evaluated. To test the pathogenicity, mycelial plugs (each isolate 5 mm in diameter) were placed in the centre of detached faba beans leaves rinsed three times in sterile distilled water, and afterwards, they were placed on a double-layer filter paper with water poured on it. Symptoms of the disease were evaluated after seven days by using a five-point scale to describe the pathogenicity's level: (0 – no visible symptoms;- 0,1 – traces of infection;- 1 – blotch is 1 cm in diameter;- 2 – blotch is 2 – 3 cm in diameter;- 3 – blotch is more than 3 cm in diameter), and letters used to describe the type of symptoms were: A – infection is homogeneous; B – infection is dotted; and A+B – both infection types (homogeneous and dotted) are present.

The colour of *B.cinerea* mycelium varied from white, grey to greyish brown; the structure of mycelium varied from unevenly fluffy, fluffy to grainy. The types of mycelium growth were different: even, uneven, concentric, or radiate. Sclerotia were formed only in some isolates. Clear correlation between the size of blotches and type of infection was not observed.

The results showed high morphological diversity of *B.cinerea*. Further investigations are necessary to clarify the relationship between morphological properties and the level of pathogenicity, as well as to evaluate the role of *B.cinerea* in the pathogens' complex that causes the chocolate spot of faba beans.

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DIFFERENT LIMING AND FERTILIZATION LONG-TERM EFFECT ON SOIL PHOSPHORUS ACCUMULATION.

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Plant available phosphorus (P) is essential for high yielding crops and is one of the major plant nutrients. In order to conserve mineral resources, and to maintain and increase agricultural productivity, phosphorus should be used efficiently. Phosphorus is most available for plants when pH (soil reaction) is close to neutral [1]. The liming is used in agriculture to achieve the right soil pH. The current study represents the relation between liming, pH and plant-available phosphorus.

The study area was the long-term experimental field "Sidrabiņi," where liming and fertilizer usage has been studied since 1982. The field experiment included 4 plots with different fertilizer and liming rates, which were split in 16 smaller plots where each plot was unique: four (slate ash with 80% neutralizing value) lime rates 0, 2.85, 5.70 and 11.40 t ha^{-1} $CaCO_3$ were used; and four rates of mineral fertilizers: without fertilizers, $N_{45}P_{30}K_{45}$, $N_{90}P_{60}K_{90}$ and $N_{135}P_{90}K_{135}$ were applied annually. Primary liming was done in 1981, the maintenance liming was performed in 1994 and in 2014.

For the average sample, 20 soil samples for analysis were taken from each plot. 16 average samples were analyzed. The Egner-Reihm method was used for plant available phosphorus. The 1 M KCl method was used for determining soil pH.

The data analysis of the long-term experiment shows a higher correlation between plant-available phosphorus and pH in the plots where $N_{90}P_{60}K_{90}$ was used with all liming rates. Correlation is medium or high (r=-0.426 to -0.683). With liming rates of 2.85 and 5.70 t ha^{-1} correlation is statistically important (alfa=0.05) in the current years of observation (n=11-12). The obtained data from the long-term experiment indicated an indirect relationship between liming and plant available phosphorus resources in soil that depends on both the liming and fertilizer doses.

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EFFECTS OF LIMING MATERIALS ON PLANT AVAILABLE PHOSPHORUS IN VARIOUS ACIDITY SOIL

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Phosphorus (P) is a naturally occurring chemical element that can be found in the Earth's crust, in water, and in all living organisms. Phosphorus is one of the 16 chemical elements essential for plant growth [1]. One of the most important environmental problems is the eutrophication process, which is facilitated by the introduction of phosphorus compounds into water bodies. Therefore, the number of studies about the efficiency of the use of phosphorus in the soil has been increasing because the level for plants easily available phosphorus is very low and sedentary in soil. Another important reason is the gradual decline of raw materials for the production of high-quality phosphorous fertilizers and the increase of their cost [2]. Soil acidity and phosphorus deficiency are related processes, so it is usually suggested that to increase phosphorus availability for plants, acid soils must be limed [3]. The aim of this study was to investigate the effects of various liming materials on plant available phosphorus in soils with different acidity. Samples for the analysis were collected from the production field located in the municipality of Kandava in the farm "Sniķeri". The soil type was a sod podzolic that had a tendency to acidify and soil grain-size composition was fine sandy loam. Soil samples were collected from 30 experimental fields, where 4 lines with 6 fields were limed with different liming materials. One line was a control variant and coarse dolomitic limestone, BaltKalk, BaltKalk +, Sātiņi was used for other lines. 2 liming doses – 10 and 5 t ha$^-$^{1} were applied in 3 repetitions in the experiment. The highest dose was applied to fields with the lowest pH values (4.3–5.7), while the lower dose was at pH (5.3–7.0). Soil samples were taken at the depth of 0-20 cm. The concentration of plant-available phosphorus was determined using the Egner-Riehm method and the soil pH with KCl solution. The climatic conditions in the years of the study differed significantly from the average climatic performance. There was abundant rainfall in the autumn of 2017, but in 2018 there was a prolonged period of drought since the end of April.

In all control fields pH units h decreased slightly by 0.003–0.297 pH units, but in the fields where liming was done – there was an obvious increase. The pH was changed by more than 1 unit in the variants where the dose of 10 t ha-1 liming materials (BaltKalk, BaltKalk+,Sātiņi) was applied, but as regards fields with dolomitic limestone, pH was changed by only 0.245–0.756 units. The results showed that in the short-term period there was no correlation between pH and plant available phosphorus. In the control field, the amount of phosphorus available to plants decreased, but in liming variants, phosphorus results reached the highest levels when the initial pH was higher than 6.5 and after liming it was higher than 7.0.

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THE MOST IMPORTANT WINTER WHEAT LEAF DISEASES

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Wheat, especially winter wheat, is one of the most profitable crops; therefore, losses caused by wheat diseases are important risk factors. Recently, reduced soil tillage has become increasingly popular, because it can be a beneficial tool to decrease the erosion of soil and save labor and financial resources. On the other hand, it can promote the spreading of disease causal agents, which develop as saprotrophs in the residues of plants. Tan spot, septoria leaf blotch, and mildew are the most significant wheat leaf diseases. The development of these diseases and their severity depend on different factors, of which the meteorological situation is the most important. [1]

Tan spot, caused by *Pyrenophora tritici-repentis*, might reduce the yields by up to 50%, especially if two upper leaves are heavily infected. The main source of infection is wheat straw, where pseudothecia with ascospores develop. Ascospores are spread by wind, but the source of secondary infection – conidia – is splash borne. *Pyrenophora tritici-repentis* develops when the air temperature is between 10 °C and 30 °C, and free moisture is required for the germination of ascospores and conidia. [2]

Septoria leaf blotch, caused by *Zymoseptoria tritici*, can cause significant losses in harvest if flag leaf and the second leaf are infected. The typical symptom of this disease is pycnidia, where conidia develop. Conidia are splash borne; therefore, frequent rains and humid leaves are necessary for the development of this disease. The optimal temperature range is between 15°C and 25 °C. [3]

Mildew, caused by *Blumeria graminis*, is one of the most common wheat diseases. During the epidemic of the disease, yields can decrease from 25% to 40%. *B. graminis* can develop in a wide range of temperatures – between 3 °C and 31 °C. This pathogen does not require free moisture on the leaves, but the relative humidity of the air should exceed 90%. [4],[5]

Knowledge about the peculiarities of disease development is necessary to create a sustainable and economically and biologically-based disease control system.

Acknowledgement

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CHANGES IN ULTRASONOGRAPHIC MEASUREMENTS FOR LAMBS DURING FATTENING

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Consumer demand for quality lamb meat contributes to the breeding of meat-type animals. Ultrasonography (US) has been the most commonly-used visual diagnostic method for predicting body and carcass composition and quality in-vivo for the past few decades. US measurements are included in animal breeding programs of various species and are used to evaluate changes in body and carcass composition during fattening. [1].

The aim of the study was to analyze the changes in US measurements during fattening and their correlation with carcass quality.

The study was carried out within the project "Different breeds and their crossbreed suitability for high-quality carcasses and lamb meat production," which was financed by the Ministry of Agriculture of the Republic of Latvia. Lambs were born during the years 2016 to 2018, and fattened under the same keeping and feeding conditions at sheep breeding farm "Klimpas". Data was analyzed: 1st group – meet type breeds (n=55): Charolais, Suffolk, Ile-de France, Texel, Oxfordown and German Merino local breed; 2nd group – lambs of Latvian Darkhead sheep (LD) crosses with meat type breeds (n=63): LD x Charolais, LD x Suffolk, LD x Texel, LD x German Merino local, LD x Dorper, LD x Hampshire crossbreeds. During the fattening period, the lambs were subjected to a live weight control, and live weight increase was calculated. The depth of the back fat and *longissimus dorsi* muscle at 13th thoracic vertebrae was measured using the US device (Mindry Dp-50 Vet). Measurements were made at the beginning of lamb fattening and before slaughter. The carcasses were weighed and evaluated according to the SEUROP classification. Dressing percentage were calculated for 24 h chilled carcass.

At the start of fattening period, the lambs had a similar age, 91.7 ± 1.7 days in average for the 1st and 89.8 ± 1.5 days for the 2nd group, while the body weight of lambs in the 1st group was significantly higher ($+2.4$ kg, $p < 0.05$), 28.4 ± 0.64 and 26.0 ± 0.46 kg respectively. The age and live weight did not differ significantly at the end of the fattening period, 157.9 ± 3.71 days and 52.46 ± 0.73 kg in average in the 1st group, 157.7 ± 1.64 days and 51.36 kg in the 2nd group. The increase in body weight per day for lambs in group 1 was 381.0 ± 12.44 g d-1, while in group 2: 378.3 ± 6.58 g d-1, with a difference of 2.7 g d-1. At the start of fattening, the depth of lean and fat tissues in lambs in group 1 was 22.4 ± 0.46 and 1.7 ± 0.06 mm respectively, in group 2 - 21.8 ± 0.43 and 1.6 ± 0.04 mm, the ratio of muscle mass fat tissue obtained being 13.8 ± 0.42 and 14.4 ± 0.43. Muscle depth at the end of fattening in the 1st group was 30.9 ± 0.45 mm and in the 2nd group 29.4 ± 0.25 mm, with a difference of 1.5 mm ($p < 0.05$), depth of backfat layer for lambs of group 1: 3.3 ± 0.11 mm and of group 2: 3.1 ± 0.09 mm. At the end of fattening, the depth ratio of lean and fat tissues was significantly reduced, 10.0 ± 0.39 (group 1) and 9.9 ± 0.27 (group 2), which indicates a more rapid development of fat tissue during fattening. For meat-type lambs, a significantly higher dressing percentage of $46.7 \pm 0.36\%$ and rating of carcass tissue development was obtained. At the end of the fattening period, the lambs' back muscle tissue depth showed a low positive correlation with the increase in body weight during the day ($r = 0.26$; $p < 0.05$), low negative correlation with the evaluation of carcass muscle development ($r = -0.30$; $p < 0.05$), and moderately close positive relationship with the dressing out result ($r = 0.46$; $p < 0.05$).

During fattening, lambs of the meat-type variety group developed more muscular tissue. The resulting US measurements provide an opportunity to predict the development of carcass muscle tissue.

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THE COMPARISON OF LATGALE'S MELONS GENETIC MATERIAL PROPAGATION AND CONSERVATION METHODS

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Asia and Western Europe are natural growing areas of melons *Cucumis melo* L. Melon cultivation is one of the most prospective industries of agriculture. Melon is an important horticultural crop, with fruitage and blossom yield being critical elements for the growth of of fresh salad, sweets, syrup and food additive production.

Valuable genetic material for growing and planting in Latvia has been obtained from the Institute of Horticulture in 2014[1]. Plants were propagated in the summer greenhouse from seeds of the Botanical Garden of Latvia University and SIA "Bulduru Dārzkopības vidusskola" from 2014 to 2017. The obtained genetic material was propagated *in vitro* from seeds three times in the Plant Tissue Laboratory of Latvia University in January 2018 and obtained plants were grown in vegetation pots in experimental greenhouse of Botanical Garden of Latvia University in June.

Latgale`s melon lines 4(3), 5(2), 8 and 14 were introduced from seeds in Murashige and Skoog medium with 30 g L^{-1} sucrose and 8.5 g L^{-1} agar. The pH level of all media were adjusted to 6.2 before autoclaving. Melon seeds were sterilized for 5 minutes with a UV lamp, for 3 minutes in 96% ethanol and sterilized for 15 minutes in 5% NaClO, and rinsed 3 times with sterile distilled water. The seeds were germinated in cultivation dishes with 50 mL Murashige and Skoog medium in fitochamber with 16 h photoperiod under cool, white fluorescent lights, at 2500 lx, witha a temperature of 24 ± 2 °C. Plants were cloned three times. This method is important for genetically homogenous clone reproduction [2]. Melon clones were planted in vegetation pots. Pots contained sterilized turf, pH KCl level 6.5. The plantlets were placed at temperature 24 ± 2 °C in a culture room for 16 h photoperiod under cool, white fluorescent lights, 2500 lx with 95% humidity for 4 weeks. By acclimatization, plantlets were transplanted on 15 liter vegetation pots and cultivated in experimental greenhouse. Plant fertilization was performed with the complex mineral fertilizer "Kristalon". Plants were pollinated artificially by putting on blossoms isolators. Plants' morphological parameters and chlorophyll content were determined. The collected fruits have been analysed for biochemical composition, such as vitamin C, total chlorophyll, dry matter and carotenoids with the spectrophotometry method and titrimetric method.

The most productive method of melon propagation is seeding. But this method does not exacerbate plant genetic homogeneity. The melon plants which are propagated by the seeds are heterogenous with different leaf forms, blossom morfology, fruit color and shape. Melon cultivars from *in vitro* culture are homogenous, there were no significant differences in chlorophyll content between melons plants. Melon yield is obtained from plants sown by seeds. Vitamin C, total chlorophyll, dry matter and carotenoids have been detected in melon fruits. More research needs to develop methodology of melon acclimatization *ex vitro*.

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WINTER OILSEED RAPE YIELD FORMATION DEPENDING ON SOWING TIME AND APPLICATION OF PLANT GROWTH REGULATOR

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Winter rape is a widely grown oil plant in Latvia and has multiple uses in the world. It is used in human consumption, for forage, as biofuel and as a technical crop. The main goal of this research was to evaluate winter oilseed rape yield formation depending on sowing time and application of plant growth regulator. At the beginning of the field experiment, the hypothesis was presumed that plant growth regulator (PGR) application rate might change depending on sowing time.

Field experiments with application of Caryx (30 g L^{-1} metconazole and 210 g L^{-1} mepiquat-chloride) have been carried out already before in Latvia, but interaction of rape sowing date and applied PGR rate was not studied [1, 2]. The research was carried out at the Latvia University of Life Sciences and Technologies Research and Study farm "Vecauce" in 2017/2018. Rape cultivar 'DK Extract' was sown on six different sowing dates (1, 5, 10, 15, 20, 25 August), and three different PGR Caryx rates (0.50 L ha^{-1}, 0.75 L ha^{-1} and 1.0 L ha^{-1}) were applied on each sowing date. Control plots with no application of PGR were arranged on each sowing date. Data was analysed using two factor dispersion analysis.

Results showed that the most efficient application of Caryx was when applying it to rape sown on the first two sowing dates (1 and 5 August). Average seed yield was 4.3 t ha^{-1} when the highest rate (1.0 L ha^{-1}) of PGR was applied to rape sown on 1 August (that from untreated plots was 3.9 t ha^{-1}). If rape was sown on 5 August, the harvested yield was 4.5 t ha^{-1} (PGR rate 1.0 L ha^{-1}); that of untreated plots was 4.0 t ha^{-1} on average. If Caryx was applied to plots sown on later dates (10, 15, and 20 August), winter oilseed rape yield decreased using the smallest PGR rate (0.5 L ha^{-1}) by at least 0.1 t ha^{-1}, if rape was sown on 10 August, by 0.4 t ha^{-1} – if sown on 15 August, and by 0.3 t ha^{-1} – if sown on 20 August. In general, there was a tendency for yield decrease by increasing application rate of Caryx to rape plots sown from 10 to 20 August. The yield of rape sown on 25 August was not obtained because less than 5 plants per 1 m^2 emerged in autumn due to drought, and after wintering weeds overcame these plots. In general, winter-hardiness was not influenced by application of PGR Caryx. Significant decrease of winter-hardiness was observed for rape sown in late sowing time (20 August), if application rates of Caryx were 0.75 L ha^{-1} and 1.0 L ha^{-1} (15 plants from 24 plants per 1m^2 survived, if the rate of PGR was 0.75 L ha^{-1} and 17 plants – if the rate was 1.0 L ha^{-1}). The highest yield (4.9 t ha^{-1}) was observed in untreated plots when winter rape was sown on 15 August. The hypothesis that the application rate of plant growth regulator in autumn depends on rape sowing time was confirmed.

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COMPARING HEMP (*CANNABIS SATIVA*) VARIETIES FOR HIGHEST YIELD AND QUALITY

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Despite the fact that hemp is one of the most valuable plants, the industry has only been growing for the last few years. The area of hemp cultivation in Latvia has increased almost 9 times from 2015 to 2018, from 106 to 875 ha [1]. It is important to continue research activities in order to make Latvia a competitive hemp growing country. Hemp is well-known for oil production, as well as being perfect for fiber production. One of the tasks for the foreseeable future is to increase seed yield. The selection of bigger seeds is important [2].

The aim of this research was to study yield changes and yield quality. During this project 4 well-known hemp varieties were sown in Priekuļi, Institute of Agricultural Resources and Economics- 'Finola', 'Adzelvieši', 'Zenit' and 'Uso 31'. Results were analyzed during one vegetation period in 2018. The test was arranged in 4 replications (5th for THC monitoring), the plot layout was randomized. The soil type of separately held experimental fields were Sod — podzolic, loamy sand. During the vegetation period, climatic conditions were observed, phenological monitoring (male plant flowering) was done, and THC monitoring and sowing density were measured. After the harvet of the whole plot, the yield was weighed and converted to t ha^{-1}. The volume weight kg h L^{-1}, thousand seed weight, g and amount of open seeds were determined using methodology at Priekuļi Research Centre laboratory.

Varieties	Yield, t ha-1	1000 seed weight, g	Volume weight, kg h L^{-1}	Open seeds, amount
'Adzelvieši' (pruned)	**1.56**	12.58	**59.58**	29.75
'Adzelvieši'	1.44	12.34	**59.58**	30.00
'Finola' (14.05)	1.09	12.26	58.40	25.00
'Finola' (24.05)	1.34	12.42	58.55	25.00
'Finola' (pruned)	1.51	12.02	58.85	21.75
'Finola' (half of seeding rate)	0.71	12.17	59.28	-
'Zenit'	0.26	**18.59**	55.30	18.50
'Uso 31'	0.16	16.01	56.83	**17.50**
LSD$_{0.05}$	0.62	2.49	15.54	7.88

In 2018, hemp (*Cannabis sativa*) showed quite low yields: only two varieties from four showed yields higher than 1 t ha^{-1}. 'Adzelvieši' (cut during flowering) - 1.56 t ha^{-1}. 'Finola' (cut during flowering) was quite close- 1.51 t ha^{-1}. The variety 'Zenit' showed highest 1000 seed weight (18.59 g). The highest volume weight showed variety 'Adzelvieši'- (59.58 kg h L^{-1}). The amount of open seeds varied from 17.50-30.00 on average, but the lowest amount was with the variety 'Uso 31'. Basically, varieties which were better in yield had worse results in quality parameters. Unfortunately, one year cannot describe complete results, because climatic conditions (2018 was dry) could also affect the yield and quality of hemp. However, long-term research in the hemp industry is important to increase its yield and quality.

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MORPHOLOGICAL DIVERSITY OF *BOTRYTIS FABAE*

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Rapid growth of faba bean sowing areas in Latvia is the main reason for the increase in faba bean disease risks [1]. Chocolate spot is one of the most serious faba bean diseases [2] whose importance, diversity and biological properties under local conditions have been insufficiently studied. Chocolate spot is common as a complex disease caused by the genus *Botrytis*. *Botrytis fabae* is one of the most important causal agents, and also new species have been found [3]. The aim of the presented research is to describe the morphology of *B. fabae* under the conditions of Latvia.

The samples were collected from infected faba bean leaves and seeds in 2014–2016. Pure cultures of pathogens were obtained on potato dextrose agar (PDA). There were different species of *Botrytis*, but altogether 13 isolates were recognized as *B. fabae*. The isolates were incubated at 20 °C for a 12-h illumination period. Morphological peculiarites of the isolates were described after two weeks. These isolates were compared with the *B. fabae* isolate from the Westerdijk Fungal Biodiversity Institute (WFBI).

Colonies of the *B. fabae* isolate from the WFBI on PDA produced low, fluffy brownish-grey mycelium with an uneven surface and a straight line edge. Locally gathered and evaluated isolates of *B. fabae* were morphologically diverse; while most of the colonies produced low, fluffy mycelium with an uneven surface, some colonies produced grainy or aerial mycelium. The colonies from the locally obtained *B. fabae* isolates greatly varied in colour – from white to yellowish-grey, grey, and brownish-grey. Out of the total number of *B. fabae* isolates obtained, there were eight that formed many small sclerotia (< 3 mm), which were either scattered or formed circles. Most of the locally obtained *B. fabae* isolates had different morphological peculiarities if compared with *B. fabae* isolate from the WFBI.

B. fabae is a morphologically diverse pathogen, which, in turn, makes pathogen determination to species level via morphological evaluation impossible. Thus, molecular genetic analysis is the only reliable identification tool available for plant pathologists. Further research about the diversity of *B. fabae* is necessary to find a potential correlation among the morphology, biology, and aggressiveness of the pathogen.

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FABA BEAN YIELD AND YIELD COMPONENTS DEPENDING ON FERTILIZATION RATE IN METEOROLOGICALLY CONTRASTIVE YEARS

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Faba bean (*Vicia faba* L.) is grown as a protein source and after-crop in crop rotation due to its benefits. The aim of this paper was to determine the changes in yield and yield components of faba bean depending on fertilization rate. The potential of faba beans' N_2 fixation are achieved if beans are grown in crop rotation with other crops in lands of poor nitrogen content and with or without minimal nitrogen fertilizer. Using additional nitrogen fertilizer has minimal chances in achieving a significant increase in yield or protein content in bean seed [1]. Application of nitrogen fertilizers to increase faba bean yields can have different consequences. It has been observed that the yield and the amount of nodules are increasing, but there have been cases where yield, nodule activity and quantity have decreased with the use of nitrogen fertilizer [2].

Field trials were carried out at the research and study farm "Peterlauki" of the Latvia University of Life Sciences and Technologies in 2017 and 2018. Several different fertilization rates were applied for the comparison (see Table) and they were ensured by different fertilizers: 1) control without any fertilization, 2) potassium chloride and superphosphate was used, 3) NPK 15–15–15 200 kg ha^{-1}, 4) NPK 16–16–16 200 kg ha^{-1}, 5) NH_4NO_3 (N 34.4%) 200 kg ha^{-1}, 6) NPK 15-15-15 200 kg ha^{-1} + NH_4NO_3 100 kg ha^{-1}. Anova was used for data analysis. In 2017, relatively low temperature and high precipitation was observed, and the weather was suitable for faba bean growth. In 2018, high temperature, drought during the whole season and little precipitation occurred, which resulted in poor growth conditions.

The results of this study showed a significant ($p<0.05$) effect of meteorological conditions and used fertilizer (Table) on the yield. The use of 30 kg N ha^{-1} increased bean yield significantly (Table) independently from used fertilizer, but an additional increase of N rate over 30 kg N ha^{-1} had an insignificant impact on the yield and yield components. In 2018, use of phosphorus and potassium fertilizer provided a significant increase in the yield and the number of pods per plant, if compared with the control variant. When 30 kg N ha^{-1} was applied in addition to P and K fertilizer, some further yield increase was observed. The results of two years indicated that reasonable N rate for faba beans is 30 kg ha^{-1}.

Yield and yield components of faba bean depending on applied fertilizer

Treatment	Yield, t ha^{-1}		Number of pods per plant		Number of seeds per pod		1000 seed weight, g	
	2017	2018	2017	2018	2017	2018	2017	2018
1. Control	3.71	2.84	13.5	5.6	3.1	2.7	553.02	514.50
2. NPK-0-30-30	×	3.07	×	8.1	×	2.8	×	504.76
3. NPK-30-30-30	5.68	3.46	14.4	8.1	3.0	2.7	538.21	513.62
4. NPK-32-32-32	5.88	3.31	12.6	7.1	2.9	2.7	545.75	509.85
5. NPK-68.8-0-0	6.06	3.46	19.5	6.9	2.3	2.7	537.80	509.89
6.NPK-60.4-30-30	5.32	3.19	14.1	6.5	2.8	2.9	535.29	512.74
p-value or LSD	0.54	0.23	p=0.38	1.12	p=0.30	p=0.54	p=0.30	p=0.88

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COMPARISON OF COLOURED CARROT VARIETIES

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Carrot (*Daucus carota* L.) is the most widely cultivated vegetable in the world [3], but until now, not many studies on carrots have been carried out in Latvia [2]. Coloured carrot is a niche product and it is becoming more popular in Latvia. Coloured carrots are marketed on supermarket shelves and elsewhere, the roots of these carrots being yellow, white, purple, red and orange. It should be stressed that carrots of each colour have a different chemical composition; for instance, purple carrots are high in anthocyanins but yellow carrots contain xanthophylls and lutein [1]. The range of varieties of carrots is wide, so it is necessary to make a comparison of varieties to determine which varieties of coloured carrots are the most commercially beneficial, the most suitable for the climatic conditions, and which ones would have the best taste. The aim of the research was to compare different coloured carrot varieties.

The following varieties were grown for the trial: 'Creampak' F1, 'Deep Purple' F1, 'Gold Nugget' F1, 'Malbec' F1, 'Purple Elite' F1, 'Rubyprince' F1, 'Snow Man' F1, 'Taborska Zluta' F1, 'Yellowbunch' F1. Trials were carried out in 2018 and will be continued in 2019. Trials were set up at the vegetable farm "Bračas" in the production field. The yield was harvested for each variety in 4 repetitions. Also, plant growth dynamics were studied and the test of organoleptic characteristics was carried out.

The results showed that 'Creampak' F1 (white root) had the highest yield and 'Rubyprince' F1 (red root) had the lowest yield. Many carrots of this variety flowered out, but this carrot was special for its bright red root colour. The most substandard carrots and the second lowest yields were found for red rooted variety 'Malbec' F1. High yield was also found for the variety 'Gold Nugget' F1 (yellow root), which was assessed according to organoleptic characteristics; 35% of 418 respondents rated it as the best. More research is needed because in 2018 there was drought and more results are necessary for the comparison.

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TOXIC EFFECTS OF SECONDARY METABOLITE GOSSYPOL PRODUCED IN COTTON

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Cottonseed meal is a common by-product of oil extraction of cotton seed. It plays an important role in animal feeding. As a protein-rich feed, cottonseed meal is a common source of protein for ruminants, notably in cotton-producing areas such as India, China and the United States, where it is used as a partial substitute for soybean meal. Cottonseed meal is valued as a protein feed: the range of protein content ranges from 30% DM for non-dehulled cottonseed meal up to 50% DM for fully dehulled meals. The fiber content varies accordingly from 5% (fully dehulled) till 25% (non-dehulled) crude fiber. Some solvent-extracted meals contain less than 2% oil, as do the other major oilseed meals, but many cottonseed meals contain higher oil values, often in the 5-10% range, and over 20% is possible. The cottonseed meal protein is less rich in lysine than soybean meal (4% vs 6% of the protein). However, the application of the cottonseed oil and protein are limited because of the presence of toxic gossypol within seed glands. Gossypol is a polyphenolic compound present in the seed of the glandular variety of the cotton plant. Polyphenols occupy an important place in biological science for their pharmacological properties; gossypol is reported to indicate antifertility, anti-parasitic and antimicrobial characteristics. It improves plant defense response to insect and pathogens. High concentrations of free gossypol may cause clinical signs of gossypol poisoning respiratory distress, anorexia, weakness. The most common toxic effect is the impairment of male and female reproduction. Cottonseed usually contains 0.4 to 1.7% of gossypol. Calves and lambs of less than 16 weeks (pre-ruminants) should not be fed gossypol at all, ruminants less than 6 months of age should not be fed more than 100 ppm gossypol. Adult ruminants can tolerate up to 1000 ppm, swine should be fed less than 100 ppm, and poultry should be fed less than 200 ppm gossypol. Agronomic selection has resulted in many cotton species devoid at glands producing gossypol, but these species are less fruitful and are more indefensible to insect attracting. Gossypol has been broadly used in clinical trials in biological science. The results of these findings supply an exhaustive understanding of the biological action of gossypol and its potential for the suppression of the therapy for indestructible tumors and chronic human disease like HIV, malaria, psoriasis.

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EFFICACY OF FUNGICIDE TREATMENT SCHEMES FOR THE CONTROL OF TAN SPOT

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In Latvia, wheat is the most commonly cultivated cereal. The country's moderate climate allows obtaining high grain yields; however, it also promotes the development of diseases. Mildew (caused by *Blumeria graminis*), Septoria leaf blotch (caused by *Zymoseptoria tritici*), and tan spot (caused by *Pyrenophora tritici-repentis*) are the most widespread wheat leaf diseases in Latvia [1], [2].

The aim of the present research was to evaluate the efficacy of different fungicide treatment schemes. Investigations were carried out in Bauska region in 2018. Wheat cultivar 'Skagen' was used for the trial. The severity of diseases was determined on the upper leaves (4th to 1st, depending on the growth stage). The efficacy of fungicide treatment schemes in the vegetation season was evaluated by calculating the area under the disease progress stairs (AUDPS).

The control variant (without fungicides) and seven fungicide treatment schemes with different active ingredients (bixafen, prothioconazole, fluopyram, prothioconazole, spiroxamine, and metconazole) combined in various proportions were used. Fungicide treatment efficacy was evaluated by comparing the AUDPS values among the variants.

Throughout the trial period, tan spot, septoria leaf blotch, mildew, glume blotch, and brown rust were observed. Tan spot was the dominant disease in the vegetation period of 2018, which could be observed starting from the end of plant tillering. The crucial period of disease development started at the stage of flowering.

All seven schemes of fungicide treatment essentially decreased the level of tan spot, and differences in the AUDPS values were statistically significant ($p < 0.001$). The best results were obtained in two variants: 1) one treatment (bixafen, prothioconazole and floupyram) at the stage of flowering, dose 1.5 L ha^{-1}; 2) the first treatment (prothioconazole and spiroxamine) applied at the time of flag leaf development, dose 0.625 L ha^{-1}, and the second treatment (bixafen, prothioconazole and floupyram) applied at ear development, dose 0.75 L ha^{-1}.

Further investigations are necessary to clarify the best schemes of fungicide application because the pressure of diseases and the efficacy of fungicides depend on meteorological conditions and other agroecological factors.

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DEVELOPMENT OF WINTER WHEAT LEAF DISEASES DEPENDING ON FUNGICIDE SPRAYING SCHEMES AND THE LEVEL OF NITROGEN

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Winter wheat is one of the most profitable crops in the temperate climate zone. Sowing areas of winter wheat are increasing every year and in order to improve the crop yield and quality, farming systems become more intensive. Tan spot (*Pyrenophora tritici-repentis*) and Septoria leaf blotch (*Zymoseptoria tritici*) are the most common and significant leaf diseases in Latvia which cause the biggest yield losses [1]. Besides agrotechnical methods, the use of fungicides is the most used method to prevent the development of plant diseases. There are several opinions regarding the timing, number and dosage of fungicide sprays – some scientists assure that one fungicide per season is enough [2] while others demonstrate the need for two or even three fungicide sprays [3]. The aim of the present investigation is to evaluate the efficacy of different fungicide application schemes for the control of winter wheat leaf diseases.

Two–factor field experiments were established at the Peterlauki Study and Research Farm of Latvia University of Life Sciences and Technologies in the growing season of 2017/2018. Factor A: fungicide treatment (five schemes); factor B: nitrogen fertilization (rates of 120, 150, 180, and 210 kg ha^{-1}). Diseases were assessed five times in the vegetation season. Severity of the diseases was noted for the whole plant at the growth stages of 31–79 according to the BBCH scale. The total impact of the diseases during the vegetation period was estimated by calculating the area under the disease progress curve (AUDPC) and the area under disease progress stairs (AUDPS).

Severity of Tan spot was low throughout all the vegetation season and did not reach even 2% while severity of Septoria leaf blotch was even lower – bellow 0.5%. The extremely low severity of leaf diseases can be explained by the meteorological situation – the untypically dry and hot conditions were not suitable for proper development of leaf blotches. However, despite the unfavourable weather conditions, there were differences in the efficacy fungicide schemes, demonstrated by the values of AUDPS and AUDPC. The use of any fungicide significantly decreased the severity of tan spot compared to no–fungicide spray. The use of a half dosage was less effective compared to full dosage or two and three fungicide sprays per season. In order to obtain more reliable data, it is necessary to continue the present experiment in more typical vegetation seasons.

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IMPORTANCE, USES, AND PRODUCTION OF CAROB (*CERATONIA SILIQUA* L.) IN TURKEY

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Carob (*Ceratonia siliqua* L**.**) from the legume family (*Fabaceae*) is also called St. John's bread or locust bean because of the fruits (pods). It is mentioned in the Bible that locust beans were eaten by John the Baptist in the Wilderness.

Carob grows well in warm, temperate and subtropical areas, and tolerates both hot and humid climates. Carob trees need a Mediterranean-type climate as well, as they survive in dry climate without irrigation and are well-adapted to dry environments with little annual rainfall (dry climates that receive more than 30 centimetres of rainfall) [1]**.** Carob trees can adapt to a wide range of soil types and have some outstanding features such as rusticity, drought and fire tolerance. Carob trees mostly cannot find a habitat that is not prevailed by macchia, which is a shrubland biome in the Mediterranean region, typically consisting of densely growing evergreen shrubs [2]. That is why in Turkey, carob trees are grown where the Mediterranean climate and characteristic elements of macchia formations are dominant in Aegean and Mediterranean regions of Turkey.

The fruit of the carob is a pod — technically a legume which is 15 to 30 centimetres in length and fairly thick and broad. Pods are found on the old stems of the plant on short flower stalks. Interestingly, most carob trees are monoecious, with individual male and female flowers.

The dark-brown pods are not only edible, but also rich in sucrose (almost 40% plus other sugars) and protein (up to 8%). Moreover, the pod has vitamins A and B as well as several important minerals [2]. They can be eaten directly by livestock, but carob is mostly known because the pods are ground into flour as a cocoa substitute. The fruit is used in both human and animal feed. Carob pod contains a high amount of carbohydrates, proteins and low levels of fat and significant amounts of potassium, calcium, and polyphenols. Therefore, it plays a significant role in human health. Mainly fruit of carob are known for its gastrointestinal, anti-diabetic, anticancer, cytotoxic, anti-impotence, anti-diarrheal effects and also they are known as natural doping because of its rich content [4].

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REACHING FOR ANISE (*PIMPINELLA ANISUM* L.) YIELD BY COMPANION PLANTING AND CROP ROTATION METHODS

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In Turkey, Anise (*Pimpinella anisum* L.) from the *Apiaceae family* is a highly popular plant because of its wide usage area such as using it in the production of special anise tea, alcohol named "Turkish Rakı", anise oil and also as a spice because of its nice taste and smell. Mainly it is used as a medicinal plant for improving digestive functions, helping to lose weight, preventing sleeplessness and improving heart health with rich vitamins and minerals [1]. Anise contains 2-7% essential oil, and the general compound is anethol (70-80%) [2]. Anise prefers soil which is rich in lime and nutrients, and it undeniably needs nitrogen for increasing high yield. An overdose of nitrogen causes flower dumping, decreases binding and production of essential oil. Growing of anise demands quite much care and risks re-seeding due to anise moth (*Depressaria daucivorella* Ragonot), anise leaf spot (*Cercospora malkoffii Bub.* L.), powdery mildew (*Erysiphe heraclei* DC) as well as aphids and agrotis.

Coriander (*Coriandrum sativum* L.), also known as Chinese parsley, is an annual plant which belongs to *Apiaceae*. Its leaves and fruits have a recognizable and pleasant aroma and are commonly used raw or dried for culinary applications. There are many vitamins and minerals in coriander [3]. Coriander has benefits such as facilitating digestion, being good for indigestion, stimulating the stomach, increasing appetite and controling diarrhea in children. The essential oil content of coriander varies between 0.2% and 1.5%. The content of this oil is 72% linalool. Petroselinic acid, which is 80% in coriander's fixed oil, is the main ingredient of this oil [4]. Both plants contain high concentrations of essential oils which are produced by plants to protect themselves from bacterial and fungal diseases by attracting or detracting insects.

Lentil (*Lens culinaris* L. or *Lens esculenta* L.) is an edible legume. It is a bushy annual plant known for its lens-shaped seeds which grow in pods. Lentil is hypogeal, which means the cotyledons of the germinating seed stay in the ground and inside the seed coat. Therefore, it is less vulnerable to frost, wind erosion, or insect attack. Lentil has 11.5 kg/da crude nitrogen amount per year and proves itself as a perfect soil enricher. According to the sources, it belongs to lentil [5] and up to 60 kg of N/ha can be fixed by lentil [6]; that is why lentil should be the pre-crop for anise in the crop rotation method.

The companion planting method, which is a form of polyculture, is the planting of different crops in proximity for any of a number of different beneficial reasons. The crop rotation method means mainly growing a series of dissimilar or different types of crops in the same area in sequenced seasons to prevent different types of problems and improving the soil in several ways [7]. To sum up, the research examined planting anise with coriander according to the companion planting method and crop rotating with lentil over different kinds of biotic and abiotic problems.

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ANALYSIS OF PRICKLY PEAR GROWING CONDITION IN MEDITERRANEAN PART OF TURKEY AND AREAS OF USAGE

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Prickly pear is the fruit of the cactus pads tree (Opuntia *spp.* L.) or "nopal" member of the *Cactaceae* family. Indian fig opuntia (*O. ficus-indica* L. (Mill.)) has the most common culinary species[1]. It is a native plant of the American continent, also cultivated in the Mediterranean countries (Spain, Italy, Greece, Egypt, Turkey), Central and South Africa, the Middle East (Israel, Jordan), Australia, and India.

In Turkey, it is located wildly in the Mediterranean Region. Prickly pear cactus can tolerate poor soil conditions. It is best to grow it in well-drained, light, sandy and loamy soil [2]. The plant flowers have three distinct colours: white, yellow and red. Flowering starts in early May to early summer, but the fruits ripen from August through October. The fruits are edible, the taste being similar to sweet watermelon. One problem is the thick outer skin. The bright red/purple or white/yellowish flesh contains many tiny hard seeds that are usually swallowed, but should be avoided by people who have problems with digestion [3].

Cactus pear may be used in a wide range of products made at home, in small enterprises or on an industrial scale such as jams, gelatine, syrups, dry fruit, candies, soap, mampoer and juice concentrate. The nutritional, medicinal and human health properties of cactus pears are factors that could contribute to an increase in cactus pear consumption (Hegwood, 1990). Another potential product that can be obtained during fruit processing is seed oil. This oil is edible and has a yield range between 5.8-13.6%. (Sawaya & Khan, 1982). Recently, the possibility of using seed oil from cactus pear and in producing ethanol and antioxidants from cladodes has been revealed. There are more than 40 cultivars, but the most popular are 'Morado', 'Gymno Carpo', 'Algerian', 'Skinners Court' (Everett, 1978). Tender cactus stems (*Opuntia spp.* L.) are harvested commercially when they are 15–20 cm long and weigh about 90–100 g (Cantwell, 1995). Cactus cladodes are well-known for their high fibre content including pectin, lignin, mucilage, cellulose and hemicellulose which could be beneficial for the metabolism of glucose and lipids (Ayadi, Abdelmaksoud, Ennouri, & Attia, 2009). Likewise, it has been shown that cactus cladodes extracts contain polyphenolic compounds such as flavonoids and phenolic acids which provide antioxidant capacity (Corral-Aguayo et al., 2008, Guevara-Figueroa et al., 2010, Sanchez et al., 2014).

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MODERN LEVEL OF AGRICULTURAL PRODUCTION IN REPUBLIC OF BELARUS

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Belarusian agriculture is an important sector of the country's economy, providing 7.5% of the country's GDP, 17.1% of investments in fixed assets. Agriculture employs 9.7% of the population. The structure of the industry is dominated by large farms (former state and collective farms), receiving multi-billion state support and subsidies; export-oriented enterprises are in the most favourable position. At the same time, most potatoes and vegetables are produced by private farms. [1]

The Republic of Belarus is the leader among the CIS countries in the production of potatoes, meat, milk and eggs per capita. Belarus takes the fifth place in per capita production of grain and vegetables. [2]

The country covers more than 100% of its own needs in milk, meat, eggs, potatoes and vegetables, by 57.5% for fruits and berries, by 15.3% for fish. Exports of agricultural products (including processed ones) exceed imports. [3]

Agriculture of Belarus is specialized in growing crops traditional for temperate latitudes. In growing grain crops predominate barley, rye, wheat, potatoes, fodder crops. In livestock farming, cattle are mainly raised for the production of milk and meat, as well as pigs and poultry.

Thus, it is necessary to develop and support this area of the country.

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INFORMATION TECHNOLOGIES

TOWARDS OPEN DATA: ISSUES OF DATA DISCLOSURE IN LATVIA

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This article discusses open data issues and proposes possible scenarios for data analysis and classification.

Regulatory enactments advise that national authorities must ensure their competence availability of the information found on the official website of the institution or on the official website and mobile application of the supervising authority, if such has been established. This does not refer to information which is classified as restricted access information or state secret or which is not to be published in accordance with special regulatory enactments [3].

Open data are freely available information without restrictions on re-use, which can be edited and automated with free applications. As well as the availability of public administration data in an open way, it is one of the fundamental principles of the e-government policy during the 2014-2020 development programming period [4].

The open data approach may cover all information published by the national authority, such as public registers and public parts of the national information systems, studies, statistics, tables, etc. The approach is based on the idea that the information must be transmitted to the public in such a way that it can be processed [1].

But not all published information is considered to be open data. One of the examples is the salary correspondence of public officials previously published, since these data are not comparable between institutions, non-discriminatory from their public availability. These data are published, not only in spreadsheet format, which could be easily processed and analysed by the data user, but even in Flipping book format, which is in a non-editable and non-copyable format, so that the data become non-usable for analysis. It should be mentioned that the open data already published reveal shortcomings, such as no metadata descriptions, or that large amounts of information is divided into several files, including aggregates that distort the data structure [2].

Information published on institutional homepages also has high potential of becoming open data, as the regulatory enactments relating to the disclosure of information have been supplemented and the definition of open data has been improved.

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ADOPTING C# LANGUAGE FOR REVERSIBLE COMPUTING

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Reversible computation is at the core of newly proposed programming paradigms for developing control systems and robots with a high level of autonomy and adaptation. Reversibility is also related to bidirectionality [1]. However, we have a lack of implementation of reversible computing in general-purpose programming languages, such as Java, C++ or C#. Of course, some recent work of general-purpose functional programming languages was presented independently by Yokoyama, Axelsen, Glück [4] (later extended [5]) and James, Sabry [6].

In this research ways of reversibility and how they work are presented. For example, the simple reversible imperative language R [3] was developed by Frank to generate instruction code for the Pendulum processor. The research focuses on the rules for which purpose they are written, the limitations that are needed for the rules for full efficiency. For example, one of the rules is the fact that there has to be an additional way to present information needed *if* case as regular C# only has one gate of entry into an *if* statement. The way around the language limitation that is proposed is to add the condition of the other gate also known, and reverse the if entry by on the same line as the comment a rule is added that anything written in the comment is the new reverse *if* condition and the regular *if* condition is just placed into the comment. So, if the *if* the rule were to be applied again the condition of the *if* would be same as before the reversion and the reverse of condition is back in the comment.

The goal of the work was to enhance C# with reversibility aspect. In order to do so, rules of transformations that would allow reversing of C# code from regular sequence of execution to a reverse sequence of execution must be identified. These rules include local backward determinism, an important property for a reversible language. The rules are defined using regular expressions. By adopting a symmetric first-match policy for case expressions, overlapping patterns must be written. They mainly cover usual math operators and some other ones. The main observation was the fact that the C# code had to be written according to the coding conventions [2], some other limitation was also imposed on the code for the code to contain additional information needed to perform a successful reversion of certain cases.

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INTEGRATION OF GEOGRAPHIC INFORMATION SYSTEMS AND LINEAR PROGRAMMING FOR SOLVING TRANSPORTATION PROBLEMS

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In this study, urban transportation problems were investigated in Canakkale, Turkey. The expectations of the passengers were determined by means of surveys. According to the results, 41% of the participants emphasized that route planning should be improved, while 59% of the passengers were not satisfied with the time they spent in the vehicle and 85% of passengers complained about the density of public transportation vehicles. They also required support to increase the amount of vehicles to match increased demand. The investors, considering passenger dissatisfaction, increased the number of vehicles between the years of 2013 and 2017. Although they increased the number of vehicles by 47% within three years, they could not predict the passengers' density. The aim of this study was to determine whether the current number of vehicles satisfies the passengers' demands. For this purpose, the study area where the passenger demands were highest, was chosen. Then, the numbers of passengers were obtained over three time periods (08:00-12:00, 12:00-16:00 and 16:00-20:00) with the aid of smart card data. Smart card automated fare collection systems are being used more and more by public transit agencies. While their main purpose is to collect revenue, they also produce large quantities of very detailed data on onboard transactions. This data can be very useful to transit planners, from the day-to-day operation of the transit system to the strategic long-term planning of the network [2]. This data was transferred into the Geographic Information Systems database in order to create the passenger density map and to determine the passenger tendency. The GIS-based transportation system has many advantages which include analytical capabilities, visual power, efficient data storage, integration of spatial database and capabilities for spatial analysis [3]. The proposed models for solving the problem were created by linear programming approaches. Linear programming is a mathematical method for determining a way to achieve the best outcome (such as maximum profit or the lowest cost) in a given mathematical model for some list of requirements represented as linear relationships [1]. It must be concluded that in comparing the proposed models and passenger density, the number of vehicles was found to be sufficient. Thanks to this research, the investors evaluated new proposals of the solutions regarding the improvement of the frequency of bus services and changes of route plans instead of buying unnecessary vehicles.

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DETECTING AND BLOCKING OF UNWANTED DOMAIN NAME SYSTEM RECORDS TO PREVENT TRACKING AND IMPROVE SECURITY ON LOCAL COMPUTER NETWORKS

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Unwanted advertisements and other trackers, sometimes even malicious, on smartphones and other internet connected devices are becoming harder to detect and block. The online advertising business model has introduced clickbait on an enormous scale. Social media companies have figured out how to make people spend more and more time on their websites to maximize ad impressions and thereby, also revenue. The aim of the research is to implement a system that can detect and block unwanted Domain Name System (DNS) requests on Local Area Networks (LAN).

By researching the possibilities of identifying, filtering and blocking unwanted advertisements, some useful methods were discovered. One of the methods of blocking advertisements online is to use a specially crafted filter list which is then installed on a DNS server which is running on the user's LAN. These filter lists could be community based or self-made.

DNS is a service which translates the Internet Protocol (IP) addresses to domain names [1]. Such a service is found out to be the fastest way of blocking access to unwanted content based on user generated or previously determined criteria. Such queries are collected and analysed using machine learning algorithms to improve filter lists in real-time. Data collection is made possible using specific DNS request logging software called Elastic Stack in a home network environment. The upcoming new standard in DNS, called DNS over Hypertext Transfer Protocol Secure (HTTPS), is also evaluated from the security point of view [3]. Blocking unwanted and intrusive advertisements can not only make the internet safer to use by blocking known malware domains, but also save bandwidth which can be limited on mobile equipment.

Solutions such as PiHole and pfSense with the DNSBL addon have been evaluated during the research, and proven that they can be used to filter and block of unwanted DNS records, which is made possible by running specialised software-based DNS server running on Raspberry PI or similar hardware [2]. The domain names are blocked by resolving them to a local address, which takes only few milliseconds. On Android operating systems, since version 9, DNS servers can be specified by user. Making PiHole DNS server (port 53) secured and exposed to the Internet [3], ad blocking on smartphones is possible not only using Wi-Fi networks at home, but also on 4G and upcoming 5G connections on the go.

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LANDSCAPE RATING WITH EYE TRACKING AND FACIAL EXPRESSION RECOGNITION

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Nonverbal communication takes an important part in overall human communication, and it can provide useful data about human feelings and emotions in many fields while interacting with certain objects or processes. Eyesight and facial expressions are part of nonverbal communication and it can be analysed using modern technologies that can provide data with 99% accuracy. Landscape rating is multidisciplinary so multiple systems and methods are used for its identification and classification [1]. To rate a landscape, experts use multiple design criteria (lines, textures, colours etc.) and physical attributes (harmony, diversity) that later on are converted in formal parameters. As human experience and feelings are in the centre of human and landscape interactions, these rating methods are often criticized and are not so objective because human psychological aspects are not considered [2]. To get society's rating about landscape, an objective method is to use eye tracking. This method provides data about eyesight velocity, directions and rating duration. This approach is popular in psychology and has been introduced in geography, cartography, nature science and has been rated as objective as it can provide useful data about human perception[3][4]. To digitally analyse human face and emotions, there are many high accuracy algorithms and services available so it is possible to use these methods in landscape rating as well. In computer science emotion recognition is called emotional computing. It is a field that studies systems and approaches that can interpret, recognize and analyse human activities [5]. Emotional computing takes a big part in artificial intelligence and computer vision sciences, and it is used in many fields like marketing, virtual reality, augmented reality, car manufacturing and entertainment [6].

The aim of this study was to create a solution to improve landscape rating process where human eyesight changed and facial expressions were considered. To reach the aim, it was necessary to research multiple facial expression recognition algorithms and services as well as eyesight tracking and its data visualisation so that solution would provide most accurate data while the landscape was rated. The solution was created using .NET framework and "Windows forms" GUI library. For eyesight tracking "EyeTribe" eye tracking device was used and for facial expression recognition "Azure Face API" service was chosen as the most suitable for the research.

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COMPARISON OF TECHNOLOGICAL SOLUTIONS FOR THE TREATMENT OF AMBLYOPIA

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Amblyopia is impaired vision without any obvious defect or change in the eye due to the eye and brain not working well together. The gold standard treatments for amblyopia are all based on occlusion therapy, such as patching or blurring vision in the dominant eye with medications, therefore forcing the use of the amblyopic eye. Unfortunately, this type of treatment can only be effective for up to 7-9 years of age [1]. However, in recent years, new therapies have been developed, such as dichoptic visual training aimed at eliminating interocular suppression and improving binocular vision. The treatment has shown progress in adult amblyopia.

There are several technological solutions that can be used with dichoptic game therapy – head-mounted video googles, virtual reality headsets, a computer screen or a hand held device together with matched anti suppression glasses for the user [2]. All of these solutions work by presenting a slightly different image to each eye, therefore stimulating the simultaneous use of both eyes to see the entire image. The aim of this paper was to determine which technological solution is best suited for treatment of amblyopia. Although the use of anti-suppression glasses is the most affordable option out of all, virtual reality also provides depth perception training[3]. New advances in eye-tracking and AI combined with virtual reality headsets in the future could allow objective measurements in oculomotor function without user input and aid in the individualization of visual rehabilitation for the patient's needs. All of the findings of this paper will later be used in the development of dichoptic presentation games for vision therapy.

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INFORMATION TECHNOLOGY SOLUTIONS IN MEDICINE

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Technology is one of the most volatile spheres of today's world. Every day, new updates are being developed with the aim of making tasks easier and more enjoyable. Technology is known to continuously influence all spheres of life, as well as professions. From commerce to law, even business and science – they have all benefited one way or another from the advancement of this sphere. The healthcare sector has not been left out either [1].

Using virtual and augmented reality technology in medical education is becoming a big trend and part of a fast-growing market. Anatomy Next is one of the few companies which sees a huge opportunity in the medical training innovation. Trauma simulation in virtual reality is designed to train medical students and residents in emergency medical situations.

Currently, specifically designed manikins are used for this type of training in a prepared emergency room that has all the necessary tools and equipment typically found in a hospital [2].

Nanomedic developed the SpinCare device, a portable wound care system that creates an on-the-spot nano-fibrous layer for tissue repair and healing without any contact from the caregiver. The device is used in European and Israeli hospitals and is set for commercial market release later this year [3].

Robotic surgery is a type of minimally invasive surgery. "Minimally invasive" means that instead of operating on patients through large incisions, miniaturized surgical instruments are used that fit through a series of quarter-inch incisions. When performing surgery with the da Vinci Si—the world's most advanced surgical robot—these miniaturized instruments are mounted on three separate robotic arms, allowing the surgeon maximum range of motion and precision. The da Vinci's fourth arm contains a magnified high-definition 3-D camera that guides the surgeon during the procedure [4].

Despite the achievements of the world, Latvia is also competitive in this field. In Latvia, the use of information technologies in the medical sector is developing every year. It would be very useful to do deeper research on this theme.

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COMPARISON OF 3D SCANNING TECHNOLOGIES

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3D scanning technologies depend on different principles and can be classified in the following technology categories: Laser triangulation 3D scanning technology, Structured light 3D scanning technology, Photogrammetry, Contact-based 3D scanning technology and Laser pulse.

D scanning would be great for virtual reality (VR) because of the scanning possibilities. If one wanted to get a specific object to use in the VR environment, one would need to create the object in a 3D computer graphics software. With 3D scanning it is only necessary to scan the chosen object and upload it to the desired VR environment.

The aim of this research is to compare these types of technologies and find out what would be suitable for interpreting them to virtual reality.

Photogrammetry, also known as 3D scanning from photography, reconstructs in 3D a subject from 2D captures with computer vision and computational geometry algorithms [2].

Laser triangulation 3D scanning consists of 3 main elements: a camera, a laser transmitter and the object to scan [3].

Laser pulse 3D scanning technology is based on the time of travel of a laser beam. The laser beam is projected on a surface and collected on a sensor. The time of travel of the laser between its emission and reception gives the surfaces geometrical information [1].

There are various types of scanning technology. Testing them in real life involves difficulties of acquiring technologies and tools, because of their cost. Presumably, in the next 10 years they will be more advanced and more available to the public.

Currently, 2 scanners have been tested: XYZ printing 3D Scanner Pro and XYZ printing da Vinci 1.0 Pro. 3D Scanner Pro uses include the RealSense image capture software made by Intel and it uses structured light technology. The scanner is suitable within the range of small objects compared to a human head. Minimum scan volume is 5 x 5 x 5 cm and the maximum scan volume is 60 x 60 x 30 cm. XYZ printing da Vinci 1.0 Pro uses Slit Laser Triangulation technology and scan volume ranges from 3 x 3 cm to 15 x 15cm. Thus, it is suitable for small objects only. In the future iSense 3D Scanner could be tried, because it is cheaper and more suitable for standard users. The iSense 3D Scanner can be attached to an iPad, so one can take this portable scanner anywhere since it only requires being attached to an iPad. The scanner uses structured light technology.

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FORESTRY AND WOOD PROCESSING

PICEA ABIES (L.) H.KART. COMMERCIAL THINNING IN *MYRTILLOSA MEL.*

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Forest managers often refuse thinning in stunted Norway spruce stands because they are afraid of further deterioration of the condition of the trees' health immediately after commercial thinning. However, properly done thinning, especially in pure stands, is considered to be a precondition for improving the stability and viability of individual trees. Light and moderate thinning in spruce stands can increase the future growth rate and can be considered as an instrument for increasing the harvest in final felling [1, 2, 3, 4].

Research data were collected in the forest type MYRTILLOSA MEL. two average age group forest stands with the dominant tree species being Norway spruce. Data collection was done before and after thinning in each of the two 0.25 ha (50x50 m) size sample plots (SP) of the forest stand. In each SP the trees were numbered. In the first stand 834 trees were surveyed and in the second – 733 trees. In each SP all the trees' diameters at breast height (DBH) and first green and dry branches of 50 trees, height of growing trees within different growth classes by the Kraft classification (dominant stand - I, II, III and suppressed stand - IV and V Kraft class trees) were measured. Dendrometric indicators of forest stands were calculated before and after commercial thinning.

The average height of the dominant species of the forest stand was 19.0 m and the average diameter - 17.8 cm, but after commercial thinning – the height was 22.1 m and diameter – 21.0 cm. The average height and diameter of the stand after the thinning had increased as a result of the removal of suppressed trees.

The research concludes that the diameter increment by 1% results in tree height increment by 7.8 cm on average.

As the commercial thinning was done with the allowable cutting intensity, not only the diameter of the remaining trees in the forest stands will increase in the future, but the height of the trees will also increase as the diameter increases. The tree's crown is a very important part of the tree, as it increases the growing stock increment. If the tree's crown is short, the tree will not have high commercial value. That is why it is very important to carry out thinning at the right time.

It is very important to conduct the research and experimental work regarding the impact of the thinning intensity on the Norway spruce forest stands, growing stock increment of trees that are left after thinning and the biodiversity of the forest stands.

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HOW DOES LIGNIN MAKE WOOD HYDROPHOBIC?

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Wood is an ideal material for innovation, because of its environmental advantages and numerous useful features and components. It is a hygroscopic material.

Depending on the climatic conditions and the place it comes from, it can absorb water or reject it. Wood fibers swell and shrink. There are several solutions to reduce the dimensional variations of wood, such as silicone and all its derivatives. They are widely used in wood waterproofing. In the same way that petroleum solvents are still present in many products, these molecules must be banned. They are not safe for either the user or the environment.

Hence, the authors thought about an alternative that is a natural product with no impact on the environment. Coating lignin wood is thus a natural solution in an innovative process for improving the characteristics of wood. The main functions of lignin are to provide stiffness, impermeability to water and a high resistance to decomposition.

To obtain this coating, lignin must be extracted from the wood and then diluted with glacial acetic acid. The Klason method was used for the experiment. After recovery of lignin in solid form, it was diluted with glacial acetic acid. The product was applied on several samples of oak (Quercus Robur) and maritime pine (Pinus pinaster).

After performing wettability tests on several samples (softwood / hardwood), it was observed that the drops of water remained on the surface. Therefore, this lignin-based product helps to prevent the infiltration of water into the wood.

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FOREST TAXATION INDICES IN DIFFERENT AREAS OF EARTH MAGNETIC FIELD IN OGRE REGION

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The research was carried out to obtain the connection between the Earth magnetic field data and forest stand indices in Latvian forests. As we know, the main resources for biological organisms are air, water, nutrients that are extracted from both the chemical and physical sources. The hypothesis was set forward that the magnetic field influences the growth of trees. The data of Earth magnetic field measurements via satellite and the forest taxation indices were used – the distribution of forest subquarters in belts of magnetic field radiation's intensity was designed. The object for studying the forest vegetation in places with magnetic field of different intensity was selected according to the map of magnetic field deviation of Latvia Geology Fund. The object of the research was chosen in Ogre Region, since it is one of the regions where it is possible to study different magnetic field parameters from zero value (an average value of magnetic field in Latvia).

In order to enable the analysis of magnetic field and forest taxation indicators, the corresponding data of the magnetic field from the satellite have been digitally added to the data of forest subquarters of the State Forest Service: a filled polygon layer with values, obtained by vector data. In the attributes of the landfills (forest stands at the subquarter level) the magnetic field parameters are specified - the minimum and maximum value of the magnetic field polygon in the compartment. In order to characterize the effects of magnetic field parameters more objectively, correlations were obtained in the calculations taking into account both of these values: minimum and maximum. The nonparametric correlation analysis and methods of descriptive statistics were used for data interpretation. The results show that there are larger and smaller differences between the parameters of the magnetic field and the taxation indices of the forest stand in certain forest site types with certain dominant species. Through scientific research, the authors have searched for deeper understanding of how trees have established a link with places with different magnetic fields, starting with the analysis of forest site types Hylocomiosa and Caricoso-phragmitosa, respectively, in the forests on dry mineral soils and wet peat soils. The statistically significant relationships between the tree species, taxation characteristics and magnetic field deviation were obtained in both analysed forest site types - Hylocomiosa and Caricoso-phragmitosa. Although the correlations are very weak, they are statistically significant. The most positive weak statistically significant correlation between the stand volume, average height, diameter and parametres of Earth's magnetic field was obtained for the birch in Hylocomiosa forest site type. The most even fluctuations of the tree stand's volume, average height and diameter with a trend of increment by different magnetic field parametres indicate birch in Hylocomiosa forest site type.

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ENERGY WOOD AVAILABLE IN THE UNDERGROWTH AND UNDERSTOREY OF FORESTS IN LATVIA

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In 2017 in the territory of Latvia there were 11.44 million cubic metres of wood cut, and the usage of wooden biomass for energy has improved. The resolution on the climate change of the European Union emphasizes that the energy policy is a crucial element of the global strategy on the climate change and use of the renewable resources is one of the main elements, including wood for heating, electric power production and transport.

The forest undergrowth and understorey, which still is not sufficiently used as a considerable amount of potential energy wood, has a good potential as storage of wood for energy. The Nordic – Baltic region is the area with most continuously increasing usage of forest fuel, and it is increasing all over Europe [1]. For example, logging residue removal together with thinning and sanitary cutting increases the extraction of forest fuel by 15 – 20 %, compared to conventional harvesting [2].

The study on the assessment of energy wood resources is necessary and sufficient number of radial plots are to be established in this case in drained forests site types. *Myrtillosa mel.* forest site type suggests that the biomass of naturally humid woody plants of understorey and undergrowth comprises 22,665 kg per hectare, but calculated as the dry mass – 12,590 kg per hectare.

During the research it was stated that the volume and biomass of forest undergrowth and understorey was higher than in the previous calculations. It is understandable that not all of the researched biomass is economically acceptable as an energy source (especially trees with small dimensions), but this source is worth studying. In further research it will have to be analysed, how much undergrowth and understorey volumes depend on different growing conditions and dominant tree species that looks significant for now.

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VARIATION OF THERMAL CONDUCTIVITY OF NON-WOVEN FIBER PANELS, ACCORDING TO THEIR DENSITY, HYGROMETRY AND SPECIES

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Non-woven insulating materials based on wood or vegetable fibers have been used for many years in building insulation. Nevertheless, research is still being conducted to improve their thermal properties. This research project evaluated of the possibility to use Guyanese wood for such insulating pannels. The aim was to determine the influence of density, hygrometry and wood species on the thermal conductivity of non-woven fiber panels.

To characterise the thermal conductivity, the guarded hot plate method was used [1]. This method is non-invasive, and it is practiced in steady state. Moreover, it requires a temperature gradient within the material. For this, tested samples (dimension 143x143x25.4cm) were positioned between two trays, one represents the hot source and the other the cold source. To determine the hygrometry influence, an AFNOR standard protocol [2] in the Polytech laboratory in Nantes was used.

For the experiments, three thermal conductivity measurements were recorded, with several different temperatures gradients ($\Delta T = 7$; 10; 13°C). Thus, by linear extrapolation, thermal conductivity of the sample was determined.

The experiments have shown that the thermal conductivity increased with the moisture of the sample. This was expected, because the wetter the sample, the more water was present. However, the water thermal conductivity was higher than the thermal conductivity of wood fibre.

The research also showed that fibre panel density and wood species have a significant impact on thermal conductivity. Indeed, the denser the panel, the higher the thermal conductivity. Finally, it was dounf that the Cecropia bark presented the best thermal properties.

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THE ADDITIONAL INCREMENT OF TREES AND GROUNDWATER REGIME IN THE SCOTS PINE *PINUS SYLVESTRIS* L. STAND IN *SPHAGNOSA* FOREST SITE TYPE IMPACTED BY A DOLOMITE QUARRY

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During the last decades the amount of mining mineral resources in Latvian forests and mires including peat and dolomite mining has been increasing. It is important to determine the distance from dolomite quarries, at which their impact on forest stands or mire ecosystems ends. Near the Great Kangari Mire the extraction of large dolomite dominates from Ropazi District, which began in the 20th century in the 80's, but rapidly expanded after 2010. The research was carried out in two objects in "Lielie Kangari": Object 1 - in Ropazi District, the Quarter 620, Subquarter 2 of the state forest (pine *Sphagnosa*, 94 years old) 900-1400 m from dolomite quarries, in the area of the potential depression funnel - 10 sample plots. Object 2 - in Ogre District, Quarter 633, Subquarter 5 of the state forest (pine *Sphagnosa*, 97 years old), outside the probable impact area of dolomite quarries, 6 sample plots were created. In each sample plot (with a radius of 7.98 meters), forest dendrometric indices (including wood increment dynamics and calculations of additional increment after the impact of dolomite quarries began) were determined. There were also 5-6 groundwater control wells installed 10m from each other in each object to determine groundwater level, (at least monthly). In each object, there were also storage compartments for precipitation measurements in the place of the typical forest stand and near the mire, obtaining data at least twice a month. The aim of the study was to analyse fluctuations of groundwater level, looking for correlations with the amount of precipitation and possible differences between the objects, including the additional increment of basal area, height and volume of the forest stand, being potentially caused by the activities of the surrounding area, as well as analysing the growth course of the forest in search of historical differences that could be explained by the extraction of dolomite. After 18 months of observation, it was stated that the average height of a forest stand was 16 meters in object 1 and 12.5 meters in object 2, whereas the basal area of a tree stand on average was 31.8 m^2 ha^{-1} in Object 1, while in Object 2 - 14.0 m^2 ha^{-1}, the average tree diameter 17.9 cm in Object 1, 15.2 cm in Object 2. The level of groundwater in Object 1 during the observation period (05.2017 to 03.2019) varied from +3 to -70cm, but in object 2 from +5 to -80cm. The groundwater level of the two objects did not differ significantly. Similar annual increment of the forest stand volume in both objects has been observed for the last 12 years. It should be concluded that Object 1 shows a significantly larger amount of volume, basal area and height of trees than Object 2, which may be related to both lower groundwater level in Object 1 or historical impact of drainage in Object 1, but there is no evidence of recent impact of dolomite quarries to Object 1. Additional increment for Object 1 (calculated for period 1983-2017, data of 1973-1982 used as retrospection) was -1.505 cm for average diameter, -1.90 m for height and 0.055 m^3 for stand volume, but for Object 2 - +0.455 cm for average diameter, + 0.011 m^3 for stand volume and +0.52 m for height. Primary results show an absence of direct drainage effect for closest Object 1, but for the Object 2 an additional analysis is needed due to signs of impact by bigger distance from dolomite quarries.

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THE CHANGES OF LOWER LEVEL VEGETATION IN FORESTS AFTER SELECTION CUTTING

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This paper concentrates on the study of the structural changes in the lower levels of vegetation in the stands after selection cutting. The purpose of this work was to identify the patterns of emergence and development of an understory in the forest plots of the Federal State Budgetary Institution of Science "Leningrad Agricultural Research Institute" "Belogorka" after selective cuttings. The main component of the forest is the canopy layer. At most stages of forest types' development, the canopy, reflecting the productivity of growing conditions, is in itself an edificator. The canopy layer is the main object of economic use and impact, therefore when considering the type of forest both in statics and in dynamics, the most attention should be paid to the canopy (together with the conditions for its growth). Its nature and features should be revealed most deeply both in statics and in dynamics. However, this does not mean that other components in the form of the lower levels of the forest can be limited to a static approach and should not be considered in the dynamics. With the change of the forest canopy (in this case its selective cutting), as well as for other reasons, there are changes in the lower levels: in the herb layer, shrub layer, and especially in the young generations of the forest – self-seeding and understory [1]. In addition to the canopy layer, which is the dominant, edificator and main producer, the forest phytocenosis also includes the understory layer, shrub layer and herb layer. The understory is a group of young trees, located under the canopy of the stand or on the cutting area, capable of replacing the old stand. The understory is a characteristic component of the forest phytocenosis at some stage of its development. [2]

The experiment was conducted in the summer of 2018 on the forest plots of the Leningrad Agricultural Research Institute "Belogorka" after selective logging. The understory was calculated using two methods: a complete enumeration and an acceptance sampling method. Circular plots of 10 m² each (R = 1.78 m) were used to account for the acceptance sampling method. Plots were made at the same distance from each other. The centre of the next plot was set at a distance of two radii forward along from the center of the previous plot. The age of the understory was determined by nodes with an accuracy of one year. The resulting material was processed by using the methods of mathematical statistics. The vegetation of the lower level is an important component of the forest. Thus, observing the course of natural regeneration, as well as the development of living ground cover and undergrowth allows us to estimate the value of the vegetation of the lower tiers in the restoration processes of the phytocenosis, maintaining its sustainability and improving productivity.

The understory in most cases is in a depressed state, most of which is not viable, which will adversely affect the health of the future stand. Based on the data obtained, it can be concluded that measures are needed to promote natural regeneration or artificial reforestation.

It was revealed that the success of natural regeneration of spruce in the studied areas is primarily affected by the moss cover, the proportion of grass and sedge plants. With an increase in the total projective coverage of these groups of plants, the number of understories has been significantly reduced.

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FOOD SCIENCE

QUALITY EVALUATION OF DIFFERENT BOTANICAL ORIGINS BEE POLLEN

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Nowadays bee pollen is a unique product which is produced in the anthers of plants and collected by honeybees *Apis mellifera* from different floral species. Enriching pollens with compounds is specific only to honeybees, obtaining the pellets with therapeutic and nutritional value [4]. Bee pollen from ancient times got attention in scientific community, because they have high biological activity. The different botanical variety of a harvesting area supplies bee pollen with a complex and rich chemical composition. This gives a great importance in terms of nutrition, but a constant composition results from monofloral pollen [2], because only a monofloral pollen maintains chemical and sensorial characteristics as the plant source identify by morphology, colour, size and flavour [3]. The season, area or time of harvesting in floral species, environmental conditions, including the soil type, can be a reason for differences between chemical and physical composition of bee pollen, but the major differences are mainly because of the bee pollen botanical origin [1].

The aim of this research was to evaluate the quality of Latvian bee pollen from different botanical origins. The research objectives were 11 bee pollen samples (7 – monofloral and 4 – multifloral), from Zemgale and Kurzeme region (Latvia) were used. The bee pollen samples were collected at the floral season 2018. The moisture content (drying at 105 ± 2 °C, 2.5 h), water activity (a_w), pH and colour (L*a*b* system) were analysed.

Regarding the moisture content analysis of monofloral bee pollen, it was in the range from $6.02\pm0.24\%$ to $11.00\pm0.43\%$ and for the multifloral – from $6.66\pm0.22\%$ to $8.38\pm0.34\%$. The results of bee pollen water activity ranged from 0.187 ± 0.02 to 0.389 ± 0.01, and they were not influenced ($p>0.05$) by the botanical origins. The analysis of variance showed that botanical origins significantly influence ($p<0.05$) the bee pollen colour. The bee pollen colour was from light yellow to orange, purple and green; the pH of the analysed bee pollen sample was in the range from 4.73–5.82 (monofloral) and 4.86–5.78 (multifloral).

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POSSIBILITY OF USING CHIA SEEDS FOR MUFFINS AS A REPLACER OF EGG

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Chia seeds are an outstanding and untraditional source of proteins, fibres, polyphenols and lipids (Zettel & Hitzmann, 2018). Due to their excellent nutritional value, chia seeds have attracted attention of many researchers as a good ingredient in food production. The aim of this study was to look into the textural, sensory, aroma, moisture and colour properties of muffins where chia seeds were applied as an egg substitute. Three samples of muffins were made separately with different concentrations of chia seeds (Cia Sēklas, Zelta Rieksts, Riga); the control sample -0 (g), second sample – 12 (g) and third sample – 24 (g). The control sample was made: 100 (g) of wheat flour was mixed with sugar (60 g), milk (54 g), butter (36 g), eggs (36 g), vanillin sugar (8 g), baking powder (2 g), salt (1 g), and water (40 g), and was kneaded for 3 minutes. Chia seeds had been grounded beforehand and added instead of eggs in Samples 2 and 3. Then the dough was put into the baking forms and baked at 190 °C for 25 minutes. The muffins were cooled down after baking. Sensory evaluation was carried out by volunteers of different ages at the university. Three samples were placed on three different numbered plates. The textural properties of the muffin samples were analysed using the texture analyser TA.HD Plus. The top part of the samples was cut before putting them on the texture analyser. The ColorTec-PCM (New York, The USA) was applied to analyse the colour of the muffins. At the end of the experiment, 5 g from each sample were put into the thermostat (Model 100-800, Memmert, Germany) for one and half hours under 130 °C. The obtained results showed that the experimental samples had more firmness and darker colour compared to the control sample. As for sensory evaluation, the results confirmed that the control sample was mostly liked by its colour, structure and aroma whereas the experimental samples were not different statistically, regarding these properties. However, the participants mentioned that concerning the taste, the sample, which had chia seeds with 12 g, stood out from other samples. Thus, it can be recommended to use chia seeds as a replacer of eggs for muffins after positive results were gained during sensory and texture evaluations. It was also reported by Sibele Santos Fernandes, Myriam de las Mercedes Salas-Mellado Laboratory (2017) and Fan Zhu, Coline Chan (2018) that the application of chia seeds in baked food products is really useful not only for improving the nutritional value, but also it can act as hydrocolloid or substitute of eggs, fat and gluten, making the product of high importance. But still there is a need to perform more analyses by decreasing chia seeds content to achieve muffins with the best properties.

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MICROBIOLOGICAL ANALYSIS OF *SOUS VIDE* COOKED DUCK BREAST

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Life is impossible without any bacteria, because they exist around and within us. Consumers are highly interested in minimally processed, convenient and affordable products that contain their natural sensory qualities and are safe to consume. Cooking meat by the *sous vide* method in restaurants can alleviate these concerns while improving food safety, quality, service times and income [1]. *Sous vide* cooking ensures preservation of natural flavours, as food is thermally processed in packaging at precisely controlled temperature regimes, in addition to eliminating secondary contamination [2].

The aim of this study was to evaluate microbiological quality of *sous vide* cooked duck breast (55 ºC and 70 ºC) during 9-day storage at 4±1°C temperature.

Duck breasts were bought at the supermarket "Rimi", Latvia, the country of origin of the ducks was Poland. The duck breasts were packaged in vacuum film pouches (thickness 60 μm) using a Multivac C300 unit. Each sample weight was 235±10 g, a small piece of thyme was added in all pouches to improve the taste of the duck breasts. 6 samples were pasteurized at 71±1 ºC (core temperature) for 45 min, and the other 6 samples were pasteurized at 56±1 ºC (core temperature) for 1 hour 35 min using a Clifton food range water bath. After cooling (20 min at 4±1 ºC), the samples were stored in a refrigerator at 4±1 ºC for 9 days.

The total plate count (TPC) was determined by plating tenfold saline dilutions in triplicate on Nutrient agar (Ref. no. 01-140, Scharlau) with incubation for 48 h at 30 ºC. The presence of *E. coli* was tested on ENDO agar (Ref. no. 4014602, Biolife Italiana) with incubation for 24 h at 37 ºC. The presence of *Salmonella* was tested according to ISO 6579-1:2017. TPC was analysed in the samples on Day 1, 3, 5, 7, and 9.

Total Plate Count, CFU g⁻¹	Storage Days				
	1	3	5	7	9
Raw duck breast	8.66×10^4	was not tested during storage			
Sous vide at 55 ºC	$<1\times10^1$	1.36×10^1	1.26×10^1	1.38×10^1	1.05×10^2
Sous vide at 70 ºC	$<1\times10^1$	$<1\times10^1$	1.61×10^1	1.71×10^1	1.10×10^1

The presence of *Salmonella* was not confirmed in any samples. *E. coli* was found in raw duck breasts (9.16×10^2 CFU g⁻¹), indicating that there might be problems with hygiene conditions at the slaughtering facility. *Sous vide* processing was able to reduce the presence of *E. coli* below the detection limit.

The results showed that the *sous vide* technology was effective in reducing the total plate count in the duck breast meat. Minimal changes in microorganism growth were observed during the storage.

Based on microbiological parameters, *sous vide* processed duck breasts at 55 ºC and 70 ºC with respective cooking time can be stored for 9 days without the loss of quality.

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SOLUTIONS FOR DEVELOPEMENT OF BIOECONOMICS-USE OF FOOD WASTES TO OBTAIN PRODUCTS WITH ADDED VALUE

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An important direction for the advancement of the national economy of Latvia is the development of bioeconomics, where development of environmentally friendly technologies is important. The use of wild and cultivated berries has increasing popularity, which in turn creates large quantities of leftover waste berry press residues. *Vaccinium* spp. berries (bilberries, blueberries, cranberries, lingonberries) are used to produce juice; after the cold-pressing of the berries the residual pomace can be used for production of, for example, tea, however, this material has low calorific value and the material is highly acidic. At the same time berry press residues contain high amounts of effective antioxidants: polyphenolics and substance groups like lipids, waxes and phytosterols.

Using environmentally friendly approach, the extraction of this material can be done using ethanol, carbon dioxide coupled with extraction methods like ultrasound, microwave or supercritical fluid extractions. The extraction parameters have been optimised by using Response Surface Methodology (RSM) which allows higher extractions yields than conventional extraction methods [2]. The UPLC-PDA-MS/MS was used for the analysis of obtained hydrophilic berry press residue extracts, while the GC/MS was used for the analysis of hydrophobic extracts.

Optimisation of extraction was done using ethanol, methanol and trifluoroacetic acid (TFA) or formic acid as additives, optimal extraction conditions for analytical work were found to be 70% ethanol with 1% TFA. The extracts of press residues were characterized and approximately 150 different polyphenols and 95 compounds belonging to lipids as well as different vitamins and carbohydrates were found. Biological activity of these extracts were tested on various food pathogens and it was found that 0.25mg/L of polyphenolic extracts showed significant inhibition properties. Antioxidant extracts were also tested to show the hypoglycaemic and hepatoprotective properties [3].

The prepared extracts show many possible applications, however, these extracts must be purified to remove carbohydrates, which can be done by using sorption chromatography or by stabilizing the extracts by using encapsulation matrices. The potential use of these extracts can be attributed to the high content of biologically active substances; the main applications can include food industry, bio pharmacy, functional foods, cosmetics and others [1].

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DEVELOPMENT OF A RECIPE OF SHORTBREAD MADE FROM PUMPKIN SEED FLOUR

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In recent times it has become popular to use new ingredients for cooking flour confectionary. Among alternative kinds of flour flax, buckwheat, amaranth, rice, and grain flour are used. Pumpkin seed flour also can be a good ingredient due to its chemical qualities. Pumpkin seed flour contains 43% protein, up to 10% lipids which have up to 22% of linoleic acid and 0.13% of linolenic, up to 35% carbohydrates 17-25% of which is fiber. Aside from basic nutrients, there are vitamins C, A, K, B3, D9, mineral elements (potassium, magnesium, calcium, phosphorus, manganese, iron, copper, zinc, selenium), bioflavonoids in pumpkin seed flour. Flour extracted from pumpkin seeds is green and yellow, having a pleasant odour.

Pumpkin flour has a positive influence on people who suffer from allergy, have urogenital disorders, problems with kidney, liver and digestion, weakened immunity, diabetes, it is also used as strengthening, anti-cancer, microbicides, anti-inflammatory, anti-parasites, cardio remedy [1].

In the research we presented the recipe of cooking of shortbread from pumpkin seeds flour instead of wheat flour. As the control variant, we took a shortbread cooked from wheat flour. We added less butter due to large amount of fat in pumpkin flour. What is more, to create the flour of the needed consistency, we added more eggs [2].

The ready-made shortbreads were organoleptically estimated by 10 tasters who checked the look, colour, consistency, taste and smell of the shortbread. The ready-made products were equal to those taken as a means of control. The tasters emphasized the pleasant nut taste of the shortbread, floury consistence as well as uneven cracked surface. We also calculated the nutritional and energy value of both shortbreads made from wheat and pumpkin flour. The shortbread from pumpkin flour contained three times more proteins and two times fewer carbohydrates, meanwhile the energy value increased by 5.5%. In addition, the new product has much more minerals and still fatty acids.

Thus, flour from pumpkin seeds can be used for cooking flour confectionary instead of wheat flour because the products made from pumpkin flour have better nutritional and chemical value, enrich the diet with needed nutrients such as proteins, PUFA, vitamins and minerals.

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DEPRESSION AND DIET

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More than a quarter of the European population suffers from mental disorders [1]. Depression seriously affects the quality of people`s life – ability to work, social life, and economic condition. Modern scientific researches in neurology and psychiatry prove that healthy nutrition, active physical and mental lifestyle can counteract the development of depression, dimension, epilepsy, Parkinson and Alzheimer diseases and many other neurologic and psychiatric illnesses [2]. Only convincing and stable proof base which can be achieved with fundamental research can serve as basics for nutrition recommendations.

The aim of this work is to compile meta-analyses which are made to define interaction between depression and diet. Many research studies describe the influence of certain microelements and vitamins (omega-3 fatty acid, B_{12} vitamin, zinc, selenium and iron) on the emotional condition of children and adolescents [3]. However, actually people do not consume separate nutrients, but eat meals that contain these elements or combination of elements that possibly interact between each other.

Experts of the International Society for Nutritional Psychiatry Research noted that diet has a direct impact on mental health and underlined that diet is a crucial factor in the mental disorder treatment and incidence. These statements are confirmed by research results that healthy and high quality diet is linked with low depression symptoms [4]. There are proofs that a high quality diet is connected to low depression symptoms, but not all results are definite and confirm the hypothesis that diets lower depression risks. In this context, the data confirms a difficult relationship between depression and diet: a diet can influence an evolution of depression, because patients, which suffer from depression, can develop bad nutrition habits [5].

In another meta-analysis, diets with high consumption of fruits, vegetables, whole grains, fish, olive oil, dairy products and antioxidants, and low consumption of animal products are associated with a reduced risk of depression development. A diet based on high amount of red meat, refined grains, sweets, dairy products, butter, potatoes and fatty sauces and low vegetable consumption is associated with an increased risk of depression. [3]

That's why it is necessary to clarify the potential interaction between dietary composition and the risk of depression and to provide a scientific rational formulation of nutrition guidelines. Additional studies are needed to confirm the effect of diet on the development of depression.

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PERSPECTIVE OF CORN OILCAKE USE IN THE FLOUR PRODUCTS PRODUCTION

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At present, the problem of using waste products of the main production process in the food industry is important worldwide. A lot of interest is caused by corn oilcake – semi-skimmed germinated corn, which is the secondary product of corn grain processing.

Nowadays, corn oilcake is mainly used as feed for domestic animals. However, this product contains a significant amount of raw protein (about 20%), fats (15-20%) and fiber. Most of germinated corn proteins are in the water-soluble fraction (25-63%), and the alcohol-soluble fraction is 1.9-3.3%. Therefore, the protein is well absorbed by the human organism [1,2].

This work presents research two types of researcg on corn oilcake: the first after double extrusion process, and the second obtained after cold press. Oilcake, obtained by different methods, contains approximately the same amount of raw protein – 20-21%. At the same time, the oilcake, obtained after cold press, contained 2.4 times more water-soluble, 2.4 times more salt-soluble and alcohol-soluble proteins, and 5.4 times less alkali-soluble proteins.

Oilcake was used to replace wheat flour in recipes of biscuit dough (for 20% and 50%). Water retention capacity was determined for flour mixtures. It was the highest for wheat flour. The introduction of corn flour reduces water retention capacity due to the peculiarities of the protein and carbohydrate complexes.

For ready-made biscuits, the density, porosity, absorptivity and organoleptic values were determined. The addition of corn oilcake had reduced the density of items 1.5 times, reduced their porosity, the pores became smaller. The samples with addition of 20% of corn oilcake were almost the same as the control sample in taste and smell, and those with 50% addition of oilcake had a nutty taste. All experimental samples received high marks by the tasters.

Due to its chemical composition, corn oilcake is an attractive raw material for production of starchy goods. As corn proteins do not contain gluten, processed corn products can be used for the production of gluten-free flour products.

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OCCURANCE OF VEROTOXIGENIC *ESCHERICHIA COLI, SALMONELLA* SPP. AND *LISTERIA* SPP IN SPROUTS, DRIED SPROUTED SEEDS AND MICROGREENS

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Edible sprouted seeds or microgreens are seedlings obtained from the germination of seeds, usually consumed without any heat treatment. *Salmonella* and shiga or verotoxin-producing *Escherichia coli* (STEC) are the most commonly reported bacterial pathogens causing outbreaks associated with the consumption of contaminated sprouts [2] Sprouts are required to be tested for *Listeria monocytogenes,* and producers are recommended to sample the processing areas and equipment for *Listeria* spp. [3]

The aim of the study was to evaluate the occurrence of pathogenic bacteria (*E. coli, Salmonella* spp. and *Listeria* spp.) in sprouts available in the Latvian retail market by using methods of molecular biology and microbiology.

In the study, 26 samples of sprouts, dried sprouted seeds or seeds marketed for domestic microgreens production, originating from various countries, were obtained. The results were obtained by the following ISO (International Organization for Standardization) methods (ISO 13136:2012; ISO 6579-1: 2017 and ISO 11290-1:2017). Bacteria were isolated by using selective media and species identified by the MALDI-TOF mass spectrometry method. The presence of virulence genes was observed by extracting bacterial DNA from the samples and applying polymerase chain reaction (PCR) for targeted pathogenicity genes (*stx1, stx2, eae*) and presence of *Salmonella* spp. specific gene (*mericon Salmonella* spp. kit, Qiagen). The research study was carried out from February 2019 to March 2019 in the Institute of Food Safety, Animal Health and Environment "BIOR", the Microbiology and Molecular Biology Departments.

76.9% of all tested samples showed no presence of STEC, *Salmonella spp.* or *Listeria spp.* bacteria. In one sample (3.8%) *Salmonella spp.* was found, and in two (7.7%) *Listeria innocua* was detected. Two dried sprouted seed samples (7.7%) contained STEC pathogenicity gene *stx*. In both samples, *stx1* was present, and in the second one- *stx1* as well as *stx2* were found. Two dried sprouted seed samples (7.7%) contained intimin (virulence factor) coding gene *eae*, and one of the samples expressed both *eae* and *stx* genes. Possible foodborne disease-causing *E. coli* serotypes were present in three samples (11.5%), all of them in dried sprouted seed products. In one of the samples, serotype O145 was found, in the second both O145 and O121, and in the third O26 and O157 serotypes were present.

In conclusion, the obtained results indicate that the fresh microgreens and seeds marketed for domestic microgreens production available for Latvian consumers are relatively safe. The exception is a microgreens intermediate product - dried sprouted seeds, whose high risk of pathogenicity could be due the methods of product preparation.

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COMPARISON OF BIOACTIVE COMPOUNDS OF CULTIVATED SWEET ROWANBERRY, CHOKEBERRY AND BLACKCURRANT JUICE RESIDUES

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The processing operation of fruit and vegetables produce about 25-35% of fresh weight of product [3]. Juice residues usually are discarded into landfills as waste. However, it has a high potential into food, pharmacy or cosmetic industry for high dietary fibre and bioactive compound content [1]. The water soluble antioxidant components are present in the cell vacuoles and are released in the juice during the pressing of berries, while the components with low solubility (anthocyanins), which are predominantly in the cell walls, remain in the press-cake. Blackcurrant and chokeberry polyphenol content in dry matter can be 1.3 to 1.7 times higher in juice residues than in fresh berries [2]. Due to the increasing amount of food and total waste, the European Union has set a reduction in the amount of waste generated by 2020. As the juice residues are most often considered as waste in food industry, their use would increase the sustainability of the agri-food sector.

The aim of this work was to determine and compare bioactive compounds of cultivated sweet rowanberry (*Sorbus aucuparia*), chokeberry (*Aronia melanocarpa*) and blackcurrant (*Ribes nigrum*) juice residues. The samples have been dried using hot air drying method at 50°C.

Anthocyanins and carotenes were determined using UV/Vis spectrophotometer Yenway 6705 (wavelength 540 nm). Total phenolic content (mg 100 g^{-1}) was determined using the Folin-Ciocalteu method as described by Singleton et al (1999). Vitamin C determined by iodometric titration method. Radical scavenging activity is based on the reaction with DPPH (1,1-diphenyl-2-picrylhydrazyl) radical.

The highest content of vitamin C determined in blackcurrant juice residues (390.54 ± 4.54 mg 100g^{-1}) was followed by chokeberry (165.19 ± 6.48 mg 100g^{-1}) and cultivated rowan berry (60.56 ± 5.33 mg 100g^{-1}) juice residues. Rowan berry juice residues contained the highest total carotenes content (42.23 ± 2.68 mg 100g^{-1}), they were followed by chokeberry (12.07 ± 2.05 mg 100g^{-1}) and blackcurrant (3.35 ± 0.04 mg 100g^{-1}) juice residues. All analysed juice residues were rich in total phenolic content. The highest content was determined in chokeberry juice residues (3146.61 ± 61.18 mg 100 g^{-1}). Chokeberry residues also showed the highest DPPH radical scavenging activity (179 ± 10.45 mg TE 100mL^{-1}).

The obtained results prove that juice residues are significant source of bioactive compounds and vitamin C and can be used in food, cosmetic or pharmacy industry. Chokeberry residues contained the highest amount of total phenols and showed the highest radical scavenging activity among the samples. Blackcurrant juice residues were rich in vitamin C and cultivated rowanberry residues contained the highest amount of carotenes.

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ABOUT THE POSSIBILITY OF USING VEGETABLE MILK ORIGIN FOR THE PRODUCTION OF FERMENTED MILK PRODUCTS

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Milk of different animals is one of the main food products. However, many people cannot use it because of lactase deficiency. Lactose-free products of plant origin can solve this problem [1]. Since manufacturers offer few such products, it is relevant to study the possibility of producing "fermented milk" products based on vegetable milk. For people suffering from lactase deficiency there is an alternative — limited consumption of dairy products with a low content of lactose. For example, in products based on goat milk, the fat molecules are much smaller than in those based on cow milk, so they are easier to digest without overloading the digestive system. Vegetable dairy products can be suitable for vegans who do not eat animal dairy products [2]. The aim was to explore the possibility of producing "fermented milk" based on vegetable milk. The methods of the research were the following; during the research work, attempts were made to ferment various dairy beverages of plant origin. Then a titrated acidity study was conducted. After that, fermented milk beverages of soy milk were obtained on the basis of activated leavens, since the remaining beverages (oatmeal and rice milk) did not form a clot, they did not increase acidity, and microorganisms did not develop. Microscopy and organoleptic analyses were performed for the finished beverages.

Positive results of fermentation were recorded only in products from soy milk. The study of titrated acidity showed that the leavens in soy milk can reach lower values of acidity and require less activation time - 6 hours, while cow's milk ferments did within 8 hours. The highest acidity and the rate of increasing of acidity were found in the acidolactic leaven. Microscopic examination of samples of finished products showed that streptococci are very well developed in yogurt from soy milk. The development of the Bulgarian Bacillus and the Acidophilus Bacillus is slow, probably not enough time for their reproduction. There are single Bacilli in the samples. The best one of the soy milk beverages is a sample made from acido-lactic leaven. Presumably, these results are due to the unconventional taste of soy beverages. They have a saturated bean flavor and aroma which do not disappear during fermentation, but they can potentially be reduced by various additives. This will be the further task of the study.

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FLAX, HEMP AND RAPE SEED PRESS CAKE CHEMICAL COMPOSITION

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The flax *(Linum usitatissimum L.)*, hemp *(Cannabis sativa L.)* and rape *(Brassica napus)* seed press cakes were collected at "Iecavnieks" Ltd., Latvia.

The fat content (%) was determined by "Soxtec 2045" (FOSS, Denmark) according to AOAC 2003.06 standard. The crude protein content (%) was determined by "Kjeltec^{TM} 2100" (FOSS, Denmark) by the Kjeldahl method according to AACC 46-20 standard. The total dietary fibre content (%) was determined by the "Analytical Fibertec E 1023 System" (FOSS, Denmark) according to AOAC 985.29 standard.

The press cakes were defatted, using n-hexane (1:5 weight/volume, 5 min) at ambient temperature, dried for 24 h and refrigerated at 4±1º C for determination of the total phenolic content (TPC), total flavonoid content (TFC) and radical scavenging capacity (RSC). 1.000 g were mixed with 10 ml 54% ethanol, and the extraction process was performed in the ultrasound bath "Citizen Scale YJ 5120-1" (Aczet, India) at 61 ºC for 64 min.

TPC was determined using Folin-Ciocalteu reagent [1] (mg of gallic acid equivalent (GAE) g^{-1} DW). TFC was measured by a colorimetric method [2] (mg catechin equivalents (CE) g^{-1} DW). The antioxidant activity was measured on the basis of scavenging activities of the stable 2.2-Diphenyl-1-picrylhydrazyl (DPPH) radicals [3]. RSC was expressed as μmol Trolox equivalent (TE) 100 g^{-1} DW. RSC of extracts was measured by 2.2′-azino-bis(3-ethylbenz-thiazoline-6-sulfonic) acid (ABTS$^+$) as well [4] and expressed as TE 100 g^{-1} DW.

Flax, hemp and rape oil-seed press cake chemical composition and RSC

Press cake	Fat, %	Protein, %	Carbohydrates, %	Dietary fibre, %	TP, mg GAE g^{-1}	TF, mg CE g^{-1}	DPPH RSC, mmol TE 100 g^{-1}	ABTS$^+$ RSC, mmol TE 100 g^{-1}
Flaxseed	12.04	36.47	29.04	22.45	398.77	6.16	42.00	29.01
Hempseed	9.68	37.87	3.54	48.91	291.28	3.75	33.47	26.53
Rapeseed	14.08	33.04	44.38	8.50	649.99	9.66	68.34	29.76

The fat content in press cakes is dependent on oil extraction technology. Rapeseed and flaxseed are known as primary oleaginous crops in Europe, but hemp as a fibre crop. The chemical analysis of press cakes showed that oil production by-products are rich in nutrients and phenolic compounds with high radical scavenging activity and, therefore, could be used in the development of new products with a higher added value. Another option could be the extraction of specific nutrients for use in the food industry.

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THE INFLUENCE OF WHEY PERMEATE TREATMENT ON GLUCOSE-GALACTOSE SYRUP PRODUCTION

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In previous study, [1] heat treatment was not used for inactivation of β-galactosidase after whey permeate hydrolyses, and the obtained data showed differences between glucose and galactose concentration in glucose-galactose syrup. The aim of this work was to conduct heat treatment after whey permeate hydrolysis in order to improve glucose-galactose syrup sweetness.

To obtain glucose - galactose syrup, the materials used for the study were following: acid whey permeate with total solids 4.80 - 5.09% (measured by the Milkoscan ™ Mars, Foss, Denmark), commercial β-galactosidase (NOLA ^{TM} Fit 5500, Chr. HANSEN, Denmark) with activity 7200 BLU, and 10% $NaHCO_3$.

The hydrolysis of lactose was carried out at 40 °C for 2 hours and heat treatment at 80 ± 2 °C with holding time 3 ± 2 minutes was used. The hydrolysed permeate was concentrated in a vacuum evaporator (Heidolph laborota 4000 efficient, Heidolph Instruments GmbH & Co. KG, Germany) up to 65 and 70 % of total solids. The syrup total solids were measured with refractometer KRUSS (DR301-95, Germany). The monosaccharides composition of the syrup was determined using liquid chromatography (Shimadzu, LC-20, Torrance, CA, USA). The statistical analysis of data was performed using t-test: Paired Two Sample for Means.

A comparative analysis of the syrup monosaccharide composition is presented in the table:

Table. Comparative analysis of the monosaccharides composition of glucose - galactose syrup

Carbohydrates	65% of total solids		70% of total solids	
	Previous experiments, %	New experiment, %	Previous experiments, %	New experiment, %
Glucose	45.0±2.0	42.0±0.2	43.0 ± 3.0	45.2± 0.2
Galactose	20.0 ± 3.0	15.0± 0.2	24.0 ± 2.0	17.3± 0.1
Unidentified sugars	-	~ 8	-	~ 7,5

During heat treatment, Maillard reaction occurs among proteins and carbohydrates. Commercial β-galactosidase, used for lactose hydrolysis, leads to conversion of lactose info glucose and galactose, where especially galactose is very reactive [2]. The decreasing of galactose concentration could be explained by the formation of Maillard reaction products, as well as galacto-oligosaccharides.

In conclusion, the results suggest that the production of galacto-oligosaccharides instead of maintenance of monosaccharides concentration in whey permeate evaporation process could be a useful strategy for production of glucose-galactose syrup.

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SENSORY IMPACT OF BANANA ON MUFFIN QUALITY

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The present work deals with the study of formulation, development and sensory quality of the traditional muffin recipe improved by the use of banana to replace eggs. Bakery products, being one of the widely consumed food products, are associated with their desired organoleptic characteristics [1]. Therefore, the impact of untraditional ingredient usage such as banana in muffins must be analysed accordingly. The above-mentioned substitution is necessary for a better understanding of the relation between ingredient changes and muffin sensory quality. In addition, this study may be helpful in further improvements, whether to obtain vegan or nutritionally improved muffin products.

Three samples of muffins with five repetitions were obtained, of which a traditional recipe was used for the control sample (C) with a 32 g egg, whereas in sample A (A) and B (B), the egg was substituted with 32 g and 64 g banana respectively. The traditional recipe consisted of wheat flour, sugar, milk, butter, eggs, vanillin sugar, baking powder, salt and water, with the net weight of approximately 300 g. The raw materials were mixed until the desired texture was obtained, and were placed in paper cups, each weighing 50 g, and were baked at 190 °C for 15 minutes. A sensory evaluation was conducted by 20 consumer panellists using a 5-point hedonic scale (ISO 4121:2003); such parameters as colour, aroma, texture and taste were tested. The colour of muffins was measured using the Color Tec PCM colorimeter (Accuracy Microsensors, USA). The muffin firmness was determined by the Texture Analyzer *TA.HD Plus* (Stale Microsystems, UK) using a 25 mm diameter cylinder aluminum probe P/25. The pre-test speed was 2 mm s^{-1}, test speed – 1 mm s^{-1}, post-test speed – 10 mm s^{-1}, the penetrating distance – 8 mm, and the trigger force – 0.05 N.

The results of sensory evaluation indicated similarities in colour between A and B, and aroma and taste between C, A and B, whereas the structure varied throughout the samples. The obtained results of the texture analysis verified the variation in firmness of each sample, eith C being the firmest (11.82±0.1 N), and A and B being softer (8.93±1.9 N and 9.51±1.3 N respectively). The colour analysis showed that L* and b* values for C were 77.14±0.8 and 28.57±2.9 respectively, while these values were lower for A and B (73.60±0.8 and 22.74±0.9; 66.83±1.8 and 20.17±2.5 respectively), which indicated a lighter yellow colour in comparison with C. Further analyses were conducted on aroma determination of the muffin samples.

The results of the conducted study showed that substitution of an egg with banana had a greater impact on the texture of the muffin samples than other parameters, therefore the banana influence on the muffin microstructure should be investigated deeper.

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VETERINARY MEDICINE

CONCEPTS AND CLINICAL APPLICATIONS FOR PLASMAPHERESIS IN SMAILL ANIMAL PRACTICE

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Plasmapheresis is an extracorporeal therapy used in both human and veterinary medicine, which aims to partly exchange patients' plasma and its protein, water-electrolite, enzyme and gas qualitative and quantitative capabilities in case of some pathological syndromes, clinical disorders or exogenic intoxications.

Plasmapheresis falls under a broader term called apheresis which means, "to take away" in Greek. Apheresis is an extracorporeal therapy in which blood is removed from the patient's circulation and separated into its various components. Plasmapheresis means that plasma is separated and discarded from the patient in the extracorporeal circuit, then subsequently replaced with another solution such as donor plasma, crystalloid fluids, colloids, or human serum albumin. Plasmapheresis means the plasma is separated and discarded via an extracorporeal circuit with the use of a replacement solution. [1., 3.] For this reason, when creating a patient treatment plan, using plasmapheresis, the goal is often to remove less than 15% of the patient's total plasma volume. Two distinctly different techniques can be used to perform plasmapheresis: centrifugal and membrane filtration. [1., 4.]

The objective of this research study was to increase veterinary awareness of this type of extracorporeal therapy. In future, we could promote research projects in veterinary medicine and adopt this method of extracorporeal therapy in our country.

This method is very popular in many advanced countries, and Latvia should be one of them. Latvian doctors have already tried to bring it in and research in small private clinics, while our goal is to introduce and start a global Scientific Research of this method at a national level and at the university veterinary clinic.

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COMPARATIVE ANALYSIS OF EFFICACY OF COMMERCIAL HYPERIMMUNE PLASMA IN CLINICALLY ILL AND CLINICALLY HEALTHY FOALS WITH FAILURE OF PASSIVE TRANSFER

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Equine neonates are born immune-competent, but almost lack serum IgG concentration; therefore, it is vital for a foal to receive a sufficient amount of good quality colostrum before gut closure that manifests around 12h of age (1,2). After this time, intravenous plasma transfusion remains the main treatment method for failure of passive transfer (FPT) of immunity. The aim of this study was to comparatively analyse the data of treatment of foals (n=42) with FPT in X hospitalization centre (Data X) in France with the work of F. Francesca et al. (Data F) (2). Foals in both centres were treated with commercial fresh - frozen hyper-immune plasma ("PlasmaLife", Italy), IgG evaluation was delivered with DVM Rapid Test II (Value Diagnostics, USA). Foals (0 -11 days old) with total (<400 mg/dL) and partial (<800 mg/dL) FPT were divided in 3 clinical groups: FPT healthy, FPT septic sick foals (FPT septic) and FPT non-septic sick foals (FPT non-septic). Statistical analysis was performed using Excel 2013 and SPSS 23.0. The results were considered significant if $P < 0.05$.

Data F (n=62) were distributed non-parametrically, pre-transfusion IgG concentration (IgG0) was 361.2 ± 280 mg/dL, post-transfusion IgG concentration (IgGPT) was 1060.3 ± 392 mg/dL, the increase in IgG concentration (ΔIgG) was 699.1 ± 436 mg/dL. This finding was in contrast to Data X which distributed parametrically, IgG0 was 374.3 ± 233 mg/dL, IgGPT $622,8 \pm 241$ mg/dL and ΔIgG was just $248,5 \pm 126$ mg/dL. Data F had no significant differences between clinical groups, whereas Data X had significant differencies ($p<0.33$) between FPT septic and FPT healthy group in IgG pre-transfusion concentration (IgG0) and post-transfusion concentration (IgGPT). In addition to this, IgG0 and IgGPT correlated by 0.860 ($p<0.0001$) in Data X whereas Data F showed no significant correlations. Distribution of FPT severity in Data X: 57.14% of foals were affected by partial FPT and 42.86% by total FPT from which 60% fell into FPT septic group. In Data F, 54.83% of foals suffered from total FPT and 45.16% had partial FPT. Most of the cases fell into FPT nonseptic clinical group. In data X, plasma quality was measured just before transfusion and IgG concentration was $16,5 \pm 0,82$ g/L that is 7.5 ± 0.82 g/L lower than the 24 g/L, quality guaranteed by manufacturer and factually used in Data F.

In conclusion, efficacy of plasma transfusion varied greatly between clinical centres. These findings could be due to the diversity of continuous clinical diseases and different supportive therapy. It is clear that initial levels of IgG, severity of FPT and quality of plasma also play a great role in how successful plasma treatment may be and that is seen in both, the work of F. Francesca et al. and data collected in X hospitalization centre in France.

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INFESTATION OF BALTIC COD (*GADUS MORHU)* WITH LIVER LARVAL ANISACIDAE IN THE ECONOMIC ZONES OF THE BALTIC SEA AND TERRITORIAL WATERS OF THE REPUBLIC OF LATVIA

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Baltic cod is an important commercial and recreational fishing object in the Baltic Sea. Latvian fishermen caught 35 tonnes of cod in the year 2017. Cod catching have significantly decreased since 2010 [1.]. One of the reasons is parasites infection. Anisacidae nematodes are a common infection of the Baltic Sea herrings and cods [2]. Anisacidae infection has been studied in Germany and Poland, but no research studies have been made in Latvia territorial waters. Anisacidae nematode not only affects the fish itself (affecting its size, health, etc.), but also has an adverse effect on humans, if they consume the contaminated fish in their meal [3]. In humans, Anisacidae nematode larval form in its third stage can cause a disease called anisakidosis, mainly affecting the stomach and intestine [2]. The aim of this research study was to determine cod infestation with Anisakidae nematodes in the marine waters under the Latvian jurisdiction, including inland sea waters, territorial sea and exclusive economic zone waters.

The samples were obtained in the European Economic Area of Latvia (EEA) during the scientific cruise BITS_Q1 and BITS_Q4 on the vessel Baltica from 26 trawling stations. Biological measurements were performed for each fish (full weight, weight without internal organs, age) and for liver – weight. Totally, 272 liver samples were obtained. 22 samples were used for histological examination, and parasites were counted in 250 samples. Anisakidae infection affected cod's body condition. The highest abundance of parasites was found in the eldest fish. Parasites caused inflammatory reaction in livers.

The research results showed that the number of nematodes in liver varied from 0 to 81 parasites. Intensity of infection was 26%, abundance – 13.2 ± 16.6 parasites in a fish. There is a negative correlation between the amount of parasites and Fulton's condition factor (P= -0.119; n=272). If the amount of parasites increases, Fulton's condition factor decreases. The examined fish was in age from 1 to 7 years. The highest abundance of parasites was found in the eldest fish (R^2 = 0,4173). The weight of the infected liver was smaller than that of the non- infected liver (R^2 = 0,0182). Histological examination showed lipidosis in liver with local inflammatory reaction around the nematodes.

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COXIELLA BURNETII IN DAIRY HERDS –DYNAMICS OF DNA QUANTITY IN MILK

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Coxiella burnetii (*C.burnetii*) is an etiological agent of Q fever. Q fever is a zoonotic disease that causes abortions, premature delivery, stillbirth or weak offspring in cattle (Agerholm J.S., 2013). The major mechanism of transmission of *C.burnetii* is by contaminated aerosols containing bacteria shed by infected animals (Guatteo R., 2013). Shedding routes of *C.burnetii* in dairy cows include milk with two shedding patterns: sporadic or persistent. The real-time PCR method used for detection of *C.burnetii* DNA allows also estimate bacterial burden (Guatteo R. *et al.*, 2007). The aim of this study was to detect dynamics of *C.burnetii* DNA quantity in milk.

In this study, the milk samples from 34 milking cows were collected initially in July and August, 2017 and 27 milk samples from the same animals were collected repeatedly in February, 2018 in five infected dairy herds. During the time to the next sampling, seven animals were culled. Samples were tested by real-time PCR amplification, using "ADIAVET™ COX REALTIME" (ADIAGENE).

Three cows (9%) in the first sampling and five cows (19%) in the second sampling were shedding *C.burnetii* DNA in milk. The quantity was from $4.5*10^1$ to $8.9*10^5$ copies of *C.burnetii* DNA per mL, that coincided with Angen *et.al.*, 2011 study where the quantity of *C.burnetii* DNA copies was $5*10^1$ to $5*10^8$ per mL milk. Dynamics of shedding in our study was from zero copies in the first sampling to a wide amplitude ($1.8*10^2 – 2.9*10^4$ copies per mL) in the second one. In the same time, animal shedding $4.5*10^1$ copies initially during six months became non-shedder whereas animal shedding $9*10^1$ copies initially continued to be shedder, presenting remarkable increase ($5.2*10^5$ copies) in the second sampling. Conclusions are that shedding of *C.burnetii* with milk increases over the time, although it can be related by sporadic pattern of shedding. Due to the sporadic pattern of shedding, a repeated sampling is always required to detect shedders in dairy herd because animals can become shedders of large amounts of *C.burnetii* over the time. When detected as shedders of large amounts of *C.burnetii* cows can be eliminated from the herd, thus limiting the transmission between animals and from animals to humans. Due to the relatively large amount of animals (21%) culled before repeated sampling, there are difficulties to make definitive conclusions, and this study is being continued.

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EMBRYO QUALITY IN RELATION TO COW PRODUCTIVITY AND AGE

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Multiple ovulation and embryo transfer (MOET) is an effective method of animal reproduction/multiplication, which allows to obtain genetically high-grade offsprings in higher numbers. This method also is used to save endangered animal breeds. Embryo quality depends on many factors – connected with animals, environment and management (Mikkola, 2017).

The aim of this study was to find out what general factors influenced embryo quality in the framework of MOET done in Latvia 2018-2019, using a follicle stimulating hormone (FSH).

The data were obtained by the team of the ERAF project Nr.1.1.1.1/16/A/025. Some parameters such as the cow age, lactation, productivity, milk fat (MF), milk protein (MP), and somatic cell count (SSC) were analysed in terms of the embryo quality obtained from each donor-cow.

Results and discussion. In this period, 19 cows were chosen for the donor's role. Five cows were rejected: before the MO induction (2 animals) and after unsuccessful MO (3 animals) because of negative energy balance (NEB) and inappropriate anamnesis of the reproductive health. The donors were 6.32 ± 3.52 years old, and they were in 4.1 ± 2.37 lactation. The oldest cow Cipra was 15 years old and had 9 lactations, but Amura was 12 years old and had just 6 lactations. The average embryo harvest was 7.35 ± 6.78 embryos from a cow (min. 0 and max. 18 embryos). The cows were in different stages of lactation. Some researchers had found that the lactation period did not influence the quality of embryos (Leroy et.al., 2005). It was noticed that 8-10 years old cows and high productivity cows had lower embryo harvest and NEB influenced negatively oocyte maturation (Hasler, 2010). From the 3 accepted cows, embryos were not received, despite of the fact that the MO had been induced successfully. No significant differences were found among the cows with successful MO induction and cows which did not respond to FSH medicine related to productivity, MF and MP ($p > 0.05$). SSC was statistically significantly increased in the cows, which had 0-2 embryos ($475.40 \pm 434.638^{^3}$ mL^{-1}) compared to the cows with embryo harvest of 3 and more embryos ($96.5 \pm 76.79^{^3}$ mL^{-1}; $p < 0.001$). All 7 pregnancies acquired up to now were from the cows with SCC below 100 000 mL^{-1}. Interestingly, the count of white blood cells (WBC) did not differ significantly among these two cow groups ($5.5 \pm 0.47^{^3}$mL^{-1} and $5.7 \pm 0.77^{^3}$mL^{-1} respectively; $p > 0.05$). In cows with SSC below $50^{^3}$ mL^{-1} 81.3% of embryos were accepted as transferable.

In conclusion, studies should be continued to reveal how the increased SSC in milk influences the embryo quality.

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PARTIAL BODY CRYOTHERAPY IN VETERINARY MEDICINE

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Cryotherapy, also known as cold therapy, is commonly used as a method to relieve pain and inflammation. Partial body cryotherapy (PBC) is one of the cryotherapy methods, where the cold is created by spraying nitrogen directly on the body, excluding the head and neck of the patient, inside the tank. The aim of the research is to get a general understanding of the cryotherapy role, its benefits in veterinary medicine, to describe and compare human and animal research studies in this field. The most widely used cryotherapy technique in veterinary medicine is local application of the cold, such as ice packs. It is commonly used to treat postoperative inflammation, musculoskeletal trauma and muscle spasm and to minimize secondary inflammation and oedema [2].

The cold is used for managing the acute phase of tissue injury, because it minimizes the inflammatory process and provides analgesia. Lowering the temperature of the skin and underlying tissue causes vasoconstriction, reduces blood flow and cellular metabolism, as well as decreases sensory and motor nerve conduction velocity, in that way reduces muscle spasms and provides pain relief [2].

In human medicine, there have been proven positive effects of whole body and partial body cryotherapy for such diseases as rheumatoid arthritis, fibromyalgia, ankylosing spondylitis, multiple sclerosis, lower back pain as well as inflammation and muscle damage. The positive effects include reduced inflammation, pain and fatigue, decrease in tumour necrosis factor α (TNF-α), increase in functional abilities and quality of life [1].

Similar diseases, as well as the same inflammatory responses, are also found in animals. PBC procedures could be adapted to animal physiology and used in veterinary medicine, therefore giving the same positive results.

In conclusion, although local cold procedures for animals have been used to treat postoperative inflammation, different traumas and muscle spasms, partial body cryotherapy is a new field in veterinary medicine and should be researched more.

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MORPHOLOGICAL CHANGES OF ABORTION CALVES IN LATVIA

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Morphological examination finding in aborted calves is poorly researched, several themes have only fragmental data or even gaps. Previous studies by research institute "BIOR" show that only in 43.75% of cases the result of abortion was discovered by postmortem examination and broad laboratory testing. The objective of this study is to investigate pathological changes in aborted calves. Tasks of this researcher is tissue histological evaluation of abortion calves and to analyze data of macroscopical and microscopical changes, microbiological and virological test results.

Laboratory testing to 48 aborted calves sent within sate monitoring plan was done in research institute "BIOR". Investigation was carried out from February 2017 to November 2018. Samples were examined by gross pathology, microbiological and virusological testing, also histological examination for 17 samples was done.

Infectious agents were detected in 47.92 % cases, *Listeria* spp. being found in almost half of these cases 47.83%. Other most commonly diagnosticed infectious agents were *Schmallenberg virus* (13.04 %) and *Escherichia coli* (13.04 %). In cases where *Listeria* spp. was found abortion happened between 5-7 month of calve development. Abortions in later development period was caused by *Schmallenberg virus* between 6.5 and 8 months of development. *Escherichia coli* induced abortion for the oldest calves 7.5 and 8 month of development. Different morphological changes were found in infected calves, commonly multiple hemorrhages, enteritis, bronchopneumonia and septicemia were found. Furthermore, aborted calves without infection had limited morphological changes and mostly was agonal changes. In some of these cases strong hypoxic changes were found that caused liver hydropic degeneration and aspiration of amniotic fluid in lungs. For other calves of the same group lymphatic tissue hypoplasia was diagnosticed.

Firstly, aborted calve morphological changes are specific to concrete infectious agent that has been isolated from the calf's tissue although the changes can be mild. Secondly, morphological changes in aborted calves without infectious agent are possibly related with metabolic or systemic disorder in mother's organism.

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ENGINEERING

ANALYSIS OF THE NEED OF ROBOT'S CAPABILITIES TO CARRY OUT THE MILITARY RECONNAISSANCE

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Robots are used as assistants in the manufacturing of machinery and military industry, space research and the entertainment sphere. These have a fast-rising popularity in European countries and elsewhere, and are now just starting their way and taking first steps in the manufacturing and military industry. Manufacturers to the robot helpers see it as a viable way to change human workforce for soldiers it is a secure way of destruction of the enemy and secure military reconnaissance. Industrial robots are used as automatically working reprogrammed devices. Their manipulators are designed as mechanisms that enforcement mechanism systems imitate human arm movements. Enforcement mechanism of this robot can make rectilinear or variable fluctuating movements. At the end of the enforcement mechanism, there is an affixed work device; mostly it is a gripper for grabbing and carrying an object to a specific location.

Military robots in the military industry are used to ensure saving soldiers' lives. They can be self-propelled, stepping, crawler, wheeled and managed remotely. A self-propelled robot is an automatic machine, able to move in the environment. These robots have the ability to move in the environment because they are not anchored in one physical location. If we analyse self-propelled robots, there are two main and most common types – stepping and driving robots. Every construction design is different and adapted according robot's functions and uses.

Nowadays in Lithuania and other European Union member states, military forces are expecting to create a robot which could protect soldier at hazardous operations by replacing human with an intelectual robot. There really is such a need. For example, a minesweeper sends a radio-controlled robot for demining of explosive weapons or for exploring hazardous territories. The robot is managed a safe distance away from potentially dangerous areas. In the case of failure when an attack begins, the only victim can be the robot and the minesweeper can stay safe. If a soldier works without necessary military security, he can be injured or be exposed to life-threatening danger in any weather conditions during hazardous operations.

Created robots are used in the army as complex constructions. They are not fast, do not fully ensure the safety of the soldier and are intended solely for the purposes of the warior training. For the purposes of training and the destruction of the enemy, the created robots show that there is a need for a robot which could be inexpensive, easy to use, designed for a variety of weather conditions. Its main task is to ensure soldier and environment safety in the precarious and firefighting situations.

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THEORETICAL AND PRACTICAL ANALYSIS OF COOLING SYSTEMS

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The failure of the cooling system is an increase in engine temperatures, but practice shows that this is already a consequence and the causes are various: a defective cooling system pump, a non-return thermostat, a foul radiator, an inactive radiator fan (a faulty fan or its temperature sensor), leakage of cooling system, damaged motor head or its gasket, (the freezing system dirt) defective cooling system, idle cooling system expansion tank (or radiator) cap with valves [3]. The number of these failures is high and are often related to each other, so it takes a lot of time to determine the root cause of the engine's heating. The diagnostics of cooling system is complicated by the fact that almost all modern car cooling systems are of closed type. That means it is not in contact with the atmosphere. According to physical laws, boiling temperature increases as pressure rises. There are cars whose fan speeds appears at 105° C. At such a temperature, the resulting leakage causes the boiling process (due to the drop in pressure) in the cooling system and the circulation of the cooling fluid is interrupted, the engine starts to heat up. For this reason, it is advisable to diagnose the cooling system if it is tight, and the test for the head and its intermediate tightness is performed. This is checked when the cold engine is pressurized. [1]

There are several practical solutions. One of them removes the cooling system cover and replaces it with the appropriate adapter, the cooling system is connected to the compressed air supply bus, or specialty hand pumps (cooling system checkers) for this purpose can be connected. Recommended supply pressure is 1-1.4 bar. Excessive leaks are well visible, as coolant starts flowing through leaky places. It is also necessary to assign a check on the expansion vessel to the valve with a cooling system tightness test. The valve must open from 0,9 to 1,3 bar. [2] Possible failures are the increased pressure in the cooling system, inactive cabin heating and cooling coolant, all of which are caused by compression into the cooling system. This compression disrupts the normal circulation of the coolant due to the resulting air cork. The essence of the test is that it uses a reagent that changes its color. Examining the cooling system diagnosis shows that it covers the operation of various car nodes. Replacing one or another node does not usually eliminate the reason for the engine to shut down.

In conclusion, cooling system failures can be various. They are often related to each other. The formation of leakage causes the cooking process in the cooling system and the circulation of the cooling fluid is interrupted, the engine starts to heat up. When testing the cooling system, it is necessary to test the leak test of the head and its seal and the cap with the valves.

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SMARTPHONES ARE BAD FOR YOUR HEALTH? – MYTHS OR WARNINGS?

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Mobile phones have become a necessity. The latest data from the "ConnectedConsumer" survey published by the international sociological and market research company "Kantar TNS" showed that smartphones were used by 60% of Latvian, 64% of Lithuanian and 65% of the Estonian population [2]. The recent research shows that every third person on our planet is using a mobile phone. However, most consumers do not even think that this hand-sized device emits electromagnetic waves that have a negative impact on our body. The research findings are shocking. Thus, the research by Swedish scientists found that the use of mobile phones increases the likelihood of brain cancer by 40-270%, and can cause cancer after 15, 20 or even 30 years, and the British medical magazine Lancet says that microwaves emitted by mobile phones have a thermal effect and they can raise the brain temperature by more than 1 degree when held to the ear. In 2010 Spanish Institute of Neurodiagnostics found that 11 to 13 years of age for children 2 minutes use of mobile phones bioelectric activity in brain remains 2 hours after the talk [1]. Similar results were confirmed by Finnish and Turkish universities. However, usually people ignore what they have read thinking that the information doesn't apply to them. Therefore, the purpose of this article is to analyze the attitudes of Klaipeda State College students to mobile phones and their health damage on the basis of specific scientific information about electromagnetic radiation emitted by mobile phones and scientific conclusions. To achieve this goal, the following tasks were set: determine the prevalence of mobile phone use among college students; evaluate the duration of the use of mobile phones; to analyze the peculiarities of using mobile phones. In September – November of 2018, an online survey was conducted at Klaipėda State College. The survey was open to all students, regardless of age and gender. 49 respondents with an average age of 28 years participated in the survey. The survey results are staggering: almost 69% of respondents use a mobile phone more than 3 hours a day, most of those surveyed carry their mobile phones in their hands or pockets, and have them by their bed through the night, although 95% of the respondents know about the negative health effects, but 25% of them still wouldn't give up their phones. Most of the respondents feel fatigue and eye pain after using the mobile phone for a long time. The research shows that the majority of those surveyed are aware of the risks posed by new technologies to the human body and health, so it would be best to abandon them, but it is unlikely to happen in this age of technology. Therefore, we must at least follow the recommendations of the World Health Organization: call only when necessary, talk by mobile phone as briefly as possible, use the headset/headphones, use the short message function instead of call function, etc. [3].

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RURAL ENGINEERING AND ENVIRONMENT

LAND MANAGEMENT AND GEODESY

LAZER 3D SCANNERS AND UNMANNED AERIAL VEHICLES WITH LIDAR SCANNING

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Technological develoment nowadays is very fast and people have to obtain knowledge about the devices they use and how to improve them. One of the most interesting and advanced devices is an unmanned aerial vehicle with LiDAR (Light Detection and Ranging) scanning and 3D scanners. In scientific publications and discussions we can often hear questions such as; how does a drone with LiDAR scanning operate? Does it have any faults? What kind of functions can 3D scanners perform? Where can we use those devices? The LiDAR system is a part of new geoinformatics, digital photogrammetry methods and technologies. The main purpose of the LiDAR system is its ability to scan and gather data from massive areas in a short period of time. LiDAR consists of three parts: laser distance measurement, global positioning system and inert navigation. This type of scanning is the most effective when creating 3D models for buildings and cities, and researching forest, power lines and vegetation conditions. However, the LiDAR system has a few problems. One of the problems is reliability and quality of the data. In addition, while analyzing the formation of 3D models it has been noticed that there are less dots in one square meter than it is necessary to have in technical requirements, and sometimes the dots' height do not meet the height of the area.

3D scanners are widely used for creating maps, tracking construction and equipment, and for architectural studies. The main aim of this research was to find out how much people know about these technologies. In order to achieve the aim, the survey was conducted in January – March of 2019 where 35 random respondents were asked if they know how and where 3D scanners and LiDAR systems can be used. After processing the survey data, the results revealed that 80% of the respondents had seen a 3D scanner or unmanned aerial vehicle, 60% knew where these technologies can be used, but only 20% of respondents knew what purpose 3D scanners could be used for. We can conclude on the basis of the survey results that a small number of people were aware of drones and how they work. To sum up, using the LiDAR system, scanning has become faster, more accurate and less time consuming. According to today's human potential limits, we can only wonder if this technology will ever be excelled.

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REAL ESTATE "SIRSNIŅAS" FORMATION

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The real estate "Sirsniņas" is located in the territory of Zirni parish of Saldus area. The core business on this property is dairy farming. For productive and profitable economic activity, it is necessary to know how to manage the existing land area. The land under management is mainly used for grazing and forage preparation which include hay, silage.

The oldest information about real estate "Sirsniņas" is found in the so-called "manor times". Lašupe manor in 1895 sold 58.55 desetins large area of its land to establish the farm "Mazie Busenieki" and that was the beginning of real estate "Sirsniņas". In addition, 0.31 desetins was purchased in 1904. The land was purchased for the creation of 58.86 desetins or 64.3 ha of real estate "Sirsniņas" [1].

Situation changed in 1940 when Latvia was occupied and the People's Saeima (22.07.1940.) adopted the "Declaration on proclamation of land in the ownership of the nation". This document abolished land ownership rights in our country, land was nationalized and taken over by the state. The Latvian farmer once again became a simple land user.

Signs of affiliation to "budgets" or "cauldrons" were so wide that any diligent peasant could be counted. The right to the land was taken away and the owners with children on March 25, 1949 were deported to Siberia in animal wagons. The property of "Sirsniņas" including 64.3 ha of land, agricultural equipment and livestock was added to the kolkhoz "Rosme" (after the restoration of Latvia's independence – "Rosme" company).

In the early 90s of the previous century after the collapse of the USSR and the restoration of independence, the law " On Land Commissions: The Law of the Republic of Latvia" entered into force in Latvia, which gave the opportunity to former owners or their heirs, who were deprived of their land during the nationalization, to claim for this land [2].

After restoration of property rights, on July 20, 1992, the legal entity, farm "Sirsniņas" was registered in the Registrar of Companies. The borders of the real estate "Sirsniņas " were marked in 1997, the land cadastral survey with the new survey methods at the end of 2018 was started which continued also in 2019.

Real estate "Sirsiņas" consists of 3 land units with the total area of 64.3 ha, the largest land unit is agricultural land (27.2 ha) used for agriculture production; forests occupy 28.8 ha. Restoring ownership rights resulted in recovering almost all of the legacy land for the real estate "Sirsniņas". After the restoration of independence, the main activity of the real estate "Sirsniņas" is dairy farming, which is intended to develop in the future. The land cadastral survey in 2018 revealed the property borders, and some borders were not in place which was drawn in documents.

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LAND DEGRADATION IN ABANDONED BUILDING AREAS

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Degraded areas (brownfields) in the Baltic States, including Latvia, are a relatively new problem. The related terminology has still not been fully developed and used in Latvian state legislation, national political documents and territorial development in general.

The issues related to land and soil degradation are mentioned in 13 strategic planning documents, 13 laws and 12 Cabinet of Ministers regulations. Despite the Land Management Act, which focuses on the risk of land degradation and its prevention, land and soil degradation and identification criteria have not been developed and adopted in Latvia, and no classification of degradation factors has been developed [1]. Despite the existence of the problem, it is still not clearly defined and described on the national level.

Similarly to other countries, Latvia is characterized by deindustrialization processes in cities. One example is the reduction of industrial activity, as a result, brownfields no longer used by people have been created in cities which have a very negative impact on the aesthetic image of the city [2].

During the Soviet period many factories as well as power stations and electricity producing objects were built in the territories of the Baltic States. After the time of the USSR, many abandoned territories remained in Latvia [5]. For example, depleted buildings, non-cultivated landfills, overgrown areas, etc. Furthermore, there are large areas that were previously used for railway and port infrastructure [3]. It was found after the analysis of the "Register of Contaminated and Potentially Polluted Sites" maintained by the Latvian Environment, Geology and Meteorology Centre using the GIS software.

To ensure that brownfields are returned to reuse, the problem must be recognized at national, regional and local level. The classification of brownfields in built-up areas may be a necessary starting point for the development of a sustainable urban planning strategy and for the further use of brownfields, which in turn will promote urban development and the use of land for the benefit of citizens, municipalities and the state. By analyzing and exploring brownfields, it is also possible to develop guidelines and proposals for their future use.

Redevelopment can be one of the solutions to degradation issues [2]. Greening and recultivation are a relatively easy-to-access, safe and effective way to develop, improve and optimize degraded areas [4].

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COMPARATIVE EVALUATION OF THE CREATION OF INDUSTRIAL ORCHARD

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The purpose of this study is to compare the costs of planting a new orchard and transplanting an existing one to another land property. The industry regulation of apple cultivation for 2010 [1] was studied for comparison. It served as the basis for obtaining the cost of growing one hectare of the garden until fruiting. For adjusting prices from 2010, recalculation was made taking inflation and denomination into account. Thus, costs were obtained that were comparable with prices of the current year. They amounted to 31524.68 rubles per 1 hectare. Recalculation was carried out by the inflation calculator [2]. In addition, when planting a new orchard, it is necessary to calculate the loss of expected profit. It is based on the time period from the moment of planting until the fruiting of fruit trees. With an average period of cultivation of seedlings until fruiting (5 years) and taking into account the profit per hectare, we get the loss of expected profit of 47,712.2 rubles. According to the results, the amount for reimbursement of expenses for one tree is 31. 69 rubles.

The second object for comparison was the cost of transplanting existing trees. For this purpose the price list was used for motor transport services for tree transplantation [3]. The time spent on digging out trees was considered [4], and the costs of transplanting one tree (excluding transportation over long distances) were calculated. They amounted to 45.52 rubles per tree.

The calculations led to a conclusion that transferring the trees by means of transplantation is not cost-effective. The economic efficiency of this project can be improved by a reduction in the price of a motor-hour due to the large amount of work. Also, this method is suitable in cases of the need to transfer particularly expensive tree species.

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CREATING 3D MODEL OF A BUILDING USING UAV-PHOTOGRAMMETRY TECHNOLOGY

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With the fast advances in surveying technology, there is an increased variety of data gathering methods. One of the latest and most innovative methods is remote surveying. By using various technologies, this kind of surveying allows remote gathering of spatial data about physical, chemical and biological object characteristics without a physical contact. Remote surveyal data can be gathered using self-piloted aerial vehicles, space apparatus and satellites, submarines, land stations etc. (Ruzgienė, 2008). When using remote surveying, data is collected by measuring reflected, radiated or dispersed electromagnetic radiation. That is done by using various sensors that operate in spectrum from ultraviolet rays to microwaves (Žilinskas, 2013). The basis of remote researching systems are passive sensors that gather reflected or radiated electromagnetic radiation (traditional and digital aerophotographs, main distant probing robotic spacecraft systems - Landsat, Spot, Ikonos ect.); active sensors that generate and send electromagnetic waves to the surface of the Earth and collect the data of the reflections (RaDAR - Radio Detection And Ranging, LiDAR - Light Detection And Ranging); sensors of radiated energy - thermal image. One of the remote research methods that uses passive sensors is aerial photographing. Aerial photographing is taking photographs of the Earths surface from a plane so they can later be used to construct a special plan of the area. This is why the main goal of the research was to make required measurements and create Klaipėda Church 3D model. To achieve our goal we used „Pix4Dcapture" software.
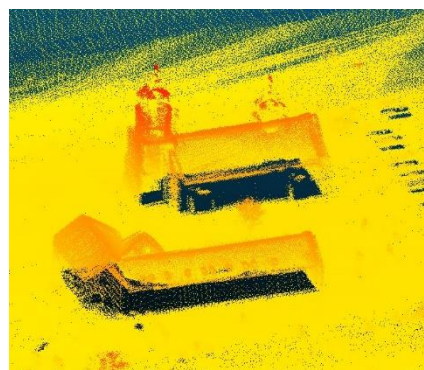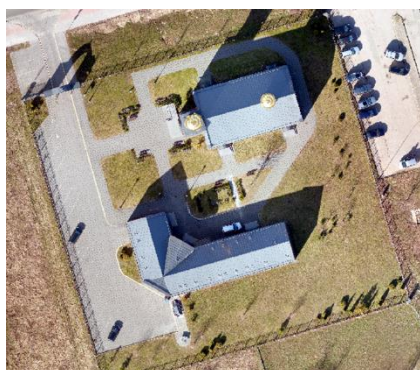
"Pix4Dcapture" supports drones from DJI, Parrot, and Yuneec, three of the biggest drone manufacturers on the market. "Pix4Dcapture" comes with 5 different missions providing the needed flexibility for projects. In order to create Klaipėda Church 3D model, double grid mission was used. The main preferences are: overlap front 20%-90%, overlap sides 20%-90%. Furthermore, speed should fluctuate between 2 and 8 m/s for copters and is not constacting during the flight since the drone slow down to trigger pictures. Defines the tilt of the camera between 45º and 80º, 90º being vertical. Moreover, "Pix4D mapper" software was used to process the data. "Pix4D mapper" is an image processing software that is based on automatically finding thounsands of common points between images. As said before, the main rule is to maintain hight overlap between the images.

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LASER SCANNING AND 3D MODELING OF A COMPLEX BUILDING

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Currently, one of the devices in the growing field of large and high precision work to carry out for geodesists is a 3D laser measurement system. 3D laser measurement systems are 3D scanner devices which look at real-world objects and environments in order to collect data on their shape and appearance. 3D laser measurement systems are divided into transport aircraft, mobile and stationary. Large scale civil engineering works, buildings, streets and bridges are complex, occupying much time and financial resources. This problem can be solved through a 3D laser scanner, which collects over a million points in just a few seconds after scanning in. 3D scans of the surface buildings assist in the assessment and measurement of industrial structures, and make it easier to coordinate the activities of the quality of design and construction. The data collected can be used to create digital 3D models. Points cloud simulation is the transformation of raw data into the final results. 3D modeling is an integral part of modern engineering, design, design and other areas, allowing one to visualize the object and change its characteristics. The goal was to laser scan the building at Bijūnų street 10, Klaipėda with the STONEX X 300 scanner to create a high-quality 3D model, using 3D Reconstructor software. The device was scanned using STONEX X 300 building, located at Bijūnų street 10, Klaipėda. The scan took places from 10 stations.

After scanning, the data imported into 3D format using the editing tools in the program and Reconstructor treatment, and at least three points of support were posted manually. Building a 3D model of the building was done in a few steps: point clouds cleaning (noise filtering, removing the outliers), meshing, hole filling, and mesh decimation. When creating a 3D building model data is transformed into las and obj format.

Measurements outside   Results of working with Stonex 3D reconstruction program
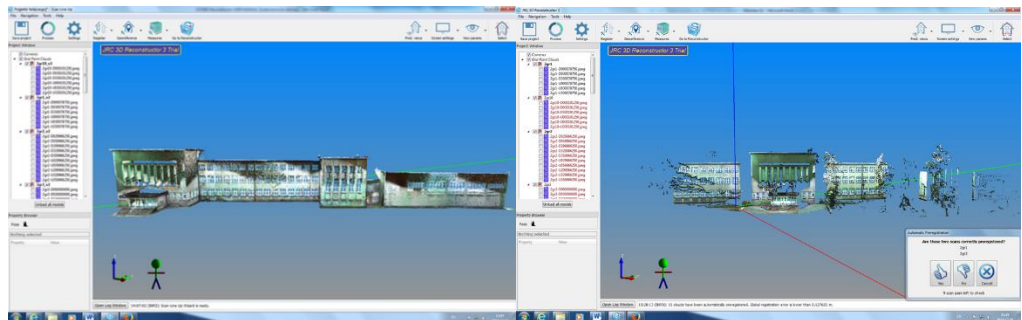
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RESPONSIBILITY FOR VIOLATION OF THE LAND LEGISLATION AS THE ADMINISTRATIVE MEASURE OF LEGAL PROTECTION OF LANDS IN THE REPUBLIC OF BELARUS

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According to article 96 of the Land Code of the Republic of Belarus, individuals who violate legislation on the protection and use of land are liable in accordance with legislative acts [1]. According to the practice in the republic, the majority of violators of land legislation are brought to administrative responsibility, which is imposed in accordance with the Code on Administrative Offenses. Administrative responsibility is expressed in the application of an administrative penalty (warning or a fine) to a physical person, an individual entrepreneur, or a legal entity.

The drawing up of records on administrative offenses and their hearings are carried out by various public authorities depending on the type of land offense. Their competence in this sphere has been established by the Procedural Code of Administrative Offenses. In accordance with Article 3.30 of the above-mentioned Code, reports on administrative offenses can be made by authorized officials of executive committees.

According to the available statistical information during 2017, specialists of departments of land management revealed 7048 land violations: 2579 protocols on administrative offenses were filed, and 4469 records on imposing the administrative penalty were issued. The structure of violations in 2017 on the territory of the Republic of Belarus was the following: unauthorized occupation of land plots (1044 cases), non-use of the land plot (1277 cases), violation of terms of return of temporarily occupied lands (467 cases), inappropriate use of land plots (205 cases), destruction or damage of boundary signs (42 cases), and failure to meet requirements in protection of lands (3347 cases, or 47.5%). A list of actions for protection of lands which land users have to follow is stipulated in Article 89 of the Land Code of the Republic of Belarus.

To promote and increase the prevention and elimination of revealed violations of the land legislation, it is necessary to use more effectively methods of remote control (possibilities of geographic information systems, aerial photographs).

The use of geographic information systems simplifies the process of checking the elimination of the revealed violations, identification of recurrence, promotes the increase in the interaction and exchange of information between supervisory authorities.

Using for the purposes of identifying violations of land legislation, aerial photographs in cameral conditions allow revealing non-use of the land plots provided, failure to take compulsory measures to protect land from erosion, land overgrowth with trees and shrubs, illegally occupied land plots and areas used for other than intended purposes, land pollution with waste, destruction of topsoil and other violations.

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THE SYSTEM OF STATE REGISTRATION OF REAL EASTATE, RIGHTS TO THEM AND TRANSACTIONS WITH THEM IN THE REPUBLIC OF BELARUS

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The Land Fund of Belarus is the basis for farming, forest management, territorial planning and forecasting, as well as for other uses. The Constitution of the Republic of Belarus establishes that one of the state's duties is to guarantee the right of ownership and to facilitate its acquisition. The owner has the right to own, use and dispose of his/her property individually as well as together with other people [1]. One of the mechanisms for ensuring the implementation of obligations assumed by the state is the state registration of immovable properties, rights to them and transactions with them.

The Law "On state registration of immovable properties, rights to them and transactions with them" dated July 22, 2002 No. 133-3 establishes the legal basis and procedure for state registration of real estate, rights to them and transactions with them within the territory of the Republic of Belarus, with the aim of recognition and protection by the state of registered real estate, rights to it and transactions with them [2]. The need for registration is made conditional on the fact that an unregistered transaction is void, an unregistered right has not arisen, has not been transferred, has not ceased, an unregistered object of immovable properties has not been legally created, has not been changed and has not ceased to exist.

The State Enterprise "National Cadastral Agency" annually prepares a report, which includes main indicators of the state registration system, and presents them in the form of annual reports. According to the report, it was found that the percentage of registered land plots covering the territory of the Republic of Belarus is 83.6% (17,329,044 ha) of the entire territory of the Republic of Belarus, which is 20,759,500 ha, as of 2017 [3]. A high percentage of registered land is achieved by the speed of implementation of registration actions. Thus, for the period of 2017, the time for performing 24% of registration actions did not exceed 1 hour; 29% of applications for state registration were completed within a period of 1 hour.

This level of state registration is explained by the pursuit of world trends, introducing reliability and transparency into its processes. The system of electronic archives and documents is also being improved, which may further eliminate the need for paperwork.

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CIVIL ENGINEERING

WORLD-WIDE APPLICATION OF HIGH PERFORMANCE CONCRETE

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In countries like the UK, where the population is growing but the land area and building area remain the same but only decreases over time, architects choose to build high-rise buildings. That is why it is necessary to construct buildings using durable and sustainable materials, one of which is concrete. [2] Concrete is the most often used building material in the world. Concrete is a composite material composed of fine and coarse aggregates bonded together with a fluid cement. [3] Any improvement in the engineering of concrete is beneficial. Improvements can include cost, strength, durability, or ease of application. "High-performance concrete" (HPC) is concrete that meets specific combination of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing and curing practices.[1] High-performance concrete is not a single type of concrete, but rather, any number of concretes engineered to possess certain properties suitable for a particular construction application. High-performance concrete applications include roadway and bridge construction, tunnels, and tall buildings. By reference to the source, one can only wonder about the properties of the material:

1. High compressive strength – the load the concrete can bear.
2. High early strength – the concrete, often known as "fast-track concrete," sets up faster, allowing for less shoring time.
3. High modulus of elasticity – A measure of the stress which the concrete will endure during use.
4. High abrasion resistance – The amount of wear that the HPC concrete will bear from vehicular traffic, wind, or flowing water.
5. High durability and good longevity in under severe conditions such as weather, the freeze-thaw cycle, or high traffic.
6. Low permeability – Water and chemicals do not penetrate below the surface.
7. Resistance to chemicals.
8. High resistance to de-icing agents (aka penetration) – The depth to which de-icing agents (which are usually made from some type of salt) will penetrate the HPC.
9. High impact resistance.
10. Ease of placement.
11. Compaction without segregation.
12. Resistance to bacterial and mold growth. [1]

Although the upfront cost is higher because of the ingredients used and the care needed in the manufacturing process, HPC can save money due to the reduced need for other building materials such as spans and supports. In addition to the cost savings, when HPC is used in construction projects, safer structures that require less maintenance are built.

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DEFORMATION CRACKS IN THE WALLS

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Construction is currently experiencing a lot of different changes, as there are four seasons and in those we experience significant temperature variations. These conditions affect both construction itself and also finishing materials. The measurement of deformation gives an idea of the processes that take place in the walls and lets us to understand the need for the formation of deliberate deformation joints. EU funding often does not take into account the various factors affecting the deformation of the wall. Usually, the problem lies much deeper – in the wrong constructive solution of the wall, without the use of projected joints of deformation.

Similar topics are addressed in scientific research by other authors [2, 3]. Today, many different materials and methods enable successful choices of solutions.

The regulatory framework, which for the large part is taken over from the Soviet time SNIP, requires that deformation of non-reinforced joints be prostatic 0, so that vertical deformation joints must not be less than 35 to 120 metres. The situation changed on July 1st of 2015 with the new version of LBN 285-15 "Brick wall construction design", which determined that the distance between vertical deformation joints should not exceed 6-12 metres depending on the material of the wall. However, unfortunately in life, this rule is not always respected.

The aim of the research is to compare two different buildings (brick walled and Aeroc walled) by setting measurement rulers in 4 different points on each of the buildings and taking readings with an electronic slider at intervals of 7-9 days.

The hypothesis was: it is possible to achieve better quality of construction and a longer lifetime for materials through the construction of deformation joints.

The research objectives were: 1. to identify available information on deformation joints and their normative requirements. 2. To monitor of measurements. 3. to compare two types of objects. 4. to compile the results obtained, and to draw conclusions on these results. The research methods included the comparative analysis, observations, experiment, method of measurement and others used in the research part.

The conclusions are the following. In order to keep buildings safe at an appropriate level, substantial resources must be invested systematically and effectively in the renovation and reconstruction of buildings. Proper design and appropriate construction help to avoid the creating of unwanted gaps, thereby saving building resources.

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STUDENT HOUSING QUALITY IN LATVIA

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In order to ensure the competitiveness of Latvian higher education in Europe, it is necessary to ensure the attractiveness of universities and studies in Latvia not only for local, but also foreign students. This in turn requires the need to improve the quality of studies and living conditions, the creation of temporary accommodation for students.

The aim of the study is to analyse the trends of higher education development in Riga, the attractiveness of studies in Riga for foreign students and the problems of affordable, high quality housing. Methods used in the study: the survey method, information gathering and analysis method, comparative method, mono graphic or descriptive method.

A survey of students from the largest universities in Latvia has been conducted in the study. It provides data that is later processed to obtain quantitative information that can be analysed and used to assess the factors that influence student housing development, as well as to identify students' needs for quality housing. The study analyses the available high quality housing problems in major Latvian universities. The respondents' answers reveal students' satisfaction with current service hotels, as well as respondents' views on what should be preferred student hotels.

In order to ensure the competitiveness of Latvian higher education in Europe, it is necessary to ensure the attractiveness of universities and studies in Latvia not only for local, but also foreign students. This in turn requires the need to improve the quality of studies and living conditions, the creation of temporary accommodation for students.
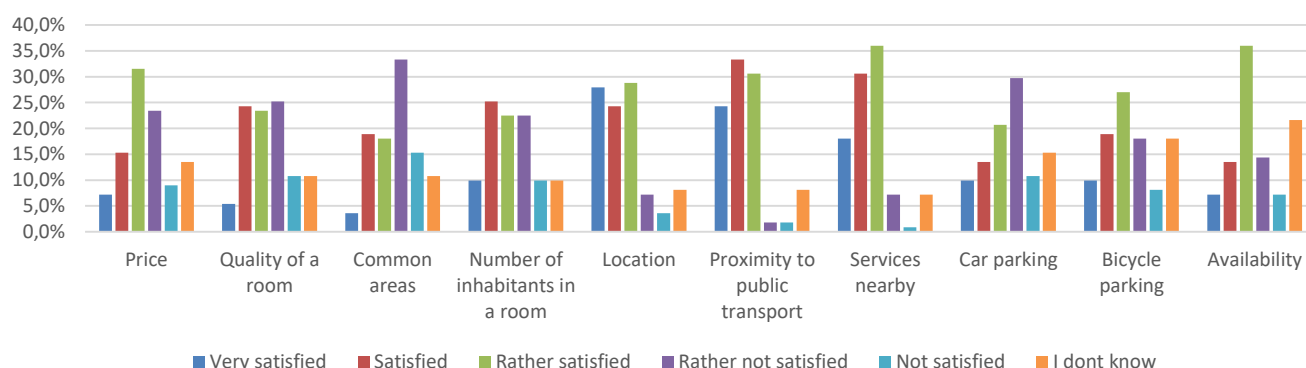
Fig.1. **Satisfaction with existing universities student residences**

The surveyed students' complaints are mainly about the different quality of the dormitories in Latvia and prices which are not always appropriate for quality. The working environment and quality is improving, by building modern university faculties in Riga and other major cities in Latvia. On the other hand, living environment is not sufficiently consistent with sustainability principles. The construction of new modern dormitories is highly rated and need, at the same time more attention should be taken to the left behind, low quality dormitories. The main problem relates to indoor climate, lighting, sound insulation, old equipment and aesthetic environment, that needs to be adjusted to energy efficient, modern lifestyle. Students have the desire for larger, brighter rooms with individual desks, shelves and closets for each student. The location of dormitories is being criticized, the time being spent on road is becoming increasingly important for urban lifestyle, highly being rated dormitories up to 15 – 20minutes walk away from the university. There is a desire for a variety of prices not according to the quality, but according to the number of students living in a room.

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COMPUTER APPLICATIONS IN THE FIELD OF ARCHITECTURE

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With the development of technologies, every field utilizes technologies in order to do tasks that are usually difficult to perform. Architecture is no exception. Most stages of architecture use the computer for increased accuracy and speed. Architects create presentations, 2-D construction documents and 3-D models in addition to typical business documents on the computer. Computers aid design understanding and implementation of complex structures through computer-solved equations and information generation.

Computers play an important role in business functions. With the help of many kinds of devices, architecture firms and individual architects can complete business functions such as communicating with clients and researching. Also, architects use computers to communicate with engineers, construction managers which leads to more successful and efficient building.

Without actually building a physical model of the building, architects can illustrate the model of the building to show to clients, by making a 3-D model in a computer program. With these 3-D models, a lot of problems can be addressed before the construction of the building.

Architects can discuss their ideas to other architects by making presentations and use them to provide visual material as well as deeper explanation of the subject.

Blueprints are no longer drawn by hands, because most architects use CAD (computer aided design) programs to create and modify structural designs. The benefits of these programs are the consistency of graphic elements and also the accuracy of dimensions. Also, the amount of effort, that has to be put in to complete these designs is significantly reduced, because most of the tasks in these software are automated, which also saves a lot of time for architects. It is much easier to make alterations in the design, when using CAD software. Sharing of these projects is no longer a problem, just because they can be saved in a computer and sent/accessed anytime. CAD software is used in fields like civil engineering landscaping, cartography, aerospace (which requires extreme accuracy) and even in places like jewellery design.

The process of designing a building with the help of computers start with GIS (Geographic Information Systems). These systems aid the design process by preparing the information of the site and geography. As said previously, the communication through these computer programmes are fast, which is the reason why designers can access the information in real-time. Designing continues in CAD software, which are used to make building designs in 2D or 3D models. Calculation and simulation software are usually used as plug-in tools in CAD. They help predict properties like acoustics, fire prevention, energy efficiency, ventilation and heating. After that the design requires authorisation and approval by an engineer.

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MUSHROOMS AS BUILDING MATERIAL

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Mushrooms are eco-friendly and sustainable natural products, which are not just fungi, but an inspiration for creating multiple products like building materials. We are increasingly starting to think about alternative materials and materials from fungi break down in a nature-friendly way without creating hazardous waste. Currently, there is just a little bit of information about this subject. Wider group of people right now can find out about mushroom usage in building materials is not popular, because it is done by only a small number of people.

The concept of using mycelium as a material was first developed by Eben Bayer and Gavin Mclntyre. Now this idea is a company named "Ecovative". By their actions, they prove that what seems to be a waste can become an environmentally friendly material. They offer a variety of composite materials.

Redhouse studio company from the USA specializes in the production of bio materials. They use bacteria, fungi and plants to create new eco-friendly materials. This company say: "Bioterials produced from mycelium in waste organic substrates exhibit properties superior to wood framing in compression, concrete in flexural strength, and EPS in insulation value, and are fire resistant. These and other biomaterials may have the capacity to revolutionize the building industry." This is the motivation for our reasearch.

India is also interested in how mushrooms can be used as material. They are worried about Earth's pollution. They discovered that materials from mycelium can be used for insulation in homes. Wood-like material obtained from mycelium can be used for building homes. The material does not emit any volatile organic compounds which can lead to sick buildings.

It is difficult to imagine that the mushrooms we perceive as waste can be useful or even successfully used as material. It is time for people to think more about alternative materials. We want to introduce one of those who have already been successful in the list of alternative materials.

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RESEARCH OF ABRASION RESISTANCE OF INDUSTRIAL CONCRETE FLOORS

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As demand for industrial buildings is increasing rapidly, so are demands for more durable, smoother, jointless and crackless floors, with increased longevity. Since the surface of floors inside factories are getting worn out by ongoing traffic, the goal is to make research, what really affects abrasion resistance – whether those are certain type of additives, hardeners, or concrete mixture itself.

An analysis of used material impact for concrete mixture was made as well as abrasion resistance testing method and sample preparation analysis. At year 2002, research shows, that increasing the cement amount up to 350kg/m3, abrasion resistance does not increase. However nowadays, its estimated that it is possible to achieve same abrasion resistance with using only 325kg/m3 cement [1]. Another research showed that the type of rock that is used in concrete mixtures affects abrasion resistance. Trap rock had the least wear of depth , followed by granitic gravel and dolomitic limestone [2].

This was followed by an experiment of testing abrasion resistance of various mixtures. Specimens were laboratory-made according to the european standard EN-13892-1. The compared floor mixtures were dry shake, various classes of concrete, poorly cured concrete, and concrete with applied hardener. Abrasion resistance tests were made according to the european standard EN-13892-4, determination of wear resistance – BCA.

The results were statistically analised and it showed that dry shake mixture has the best abrasion resistance. Increasing the amount of cement in concrete mixture, increases abrasion resistance, however dry shake mixtures provide supreme results over C35/45 concrete mixture. It has been observed that porosity, curing conditions and when concrete is power-troweled, affects the outcoming results.

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CROSS-LAMINATED TIMBER COMPARED TO REINFORCED STEEL

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When people are thinking about skyscrapers, they usually imagine huge buildings made of concrete, steel and glass. But this thinking is way too old-fashioned and false because in nearest future, and even nowadays, cross-laminated timber (CLT) breaks its way in being used in large buildings including skyscrapers. It's possible because of CLT's exclusive features that can outstand reinforced steel. (3)

It is heard that wooden buildings can have problems with fire resistance. A lot of research proves this is a false statement.(2) Yes, lightwood structures don't have sufficient fire resistance, but when we are talking about buildings made from CLT, their size make them good in fire resistance. It can easily gain 120 min fire resistance. When CLT or other mass timber construction starts to burn, it forms coal layer that protects inner layers from fire so the strength is reduced minimally. (1) Meanwhile, reinforced concrete exposed to fire starts to lose its strength and other important features very quickly and can even collapse. (4)

Other really important aspect is sustainability. Unlike concrete, building with CLT has a number of environmental benefits. Research shows that wood outperforms reinforced steel in terms of energy, air pollution and water pollution.(1) And CLT is made from wood that is renewable resource instead of reinforced steel. Also, CLT stores carbon dioxide. And in some places like British Columbia, CLT is made out of Mountain Pine Beetle-killed wood, so it helps to use usually unusable wood. (3) Thanks to the prefabrication there are almost no CLT waste on construction site. Living in houses made of CLT is good for physical and mental health (2)

Construction strength and costs are one of the most important things while planning construction. CLT is five times lighter than concrete, but CLT has comparable strength per weight ratio to concrete. (3) Thanks to the light weight, buildings from CLT are much lighter than buildings in which are used reinforced concrete, so buildings can have smaller and cheaper foundations. Also, CLT can be prefabricated so making working in construction site even faster and more efficient. It also makes building process cheaper. (2)

CLT can outstand reinforced concrete in almost all of the properties that are listed higher. This is the reason why CLT is being used more and more in large and high-rise buildings. It's sustainability, fire resistance and price make CLT a much smarter, cheaper and sustainable choice when planning a building.

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ALUMINIUM FACADE PROFILE EFFECTIVE CROSS SECTION CALCULATION OF PROPERTIES

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Nowadays the demand for glazed facades is constantly growing. New building with the facade of glass is a challenge, because projects are becoming more complicated and old standart solutions are not effective anymore. The reason why it is important to find for new solutions is that customers' budget is limited but they want high quality product without giving money for that. One of the most important factors is the facade profile cross section, because the optimal size give us more economical and technical solution, for example, a smaller cross section means larger glass area. Optimal size of a profile cross section give us a chance to save resources, get better architectural solutions, get larger glass areas thus projects become cheaper. The purpose of this study is to make an algorithm for effective facade profile cross section properties and compare the results with the tests in the laboratory to understand whether it is appropriate and appropriate to life situations [1].

There is a company in Latvia that offers calculation services, to get effective moment of inertia but the calculation is too expensive for others and this is a reason why we need to make algorithms for ourselves.

In addition to information research, calculation development and profile testing in the laboratory were used. The research resulted in numerical characteristics of effective modulus for practical application.

Conclusions are the following: 1) every new building with the facade of glass is a challenge because engineers need to look for new solutions for a project and this is the reason why engineers need to make research and tests in the laboratory to find the best way, 2) an effective moment of inertia calculation gives an optimal size of cross-section and an optimal size of cross-section gives a chance to save customers' money. It is necessary to make capital investments in order to get reduced operating cost in the future, 3) numerical characteristics of efective moduls for practical application was developed and this calculation was tested in the labaratory to be safe that its worked in the life, 4) an effective moment of inertia calculation raise utility and give a new chance to build more complicated glass facades.

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COMPARISON OF GEOTECHNICAL INVESTIGATION METHODS OF STATIC PROBING AND FLAT DILATOMETER TEST

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Geotechnical investigation of the soil must be performed to design safe and economic foundation of the building. It is necessary to perform geotechnical investigation, when the foundations of new constructions are designed or a reconstruction of the building is performed, if the load on the foundation is increased or enforcement of the foundations is performed. Geotechnical investigation consists of preparations, field and laboratory works and the drafting of geotechnical investigation report. Laboratory works are an expensive and time consuming process, therefore data obtained by geotechnical investigation and field works must be used and processed.

Static probing (static cone penetration test with (abbreviated *CPTu*) / without pore pressure metering device, abbreviated *CPT*), is probably Latvia's most common geotechnical field investigation method [4]. Dilatometer test (flat dilatometer test, abbreviated *DMT*) is a new method in Latvia and worldwide, and it is used in approximately 70 countries of the world [3]. In Latvia, the dilatometer testing device has been in use since 2017 only, and the only device is owned by the joint stock company *Ceļu projekts*.

The literature review describes the structure of static probing and dilatometer devices, their development, principles of operation. Methods of several researchers for the determining of soil characterising parameters, which can be used to design the foundations of buildings have been summarised and analysed.

The research part compares soil investigation data at three objects, where two static probing, two dilatometer tests and one geological drilling were performed at each of the object. Geotechnical investigation data were obtained from the joint stock company *Ceļu projekts*. The total number of static probing measurements performed in the framework of the Master's thesis amounted to 4,580, the number of dilatometer measurements amounted to 459. Sandy, loamy, biogenic (sludge, peat) soils and layered mixtures were detected at the objects. In the Master's thesis, the soil types obtained by several static probing testing correlating methods and the dilatometer test method were compared with the description of the geological drill. Soil properties obtained after using several static probing testing methods and the dilatometer testing method were mutually compared and analysed for specific gravity of the soil, angle of internal friction of the sand and its mixtures, degree of reconsolidation and soil binding properties of clay and its mixtures, deformation module and coefficient of earth pressure at rest [2;3].

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BIM (BUILDING INFORMATION MODELLING) APPLICATION IN LITHUANIA

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BIM (Building Information Modeling) is a digital building technology where a building emerges in 3D on a computer, not on paper or in any plane. The BIM model allows one to manage all building information at all stages of its life from the initial design concept to its demolition. All of the details of the building are detailed, and it is very important that the modeling of the building takes place in real time. With BIM, all construction workers work and see changes or new solutions in real time [2]. In other words, if a designer has made a correction, the engineer, after seeing the system, sees it no matter what. Lithuania is also trying to introduce the best practices of other countries [1].

Modelling is a process that includes modelling of the building and its implementation and operation processes using integrated tools. BIM Solutions: 3D - Static Modeling, 4D - Design, 3D + Time, 5D - Design, 4D + Money, ND - Building Management, Maintenance, Logistics, Energy Efficiency, Life Cycle Analysis and Other Possible Dimensions of the Model [3].

The implementation of the digital construction programme for 2014-2020 in Lithuania is important for the further development of construction sector organizations, and the measures envisaged therein will have a significant positive impact on both the construction sector and other business sectors related to the construction sector [3]. Uniform requirements for information modelling of structures have been created. Consistent development of a unified construction information classification, BIM-related standards, procurement specifications, coordination and organization of other activities related to digital construction, promotion of digitalisation and automation of complex interrelated construction processes and optimization of activities are being implemented. The aim of the study was to apply the construction information model in Lithuania. The conclusions are the following: 1) BIM projects allow one to manage the entire building's information from the life stage to the demolition, 2) the model of the building allows one to perform another analysis of the life of the building such as energy efficiency, 3) a digital construction programme is being implemented in Lithuania, which helps to develop a unified construction classification and public procurement specifications; business is encouraged to digitize.

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EVALUATION OF THERMAL COMFORT INDICATORS IN BUILDINGS WITH DIFFERENT ENERGY EFFICIENCY LEVELS

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Humans always tend to create thermally comfortable environment around themselves. Anciently traditions of construction have been focused on providing comfortable properties for residents and important factor in its entirety was thermal-technical indicators. Thermal comfort philosophically is a condition in which human brain is completely satisfied with its current environment and ongoing processes in it. However, to ensure this condition, it is required to correctly understand many thermal comfort physical and physiological factors of humans. It needs to be taken into consideration that list of these factors is comparably extensive and it is not enough to know few, therefore it is important to estimate a set of factors in different variable situations. In advancement of architectonic, technologically economical requirements, as well as energy efficiency requirements, also influencing factors of thermal comfort change. Taking into consideration that buildings are becoming more thermally efficient, the amount of glazed surfaces increase as well. The purpose of this study is to research how requirements of thermal comfort changes in buildings with various energy efficiencies [1].

To carry out the research, the author used the practical research methods: comparative method, theoretical research method – source analysis, information gathering and analysis methods.

Summarizing the results and calculations, it is concluded that better energy efficiency indicators of the building also mean better indoor thermal comfort, because the thermal performance of the structures provides higher surface temperature. From this point of view more attention should be paid to the area of the surfaces of light transmissive structures in buildings and their individual components, as large glazed surfaces are one of the most important causes of thermal discomfort. Projects from both architects and heating and ventilation specialists would require more in-depth exploration of thermal comfort solutions to provide both comfortable indoor temperature and controllable spending on comfortable microclimate.

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ENVIRONMENT AND WATER MANAGEMENT

DISTRIBUTION OF HEAVY METALS IN LAKE ECOSYSTEM

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Heavy metals are a major group of environmental pollutants found in water ecosystems. Sources for heavy metals can occur from fuel combustion, waste incineration, sewage disposal, spills, surface runoff form urban areas and atmospheric deposition. Amongst natural sources, an increased amount of anthropogenic sources can be found in environment. Heavy metals can accumulate in sediments, interact with biota and form complexes, or even may biomagnify through food chains. Also, organometals have been found in environmental samples as a result of their extensive usage and biotic and abiotic methylation processes [1]. This shows importance of knowledge about heavy metal concentrations in environment and their possible toxicity to freshwater ecosystems. The aim of research is to analyse content of heavy metals in two lakes in Latvia which are affected by anthropogenic influence.

Content of heavy metals were analyzed in sediments, water and fish soft tissue in Balvu and Pērkonu lakes located in NE Latvia. Concentrations of metals in the studied lakes were comparable with other studies done in Latvia [2, 3]. Slightly elevated concentrations of Zn, Cd, and in some cases Ni have been found in sediments of studied lakes. Cd and Pb clearly show anthropogenic impact, and only partly can be connected with atmospheric deposition. Possible sources of these metals can be surface runoff from urban territories and landfills.

Analysis of water samples show minor differences between lakes, however the analysed metals are in similar or slightly higher concentrations in Pērkonu Lake, which depends on their watershed basin. Balvu Lake reaches water from Pērkonu Lake, groundwater flows and surface runoff from Balvi city. In result, there are higher concentrations of Na and Zn than in Lake Pērkonu. Metal content differences in sediments indicate the presence of sedimentation processes in lakes, where metals accumulate in sediments.

It is believed that fish fauna reflects heavy metal levels found in sediments and water of the particular aquatic environment source. Real time, exposure and presence of migratory fish can make a difference in variability of metals and their concentrations. The studied lakes, which have similar pattern with metal content in water, have higher concentrations of metals in the analysed fish tissue, such as Ba, Ca, K, Mg, Sr and Zn in Pērkonu Lake. Actual differences with metal content in water and fish clearly shows metal uptake by the trophic chains and possible biomagnification in these chains, although detected levels of heavy metals do not reach environmental and food requirements.

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COMPOSITION AND DISTRIBUTION OF MARINE LITTER IN THE GULF OF RIGA

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Thus far, the only scientific results concerning marine litter in Latvia have been published about coastal areas and even then, only relatively large sized particles were considered. There have been no previous research activities concerning microscopic marine litter particles in the waters of Latvia. Furthermore, there is little research in the Baltic Sea reflecting it. This present research has been focusing on one of the qualitative descriptors for determining good environmental status by Marine Strategy Framework Directive – marine litter [1]. The aim of this study was to assess composition and distribution of marine litter in the Gulf of Riga, territory of Latvia.

Surface water sampling in 10 transects of the Gulf of Riga was carried out in the time period from May 2018 until July 2018. A "Manta" net (300 μm) that was attached to the side of the vessel was used to trawl for 1 hour at speed of approximately 2 knots. For preparation of samples, easily degradable organic matter of biogenic origin was dissolved with 30% hydrogen peroxide and thereafter filtration method was used to collect particles. Detection of marine litter was carried out with the help of a microscope Leica DM400 B LED and camera DFC 295 using visual identification and "hot needle" method. Particles were analysed for their colour and size using image analysis, and each detected particle was categorized into one of the eight categories (fragment, filament, sphere, film, granule, foam, rust and foil). For identification of chemical structure Fourier-transform infrared spectroscopy method was used. The analysis of composition of particles was carried out in collaboration with Slovenian National Institute of Biology, using PerkinElmer spectroscope "Spotlight 200i FT-IR Microscopy System".

Results show the presence of marine litter in all samples; most particles belong to fragment and filament categories. The number of particles varies from 0.4 particles/m^3 to 6.23 particles/m^3. The greatest concentrations of particles are observed near costal recreational sites and river estuaries; dispertion of particles in sample transects more distant from the coast is observed. For representative composition analysis 576 visually identified particles were tested. Most particles consisted of different polyethylene compounds and degradation products (60.24%). A second, relatively smaller group was polypropylene particles (13.19%). Rubber (1.22%), palm wax (1.22%) and polystyrol (0.52%) particles were also identified.

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MOSS BIO-FILTER

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Since a decade ago, Latvia and countries bordering the Baltic Sea have faced problems of nutrient losses to water from agriculture activities [2]. Chemical elements, such as nitrogen and phosphorus, have terrible effects on water sources, particularly in the Baltic Sea, where they cause such processes as eutrophication [3]. The aim of this research is to take practical actions for holistic drainage management to reduce nutrient inflow to the sea by implementing a moss bio-filter system in agricultural ditches and canals.

The research process has started in the spring of 2018 by participating in Interreg Central Baltic programme project "NutrInflow". The first stage was to develop an idea of managing nutrient losses by completing secondary research method with reviewing existing articles and analyses and collecting data from them. In this way, after studying and processing all information, the idea of moss bio-filter was approved. The main concept of it was to create ecologically and biologically friendly filter that could help to manage nutrient losses in natural way. During water filtration with mosses, such chemical elements as zinc, copper, nitrogen are accumulated in hollow dying cells that produce antiseptic substances which help to eliminate microorganisms [1]. Mosses are supposed to be enclosed in carcass with specific pore structure and substratum, and placed in water source.

After finishing with the theoretical part of research, implementation of physical model began. The first step was to re-create natural conditions in which filter should work. For this, detailed model of drainage agricultural field system was rebuilt by using natural materials matching the ones that exist and are used in Latvia. The second step was to create prototype of carcass using 3D modelling software and a 3D printer. As both of previous steps were accomplished successfully, the final stage was to put them together and finish the experimental research by making it works and challenging moss filter system in conditions closed to natural.

In the summer of 2018, the final model was presented in working state to commission of Latvia University of Life Sciences and Technologies that admitted its filtering possibilities and rewarded it with a reserved seat at project's final conference in Finland. In the autumn of 2018, the model and research were presented in Helsinki to colleagues from Sweden, Estonia and Finland.

Moss bio-filter system demonstrates its possibilities to function and its incredible potential for helping environment maintaining the cost as low as possible. It can have further development and implementing in different areas from agricultural to civil engineering. However, this research is an initial stage and it should be study deeper in order to acquire final and precise results.

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ASSESSMENT OF ECOSYSTEM SERVICES IN NIDA BOG

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Ecosystems services are benefits gained by the human beings from various ecosystems. They are distributed into three categories: provision or supply services, regulatory services and cultural services [1]. Changes in ecosystems and the ecosystem services they provide, may affect the mankind to a crucial extent, therefore it is important to take into account their values and human well-being before making decisions related to ecosystems [2].

Evaluation of the ecosystem services is a relatively new approach in Latvia and is used within the various projects, such as "LIFE Restore Project", which aims to develop guidelines for sustainable management of the degraded peatlands in Latvia [3]. This project provides wide-ranging information on the basic principles of evaluating the ecosystem services, thereby providing support for this research.

The aim of the research is to explore and to evaluate ecosystem services in the Nida bog. This research evaluates ecosystem services for peatlands, because natural peatlands are significant carbon stocks, while degraded peatlands produce significant amount of GHG emissions; therefore it is crucial to do recultivation of degraded peatlands in a way to provide carbon storage. Within a research, ecosystem services are evaluated in Nida bog because this bog is the only bog in Latvia located close to the Baltic sea, and has a high diversity of habitats with fen, transition and raised bog characteristics. Also, area of Nida bog is an important peat extraction site [4].

Evaluation of the ecosystem services in Nida bog is carried out by using the Burkhard assessment method, which provides information of the available ecosystem services in a matrix form. This biophysical assessment method is the most widely used approach to map and evaluate ecosystem services [5].

In conclusion, the supply services in the Nida bog have very high service value for the peat and vegetation, including medicinal plants. For the regulatory services, the high value is the ability of the soil to absorb and accumulate nutrient elements, vegetation cover, and number of plant species, air temperature and quality. High value within the category of cultural services is observed in bird watching ecosystem service.

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MERCURY BIOACCUMULATION IN EUROPEAN PERCH MUSCLE OF THE GULF OF RIGA

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Human activities are responsible for considerable amount of mercury that is released into the environment and it involves in global cycle traveling across the continents after being deposited in soil, water and biota. Mercury contamination problem emerged in Japan in the middle of the 20th century when people were mercury poisoned by eating fish from Minamata bay and Agano river [4]. Today mercury is seen as significant environment pollutant. Water biota is used for mercury concentration measurements because it is directly used as food source and research data on fish is comprehensible for all the society. According to Swedish data fish is the biggest mercury source from food [3]. European perch (*Perca fluviatilis*) is used as indicator species and it is very common to assess environmental and ecological state; long-lived, sensitive to short- and long-term changes in the environment, very common and key species in aquatic ecosystem of the coast of the Baltic sea [1] [2].

The aim of the research was to determine Hg content in the European perch muscle samples caught at the coast of the Gulf of Riga during May-September 2018 and to determine Hg dependence on fish size, season and diet preferences. Hg concentrations in fish muscle were analysed according to US EPA 7473 method. Stable carbon and nitrogen isotope ratios (δ^{15}N and δ^{13}C values) were used for description of perch food source preferences by fish size. In addition, stomach content analyses were performed.

Hg content displayed a wide range of disparity in studied tissues defined by the season and diet preferences and varied from 33 µg kg⁻¹ WW to 165 µg kg⁻¹ WW by different size groups (10-27 cm). The observed concentration could be related to the specific diet. Stomach content analysis showed that main composition of perch diet included Mysids, Copepods and Round goby. The relative composition of food items varied with fish size (outgrowing 14 cm fishes reach next trophic level) and season (most likely due to changes in food item availability). Hg concentrations exceeded EQS level in muscle tissue in all samples according to EU Directive 2013/39/EU.

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REMOVAL OF NICKEL USING FE₃O₄ IMPREGNATED ONTO SUGAR BEET PULP FROM AQUATIC ENVIRONMENTS

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Industrial wastewaters which contain heavy metals are one of the most serious environmental problems. Adsorption has preferable properties compared to other conventional treatment techniques due to the operating and design facilities in heavy metal removal from water and wastewater. However, low-cost adsorbent materials should be used in order to be economical. The use of industrial wastes in the adsorption process provides both a solution to the problem of the removal of wastes and a reuse method for the use of wastes as a low-cost adsorbent for a useful purpose. Therefore, it has two advantages: There is a need to investigate the feasibility of investigating all possible industry-based cheap adsorbent sources as well as the removal of heavy metals to produce a reliable and harmless adsorbent. A large number of industrial low-cost and environmentally suitable adsorbents such as tea waste, waste of leather factory, waste of olive oil products, newspaper dough, battery industry waste [1., 3.] are used for heavy metal removal from aqueous solutions. In recent years, the usage of adsorbent materials with magnetic properties due to their surface properties and enable easy separation from the solution, increases in the removal of different pollutants from water and wastewaters.

In this study, the magnetic composites material was synthesized with Fe_3O_4 impregnated to sugar beet pulp using chemical precipitation techniques based on the methods described by Panneerselvam et.al. (2011). Nickel removal performance of magnetic nanoparticles was investigated under different environmental conditions such as contact time, adsorbent dose, pH, initial heavy metal concentration, etc. The experimental studies showed that the maximum adsorption capacity of material was achieved as 9.36 mg/g for aqueous solution containing 25 mg/L initial nickel concentration at 40-minute contact time, 200 rpm shaking speed, 5 g/L nanoparticle dose and pH 6.6 (original pH). Freundlich and Langmuir isotherm experiments were performed, and correlation coefficients were determined as 94.5% and 99.4%, respectively. Nanoparticle characterization was illuminated with XRD, SEM/EDX analysis.

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SOCIAL SCIENCES: ECONOMICS, MANAGEMENT AND ADMINISTRATION

VALUES AND MOTIVATION OF GENERATIONS IN LABOUR MARKET

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Generational studies became topical at the end of the 20th century. Each generation has its own motivation for work, values and style of communication [1]. Lack of awareness of those aspects can have a negative impact on employment relationships and work efficiency [2]. Therefore, the aim of the study is to explore the values and motivation of different generations in the labour market. According to scientific literature, there are four generations in the labour market – traditionalists (born before 1945), baby boomers (1946-1964), generation X (1965-1980), generation Y (1981-1995) and generation Z (1996-2010).

Traditionalists perceive work as an obligation. They are very responsible, disciplined, conservative and good team players. They prefer formal, face-to-face communication and usually they work for one employer for all their life [3]. Baby boomers live to work; they perceive work as an adventure. They are ready to work after the end of the working hours and on weekends [4]. Baby boomers are loyal, very responsible and demanding to themselves and to others [5]. In their communication, they prefer formal and informal style, long phone conversations and personal relationships. They can be motivated by involvement in decision-making processes, material reward, acquisition of new skills and knowledge.

For generation X, work is a challenge. They are self-confident, individualistic and result-oriented [5]. In communication, they use both formal and informal styles. Generation X is motivated by flexible working hours, education, appreciation, professional growth and career opportunities, which ensure their material well-being. They are less loyal to the employer comparing with previous generations.

For generation Y, work is a tool or opportunity to be together with companions. Generation Y is able to maintain a balance between work and other areas of life, responding flexibly to change. For them very important are fast career opportunities and challenges, financial independence, an interesting work environment without strict restrictions and regulations. They are ignoring the hierarchy, informal style is chosen for communication, especially communication via smartphones and social networks. Generation Y is motivated by flexible working hours, dynamic working environment and work that has a meaning [5].

Taking into account the values and motivation of different generations, it is possible to create an efficient working environment, form teams and develop an appropriate motivation system that meets the expectations of a particular generation.

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KNOWLEDGE ASSET IN ORGANIZATION

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Nowadays knowledge has become an important intangible asset in an organization. The role of knowledge has increased and organizations benefit not only from knowledge, but also from the total amount of knowledge in the economy [1]. The first principle, why organizations pay attention to knowledge creation is to ensure its competitiveness and sustainable development. The second principle is today's economic and social context which is characterized by rapidly changing technologies and larger amounts of information that has become difficult to manage [2]. The creation and diffusion of knowledge have become ever more important factors for competitiveness [4]. Most of organizations include these goals in their strategies and long-time planning documents. The aim of the research is to study the available literature and review different points of views why knowledge is so valuable in the organization in order to summarize the main theoretical aspects and to find an answer to the question, why knowledge is so important for organizations to reach their strategical goals. The main aspects are the following: knowledge is a transdisciplinary field and incorporates many disciplines such as philosophy, economics management, information technology, human resources, psychology, sociology, communication studies and many more [5]. The other problem is how to manage knowledge in organization. Why is it necessary to collect, share and use the knowledge? These and other questions are topical from the first decade of the 1990s, when the concept of the knowledge management appeared [2]. Many scientific and research publications have been published since 1994. The topicality of knowledge management has extended rapidly. It reached a peak in 2012 [3]. The topics of knowledge management were published in journals indexed in the Web of Science database [3]. In conclusion, the knowledge in the 21st century is the main asset for organizations. The knowledge management is widely known in organizations, but there is no sufficient information or statistics how knowledge practically is managed in organizations. Most of all the knowledge is associated with documents, computer files or information. The importance of knowledge has achieved its highest peak, and deeper studies are necessary for finding new theories and practices, which would improve and enrich the previous scientific research.

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POSSIBILITIES AND RISKS OF BIOPLASTIC IN PAKISTAN

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Bioplastics are the plastics derived from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, food waste, etc. It is estimated that by 2050 plastic could be responsible for 15% of global CO_2 emissions. Plastic derived from the petroleum (fossil fuels) contains carbon; if CO_2 increases in the atmosphere, the temperature could be increased and the climate will change leading to natural disasters [1].

"Plastics are considered essential materials in today's society, but throughout their life cycles they contribute to pollution and depletion of non-renewable natural resources. Bio-based plastics appear to be more environmentally friendly materials than their petroleum-based counterparts, when their origin and biodegradability are compared. But which of the bio-based plastics currently on the market or soon to be on the market are preferable from an environmental, health, and safety perspective? [1]. Bioplastic is a biodegradable plastic made from renewable biomass sources instead of petroleum. In Pakistan, the different biological materials are used to synthesize bioplastics. Pakistan is an agricultural country, and production of wheat, sugar cane and maize is very high. Pakistan currently faces a lot of climatic and environmental issues, including global warming. One of the major reasons is carbon emission, and it can be addressed by producing bioplastics [1]. Two strains which are analysed in this study can be exploited for large scale production of PHA (bioplastics) using bagasse as carbon sources. In this study, some effort has been done for bioplastic production using agriculture waste bagasse for improvement of the economy and environment [2].

Non-bioplastic bags are banned in Pakistan, and the solution of this problem is to produce bioplastics which are a potential replacement to synthetic plastic. Bagasse is a cheap carbon source in agricultural countries like Pakistan and has no significant applications. In Pakistan, annual production of sugar cane bagasse is 10 million tons. Bagasse can be used as carbon source for bacterial strains to provide low carbon/nitrogen ratio. By producing bioplastics, we can increase energy saving and decrease non-biodegradable waste. It is very important to develop and manage the capacities and technologies to produce bioplastic products rather than plastics, since they are environmentally friendly and less harmful for environment [3].

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THE CONCEPT OF URBAN AGRICULTURE

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More than 55% of population are living in cities, and the United Nations forecast that the total population will be growing from 7.6 to 9.8 billion people before the year 2050, increasing the proportion of population living in cities to 68%. [1, 2] The acceleration of the urbanization identifies some specific problems in urban areas: pollution that causes also climate changes, insufficiency of food security, low income level, health care availability and growing unemployment and social alignment.

Urban agriculture as a new trend of agriculture in the Global North, and a new way of agriculture in Latvia can be one of indicators that although it cannot resolve most of the problems and risks caused by urbanization, it can make a significant contribution to mitigating the negative consequences.

Urban agriculture as the concept and its benefits in the research field appeared in 1980s publications. [3] But various characteristics such as motivation, socio-economic benefits, resource usage, and technological development indicate significant differences between urban agriculture in the Global North and South. These differences determine also variations of definition of urban agriculture. [4] The main characteristic of the concept of urban agriculture is the use of agricultural forms in the urban environment with an aim to produce food for self-consumption or commercial process. Urban environment allows the use of agricultural forms such as horticulture, poultry farming, apiculture, in some cases also dairy farming [3] and can be classified as community gardens, backyard gardens and allotments, rooftop and balcony gardens, vertical gardens, windowsill growing, urban farms and indoor farming.

In the context of accelerated urbanization, sustainable development is one of the main challenges. In the Bruntland Report, sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," and is based on three dimensions – economic, social and environmental. [5] Although the impact of urban agriculture on the environment and climate changes is controversial, farming in cities has an economic and social effect. Urban agriculture can provide economic benefits as increasing household income, reduce food costs, improve food availability and safety in addition to social benefits such as social cohesion, provision of physical activities, satisfaction of the renewed interest in agriculture and food production in urban areas.

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CULTURE AS A DRIVING FORCE OF A PLACE DEVELOPMENT

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The report is a part of the project "Development of a sustainable and cohesive Latvian society: solutions to demographic and migration challenges" of the National Research programme "Latvian Heritage and Future Challenges for National Sustainability" Project activity No.7: "Interplay of tangible and intangible regional cultural resources." The aim of the research is to identify areas where the impact of culture is seen as a tool for a place development. Accordingly, for the theoretical discussion, the ideas of scholars analysing culture from diverse points of view is used in the report. Maximillian Bennar has defined the actors and change makers involved in the development process. He names policy makers, civil society, local municipality and networks between them as the main change makers. Also, entrepreneurship education is recognized as a significant tool for the promotion of a local development impact. He urges to recognize local actors as facilitators of culture, but culture itself as an economically and socially valuable resource. An important role for development is played by interrelationships between local framework conditions, culture, creative industries, culturally relevant products, and local or regional development itself. Nancy Duxbury and colleagues describe three models of a role of culture for sustainable development. Culture may be absorbed as an element in sustainable development, for sustainable development or culture as sustainable development. Whichever model is used, culture still has an integral part in a place development. The discussion arises on interconnections among civic domains as a key action for sustainable local development, where benefits of culture activities must be appreciated. Local cultural policies, put in the right approach, may turn into a catalyst for social cohesion, integration, environmental improvements and other challenges that concern locals. Thus, culture affects both the economic and social spheres of a place. Only an economic standpoint of a place development is neither effective nor sustainable. Agust Einarsson has been collecting ideas for statistical measurement of culture and provides an economic point of view on culture. He perceives creativity as a key driver for innovation and creation of knowledge. Creation and innovation are key concepts in cultural economics. He agrees that culture puts responsibility on current and future generations in terms of the development of a society as a whole and citizens as individuals. To conclude, culture is viewed as a directly or indirectly added value for the place development in an economic, social, educational and environmental way.

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CIRCULAR ECONOMY (WATER RESOURCE)

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There is a significant misconception that circular economy and recycling are similar terms, but there is a small difference in definition which can make great impact on the resources. Recycling means reusing resources which have been already used, but when it comes to circular economy, it doesn't only mean the reuse of resources but also how to make most of the resources. The aim of this research was to understand why there is a need to use water resources not only for recycling but also as a circular economy resource [2].

According to findings of this research, today's generation cannot even imagine the quality of water that used to be available in rivers and was easily drinkable. In last 50 years, water resources have not only decreased but have also been damaged [4]. Many reports have been published on water scarcity since 2002, and several steps have been taken including water recycling. People have been given instructions to use water resource wisely, but they are not making a big difference [1].

Each second, more than 500 million liters of water is consumed, from which 70% is in use for agriculture, 20% for industry and 10% for households. According to the world development report, over 80% of wastewater is discharged without treatment [6].

Earth's population is increasing by more than 150 every minute. Many countries around the world already face water scarcity or have low quality water. It is te present generation's duty to find a way to save water resources before the next generation uses only recycled water and no fresh water will be left for them [5].

The main findings of this research show that good examples of water circular usage can be found. For example, a Japanese toilet sink combo was introduced in 1956. At first it was introduced just as a space saving tool. Today it is not only a space saving tool, but also a tool which can help to reduce usage of daily water. According to the research, Japanese toilet sinks can save 27% of water wastage.

In conclusion, it is possible to fight with water scarcity which involves the processes of education and facilitation of the new use of water resources. 70% of fresh water is used for agriculture to improve irrigation system to close the gap of supply and demand. The most important solution is to improve the sewage treatment systems to save the natural water.

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PERSONAL INCOME TAX RELIEFS FOR THE AGRICULTURAL SECTOR IN LATVIA

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The tax burden on economic activity refers to the profitability of the industry as well as the amount of relief that is applied. In recent years, there is a tendency to restore personal income tax (PIT) payer's status through its benefits (simple accounting, no additional income tax on an owner's personal consumption) [1].

The aim is to analyse what PIT reliefs are applied to farmers in Latvia. The tasks of the research: 1) to study the regulatory framework for PIT relief for farmers; 2) to analyse the amount of PIT relief farmers used.

The agricultural sector has always been one of the sectors where taxation is the most complex and controversial. It is influenced by a number of factors, but mainly because of the seasonality of agriculture and regional distribution. Economically, agriculture is affected by both business or personal income tax payments and social security contributions [2].

Since 2018 the personal income tax rate in Latvia has been progressive (20%, 23%, 31.4%). As regards small farmers (if taxable income does not exceed 20,004 EUR per year), 20% rate is applied. Besides, farmers do not pay tax on income from the EU and state subsidies, as well as on income from agricultural production and rural tourism, if it does not exceed 3,000 EUR per year. The total non-taxable income in the period 2013-2016 increased from 159 million euro to 201 million euro, but their share in the total non-taxable income has not changed significantly.

With a view to promoting legal employment in rural areas and improving the social protection of workers, the administrative burden was reduced starting from 2014 by introducing a special option for seasonal workers in agriculture, i.e., a seasonal farm income tax of 15% of the calculated salary. Over the last four years the number of farms using this opportunity has doubled, and in 2017 they accounted for 166 farms, and the number of such employees has increased by 53%. A positive trend is also the increase in average pay of seasonal farm workers which has grown twice as much over the period of four years [3].

In conclusion, the use of PIT relief in agriculture is influenced by the legal form of the company, the amount of income and subsidies received, and the use of seasonal farm workers.

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NATURAL RESOURCE TAX AS A INSTRUMENT FOR THE RATIONAL USE OF A NATURAL RESOURCE

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It is necessary for every country to act with the foresight and thoughtfulness of natural resources, because natural resources are limited and the number of population increases, so does the consumption of natural resources. The aim of the research is to analyze the natural resource tax in the extraction of natural resources.

Natural resources are part of nature, also soil, subterranean depths, air, waters, biological diversity. In Latvia, the efficient use, realization and environmental protection measures of natural resources are promoted by the application of natural resource tax (NRT). The purpose of the NRT is to promote economically efficient use of natural resources, restrict pollution of the environment, reduce manufacturing and selling of substances polluting environment, promote implementation of new, environment-friendly technology, support sustainable development in the economy, as well as to ensure environmental protection measures financially [1].

The Ministry of Environmental Protection and Regional Development and institutions subordinate thereto is entitled to control the use of natural resources, the amount of goods harmful to the environment, coal, coke and lignite (brown coal), packaging and radioactive substances used for ensuring economic activities and the conformity with norms for recovery of the used packaging, as well as the amount of fireworks. The calculation of the tax is controlled by the Ministry of Environmental Protection and Regional Development, institutions subordinate thereto and the State Revenue Service, that also control, accounting, collection and distribution of tax payments [1].

The overall aim of Latvia's environmental policy is to enable citizens to live in a clean environment through sustainable development measures, preserving the quality of the environment and biodiversity, ensuring the sustainable use of natural resources, and public participation in decision-making [2]. From 2017, the rates of resource and pollution tax have been significantly increased in Latvia. Tax rates have been increased, with the aim of promoting the careful and prudent use of natural resources - reducing environmental damage, thereby contributing to increasing the efficiency of natural resources. The highest increase in the tax rate is for those natural resources that play a role in the development of the Latvian economy, given their availability and value. In Latvia the highest increase in tax rates since 2017 refer to soil.

The research results gave evidence that the NRT revenue actually collected in the budget is smaller than planned. One of the reasons of differences between the planned and collected amounts of the tax is that the NRT is paid at the rates set by the Natural Resources Tax Act for the actual extraction which cannot be accurately estimated when planning the budget revenue.

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GENDER DISCOURSE ANALYSIS OF MODERN MASCULINITY IN ADVERTISING

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Advertising is becoming more inclusive than ever before, and men are being depicted in advertising in new ways that could be characterized as modern masculinity. However, this depiction of modern men is still causing some heated debate about gender, both men and women, on the internet. According to the literature review, traditional masculinity, among other things, is associated with display of strength, power, bravery, sense of patriotism, decisiveness, dominance, heterosexuality and the role of the "breadwinner" (1; 2). However, modern masculinity, which was the subject of this research, is associated with a display of fashion, culture, open mind, progress, forward-thinking, being sensitive and being brave enough to be whoever a man wants and be (3; 4; 5). The object of this research was gender discourse in advertising; however, more specifically, the object was gender discourse of modern masculinity in three specific advertisements that depict modern masculinity at the core of the ads and make the message around it. The ads chosen were the Dove Men Care ad "Calls for dads" showing men being involved with their children and displaying care and affection; Bonobo's ad "Evolve the definition" where men are rejecting the notion that the definition of masculinity entail only traditional masculinity traits; and the Lynx ad "Is it ok for guys" where the ad asks questions about masculinity by challenging traditional masculinity. The aim of this research was to analyze specifically the gender discourse that was noticeable in the YouTube comment sections of the ads.

Overall, two key methods were used to attain the aim of the research: 1) Analyze the academic literature about traditional masculinity, modern masculinity and gender; 2) Conduct and extensive online data collection by harvesting and analyzing more than 7000 YouTube comments of all three ads depicting modern masculinity.

The results of the research present the following conclusions: 1) The literature review suggests that the traditional masculinity mindset is very toxic in the debate about gender, and the discourse analysis of YouTube comments prove that; 2) The gender discourse of modern masculinity in advertising is a heated debate and negotiation about which gender is more oppressed and which gender is under greater scrutiny in society; 3) Evoking modern masculinity in advertising certainly gets a lot of attention for the brand; 4) However, the consumers get very distracted from the product and the brand of the commercial, because they are too focused on the debate of modern masculinity and gender in general; 5) The success or backlash of using modern masculinity in advertising highly depends on the way modern masculinity is being presented; 6) Marketers should not force modern masculinity on to people, but rather depict it in a subtle way by asking questions or presenting modern masculinity in the context of Love as Dove Men Care ad depicted modern masculinity.

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ANALYSIS OF JOINT VENTURES WITH BORDER COUNTRIES IN LATVIA

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Latvia has a land border with four countries. The geographical proximity affects the national economy of Latvia. The aim of the research was to review the dynamics of the creation of joint enterprises in Latvia with neighboring countries. Estonia, Lithuania, Russia and Belarus are reviewed in the research. The main research methods employed in this study were literature review, and the economic and geographical methods.

The length of the land boundary is about 1,388 km [1]. It creates conditions for the development of joint ventures with border regions. In 2012, the situation with joint ventures [2] is depicted in Table 1. There are no data on the number of enterprises with Belarus in 2012, but there are [3] data that there were about 175 firms in Latvia in 2002.

According to the company Lursoft, in 2019 there were changes in comparison with 2012 [4].

The dynamics of the number of local enterprises in Latvia with neighbouring countries is also presented in Table 1.

Table 1. **Comparison of the number of joint ventures in Latvia in 2012 and 2019**

No.	Country	The length of land boundary with Latvia, km	The number of joint ventures in 2012	The number of joint ventures in 2019
1	Belarus	173	n/a	949
2	Estonia	343	1,888	1,978
3	Lithuania	588	2,162	2,034
4	Russia	284	3,838	5,474

The research shows that the business of Latvia depends on the economy of the neighbouring countries. In the period from 2012 to 2019, the number of joint ventures with Lithuania decreased. The number of joint ventures with Estonia slightly increased. As regards joint venture companies with Russia and Belarus, there was a significant increase in the number of such companies.

It is necessary to add a point on the improvement of joint business mechanisms with border areas and other states to the programme of the Development of the Business Environment of Latvia.

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MOTIVATION TO BE SELF-EMPLOYED

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Globalisation and the progressive development of technologies, as well as migration and changes in the family values have contributed both to the changes in cooperation relationship in business and employment. Entrepreneurs more and more frequently choose an agreement-based cooperation. In addition, remote work opens up new opportunities for jobseekers who are willing to find jobs outside the borders of a particular country. The aim of the research is to identify the main factors encouraging people to choose self-employment as a form of employment.

The analysis of the opinions of different scientists leads to a conclusion that self-employment is characterised both positively and negatively. On the one hand, self-employed persons can be more flexible by combining their careers with personal life thus finding a balance between different areas of life. Self-employed persons have autonomy in decision-making and the ability to schedule their own working hours. Such options increase the satisfaction with the work to be done. In addition, group of researchers managed by Sewdas et al. (2018) conducted a study and found a positive interaction between self-employment and labour productivity. The researchers concluded that labour productivity was closely related to the independence of a self-employed person [3]. On the other hand, self-employed persons are fully responsible for their own activities (also materially) [1]. As a result, a high level of responsibility is transformed into not fixed working hours that contribute to stress and burnout; hence, negatively affecting a person's health [2;5].

Despite the confirmation made by some researchers that the self-employed persons choose this type of employment because it is the only way to enter the labour market, Eurofound research data reveal the opposite. The survey among the European Union Member States showed that only 20% of respondents did not see other opportunities to enter the labour market. The researchers admitted that it was difficult for this group of respondents to assume the leading role and responsibility for their decisions [6].

The summary of research results leads to a conclusion that the population chooses self-employment because it gives the opportunity to work remotely consistent with the individually developed work schedule. A self-employed person is independent in decision-making and is more satisfied with his/her job compared with a paid employee.

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HISTORICAL DEVELOPMENT OF SOCIAL ENTREPRENEURSHIP

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The term "social entrepreneurship" has emerged relatively recently, but thanks to the Europe 2020 development strategy, as well as to social development and business trends, social entrepreneurship has become an integral part of national development strategies. The aim of the study is to find out what the origin of the term "social entrepreneurship" is and its basic principles.

Various studies [1,2] show that various organizations and foundations have been engaged in social entrepreneurship already in the 19th century even before the concept of social entrepreneurship emerged. The term "social entrepreneurship" is believed to have been used in 1972 for the first time, and it was defined by Joseph Banks [3].

Social entrepreneurship has become an innovative field of activity as evidenced by Muhammad Yunus, a winner of the Nobel Peace Prize, who was a social entrepreneur and one of the founders of social entrepreneurship in the world. M. Yunus defined the basic principles of social entrepreneurship, which are: the business goal is not to maximize earnings but to prevent / tackle poverty or other social problems; financial and economic sustainability; investors return only their investment without interest; when the investment is repaid, the company's profits are used for further development and solving social problems; responsible attitude to the environment; the labor force receives appropriate remuneration for the labour market and better working conditions; ... and doing the job with pleasure [4].

As the idea of social entrepreneurship develops, European countries are actively working on the legislation defining requirements and incentives for social entrepreneurs. The first country that developed social business legislation was Italy in 1991, the new Italian Law on Social Enterprise was added in 2006. The example of Italy was followed by Britain and Lithuania in 2004 [5].

In order for social entrepreneurship to develop, it is essential to establish common criteria and definitions for more successful transnational cooperation, not only in Europe but also in the world; that is why it is essential to identify the beginnings and founders of social entrepreneurship.

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COMPARISON OF LABOR TAX BURDEN IN LATVIA AND GERMANY

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During the time period of open borders in the European Union, Germany has become a popular destination for emigrants from Latvia. The main arguments for this choice are mentioned to be salary and social contributions, as well social guarantees [1; 2; 3]. In 2018, there were changes in the labour tax systems in both countries. Taking into account the reports on the tax load comparison before the tax reforms, the aim of this study was to analyse the differences in labour tax burden in Latvia and Germany and the labour tax impact on net salaries after the tax reforms in 2018. The authors have proposed a hypothesis that the labour tax effect on employees in Latvia is much higher than in Germany.

The theoretical framework for the research was based on the analysis of the state laws and other empirical research studies carried out before the tax law changes in 2018, as well as statistical data.

The authors define labour taxes as the taxes that are deducted from salary or are paid as an extra (on top of the salary) by the employer. There has not been a unanimous opinion about such hypothesis before, thus the authors used various methods, including mathematical statistics and graphical statistics, monographic methods and others, to test their hypothesis.

The results of the research study do not support the hypothesis, allowing to conclude that the labour tax burden in Latvia is actually smaller than in Germany. The effect of the taxes depends on several reasons: the amount of gross salary, particularly *bundesland* in Germany, the family status and other aspects. The cost of living was excluded from the analysis of the study.

To stop emigration from Latvia to Germany, it would be necessary for the state authorities to look through the social contribution system to develop an employee-friendly long-term model. In addition, it would be necessary to focus on the tax burden of employees instead of the employer. Owing to this kind of the tax system, employees would have more influence on their social benefits for the future, and it would decrease the illegal employment as well as risks for socially unsecure future for employees.

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COOPERATION BETWEEN SCIENTISTS AND ENTREPRENEURS OF ZEMGALE

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Cooperation between scientists and entrepreneurs has been a popular subject of discussion in Latvia for a long period of time; however, these discussions have resulted in real life changes rarely. From the scientific perspective, carrying out a research study on this subject is important, because statistically the subject has been studied negligibly – the amount of data is poor and it has been collected just with quantitative research methods. Recent studies show that Latvia's productivity is still significantly lower than average productivity level in the EU – comparatively, only 44% [2]. Experts agree that the key to increasing productivity indicators is to implement innovations in entrepreneurship [3,1]. Zemgale is a region in Latvia that offers numerous possibilities to develop scientifically advanced and successful companies that could become highly productive [3,4].

The aim of this study was to identify and find solutions to cooperation problems between scientists and entrepreneurs of Zemgale. The following research questions were put: 1. How and who is involved in cooperation implementation between scientists and entrepreneurs of Zemgale; 2. How is the cooperation encouraged – what sort of benefits are presented to scientists and to entrepreneurs; 3. What are the most significant problems and possible solutions that are related to cooperation effectuation between scientists and entrepreneurs in Zemgale region.

The theoretical part of the study consists of two chapters: 1. Theoretical description of scientists and entrepreneurs as separate social categories. 2. Sociological- theoretical aspects of cooperation. For the theoretical framework, the authors have used the Actor-network Theory (ANT) by Bruno Latour offering the ANT as a concept of research. The theoretical part also describes the current situation and supporting activities of cooperation between scientists and entrepreneurs in Latvia.

A qualitative approach method with partly structured eight interviews is used: six of them with entrepreneurs, one with a scientist and one with an expert. This chapter reveals the current situation of cooperation between scientists and entrepreneurs of Zemgale region and gives answers to the above research questions.

The main conclusions are: 1. Cooperation does provide individually unattainable perspective and outcomes. 2. Popular science and promotion of science and knowledge play an essential role in providing interaction between scientists and other groups of society. 3. Social sciences are an important force, though undervalued, for enhancing interdisciplinary knowledge transfer and implementation of cooperation. 4. Entrepreneurs experience difficulties in business due to the lack of information on cooperation costs and the financial aid available. 5. Building an intellectual property depository by converting human resources into intellectual assets helps to remove time and communicative barriers.

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REPATRIATION PROCESS IN LATVIA: THE EXPERIENCE OF REPATRIATES AND FUTURE REPATRIATES

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According to the Central Statistical Bureau, at the beginning of 2018, less than 2 million people lived in Latvia - 1 million 934 thousand [1]. According to the Ministry of Foreign Affairs, more than 370 thousand representatives of the foreign diasporas of Latvia live, study and work in different countries of the world, maintaining links with Latvia [2]. Various studies have studies the experience of the foreign Latvians in the process of repatriation, the reasons for returning to Latvia and the obstacles faced by repatriates in the process of repatriation [3].

The aim of the research was to investigate the process of repatriation and to make proposals for the improvement of the repatriation process: 1) to analyze the current repatriation process in Latvia; 2) to find out the problems in the process of repatriation, within the framework of which it is difficult for the foreign Latvians to return to their home country, as well as possible solutions to these problems; 3) to make proposals for improvement of the repatriation process. The main research methods used were document analysis, partially structured interviews.

Two groups of respondents were established within the framework of the study: potential and existing repatriates. A qualitative research method was used for the survey - semi-structured interviews conducted between 9 November 2017 and 6 December 2017. The "snowball" method was used to select the sample: when the first respondent was found he (she) pointed to the next, which also pointed to the other respondents known to him (her).

The results of the study show that in order to facilitate the repatriation process, all Latvians and Livs should be given the same conditions for obtaining repatriate status, regardless of their country of origin and emigration, and the information should be more widely available. In order to improve the repatriation process, a one-stop shop should be set up to gather all the information about repatriates. This state agency was set up several years ago, but it has not been implemented so far due to the lack of funds. Several respondents have noted that they do not know their right for the support, but officials do not explain these issues in detail to repatriates.

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APICULTURE IN CAMEROON

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Apiculture is the science and practice of domestication and keeping of bees [1]. Apiculture in Cameroon is mostly rural because of a lack of financial resources and knowledge. Nevertheless, there are still some wealthy individuals and organizations doing urban apiculture. Cameroon also exports honey and its products for the entire continent. They are producers-sellers who buy and sell it in small or big markets. I am also a small producer for very small market. We will present ecological, historical, social, economical and global factors. "If the bee disappeared off the surface of the globe, man would have only four years to live", because if there are no more bees, there is no more pollination, no more plants, no more animals, no more men. (Albert Einstein). Apiculture has been practised for at least 150 years. Oral history tells us that a century ago, during a period of famine in the Northwest, honey was used for food and medicine. About sixty years ago, it began to be bartered in Nkambe and at the Nigerian border where a 'tin2' was exchanged for two tins of red palm oil or salt, the main exchange commodities prior to monetary currency. Literature confirms the existence of a centuries-long regional trade in honey and wax which was incorporated into European colonial commodity trade [1].

Apiculture in Cameroon produces two product types: bee and hive products, and ecological and cultural services. Bee products are those directly derived from bees, in this study - the African honey bee (*Apis mellifera adansonii*) and solitary bees (*Trigona, Meliponula, Dactylurina, Hypotrigona and Liotrigona spp.*). Products include royal jelly, pollen and bee venom. Hive products are produced by bees and include honey, beeswax (*Cera alba*) and propolis. Apiculture products are used for cosmetics, medicine and food [1].

Biochemical composition of Adamaoua and Highlands honey shows that it contains between 18 to 24% water and 70 to 80% sugars. Bees secrete wax forms an energy-rich, protective structure, formed into combs for storing bee larvae, honey and royal jelly. Wax is melted, processed further and stored for years. Propolis is a resinous mixture created by bees from buds, resins, sap and other botanical sources. It is used to fill unwanted gaps in the hive. Bee and hive products can be processed into a variety of hive by-products (honey beer and wine, candles, soaps, creams, polishes, ointments etc.) [1].

For consumers, 60% in the Northwest and 80% in urban areas use it as a high-energy food with 8% using it as part of a special diet. It is occasionally eaten with the comb, but mainly purchased filtered and eaten with bread and as a sweetener in drinks. In Ngaoundal 29% of beekeepers and 7% of Northwest beekeepers mix honey with water to brew a sweet, openly fermented alcoholic drink called "sha" or "shah" in the Northwest, "ntop" when mixed with raffia palm wine, and "kuri" or "koori" in Adamaoua. Honey is well-known and valued for its medicinal use. Majority of beekeepers (71% in Adamaoua and 92% in the Northwest) use it to treat coughs, wounds, skin infections, asthma, stomach ache, burns and gonorrhoea. Knowledge of medicinal uses varies between 80% of consumers in the Northwest and 45% in Adamaoua who use it medicinally, compared to 5% in urban areas [1].

Table. CMR 2016 export and import of honey [2]

	France	Belgium	Moroco	UAE	Spain
Export value	$41.51k	$8.15k	$1.99k	$1.42k	
Import Value	$6.36k	$106.00			$265.00

What lacks in Cameroon is the knowledge management in this nature-gift resource.

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DIFFERENCES BETWEEN GREEN ECONOMY, BIOECONOMY AND CIRCULAR ECONOMY

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The three concepts – circular economy, bio-economy and green economy – are currently high on the political agenda and mainstreamed in academia as key sustainability avenues [1, 2]. Interest in these concepts is particularly high in Europe [2]. Despite their evidently different assumptions and operationalization strategies, these concepts are joined by the common ideal to reconcile economic, environmental and social goals [1]. However, a comparative analysis of such concepts is missing. Therefore, the aim of this study was to analyse students' understanding of the concepts: green economy, bio-economy and circular economy.

Research results have shown that implementation and practical application of the principles of green economy, bio-economy and circular economy has raised society's awareness about environmental problems, and these concepts have been used as effective tools to deal with these problems. In order to better understand the differences between green economy, bio-economy and circular economy, a literature review was done, and several case studies were analysed. In order to analyse the students' understanding of these different concepts, a survey was made. The survey was conducted in person and in an electronic form with a questionnaire containing four questions regarding the above three areas. The results of the survey show that among the students there is a lack of understanding what are green economy, circular economy and bio-economy and what are the difference between these concepts. The most popular statements of students were as follows: *"Bio-economy is important for everyone to save environment and humans.", "Is a science about how society uses and saves natural resources.", "Green economy is a power of environment of beauty and forever economy."* or *"How to reuse natural resources and the resources which are very limited."* The results of this study allowed the authors to conclude that students should be more educated to raise their awareness of green economy, circular economy and bio-economy. A better understanding of these concepts may help students become aware of the importance of taking care of the environment in different ways.

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ANALYSIS OF LOGISTICS TRANSPORT FUNCTION IN COMPANY

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The construction industry is one of the main industries that makes up the economy of the country. It is important for the Latvian national economy that it is possible to export construction materials, which is determined by logistics and transportation costs. The main element of the logistics chain is the transport system, which connects various transport operations. Transportation occupies one third of the amount of logistics costs, affecting the operation of logistics and transport systems. Transport costs may be based on company-owned transport or transport outsourcing.

Currently, there is not a unified logistics definition but summarizing the Australian professors' Tseng and Yue research about the role of transportation, logistics can be defined as the process of moving and handling goods and materials, including processes from the beginning to the end of the production, to satisfy customers and to add to business competitiveness [2].

Gilley, Professor of Oklahoma State University, in the research about outsourcing effects on the firms' performance suggested that production costs can be reduced through outsourcing since there is no need to invest in equipment, there is no need to pay wages to specialists. In addition, resource costs are saved, other expenses are also reduced, time is saved, flexibility is given to react to changes in the market. These costs have a short-term effect, so very often outsourcing seems more profitable for the financial situation of the company, but long-term expediency should also be evaluated [1].

The main aim of this research was to find out if transport outsourcing has long-term benefits of the company's logistics processes. In the research costs were compared and it was concluded that the transportation function in the local and Baltic markets should be based on transport outsourcing, because the company was not able to provide enough amount of load for its transport to reduce existing costs at existing production volumes. As regards Swedish market, it was found that it could be profitable for the company to buy three cargo platforms and use them with a hired truck.

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EDUCATION

DISCOVERING A SUSTAINABLE MINDSET IN HOSPITALITY EDUCATORS

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Sustainability is one of the most important issues facing many sectors of the economy, including hospitality. Hospitality businesses have historically had a great environmental impact through three sustainability pillars: economic, societal and environmental.

In order to promote a sustainable mindset got both educators and hospitality professionals, a blended learning course "Discovering a sustainable mindset for future-thinking professionals in guest-oriented businesses" within the ProfESus project was developed. It consisted of an introductory Module 1, face to face over a week, followed by two online modules: Module 2, comprising 7 units over 8 weeks exploring how Green Pedagogy can facilitate development of sustainability competences, and Module 3, the planning and executing of a series of lessons over 5 weeks, and Module 4, the final face to face week, in which participants assessed their project lessons and made plans for their future practice in their classrooms. The aim of the research was to promote a sustainable mindset in the hospitality educators using the developed blended learning course. The content analysis method was used to discover changes in the educator mindset through learning diaries. The content analysis was based on the use of the Leximancer content analysis software. In the first six month of 2018, 19 participants, recruited globally, took part in the research. They were required to keep learning diaries for the first 14 weeks (representing nine entries and three modules) of the blended learning course. Participants were guided in what to write about in their learning journals with questions relating to the module or unit it was included in, however participants were always free to write about whatever they thought was relevant. The learning journals were not visible to the other course participants.

The comparison of three documents that are specifically related to sustainability education [1-3] and the key texts used in the ProfESus Project and the texts of the participants' learning diaries indicate that the participants of the ProfESus course were writing about sustainability about the same degree as the authors of the key texts. Therefore, it can be concluded that the course did lead to the participants engaging with the idea of sustainability.

There are clear differences in the main theme maps at an early stage compared to the late stage of the course. By the late stage of the course, participants were more concerned with specific aspects of sustainability such as plastics and waste whereas at the beginning they were more concerned with the differences that were being presented to them in terms of everyday processes, pedagogy and organisations. This is indicative of a more nuanced understanding of the concept of sustainability over time although it does not provide evidence of actual increased sustainable behaviour.

Teacher learning diaries are a rich source of feedback on the efficacy of the course and can be used as a tool for revealing changes in the educator's mindset.

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BIGGS' CONSTRUCTIVE ALIGNMENT MODEL AND ITS RELEVANCE FOR INSTRUCTIONAL DESIGN IN THE DIGITAL LEARNING ENVIRONMENT

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Nowadays information technologies are being actively implemented in the all spheres of our lives. Particularly, the process of intensive informatization has affected education. According to the report by the Centre for Strategic Research and the Higher School of Economics, "Russia is the absolute world leader in the number of students enrolled in distance education programs. This, therefore, creates the conditions for use of the infrastructure and modules of distance education programs for developing advanced training as an element of continuing education" [1, p. 52].

The purpose of the research is to consider the Biggs constructive alignment model, analyze its capabilities and draw conclusions of this model's effectiveness, which can be applied to instructional design in the digital learning environment.

According to the Digital Learning Environment Manifesto, "We are experiencing a fundamental shift away from the conditions under which our present educational system was constructed, and a new learning environment is being established. In this environment, it is not always a simple task to continue on with the old materials and methods, but on the other hand, new possibilities are arising."[2]. For this reason, new approaches to educational courses are being born, such as pedagogical design. All in all, the need to create and apply new models when designing learning materials has become vivid.

One such model is constructive alignment, proposed by John Biggs [3]. He characterized this model as the link between assessment tools, teaching and learning activities and learning outcomes [3]. According to Biggs, the traditional approach claims the assessment system is the last to be determined. The first and the most important task is to plan the learning outcomes. Learning process will be more effective if the assessment tools have been declared before teaching and learning activities [3]. However, it does not diminish the importance of the other two curriculum components. If the curriculum has imbalance between three identified components such as learning outcomes, teaching and learning activities, and the assessment system, then it will lead to inconsistencies between the goals and the learning outcomes.

To conclude, the Biggs' constructive alignment model contributes to the design of a harmonious curriculum and is aimed to eliminate the gap between theory and practice. In the digital learning environment, there are similar learning processes as in the offline learning. However, this form of education requires a different approach. For this reason, all the learning objectives and criteria should be stated clearly. To sum up, the model under consideration can be useful for teachers looking for the new approaches to the educational courses design, both online and offline.

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ANALYSIS OF USING PROGRESS-TRACKING TECHNIQUES FOR CHECKING STUDENTS' PROFICIENCY IN ONLINE LEARNING

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The growth of the popularity and number of online courses questions the validity of certificates obtained by learners finishing them. The research is aimed at investigating and describing the experience of applying progress-tracking instead of entry and final tests for checking students' proficiency in problem solving e-learning. D Abbakumov, P. Desmet and W. Van den Noortgate conducted the research on about 9,000 students measuring their interactions with video and efficiency of attempts whilst passing tests and proved that measuring and tracking students' progress can give us more information that the result in certificates [1]. At the same time, the research conducted by Shu-Chuan Cheng, Hsiao-Ching She and Li-Yu Huang on 126 students in Taiwan shows that problem-solving learning improves scientific knowledge, reasoning and problem-solving skills [2].

The hypothesis of the investigation is that the measuring of progress in problem-solving learning reflects more information about students' skills and personal features than final test results. The pilot research considered as the basis for future research with a bigger number of participants, was carried out in the period from 1 January until 13 March 2019 in specifically created online-space on the selected topic "humour" among 32 students of St. Petersburg's universities in English. Recorded students' data were the number of attempts, the amount of time spent on finishing one task, the number of interactions in peer-to-peer learning tool. All analyzed data was recorded in accordance with other learners from the same course. The methods used are theoretical analysis of the available literature, observation of focus group's results, block chain technology used for collecting and protecting students' data, data analysis.

The conducted pilot research showed us that on average successfully finishing learners make 1.76 attempts which is supposingly connected with some students' attempts to answer at random. In learning process students have 0.42 interactions in peer-to-peer tool which may be determined by the lack of learners' experience in using such educational platforms. The average time spent on finishing one task is 12 minutes which shows us that the created tasks require problem-solving thinking and searching for the answer rather than testing already obtained knowledge on a given subject.

The collected data indicate that the presented way of analysing the students' progress in the special space for problem-solving learning is effectively reflecting not only the growth of proficiency, but also some personal features of a learner. Considering the obtained results we plan our future research in the sphere of investigating new tracking metrics of problem-solving learning for effective development of online educational systems.

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ROLE OF TEACHER IN WORK WITH MULTI-LINGUAL CHILDREN

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The teachers' beliefs in multi-lingual education are guided by their professional experience as well as by their personal beliefs in the choice of language to be used in their classrooms [1]. Multi-lingual education promotes an effective language education model and thinking not only in the native language bat also in the dominant language. Multi-lingual teaching and learning develop mental abilities although it may initially seem the opposite [2].

Multi-lingual speech can develop a language contest and mutual influence. It can be a disturbing factor for separate language use [3].

Components for effective multi-lingual content lesson in lesson planning are: learning objectives – language and contents, instructional adjustments – materials, atmosphere, teaching functional language, activity plan, support strategies like peer learning or mentoring or tutoring activities, native language support [4].

The multi-lingual classroom is optimal language education context, where primary language learners can develop multilingualism. Based on studies of the multi-lingual language environment that kind of learning aids the second language learning. In multi-lingual learning/teaching method speech and thinking in two languages develop [5].

Multilingual children have diverse perspectives and languages that could contribute to classrooms and society. However, many immigrant and multilingual children are being underserved by schools [6].

Multi-lingual children may score below that of their typical monolingual peers. Children's home languages are essential parts of their communicative repertoire and the prior knowledge. This prior linguistic knowledge could be used in classrooms to make connections between prior experiences and new educational content.

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