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**STUDENTS ON THEIR WAY TO SCIENCE**  
**(undergraduate, graduate, post-graduate students)**

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## **STUDENTS ON THEIR WAY TO SCIENCE**

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## **AGRICULTURE**

# GROUND BEETLES (COLEOPTERA: CARABIDAE) AS INDICATORS OF MANAGEMENT OF EU PROTECTED MEADOW HABITATS

Niks Badauķis

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

Jānis Gailis

Latvia University of Agriculture, M.sc.biol., Latvia

EU protected meadow habitats – natural or semi-natural grasslands – are important feed resource as well as elements of biological and landscape diversity, which is significant precondition for successful integrated pest management in every crop. In Latvia, since 2014, studies on how digestate application affects natural meadow habitats have been started. Ground beetles (Carabidae) are used as one of the indicators of digestate influence, because they are known as good indicators of different agro-ecological factors, which cause soil surface and vegetation changes in habitats [2].

The main goal of this research is to find out 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) Fennoscandian 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: 24.804; habitat code: 6510; digestate application: 6 May 2015), More (Lat: 57.068, Lon: 25.091; 6270\*; 6 May 2015), Allaži (Lat: 57.047, Lon: 24.833; 6270\*; 13 May 2015), Allažmuiža (Lat: 57.022, Lon: 24.757; 6210; 13 May 2015), Ludza (Lat: 56.551, Lon: 27.706; 6210; 12 May 2015), Vecslabada (Lat: 56.269, Lon: 27.998; 6210; 12 May 2015). In each one, four sample plots (150-350 m<sup>2</sup>) were established, 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 23 May till 20 June 2015. The ground beetles species composition is analysed by calculating dominances structure [1], but the biodiversity is expressed as reciprocal Simpson's index.

In total, fifty ground beetle species were observed in all stations. *Poecilus versicolor* noticeably dominated over other species in all sample plots in all stations excepting Ludza. Other dominant and subdominant species and their percentages noticeably differed between differently managed sample plots in three stations – More, Allažmuiža and Ludza. In Allaži and Vecslabada, minor differences of species community were observed. For example, *Syntomus truncatellus* was subdominant in sample plots without digestate application, but dominant in other sample plots in Vecslabada station. In Sigulda, digestate application did not cause noticeable changes of ground beetles species community. In three stations (Allaži, Allažmuiža, Ludza), digestate application in meadows promoted significantly higher biodiversity of ground beetles. In other stations, effect of digestate application was insignificant.

The main conclusion is, that digestate application affects fauna and biodiversity of ground beetles inhabiting EU protected meadow habitats, but research should be continued to get more data.

## Acknowledgements

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# INFLUENCE OF DIFFERENT AGROTECHNICAL ELEMENTS ON CRUDE PROTEIN CONTENT OF FABA BEAN

**Reinis Balodis**

Latvia University of Agriculture, Faculty of Agriculture, master student, Latvia

**Zinta Gaile**

Latvia University of Agriculture, Faculty of Agriculture, professor, Dr. agr., Latvia

Field bean (*Vicia faba*) is important protein source in animal diets, as well as for human consumption. NewEU policy of agriculture using “Greening” instrument dramatically increased the spring field bean sowing areas in Latvia, thus, it is important to study the suitable agrotechnology and to justify effective fungicide use for better quality of field bean yield. Field trials were carried out at the Research and Study farm “Pēterlauki” in 2015. Growing season of 2015 for field bean was with lower rain level than long-term average on farm. The whole season was characterized with hydro-thermal coefficient  $HTC = 1.1$ , which means that on average moisture is provided sufficiently. Evaluating specific growing stages of field bean, we found that  $HTC$  varied from 3.0 which means “very wet conditions” at full germination stage to  $HTC = 0.5$  which means “drought” from bean filling stage to harvest. Temperature on average was suitable for field bean growing. Three popular varieties (‘Laura’, ‘Boxer’ and ‘Isabell’) in Latvia sown at three different densities (30; 40 and 50 germinate able seeds per  $1\text{ m}^2$ ) were used in trial. They were sown in two blocks: with and without fungicide (boscalid,  $267.0\text{ g kg}^{-1}$ , pyraclostrobin,  $67.0\text{ g kg}^{-1}$ ;  $1.0\text{ kg ha}^{-1}$ ) application at the start of flowering stage. All trial versions were replicated four times. The protein<sup>DM</sup> % level was determined from fully clean yield sample of 1 kg using Infratec Analyzer 1241 at Grain and Seed Study and Research laboratory of Latvia University of Agriculture.

The highest average protein level was obtained using variety ‘Boxer’ (31.06%), but it was not significantly higher than that of variety ‘Laura’ (30.95%) or ‘Isabell’ (30.97%). It is interesting that significant differences between varieties were not detected. In Poland, it was determined that crude protein level significantly varied using different varieties [1], but they used different types of varieties: traditional, with terminal inflorescence and low-tannin.

Sowing rate 50 germinate able seeds per  $1\text{ m}^2$  provided the highest protein level (31.07%), but it was not significantly higher than that, when 40 (31.03%) or 30 (30.89%) germinate able seeds were sown. In Egypt, it was concluded during a two year experiment that increasing plant density the protein level significantly decreased [2]. Also, opposite data is reported from Egypt, where using higher sowing rate protein level increased [3]. Protein level in our experiment around 30-31% is similar to that reported by all the above mentioned researchers.

Obtained results showed yield quality increase by used fungicide spray, but it was only 0.77% (on average – without application: 30.61%, with application 31.38%) in season 2015. Our result is mathematically significant, but unimportant from agronomic point of view. Researchers from Poland [1] did not find significant fungicide application effect on protein content in field bean. Continued research is needed to test fungicide influence on quality of field bean in Latvia.

It is needed to repeat this study on following years to obtain more detailed long term information on the influence of different agrotechnical elements on quality of field bean in Baltic Sea region.

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# GROWING OF EARLY POTATOES IN DIFFERENT TYPES OF ORGANIC MULCHES ON SOIL SURFACE

**Ruta Briede**

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

**Dzidra Kreišmane**

Latvia University of Agriculture, Faculty of Agriculture, Institute of Agrobiotechnology, Professor, Dr. agr., Latvia

Organic matter affects both the chemical and physical properties of the soil and its overall health. Using organic mulches can suppress annual weeds and offer other important benefits, such as organic matter, nutrients, moisture conservation, soil protection, and moderation of soil temperature. Properties influenced by organic matter include: soil structure; moisture holding capacity; diversity and activity of soil organisms, both those that are beneficial and harmful to crop production; and nutrient availability [1] [2].

The tasks of this research study are to grow potatoes (*Solanum tuberosum*), in particular, the medium early breed "Prelma", in different types of organic mulches. A survey will take place in 2016, during the early potato growing season (from April to September), in Jelgava District, Gludas parish. These options will be included in the field, which covers an area of 18 m<sup>2</sup>, in four replicates. During the vegetation session, observations will take place, comparing differences between the variations. In order to observe how intensive the work of soil microorganisms is, a piece of cloth (cotton or linen) will be used for each mulch variation. Comparison of quantitative and qualitative indicators variations between the count of tubers, the quantity of starch etc. will be carried out. The study will focus on potato cultivation in such types of mulch as: 1. control - straw, 2. tree leaves, 3. peat mixed with straw, 4. straw and cut grass.

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# DIFFERENT ORIGIN LATVIAN DARK-HEAD BREED RAM FATTENING RESULT ANALYSIS

**Gunārs Buševics**

Latvia University of Agriculture, Agriculture Faculty, master's student, Latvia

**Daina Kairiša**

Latvia University of Agriculture, Agriculture Faculty, Dr. agr., professor, Latvia

In the beginning of the 21<sup>st</sup> century meat production became the main product of sheep farming. As fast growing and meat quality-improving breeds, German blackhead (GB) sheep breed (1998) and Estonian darkhead (ED) sheep breed with Oxford Down (OX) blood admix (2003) were imported in Latvia. To improve Latvian darkhead sheep breed meat productivity characteristics, the pedigree breeding programme in sheep farming till 2013 allowed single blood admixes with cognate sire breeds as GB, ED, Lithuanian darkhead (LD) and OX.

**The aim of this study** was to explain the related breed effect on lamb fattening results used in the breeding program.

**Methods.** In this study 56 Latvian dark-head breed rams fattening results were used, obtained from the association "Latvia Association of Sheep Breeders" breeding ram station "Klimpas", 2014. The location of the station is in Jeru parish, region of Rujiena. In fattening period lamb live weight changes and feed intake of 1 kg live weight growth extraction were determined. After slaughter, carcass quality has been evaluated according SEUROP classification, measured carcass length, hip circumference and calculated result of dressed weight. To analyse the obtained results, two lamb groups: control group – LD breed rams (n=25) and research group – LD breed rams with blood admix from GB, ED and OX breeds (n=31) were used.

**Research results.** Purchase age of lamb and live weight affects fattening results. The control group lambs average age in fattening initiation was 118.4 days with average live weight 28.6 kg. The research group lambs were significantly younger (108.6 days) and significantly lighter, with average live weight in fattening initiation – 26.3 kg ( $p<0.05$ ). Fattening period for control group lambs lasted fairly 66.6 days reaching average 331.4 grams of daily live weight gain, but the research group lambs - 69.5 days reaching 336 grams daily live weight gain. Obtained live weight gain in average was for 60 grams lower than in previously published studies [1]. The control group lambs average age at the end of fattening was 185 days with average live weight 50.6 kg, while the research group lambs 178 days and 49.5 kg, respectively. During the study 1 kg of live weight gain was consumed from 2.9 to 3.1 kg hay and 4.7 kg concentrated feed. In production conditions of similar type of study in 2005, Latvian darkhead lamb fattening average age was 308 days with live weight 45.3 kg [2]. Comparing with research carried out in Turkey, Latvian darkhead lambs were in average 13.45 kg heavier than Tuji and Hemsin breed lambs [3].

**Conclusions.** Under intensive fattening conditions Latvian darkhead purebred and Latvian darkhead lambs with cognate sire breeds blood admix were realized average of 6 months old.

Both group lambs gained similar daily live weight, control group – 331.4 and the research group – 336.0 grams, respectively.

During fattening lambs consumed average 2.9 till 3.9 kg hay and 4.7 kg concentrated feed to increase 1 kg live weight gain.

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# FORMATION OF WINTER WHEAT YIELD DEPENDING ON VARIETY AND APPLICATION OF FUNGICIDES

Madara Darguža

Latvia University of Agriculture, master student, Latvia

Zinta Gaile

Latvia University of Agriculture, Dr. agr., professor, Latvia

Wheat (*Triticum*) is the third most important crop in the world by the total yield. Increasing demand for food in the world also demands solutions of how to obtain higher wheat yield on the existing land resources. Two of the solutions could be a choice of improved varieties and new ways for control of harmful organisms. Disease risk factor is very important for production, and can greatly reduce yield and its quality [1]. Field trial was carried out at the Research and Study farm „Vecauce” in 2014/2015, with the aim to evaluate the formation of winter wheat (*Triticum aestivum*) yield and yield components depending on variety and fungicide application. Soil and applied cultivation technology was suitable for winter wheat growing. Three winter wheat varieties (factor A) were used: ‘Edvins’, ‘Skagen’ and ‘Olivin’. All together seven fungicide treatments (control and 6 fungicide spraying schemes – factor B) were performed (5 of them contained strobilurine), totally 21 variants were included. Results of two-factor analysis of variance gave evidence that there is a significant ( $p < 0.05$ ) difference between the values of yield components depending on variety (Table). Significant effect of fungicide application if compared to the control treatment was observed only for 1000 grain weight (TGW) – the higher ( $p < 0.01$ ) TGW was noted in variants where strobilurine containing fungicides were used. The highest TGW showed variety ‘Edvins’, but significantly lower was that of ‘Skagen’ and ‘Olivin’. Similar dependence of winter wheat TGW from variety was observed also in many other researches, e.g. in Stende [2].

**Winter wheat yield and yield components depending from variety**

Variety	Field germination, %	Number of spikes per 1 m <sup>2</sup>	Number of grains per spike	TGW, g	Yield, t ha <sup>-1</sup>
Edvins	93 <sup>a</sup>	728.5 <sup>b</sup>	40.0 <sup>a</sup>	52.79 <sup>c</sup>	11.16 <sup>a</sup>
Skagen	89 <sup>a</sup>	699.5 <sup>b</sup>	41.1 <sup>a</sup>	49.2 <sup>b</sup>	12.13 <sup>b</sup>
Olivin	91 <sup>a</sup>	657.0 <sup>a</sup>	53.0 <sup>b</sup>	41.73 <sup>a</sup>	11.91 <sup>b</sup>
RS <sub>0.05</sub>	3.5	43.74	1.51	0.52	0.60

Field germination was assessed in autumn, when the fungicides have still not been used. Field germination was good throughout the trial (Table). The highest number of spikes per 1 m<sup>2</sup> and TGW formed ‘Edvins’, but its number of grains per spike was the lowest. ‘Olivin’ formed the lowest number of spikes per 1 m<sup>2</sup> and TGW, but this variety had the highest number of grains per spike. In this study, ‘Skagen’ with average values of yield components gave the highest average yield (Table). Yields in trial fluctuated from 10.25 to 12.90 t ha<sup>-1</sup> depending on treatment. All three investigated varieties achieved high yields because of ability of later forming components to compensate lower values of earlier forming yield components. Strong negative correlation ( $p < 0.01$ ) between number of spikes per m<sup>2</sup> and number of grains per spike was determined, as well as between number of grains per spike and 1000 grain weight.

## Acknowledgements

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# MELON AND WATERMELON GROWING OPPORTUNITIES IN LATVIA

**Jānis Haļzovs**

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

**Ina Alsīņa**

Latvia University of Agriculture, Institute of Soil and Plant Sciences, Dr. biol., Professor, Latvia

Latvia is the farthest region in the North where it is possible to grow watermelons and melons. The seeds come from Western Europe and Asia, which are natural growing areas of cucurbits. The first well-known watermelon and melon grower in Latvia was P. Sukatnieks [3]. He has selected new types of melons in Latvia. Watermelon and melon cultivation is one of the most perspective industries of non-traditional agriculture [4]. It is possible to cultivate cucurbit plants in greenhouses and the open field in Latvia's climatic conditions [1].

In heated greenhouses watermelons and melons start to grow in April, but in unheated greenhouses - in May. Seeds are sown directly in the field or seedlings are planted in the field. In greenhouses melon and watermelon plants are tied up vertically and fruits are hung in mesh bags [3]. The main disadvantages: the female and male blossoms are unable to reproduce because of the high temperature (28°C), high moist value and bad air exchange. These are the reasons for downy mildew development and the prevalence of whiteflies and spider mites in greenhouses.

In the open field seedlings are being planted in the middle of the May or with the seeds sown directly in the field at the end of May [3]. In the beginning of cultivation the field is covered with agricultural fleece. In the open field there can be used either the mulch of black agriculture polyethylene or black agro textile material. The main disadvantages are high weather variability (hail, cold nights etc.), moles and European mole-cricket, and *Fusarium oxysporum* can be observed as a result of an incorrect crop rotation.

In order to adapt these plants to Latvia's soil and weather conditions, watermelon and melon plants can be grafted on *Cucurbita maxima* rootstocks. For pollination the isolation method is used, for high quality seed or there can be used pollinating insects in greenhouses and in the open field [4].

Pure Horticultural Research Centre has carried out various studies about melon cultivation [2]. Now this scientific work has been stopped. Generally, in order to obtain high yields of watermelons and melons in greenhouses and open soil plantations in Latvia, plant selection work must be done. The main tasks of selection are to get cold resistant, pest resistant and more productive watermelons and melons. Research on watermelon and melon growing and grafting methods must be conducted.

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# ECONOMIC EFFICIENCY OF RAPE FERTILIZATION

**Arnis Jekabsons**

Latvia University of Agriculture, Faculty of Agriculture, post-graduate student, Latvia

**Aldis Karklins**

Latvia University of Agriculture, Institute of Soil and Plant Sciences, Dr. habil. agr., professor, Latvia

In Latvia rape production output is growing almost every year, especially winter rape. Rape fertilization take up from 37 to 46% of all cultivation costs, but particularly nitrogen 54 to 60% from all winter rape fertilization costs [1,2]. Nowadays, when raw materials and services are getting more and more expensive, it's very important to use as little resources as possible to get out maximum value. The objective of our research was to evaluate the economic return from nitrogen use and to find out the maximal economic nitrogen rate for winter and spring rape.

The economic efficiency was calculated using data from 4 year field trials for winter rape and 3 year trials for spring rape carried out in 2 different places: "Vecauce" and "Pēterlauki". In all trials 9 different variations of fertiliser application were used: N<sub>0</sub>P<sub>0</sub>K<sub>0</sub> (control), N<sub>0</sub>PK, N<sub>30</sub>, N<sub>60</sub>, N<sub>90</sub>, N<sub>120</sub>, N<sub>150</sub>, N<sub>180</sub>, N<sub>210</sub>. Every year before fertiliser application soil samples were taken for adjustment of PK fertiliser rates. This part of research was done by prof. A Ruza with co-authors.

In our research after consulting of several farms, standard rape growing technology was constructed. Gross margin was evaluated in 3 different variations: gross margin 1 (earnings minus raw material costs), gross margin 2 (earnings minus all costs) and gross margin 3 ((earnings plus European Union support) minus all costs). For further analysis gross margin 3 was chosen as most appropriate. Average seed yield for all trial years were used in both places.

For winter rape lowest costs was for control: 586.52 EUR, but maximum costs was for N<sub>210</sub>: 1089.71 EUR. Best gross margins in "Pēterlauki" for winter rape were N<sub>120</sub> (511.22 EUR), N<sub>90</sub> (488.76 EUR) and N<sub>150</sub> (486.46 EUR), but in "Vecauce" situation was little different. There the best gross margins were N<sub>150</sub> (425.35 EUR), N<sub>180</sub> (390.65 EUR) and N<sub>120</sub> (385.80).

Situation with spring rape was completely different, because there were few gross margins with negative results. Lowest costs for spring rape were for control: 461.29 EUR, but maximum costs were for N<sub>210</sub>: 922.74 EUR. In both places the best gross margin was for N<sub>60</sub>. For N<sub>60</sub> gross margin in "Pēterlauki" was 91.87 EUR and in "Vecauce" – 133.68 EUR. In "Pēterlauki" next highest gross margins were N<sub>30</sub> (75.11 EUR) and N<sub>90</sub> (66.82 EUR), but in "Vecauce" N<sub>90</sub> (127.92 EUR) and N<sub>30</sub> (123.35 EUR).

For winter rape the best nitrogen rates were N<sub>150</sub> and N<sub>120</sub>, but for spring rape N<sub>60</sub>, N<sub>30</sub> and N<sub>90</sub>.

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# DISEASE DEVELOPMENT OF FABA BEAN (*VICIA FABA*) DEPENDING ON FUNGICIDE USE

Artūrs Katamadze

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

Biruta Bankina

Latvia University of Agriculture, Institute of Soil and Plant Sciences, professor, Dr. biol., Latvia

The importance of faba bean as crop has significantly increased in Latvia. The sowing area has grown more than 20 times since 2010. It is necessary to understand the impact of fungicide use on foliar diseases distribution and development. Past research have identified that the most harmful diseases of faba bean in Latvia are *Botrytis* spp., *Alternaria* spp. and *Uromyces vicia – faba* [1, 2].

Previous studies have shown that use of fungicide can reduce disease development on faba beans and increase yield by up to 22%. However, no such research has been done in Latvia or neighbouring countries [3, 4].

Field trials were carried out at the Study and Research Farm "Pēterlauki" of the Latvia University of Agriculture. This study shows results related with variety 'Laura' - the most sensitive variety according to previous investigations [2].

One factor trial was established: 1) fungicide Signum (boskalid 267.0 g kg<sup>-1</sup> and pyraclostrobin 67.0 g kg<sup>-1</sup>) at beginning of flowering; 2) without fungicide. Diseases were assessed when first symptoms occurred, in each plot 20 random plants were chosen and severity of diseases were noted (0 – 9 points scale). Total impact of leaf diseases during period of vegetation was indicated by calculation of AUDPC (area under disease progress curve) and technical efficacy of fungicide application was calculated. Causal agents were identified by obtaining pathogen pure culture on PDA agar. Genera of causal organism were determined according to traits of colonies and conidia, but results were confirmed by molecular analyses in cooperation with Latvian Biomedical Research and Study Centre.

Leaf blotches (caused by *Botrytis* spp. and *Alternaria* spp.) were observed during period of vegetation, leaf rust (caused by *Uromyces vicia - faba*) was noted as well. Chocolate spot (caused by *Botrytis* spp.) is recognized as most important disease all over the world. All three species *B. fabae*; *B. fabiopsis* and *B. cinerea* were founded in damaged leaves in our investigations, but importance of each pathogen is not clear yet.

First symptoms occurred early in vegetation period, but rapid spreading started during flowering. Fungicide use reduced severity of *Alternaria* leaf blotch, but did not show significant effect on severity of *Botrytis* leaf blotch. Fungicide Signum technical efficiency was low, only 38%.

More research needs to be done, in order to determine harmfulness of diseases and most effective schemes of fungicide use.

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# LATVIAN DARKHEAD BREEDING RAM LINE ANALYSIS BY OFFSPRING PERFORMANCE

**Davis Krezins**

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

**Daina Kairisa**

Latvia University of Agriculture, Institute of Biotechnology, Dr.agr., Professor, Latvia

Breeding ram quality have major role in economically sustainable sheep production. As this industry grows it calls for more precise tools to base selection decisions on. Economical efficiency in sheep production is partially determined by litter size, lamb birth weight and their ability to gain weight. These three traits are greatly influenced by environmental factors like herd, birth date and of course genetic factors like dam and sire [1]. Sire factor is the one that we can influence most greatly by selection [2]. In this study sheep recording data from 01.07.2007 to 30.06.2015 was used. Data set consists of 51195 lamb records with birth weight, weaning weight, birth date, litter size, herd and pedigree information. Analysis was done for 4 major ram lines with phenotypic data.

**Results.** Breeding ram line “Skaris”, showed the best results against three other ram lines. With litter size on average  $1.92 \pm 0.02$ , birth weight  $4.44 \pm 0.04$  kg and weaning weight  $21.29 \pm 0.23$  kg at 70 days of age. Although other ram lines have close progeny performance, it is unique that one ram line can have best results in litter size and birth weight, because while litter size increases, the birth weight should go down. This can be explained when we look at different rams in “Skaris” line, one is responsible for high litter size while his progeny has average birth weight, another has small litter size and top birth weight. We have to acknowledge “Sigars” ram line, because the rams in this line show individually the best results in litter size  $2.11 \pm 0.04$ , birth weight  $4.87 \pm 0.08$  and weaning weight  $26.30 \pm 0.83$ .

**Conclusions.** Comparison of breeding ram lines is important measure to distinguish superior rams in breeding, but we cannot forget to compare individuals as well. This study was done as an initial stage for genetic variance component estimation and later on breeding value estimation.

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# INFLUENCE OF DIVERSE SEED CATEGORIES ON SPRING WHEAT 'HAMLET' VARIETY PURITY AND YIELD

Uģis Ozoliņš

Latvia University of Agriculture, Faculty of Agriculture, master student, Latvia

Zinta Gaile

Latvia University of Agriculture, Dr. agr., professor, Latvia

The research was carried out at farm „Kotiņi” in Viļaka region. Three seed categories of spring wheat variety ‘Hamlet’ were compared in this research – basic (B), and two generations of certified (C) seed: C1 and C2. Field trials were arranged for two years, in 2014 and 2015, in fields planned for seed production; and all the conditions comply with requirements of the Regulations of Cabinet No. 120 [1]. Sowing rate was equal for all three categories – 500 germinate able seeds per 1 m<sup>2</sup>. Used agrotechnology was in line with demands of spring wheat in region, and elements of precision agriculture were included for fertilization and yield accounting. To test variety purity and growing conditions, field inspection was carried out during the vegetation period according the Regulations of Cabinet No. 120 [1]. Spring wheat yield was harvested by Claas Lexion 560, equipped with „Quantimeeter” system to determine average yield and content of moisture. Meteorological conditions varied between years, but the year 2014 was more suitable for high spring wheat yield formation.

Field inspection was carried out during heading stage of spring wheat and 200 m<sup>2</sup> was examined. Variety identity in fields of all three seed categories was appropriate in both years. Quarantine weeds were not detected in seed field in 2014, field was clean from other weeds. Presence of some diseases was detected. Septoria leaf blotch (*Zymoseptoria* spp.) was observed in sowings of all seed categories, but in fields where C1 and C2 categories’ wheat was grown also powdery mildew (*Blumeria graminis*) was noted. Common bunt caused by *Tilletia caries* was not detected, and general conditions of seed fields of all three categories were rated as good. No plants of other cereal species were detected in B category seed field, two plants were detected in C1 seed field and five plants – in C2 seed field. Spikes not corresponding to variety description was detected only in C-category seed fields (14 spikes in C1, and 18 spikes in C2). Also in 2015, during the field inspection, quarantine weeds and insects were not detected, and field was clean from other weeds. Powdery mildew was detected in B-category seed field, but in C2 seed field tan spot (*Pyrenophora tritici-repentis*) was detected; no diseases were detected in C1 seed field. Common bunt was not detected at all in 2015. Some plants of other cereal species were detected in fields of all categories, but not as much to cross the permissible level. Three plants were detected in C2 seed field, two plants in C1, and one plant in B seed field. Spikes not corresponding to variety description also were detected in all fields: 7 spikes in B-category seed field, 12 spikes in C1 field, and 14 spikes in C2 field. General condition of seed field again was evaluated as suitable for seed production. Conditions which can deteriorate seed quality, e.g., plants of other cereal species and spikes not corresponding to variety description were found at significantly low level in both years of research, describing good seed production practice.

Spring wheat yield varied, but did not depend significantly ( $p>0.05$ ) on the seed category used. The highest average yield in 2014 was harvested from B-category seed field – 8.83 t ha<sup>-1</sup>, average C1 category seed field yield was 7.84 t ha<sup>-1</sup> and that from C2 field – 8.09 t ha<sup>-1</sup>. In 2015, the highest yield was harvested from C1 category seed field: 6.10 t ha<sup>-1</sup>, yield from B-category seed field was 5.57 t ha<sup>-1</sup> and that from C2 category seed field – 5.35 t ha<sup>-1</sup>. Significant ( $p<0.05$ ) difference was detected between average yields harvested in two trial years, and yields were affected mainly by weather conditions.

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# DEVELOPMENT OF WHEAT LEAF DISEASES DEPENDING ON FUNGICIDE APPLICATION SCHEMES

Laura Paulovska

Latvia University of Agriculture, Faculty of Agriculture, post-graduate, Latvia

Biruta Bankina

Latvia University of Agriculture, Faculty of Agriculture, professor, Dr. biol., Latvia

Wheat (*Triticum* spp.) is one of the most profitable and most widely produced crop in the world as well as in Latvia. Continuous wheat sowing and reduced soil tillage has become more popular in Latvia during the last few years, but these technologies could increase a risk of developing diseases, including leaf blotches. Tan spot (caused by *Pyrenophora tritici-repentis*) and Septoria leaf blotch (caused by *Zymoseptoria tritici*) have become the most harmful wheat diseases in recent years in Latvia and Lithuania [1, 3]. It has been concluded that by using fungicides the grain yield increases [2]. Fungicides are widely used for winter wheat production, but it is still necessary to specify better schemes of fungicide application for the conditions of Latvia.

The aim of this research is to investigate the development of wheat leaf diseases depending on growing technologies and fungicide application.

The field trials were conducted in Research and Study farm „Peterlauki” in Jelgava during 2014/2015 vegetation season. Two factor field experiments were established in 2015 at the Study and Research farm “Pēterlauki”: A – pre-crop (1 – wheat; 2 – oilseed rape); B – soil tillage (1 – ploughing; 2 – without ploughing). Fungicide (epoxiconazole 62.5 g l<sup>-1</sup> plus fluxapyroxad 62.5 g l<sup>-1</sup>) were used for all plots during heading and two additional trials were arranged with an additional fungicide (metrafenone 75 g l<sup>-1</sup> plus epoxiconazole 62.5 g l<sup>-1</sup>, plus fenpropimorph 200 g l<sup>-1</sup>) application at the stage of stem elongation. Diseases were assessed every week, their severity and incidence was noted, AUDPC (area under disease progress curve) was calculated.

Tan spot and Septoria leaf blotch dominated in the period of vegetation during this study. Severity of Septoria leaf blotch achieved only 3%, therefore it is not possible to evaluate the influence of technologies on the development of this disease. The first symptoms of tan spot (severity 4%) were observed at the time of the stem elongation, it reached 35% at the time of milk ripeness. Soil tillage without ploughing and continuous wheat sowings increased severity of tan spot, but the lack of crop rotation was a much more significant influence. The plant residue on the soil surface is the main source of tan spot infection, but Septoria leaf blotch that has overwintered in already infected plants is distributed by rain splash, therefore meteorological conditions are one of the most important factors influencing the development of this disease. Additional application of fungicides at the stage of stem elongation did not increase yield of wheat, this result could be explained by the low stage of diseases in these trials.

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# SOIL TILLAGE AND CROP ROTATION EFFECT ON WHEAT STEM BASE AND ROOT ROT INCIDENCE IN LATVIA

**Olga Pavloviča**

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

**Biruta Bankina**

Latvia University of Agriculture, Faculty of Agriculture, professor, Dr. biol., Latvia

Wheat (*Triticum* spp.) is the most outspread cereals in Latvia, and demanded in the world. Reduced soil tillage and wheat monoculture have become popular technologies in Latvian agricultural management. In those circumstances, there is an increased risk of the development of plant diseases. Plant residues are an important source of inoculum material, therefore crop rotation can impact the incidence of wheat diseases. Wheat crown and root rot might cause by different pathogens, so the symptoms vary, for that reason accurate determination of disease's causal agents is difficult or impossible. The aim of this investigations was to estimate the development of wheat stem base and root rot depending on soil tillage and crop rotation and to identify causal agents of disease in Latvia. Two-factor experiments were carried out in 2012-2015 at the Study and Research farm "Pēterlauki": A - crop rotation (1 – continuous wheat; 2 – wheat and oilseed rape; 3 – crop sequence), B – soil tillage: 1 – conventional ploughing (20-22 cm) with mouldboard plough; 2 – reduced tillage (10-12 cm) with disc harrow. Trial conditions were similar to the industrial crop production conditions. Each plot area was 0.25 ha. The incidence of the disease was determined in each plot separately after wheat harvesting. Agrotechnical measures were applied according agronomic practice in central part of Latvia. Pathogens were identified by mycological analyses, results were confirmed by molecular methods in cooperation with Latvian Biomedical Research and Study Centre.

Contradictory results are observed in different studies depending on soil management, crop rotation and pathogen spectrum [1], [2], [3]. Results of this investigation differ as well.

The diseases incidence fluctuated during period of investigations from 15 till 98%. Development of the disease was affected mostly by year. Crop sequence essentially decreased level of wheat stem base and root rot, but short crop rotation (wheat – oilseed rape) did not influence development of disease to compare with continuous wheat. The most important causal agents of the disease were *Fusarium* spp. and *Oculimacula* spp. Lack of crop rotation significantly increased relative density of pathogens from genus *Fusarium*, it leads risk of mycotoxins accumulation in the grains.

## Acknowledgements

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# **FUSARIUM SPP. AS IMPORTANT PATHOGEN OF MAIZE GRAINS**

**Monta Priedēna**

Latvia University of Agriculture, Faculty of Agriculture, undergraduate year student, Latvia

**Biruta Bankina**

Latvia University of Agriculture, Dr. biol., Latvia

Maize (*Zea Mays L.*) cultivation has become more popular in Latvia. This crop is used for forage and biogas production. Maize silage is good forage plant because it is prolific and rich in energy. Mycotoxins produced by fungus in the grains can damage feed and cause health problems for cattle. *Alternaria*, *Fusarium* and *Penicillium* spp are most important pathogens capable of infecting maize grains [2]. *Fusarium* spp. is widespread worldwide, including United States of America, Europe, Brazil, Southern Africa and China but mostly in cold and humid areas. Some *Fusarium* species can also infect wheat, especially *Fusarium graminearum* (teleomorph *Gibberella zeae*) [1, 3].

The aim of this study was to identify most important fungus occurring in maize grains.

The field trials were carried out at the Study and Research Farm “Vecauce” of the Latvia University of Agriculture in 2015. The trial was established as a one-factor trial with 24 hybrids in four replicates. Ten cobs from each plot were collected and from each cob five grains without visible fungal infection signs were sampled and put on the artificial medium. Pure cultures of pathogens were obtained and genera of fungus determined according to mycological analyses, but results were confirmed by molecular methods in cooperation with Latvian Biomedical Research and Study center.

The most abundant fungi in the maize grains belonged to the genera *Alternaria* (38%), *Fusarium* (32%) and these are potential producers of mycotoxins. Relative density of *Penicillium* spp. was 5% but other genera occurred more seldom. Five species of *Fusarium* were identified – *F. graminearum* (*Gibberella zeae*), *F. sporotrichioides*, *F. equiseti*, *F. poae*, *F. subglutinans*. Relative density of *F. graminearum* was 38% and it is important because this fungus is harmful also for wheat. The potential mycotoxin producing fungi were present in maize grain without symptoms of diseases collected from trial in Research and Study farm “Vecauce”. There is a risk that maize production can contain mycotoxins.

Further investigations are necessary to clarify spectrum of fungi in the grains and to evaluate conditions, which promote infection of grain.

## **Acknowledgement**

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# IMETOS®SM FORECASTING MODEL FOR *BOTRYTIS CINEREA* CONTROL IN LITHUANIA

Neringa Rasiukevičiūtė

Institute of Horticulture, Lithuania Research Centre for Agriculture and Forestry, Lithuania

Alma Valiuškaitė, Skaidrė Supronienė

<sup>1</sup>Institute of Horticulture, Lithuania Research Centre for Agriculture and Forestry, Dr. Lithuania

<sup>2</sup>Institute of Agriculture, Lithuania Research Centre for Agriculture and Forestry, Dr. Lithuania

One of the most important horticultural crops disease grey mould is caused by *Botrytis cinerea* Pers.: Fr. Plant diseases cause yield losses and quality damage all over the world [1]. Now the control of diseases are more difficult because the usage of pesticides becomes more restricted, also leads to fungicide resistance [4]. Forecasting models indicate favourable conditions for the disease development, beside that fungicides application are made more accurate [2]. The applications of fungicides are minimized and made only when needed [3].

The aim of study was to evaluate strawberry and onion grey mould control efficiency according IMETOS®sm forecasting model. There were used two plant protection systems: conventional and forecasting model. According to the model applications were made when it indicated disease risk. Models record leaf wetness, rainfall, air temperature, relative humidity, precipitation amount and other parameters and accumulates disease infection risk every hour. If model shows the infection (which lasts longer than 3 days) of more than 60%, it's recommended to use fungicides. Analysis of strawberry forecasting model records showed that the conditions for grey mould development are favourable mostly in the end of May and in the beginning of June. Favourable conditions for *Botrytis cinerea* infection in onions mostly arise in the first two weeks of July. Using forecasting model we can reduce grey mould and increase yield. In strawberry experiments yield increase was significantly higher in 2013 and 2014 experimental year (1.55 t ha<sup>-1</sup> and 0.54 t ha<sup>-1</sup> respectively) compare to conventional system. The onion treatments showed similar tendency, in three years (2012-2014) experiment yield increase was 0.24 t ha<sup>-1</sup>, 0.04 t ha<sup>-1</sup> and 1.01 t ha<sup>-1</sup> higher compare to conventional. Forecasting model is innovative plant protection measure for reducing grey mould of horticultural crops and improving the application time.

## Acknowledgements

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# DEVELOPMENT OF WHEAT LEAF DISEASES DEPENDING ON AGROTECHNICAL MEASURES

Terēze Stanka

Latvia University of Agriculture, Faculty of Agriculture, undergraduate student, Latvia

Biruta Bankina

Latvia University of Agriculture, Dr. Biol., Latvia

Winter wheat, which covers almost half of the total sowing area, is one of the most profitable crops in Latvia. In order to increase incomes, reduced soil tillage and continuous wheat sowings have become more popular among producers in recent years. Tan spot, caused by *Pyrenophora tritici-repentis*, and Septoria leaf blotch, caused by *Zymoseptoria tritici*, are the most widespread and harmful wheat diseases which have caused the biggest yield losses in Latvia during the last 10 years [1]. *P. tritici-repentis* survives in the residues of plants, but *Z. tritici* mostly in the living plant, therefore the development of diseases is largely dependent on the agrotechnical measures. Soil tillage and crop rotation are considered to be the main factors which determine development of diseases reaching higher values in cases with minimum soil tillage and monoculture of wheat combination [2], [3].

## Materials and methods

Two-factor field experiments were established at the “Pēterlauki” Study and Research Farm of the Latvia University of Agriculture in autumn of 2008: 1) crop rotation (continuous wheat sowings; wheat and oilseed rape; crop sequence 2) soil tillage (ploughing; without ploughing). In this study the data obtained in 2013 and 2014 were analysed. Diseases were assessed weekly. Incidence and severity of the diseases were noted for the whole plant at growth stages 31 – 75 according to BBCH scale. The total impact of the diseases during the vegetation period was estimated by calculating the area under the disease progress curve (AUDPC).

## Results

Tan spot was the dominant disease during investigations, also Septoria leaf blotch was observed, but other diseases did not reach a biologically significant level. Severity of diseases was affected by year, 2014 was more favourable for leaf blotch development, however the influence of technologies was observed. Lack of crop rotation essentially increased the level of tan spot ( $p < 0.1$  and  $p < 0.01$ , in 2013 and 2014 respectively). Ploughing reduced the development of tan spot in average, but the influence was not statistically significant. The severity of Septoria leaf blotch was not high, and the effect of technologies was not clear. The highest level of winter wheat leaf blotch was observed if reduced soil tillage was combined with continuous wheat sowings.

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# EFFECTS OF SUPPLEMENTAL LEDS INTERMITTENT ILLUMINATION ON THE GROWTH AND ANTIOXIDANT PROPERTIES OF MICROGREENS

Viktorija Vaštakaitė

Lithuanian Research Centre for Agriculture and Forestry, Institute of Horticulture, doctoral student,  
Lithuania

Akvilė Viršilė<sup>1</sup>, Aušra Brazaitytė<sup>1</sup>, Giedrė Samuolienė<sup>1,2</sup>, Julė Jankauskienė<sup>1</sup>, Pavelas Duchovskis<sup>1,2</sup>

<sup>1</sup>Lithuanian Research Centre for Agriculture and Forestry, Institute of Horticulture, Lithuania

<sup>2</sup>Aleksandras Stulginskis University, Lithuania

Light is the most important environmental factor for plants, as a primary source of energy. The photosensory/ regulation systems in plants are switched by specific photoreceptors, which are responsible for growth, developmental processes and secondary metabolism [1, 2]. High pressure sodium (HPS) lamps are common used in artificial environment (greenhouse or indoor) as a light source for sufficient plant growth. However, HPS lamps provide more yellow/orange spectra and less red or blue. Many studies revealed that technology of light-emitting diodes (LEDs) provides better regulation of the photosynthetic photon flux density (PPFD), photoperiod, and light spectra [4].

The aim of this study was to investigate the combinations of HPS and LED lighting on microgreen quality. HPS lighting was supplemented by ~20  $\mu\text{mol m}^{-2} \text{s}^{-1}$  PPFD 455, 470, 505, 590, or 627 nm wavelengths of LEDs (total PPFD ~200  $\mu\text{mol m}^{-2} \text{s}^{-1}$ ; 16 h photoperiod). The effects of frequencies of intermittent illumination (2, 32, 256, and 1024 Hz), and continuous lighting (0 Hz, as a control) on growth and phytochemicals' changes in basil (*Ocimum basilicum* L. 'Sweet Genovese') and mustard (*Brassica juncea* 'Red Lion') microgreens were investigated. The plants were grown within controlled-environment growth chamber, and the temperature at 21/17 $\pm$ 2°C day/ night with a relative air humidity at 55 $\pm$ 5% were maintained. The results showed that the effects of intermittent illumination on growth parameters (height, hypocotyl length, leaf area, fresh and dry masses) of microgreens were wavelength of LED depended, and varied among species. The same tendency was determined on photosynthetic and secondary metabolites changes. The significantly ( $P \leq 0.05$ ) increased contents of saccharides (fructose, glucose, and maltose) showed a response to light quality changes in microgreens. Moreover, the supplementation with LEDs at various frequencies evoked antioxidant activity of treated plants – ABTS and DPPH radicals' capacity, ascorbic acid and phenolic compounds contents. In summary, the supplementation of LEDs to HPS lamps' lighting affects photophysiological parameters of microgreens. However, the target management of spectra and intermittent illumination conditions is required.

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## **VETERINARY MEDICINE**

# OCCURANCE OF ANTIBIOTIC RESISTANT PATHOGENS IN EXOTIC ANIMALS

**Maija Alike**

Latvia University of Agriculture, Faculty of Veterinary Medicine, 6th year student, Latvia

**Anda Valdovska**

Latvia University of Agriculture, Professor, Dr. med. vet.

**Introduction:** Nowadays, antibiotic resistant pathogens, that can cause serious infections, is a worldwide problem. *Staphylococcus spp.* and *Pseudomonas aeruginosa* are widespread in nature and can present a major threat to human and animal health, because of their virulence and ability to develop resistance to antibiotics. Also, there is a possibility of transmission between humans and animals. These pathogens that are resistant to one or more antibiotics are also found in exotic animals.

There are many people who choose to keep exotic animals as pets, but there is very little research reported about the occurrence of the pathogens in exotic animals.

**Aim:** to clarify the occurrence of *Staphylococcus spp.* and *Pseudomonas aeruginosa* and determine their antibiotic resistance in exotic animals in two local pet shops and the ZOO, located in Latvia

**Methods and materials:** 48 samples from 40 healthy exotic animals were investigated. Sterile swab was used to collect samples from the nostrils or oral cavity of mammals and from nostrils, oral cavity and cloaca of reptiles.

Firstly, samples were tested with microbiological methods for the presence of *Staphylococcus spp.* and *P.aeruginosa*, using selective agar plates.

Isolates were further characterised by *16SsRNS* and *mecA* gene using different types of primers.

Antimicrobial susceptibility of isolates was determined by Kirby Bauer disc diffusion method.

**Results:** Coagulase negative staphylococci (CoNS) and *P.aeruginosa* have been isolated from reptiles. 71% CoNS and 29% *P.aeruginosa* were isolated from the respiratory system, but 80% CoNS and 29% *P.aeruginosa* were isolated from the digestive system. 40.5% CoNS and 16.1% *Staphylococcus aureus* have been isolated from mammals. *P.aeruginosa* samples of reptiles were tested on 4 antibiotics: Ciprofloxacin, Cefotaxime, Erythromycin and Penicillin, all isolates showed resistance to Penicillin and Erythromycin. CoNS samples of reptiles were tested on 5 antibiotics: Ciprofloxacin, Cefotaxime, Tetracylin, Vancomycin and Methicillin. 23% of isolates were resistant to Methicillin, but 7.7% of isolates - to Tetracyclin and Vancomycin. For these 5 antibiotics CoNS and *S.aureus*, isolated from mammals, were also tested. 50% of CoNS isolates showed resistance to Tetracylin, 10% to Vancomycin and Methicillin and 5% to ciprofloxacin., and 20% of *S.aureus* were resistant to Tetracyclin.

**Conclusion:** The results of this study show that CoNS and *P.aeruginosa* were found in ectothermic animals, but CoNS and *S.aureus* in warm-blooded animals. Although CoNS and *P.aeruginosa* are considered to be a normal micro-flora in animals, they have a significant role in animal health because of their ability to develop resistance to one or more antibiotics in the same time. A positive trend that there was not any *S.aureus* with resistance to Methicillin was observed.

# COMPARISON OF DIAGNOSTIC METHODS OF SUBACUTE RUMINAL ACIDOSIS

**Andris Auniņš,**

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate student, Latvia

**Laima Liepa,**

Latvia University of Agriculture, Assoc. Professor, Latvia

**Introduction.** Subacute ruminal acidosis (SARA) is a ruminal fermentation disorder that is characterized by ruminal pH below 5.5 – 5.6. [1.]. It is often diagnosed on dairy farms and can be the cause of decrease in milk yield and also in milk fat. SARA can also be the reason of other problems in cows such as milk fever, dislocation of abomasum, ketosis and laminitis. Samples of rumen content can be taken using an oral-ruminal probe or rumenocentesis. The study of these methods was conducted using an oral-ruminal probe obtained at the National Research Program “AgroBioRes (2014-2017)”.

**Aim.** The aim of the study was to compare pros and cons of the two SARA diagnostic methods – rumenocentesis and oral-ruminal probing.

**Material and methods.** The experiment was conducted in two dairy cow farms in which individual cases reported a decrease of milk fat under 3%. During the experiment the ruminal content was sampled in total from 10 cows with an oral-ruminal probe and rumenocentesis through puncture of the abdominal wall below the knee skin folds using a 14G needle with a 25 ml syringe. The pH measurements were made with a GREISINGER electronic GMH 3530 pH-meter. To avoid saliva contamination the first 300 ml of each sample was poured out and the pH was measured only in the second sample. The study compared the ruminal content pH measurements of both methods and the advantages and disadvantages of diagnosing SARA were determined. The statistical analysis of the data was carried out using Microsoft Excel.

**Results and discussion.** The average values of ruminal pH using rumenocentesis were  $0.19 \pm 0.14$  lower than using an oral-ruminal probe. Sampling the rumen content through the oesophagus is less traumatic, painful and can be used in any physiological phase. It is possible to take large samples many times in one day not making tissue damage. But rumenocentesis is painful and can cause complications – local peritonitis and it is possible to get only around 5-15ml samples per cow and is not allowed in the peripartial period because of the enlarged uterus.

## **Conclusions.**

1. Using the oral-ruminal probe the pH results are  $0.19 \pm 0.14$  higher than rumenocentesis and  $p < 0.001$  which shows that the factor is statistically significant.
2. In diagnostics of SARA the oral-ruminal probe is easier to use and is less traumatic for the cow.

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# EFFICACY OF FAMOTIDINE DOSES FOR DOGS WITH ULCERATIVE GASTRITIS AND IMPROVEMENT OF CLINICAL SIGNS

**Aukse Janina Caraitė**

Lithuanian University of Health Sciences, Veterinary Faculty, undergraduate, Lithuania

**Gintaras Zamokas**

Lithuanian University of Health Sciences, Veterinary Faculty, Dr.med.vet., Lithuania

Famotidine is a histamine-2 blocker that decreases acid produced by the stomach. Famotidine is especially effective for treating bleeding stomach ulcers. When used in small doses Famotidine has worked in a preventative way with regard to stomach ulcer occurrences [1]. Experimental studies with dogs have shown that doses of 0.1 – 0.2 mg/kg inhibit stomach secretion, but other clinical studies have shown that doses of 1.0 mg/kg suppress stomach acid for 24 hours [2]. If the stomach ulcers are the most acute cases, when the dogs are vomiting regularly, oral administration may be difficult or even impossible. In these cases, Famotidine is given intravenously. The doses vary from 0.5 mg/kg to 1.0 mg/kg every 12 or 24 hours [3]. In our research study **the aim** was to find out the most effective intravenous dose of Famotidine to treat ulcerative gastritis. We did observations, registrations and administrations in two small animal clinics and one animal shelter in Kaunas, Lithuania. All the animals were showing clinical signs of gastritis: epigastralgia, where vomiting occurred either with or without blood, acid reflux and melena. For the patients who exhibited these symptoms blood samples were taken (morphology and biochemistry) along with x-ray and ultrasound examinations. Any abnormalities in these tests showed renal or liver dysfunction as well as stomach neoplasia, foreign bodies or other parallel causes. The blood tests checked the levels of creatinine, urea, GOT, GPT, albumins, haematocrit, erythrocytes and leukocytes. Express stool samples were also taken to check for bleeding in the digestive tract. Nine dogs were examined, and the results were independent in terms of both breed and gender. The ages ranged from one to ten years. For treatment “Quamatel” was given intravenously every 24 hours. The animals were separated into three groups where every group contained three dogs each. The first group got 0.5 mg/kg, the second group 1.0 mg/kg and the third group 2.0 mg/kg.

Our **research results** indicated that the first group that was administered the minimum dosage revealed no diminished clinical signs during a five day period. The second group showed less clinical signs after two doses: vomiting was reduced from three to four times a day to only one. After two more doses this group also was able to eat a special diet. The third group, that received the maximum dose of “Quamatel”, showed a considerable reduction of clinical signs in a short period of time. The dogs in this group did not vomit at all, but one did show signs of side effects (bradycardia, tremor of muscles, and weakness). Katherine K. Williamson presents several research studies that showed that minimum doses of Famotidine are effective for prevention [1]. The data showed the most effective intra-venious famotidine dose was 2,0 mg/kg.

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# EFFECT OF LOW INTENSITY TREADMILL EXERCISE ON PHYSIOLOGICAL STATUS OF DOGS

Irita Cirite, Madara Nikolajenko

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate students Latvia

Aija Ilgaža

Latvia University of Agriculture, Dr.med.vet., Latvia

Current studies of exercise induced changes in dogs are more focused on the endurance of sled dogs and the sprinting Greyhound, but this data represents only the opposite extremes, that can hardly be used to evaluate average dogs[1]. Popularity of canine sports has increased significantly over the last decade[2]. More data should be collected in order to understand exercise induced changes. Exercise tests could become a good diagnostic tool to evaluate fitness level of a dog, and also prevent possible trauma and illness[3]. The purpose of this study is to evaluate exercise induced physiological changes, during low intensity treadmill exercise in clinically healthy dogs, by measuring heart rate (HR), respiratory rate (RR), rectal temperature (RT), some hematology parameters (HTC, HGB, RBC, WBC), blood glucose (GLU) and serum creatinine (CREAT) levels, and observe differences and similarities between dogs with different training backgrounds.

10 clinically healthy dogs, divided in two groups of 5, were examined. "Trained group" (Tg) consisted of dogs that regularly participate in agility competitions and regularly undergo moderately high intensity daily training, and "Untrained group" (Ug) was formed of beagle dogs raised for experimental use that were living outdoors at the time when the study took place. Data were collected during seven control times (T<sub>0</sub>-T<sub>6</sub>). "Physiotech" treadmill with a 30 ° elevation at speed of 3.4 km/h was used. All dogs were placed on the treadmill for 2 periods of 25 min (T<sub>1</sub>-T<sub>2</sub>) with 5min pause in between. T<sub>2</sub> measurements were made when the dogs completed a second stage of the exercise or when exhaustion was reached. Afterwards, data were collected every 15 min within 1 hour resting time (T<sub>3</sub>-T<sub>6</sub>).

HR of 9 dogs elevated in T<sub>1</sub> by average 25,7% (Tg -22,5%, Ug - 28,3%), and in 8 dogs it continued to elevate in T<sub>2</sub> by average 9,5% (Tg-12,7% , Ug -7,2%). HR of all dogs decreased in T<sub>3</sub>. HR of 2 dogs was still higher in T<sub>6</sub> compared to T<sub>0</sub>. During exercise HR of Ug were elevated more than Tg in T<sub>1</sub>( Tg -22,5%, Ug - 28,3%), but in T<sub>2</sub> comparing to T<sub>1</sub> heart rate was more elevated in Tg than Ug(Tg-12,7% , Ug -7,2%), but comparing to T<sub>0</sub> elevation was almost equal by average 37, 72%. HTC elevated in 5 dogs by average 6,31% and decreased in 5 dogs by average 6,3%. At T<sub>6</sub> HTC of 9 dogs decreased by average 6,9% (Tg- 6,1%, Ug- 7,9%) when compared to T<sub>0</sub>. CREAT at T<sub>0</sub> were higher in Tg comparing to Ug by average 25,9%. CREAT levels of all dogs increased in T<sub>1</sub> by average 4,8% ( Tg- 3,4% , Ug - 6,7% ), and then decreased by average 3,6%, but only 3 (Tg-2, Ug-1) dogs CREAT levels were lower than T<sub>0</sub>. Data analysis did not show any relevant differences between group tendencies in response to exercise and in resting time.

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# CLINICAL CASES OF NUTRITIONAL SECONDARY HYPERPARATHYROIDISM IN KITTENS

**Arturs Ivanovs**

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate student, Latvia

**Jekaterina Plaksina**

Latvia University of Agriculture, Dr. med. vet., Latvia

Nutritional secondary hyperparathyroidism is an overactive parathyroid gland condition with abnormally high levels of circulating parathyroid hormone in the blood as the result of an erroneous feeding.

Three cases of kittens aging 3,5-6 months with nutritional secondary hyperparathyroidism symptoms were analysed. The mechanism of the disease is based on the endocrine system pathogenesis.

The insufficient amount of calcium (Ca) in the diet results in a low circulating calcium level in the blood, which is detected by the calcium-sensing receptors of the parathyroid glands and leads to an increase in parathormone excretion [1].

Continuous PTH exposure results in RANKL (receptor activator of nuclear factor K $\beta$  ligand) activation and concomitant osteoprotegerin (OPG) suppression [3].

The stimulated RANKL-RANK interaction leads to osteoclast proliferation and an increased bone remodeling/turnover.

Osteoclasts create resorptive pits with their villous, thus increasing and inducing excretion of acid and hydrogen ions, which results in salt dissolution in bones [2].

All materials, located in the resorptive pit, are phagocytosed and released from the bones. This results in an increase of ion concentration in the blood.

The loss of ions and matrix collagen in bones as well as unbalanced resorption and formation of the bone, results in osteopenia, bone gaps and risk for fractures.

An X-ray examination was performed in all three cases revealing osteopenia. Treatment is based on a balanced diet, restricted movement and drug treatment. Recovery was noted after medical treatment from 3 weeks (in milder cases) to 2 months (in the case of the bone fractures).

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# LEVOFLOXACIN PHARMACODYNAMICS AND PHARMACOKINETICS IN BROILER CHICKEN

**Kristīne Jemeljanova, Žanna Kondratjuka**

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate, Latvia

**Kaspars Kovalenko**

Latvia University of Agriculture, Faculty of Veterinary Medicine, Latvia

In Veterinary Medicine, fluoroquinolones, such as enrofloxacin, are often used, but other antimicrobial agents of this group have not been tested yet, whether they are safe for animal use and what dosage should be used. There is only one study that has been carried out in India in 2009, and Varia and colleagues studied levofloxacin (LF) pharmacokinetics, but pharmacodynamics data were obtained from other studies.

Forty clinically healthy broilers, 1 month old, with body weights from 1.1 kg to 2.1 kg, were included in the experiments. Group A (20 broilers) received i.v. injection at a single dose of 10 mg/kg/day via catheter. Group B received p.o. administration at a dose of 10 mg/kg/day. Also, blood samples were collected via wing vein at 0, 5, 10, 15, 30, 45 minutes and 1, 2, 4, 8, 10, 12, 24 hrs. Plasma concentration of levofloxacin was determined by high performance liquid chromatography using ultraviolet absorbance detection (HPLC-UV) (Giorgi et al., 2013, Varia et al., 2009).

*In vitro time-kill-curve:* For *in vitro* efficacy of LF, different concentrations of LF (ex 1xMIC, 4xMIC) were tested against target bacteria – *E.coli*. Then time-kill-curve was conducted. *Ex vivo time-kill-curve:* Based on the pharmacokinetic data of LF, samples corresponding to concentrations for *in vitro* exam were chosen, and a time-kill-curve was conducted. On the basis of *ex vivo* data, the sigmoid *E<sub>max</sub>* model was used to integrate parameter (AUC/MIC) with the plasma concentration of LF. Parameter for the bacteriostatic and bactericidal effect was calculated (Giorgi et al., 2013, Varia et al., 2009).

Following a single dose intramuscular administration, the drug was rapidly distributed  $T_{1/2}$ :  $6.67 \pm 2.07$ h from the body. The drug rapidly absorbed  $C_{max}$  2020.24 ng/ml and  $T_{max}$  0.8h. MIC for *E.coli* was 0.060ppm and MBC was 0.12 ppm. Following an oral administration, peak plasma drug concentration of  $C_{max}$   $1768.42 \pm 375.84$  ng/ml was observed at  $T_{max}$ :  $1.22 \pm 1.11$  hrs and elimination half-life was  $t_{1/2}$  7.78 h.

The pharmacokinetic profile indicated that levofloxacin can be used to treat various bacterial infections in broiler chickens.

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# TEMPERATURE, HEART RATE, RESPIRATORY RATE, BLOOD PRESSURE AND OXYGEN SATURATION MEASURING IN ADULT LONG-TAILED CHINCHILLAS

Sandra Lapsiņa

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate student, Latvia

Aija Ilgaža

Latvia University of Agriculture, Dr. med. vet., Latvia

The long-tailed chinchilla (*Chinchilla lanigera*) is a small, grey rodent formerly inhabiting only the sparse and rocky regions of the Andes Mountain range 3000 – 5000 metres above the sea level [1.]. Although in captivity chinchillas are mostly bred for fur only, since '60s this animal has also become a popular pet, thus ensuring a need to generally inspect and monitor chinchillas in veterinary clinics [3.]. Therefore our **aim** was to evaluate the temperature, heart rate, respiratory rate, blood pressure and oxygen saturation measuring possibilities in adult long-tailed chinchillas.

**Materials and methods:** In a chinchilla farm “Cranberry”, 15 clinically healthy adult chinchillas (n=15) of both genders were selected. Each parameter was measured in all animals. The rectal core body temperature was measured using an electronic thermometer *DT-series*, whereas for the shell body temperature an infrared tympanic thermometer *Grado* was used. A multi-parameter veterinary monitoring device *Vet420A* was used for heart and respiratory rate as well as blood pressure and oxygen saturation measurements. The heart rate was also measured manually with a phonendoscope *RenLor Medical*, as well as the respiratory rate was also counted visually. The gained data was processed with *Microsoft Excel*.

**Results and discussion:** The average rectal temperature was  $+37.3 \pm 0.7^{\circ}\text{C}$ , thus corresponding with the physiological body temperature range  $36.1^{\circ}\text{C} - 37.8^{\circ}\text{C}$  found in research literature [2.]. Meanwhile the tympanic temperature appeared to be  $+35.3 \pm 0.7^{\circ}\text{C}$ , thereby showing the 2-3 $^{\circ}\text{C}$  difference between the core and shell body temperatures mentioned in literature. These results also correspond with the previously thermographically obtained perivaginal temperature  $34.3 \pm 0.9^{\circ}\text{C}$  since it is also a shell body temperature [4.]. Manually measured heart rate was  $262 \pm 16$  bpm with respiratory rate  $106 \pm 17$  bpm most likely due to stress. Using pulse oximetry of the multiparameter veterinary monitoring device on all 15 animals only 3 heart rate measurements ( $222 \pm 7$  bpm) and only one with the manual measurement uncorresponding respiratory rate value was obtained. Blood pressure, oxygen saturation and heart rate measurements obtained with electrodes using the same monitoring device on chinchillas were not successful.

## Conclusions:

1. The most suitable core body temperature measurement method is rectal thermometry, since both tympanic and perivaginal temperatures differ significantly.
2. Heart and respiratory rate should be measured manually - using phonendoscope and by inspection.
3. When about to examine unaccustomed chinchillas at least 15 minutes should be given to the animals beforehand to adapt to the examiner.
4. The multi-parameter veterinary monitoring device is not suitable for the physiological parameter measurements in chinchillas.

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# ARE HIBERNATING BATS SENSITIVE TO LIGHT AND NOISE DISTURBANCE

**Endija Maraka**

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate student, Latvia

**Gunārs Pētersons**

Latvia University of Agriculture, Faculty of Veterinary Medicine, Dr. biol.,  
Associate Professor, Latvia

Law in Latvia and in other countries of EU protects all bat species. The disturbance of bats during the hibernation is forbidden. However, the monitoring of hibernating bats is performed in many European countries, including Latvia, to determine the population trends of these endangered animals [3]. To minimize the possible disturbance of bats at hibernacula's bat experts usually behave them as silent as possible and try to limit the duration of illumination of torpid bats. However, there are few studies done in natural conditions about effect of non-tactile stimulus on bats. [1] Some studies showed that light and noise can cause arousal of bats thus increasing their energy expenditure [2]. A simple experiment was performed to test if bats respond to noise and light incentive with arousal.

The study took place in February 2016, in an abandoned military bunker on 11-12 northern bats (*Eptesicus nilssonii* Keyserling et Blasius). The bats found were hibernating at relatively low ambient temperature (medium of 2.1 °C). During five visits the bats were exposed to the following treatments: in the first visit to medium strong (1.3 lux) and strong (6.2 lux) torch light at a distance of 50 cm for duration of 10 s; in the second visit to strong torch light for duration of 60 s, and in the third visit to medium volume noise at 1-2 m distance for duration of 60 s. During the fourth visit of the hibernacula a group of 7 persons came, and each person used a torch light; low volume speech was allowed. During the last visit a group of 10 persons came and the same instructions were followed. After each treatment, a revisit took place on hibernacula to check, if the arousal of bats occurred.

The result of all treatments was negative- no arousal of bats was observed.

Our results suggest that non-tactile stimulus caused by bat workers during the censuses of hibernating bats does not disturb them. However, this conclusion cannot be applied to all types of hibernacula and to all hibernating species. It is known that the sensitivity of hibernating bats to external stimuli increases with increasing ambient temperature and towards the end of hibernation period [2]. In addition, we cannot exclude that there are differences in sensitivity among native bat species. Despite the optimistic results of this study, we recommend to limit the use of light as much as possible and to be silent during censuses of hibernating bats, especially at relatively warm hibernation sites

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# EVALUATION OF CANINE MASTOCYTOMAS HISTOLOGICAL GRADE

Vita Misiūnaitė

Lithuanian University of Health Sciences, Faculty of Veterinary Medicine,  
undergraduate student, Lithuania

Nomeda Juodžiukynienė

Lithuanian University of Health Sciences, Assoc. Professor. Dr., Lithuania

Mastocytomas (MCTs) are perceived to be one of the most common skin cancers in dogs. MCTs are highly unpredictable in its biological behavior and the precise histological grade evaluation is essential for the prognosis of it. Frequently, they are recognized as malignant or potentially malignant. The **aim of this study** is to evaluate the incidence of MCTs and determine the MCTs grades using a 2-tier grading system. Data and samples used in this study have been collected from the Pathology Center of the Veterinary Academy database. The study was based on ninety nine dogs that were 6 months to 15 years of age (mean, 7.33 years  $\pm$ 3.48; median, 7 years). The observation period was 2013 to 2015. The sample represented 33 breeds, including mixed-breed dogs. 55 dogs were females, five of them with MCT (9%); 44 were males, nine of them with MCT (20%). Grading was performed using histological examination where 12 out of 14 samples were available for grade determination. Distribution of MCTs incidents and other criteria (such as age, sex, and breed) were calculated using Microsoft Excel 2010.

Kiupel et al.[1] suggested a novel grading system, splitting the canine cutaneous MCTs into high grade and low grade MCTs. Based on this grading method, a high-grade MCT is characterized by any one of the following criteria: at least 7 mitotic figures; at least 3 multinucleated cells or at least 3 bizarre nuclei in 10 high power field; karyomegaly.

91.67% (11 from 12) histological samples were assigned to high grade MCT using the above mentioned criteria.

MCTs may affect dogs at any age, but it is more common in dogs that are older than 8 years. Most commonly affected breeds include Boxer, Boston Terrier, Collie, Bull Mastiff, Labrador and Golden Retrievers, Pug, Vizsla, Miniature Poodle, Weimaraner, Shar Pei, Rhodesian Ridgeback and German Shepherd [2, 3].

On the contrary to other cancer diagnosis only in cases of MCTs breed predisposition was found. It was statistically significant in Shar pei ( $p=0.0004$ ) and French bulldog ( $p=0.0480$ ). Age and sex were not statistically significant ( $p>0.05$ ).

In conclusion, using the method suggested by Kiupel et al., 91.67 % of samples were high grade MCTs. MCTs were the most common neoplastic diagnosis. In this study breed predisposition was established, but the age and sex influence was not detected.

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# SHORT-TERM STRESS EFFECTS ON HOME AND SHELTER DOGS

**Madara Nikolajenko**

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate, Latvia

**Jevgēnija Kondratjeva**

Latvia University of Agriculture, Latvia

Animals living in different environments have different living conditions, therefore they have learned to adapt to physiological and behavioral changes [2]. Physiologically, the body responds to the stress with increased body temperature, heart and respiratory rate [1, 3].

The **aim of the study** was to find out the different physiological and behavioral changes in home and shelter dogs under short-term stress conditions. To achieve the aim, the following **tasks** were set: to investigate the amplitude of changes of physiological parameters in animals after short-term stress; to observe behavioral changes during the stress; to compare the results between both study groups and sources of research literature.

Six clinically healthy home and six clinically healthy shelter dogs took part in the study. They were let into a fenced area one by one. The body temperature, respiratory and heart rate were measured before the stress. These ranges were admitted as the individual control points. Loud drum sounds (in cooperation with "Andžeja Grauda drum school") were used as a stressor for five minutes. The animals' behavior was marked in the time of the stress. Next physiological parameters were measured immediately after the stressor, then 15 and 120 minutes later.

Immediately after the stress the heart rate did not change in 17% of the home dogs, in 66% it increased and in 17% - decreased. It did not change in 33% of the shelter dogs, but decreased in 67%. In half of the home dogs it returned to the control point after 15 minutes, in the other half – within two hours. In 33% of the shelter dogs it continued to decrease after 15 and even after 120 minutes. It increased in other 33%, and decreased after two hours, but still did not reach the control point.

The respiratory rate increased after the stressor in 83% of the home and in 33% of the shelter dogs, but decreased in 17% and in 67% of the animals respectively. In 83% of the home dogs the measurements returned to the control point within two hours, and in 17% did not reach the control point after two hours. In one third of the shelter dogs the values returned to the control point after 15 minutes, in two thirds – within two hours.

The environmental temperature in the day, when the study of the home dogs took place, was 25°C and 17°C for shelter dogs. On the day when the environmental temperature was higher dog body temperature increased less than in the cooler day.

According to the literature data, the physiological indicators always have to increase, but in the author's study it proved true in 50% of home animals, and in none of the shelter dogs [1].

The observations of behavior showed that 67% of the home dogs were trying to get out of the fenced area, one third was howling or crying, but 33% did not respond to the stressor with behavioral changes. The shelter dogs were interested and tried to move closer to the stressor.

According to the results of the study it can be concluded that each animal responds to the stressful situations with different physiological and behavioral changes, so these measurements are not objective indicators to determine whether the animal is under stress.

## **Acknowledgements**

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# COMPUTED TOMOGRAPHY FINDINGS IN CATS WITH UPPER RESPIRATORY TRACT DISEASES

**Aija Ozoliņa**

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate student, Latvia

**Armands Vekšins**

Latvia University of Agriculture, Faculty of Veterinary Medicine, Lecturer

**Introduction.** Feline upper respiratory tract diseases are common in veterinary practice. Ascertainment of the etiology is one of the most important steps in the diagnostic process with computed tomography (CT) playing an important role in it, since morphological changes can be easily seen. Common corresponding etiological factors are virus infections, foreign bodies, neoplasia, trauma, dental abscesses, allergy, parasitic and fungal infections. [1., 2.]

**Materials and methods.** The material was collected during the time period from September till December 2015. The examined animals were not divided into groups based on age or sex. Two types of material was used for this research – an already stored LUA Veterinary Clinic database information of four cases with cat head CTs and self-performed head CT scans in 7 cats from an animal shelter. All scans were performed in LUA Veterinary Clinic in supervision of Armands Vekšins, using 16-row multi-detector computed tomography scanner *Philips MX-16*. The animals were positioned in sternal recumbency with the second cervical vertebrae in zero position. A CT scan protocol of 90 kV voltage and 40 mA current was used. In total 11 CT images were analysed for morphological changes.

**Results and discussion.** After analyzing the morphological changes in CT scans the following diagnoses were made: rhinitis (64%), neoplasia (18%), nasopharyngeal polyps with tympanic cavity and ear inflammation (18%). The most common diagnosis made at the LUA Veterinary Clinic was the nasal cavity neoplasia, whereas among the shelter cats it was rhinitis. The most frequently observable clinical symptoms of feline upper respiratory tract disease were stated to be nasal discharge, sneezing and inspiratory dyspnea.

**Conclusions.** Additional diagnostics - cytology, histopathology, hematology and bacteriology – give a broad and important insight into the development and dynamics of the disease, when following the detection of morphological changes in CT scans. Common findings in feline upper respiratory tract disease patents are – rhinitis caused nasal meatus discharge; destructive neoplasia changes in bones and sinusitis; polyp caused obstruction of nasopharyngeal meatus and otitis.

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# IDENTIFICATION OF ANIMAL SPECIES USING ALTERNATIVE MICROSCOPY TECHNIQUE OF HAIR MICROSCOPIC STRUCTURE

**Sanita Putniņa, Māra Lisovska**

Latvia University of Agriculture, Faculty of Veterinary Medicine,  
undergraduate students, Latvia

**Inga Pigiņka-Vjačeslavova**

Latvia University of Agriculture, Junior Lecturer, Latvia

Identification of animal species is a pressing issue in veterinary forensic science, since it is often necessary to identify the species just by a hair-covered skin part. It is particularly often in forest animals, since different animals are killed in illegal hunting and afterwards only animal remnants are presented for expertise. For this reason forest animal species were selected for this research. Nowadays, it is well known that the microscopic structure of animal hair surface is specific and can be used to identify species [1]. Currently a scanning electron microscope is used to examine animal hair surface [2]. But the method is very expensive and requires specific knowledge to work with this device [3]. That is why **the aim** of this research was to develop an alternative and cheap forest animal species identification technique of hair microscopy and also to establish parameters for it.

**Materials and methods:** In this research, 24 forest animal hair samples were used - wild boars (9), deer (8), moose (2), foxes (2), marten (1), and mink (1). Hair samples were of various ages – the most were fresh, but some were a few decades old. Hair was observed by scanning, using the electron microscope Tescan Mira/LMU, but before that, hair was covered with a 15 nm thick gold layer in sputter coater Emitech K550X. Furthermore, hair was observed by the alternative light microscopy: a microscope slide was covered with an even, transparent, medium thick nail polish layer; after 15-20 seconds hair was placed on the nail polish layer and kept there until the nail polish dried completely; then the hair was removed from the slide and the imprint was viewed by the light microscope Leica DM750 with Leica LAS Software.

**Results and discussion:** Hair surface structure was similar in different body parts of one animal, but a significant difference was noted only in the hair itself (root, middle and tip). In this research, the hair structure was found to remain unchanged after several decades – thus allowing the use of the light microscopy method to identify an animal even, if it has been dead for years.

**Conclusions:** The structure of the hair surface was very well observable in the light microscope and the image is equal to the one obtained by an electronic microscope, therefore light microscopy can be used for animal species identification. To precisely identify animal species, it is important to examine the whole length.

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# INCIDENCE OF LUMBAR SPONDYLOSIS DEFORMANS IN DOGS

Aistė Šiaučiūnaitė

Lithuanian University of Health Sciences, Veterinary Faculty, post-graduate student, Lithuania

**Ligita Zorgevica - Počkeviča**

Lithuanian University of Health Sciences, DVM, Lithuania

Spondylosis deformans (SD) is a degenerative disease of not well known etiology [1, 2]. It is associated with a new bone formation on cranio-ventral and caudo-ventral aspects of the vertebral bodies [1]. Osteophytes vary from small spurs till big branches that connect two vertebral bodies [2]. By the appearance the disease is divided into three stages [1].

According to the research literature, the incidence is increasing with the age. Mostly there are no clinical signs, but in severe cases they could be: stiffness in the back, lameness, changes in the gait, pain and decreased activity [2, 4]. In rare cases osteophytes could compress spinal nerve roots [3]. Despite the fact that there is a correlation between SD and diseases of intervertebral disks, SD can be found while the disks are healthy [2].

**The aim** of this study was to evaluate the incidence of SD for random dogs brought for an x-ray examination to the Dr. L. Kriaučeliūnas SmallC.

A retrospective study was carried out for 56 dogs which had undergone an x-ray examination of an abdomen or lumbar spine at a period of 01.01.2016 – 29.02.2016. Records about age, gender and weight were collected from computer files on case histories.

According to the results, a high incidence (35.71 %) of SD was diagnosed for random dogs that were examined due to other complaints. Male dogs and bitches were equally affected by the disease. SD was diagnosed from 2.5 years of age. Average age of dogs with SD is significantly higher than average age of dogs without the disease. SD was more often diagnosed for: German shepherds, Pugs, French bulldogs, and localizations were: L1-L2, L2-L3, L3-L4, L4-L5.

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# THEORETICAL AMMONIA EMISSIONS FROM DAIRY COWS

Aīda Vanaga, Lauris Štelfs

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate student, Latvia

Ilgā Šematoviča

Latvia University of Agriculture, Faculty of Veterinary Medicine, Clinical institute,  
Dr. med.vet., Docent, Latvia

**Introduction:** In order to ensure maximum productivity, dairy cows are intensively fed with high energy and protein containing feed ration. Unbalanced feed ration proportion affects the cows' productivity, makes changes in the composition of milk, including milk urea (MU) increase. Unused nitrogenous substances are released into the environment. Milk urea nitrogen (MUN) may be a useful tool to predict the urinary urea nitrogen (UUN) excretion and, ultimately, ammonia (NH<sub>3</sub>) emission from dairy cattle manure. Close relationship among UUN excretion (g d<sup>-1</sup>) and MUN (mg dL<sup>-1</sup>), as well as MU (mg dL<sup>-1</sup>) correlation with plasma urea nitrogen (r=0.99) were found, and possibly way for prediction of ammonia emissions from dairy cattle were found [1; 2].

**The aim of the study** was to establish theoretical ammonia emission from dairy cow in one dairy cattle farm with 500 animals during a 10 month period. The milk tests were performed at *Pienaimnieku Laboratorija*, ISO 9622 / IDF 141:2013, registration number LATAK-T-283-11-2003, accreditation standard: LVS EN ISO/IEC 17025:2005. Data were analysed by California University developed model [1;2]. This method was used also in other scientific works [3.].

**The results** showed that the average productivity was 31.4±1.06 kg per cow, and average NH<sub>3</sub> emission was 85.8±9.17 g day<sup>-1</sup> per cow. The highest NH<sub>3</sub> value was in January and February (98.5±0.05 g day<sup>-1</sup> per cow), when productivity was at the lowest level 29.9±1.26 kg per cow. In May, July, August and October, there was the best usability of nitrogenous substances per cow, when average productivity reached the highest level (32.3±0.32 kg), and it was 81.4±7.9 g day<sup>-1</sup> per cow. The amount of NH<sub>3</sub> emission has a mean positive correlation with milk fat protein (F/P) ratio (r=0.52) and negative correlation with cows' productivity (r=-0.34). In **conclusion**, it is important to provide cows with a well-balanced food ration to get a higher productivity, reduce cost of wasted protein and reduce pollution of the environment.

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# PREVALENCE OF EXTERNAL AND INTERNAL PARASITES IN COMMERCIAL POULTRY FACTORY COMPARED TO SMALL FLOCK FARMS

**Janete Zute**

Latvia University of Agriculture, Faculty of Veterinary Medicine, Latvia

**Dace Keidāne,**

Latvia University of Agriculture, Faculty of Veterinary Medicine, Assoc. Professor, Latvia

**Introduction.** Protozoal diseases are common in poultry and birds, and some of them cause moderate or severe losses. Confinement rearing and high-density flocks in the rearing of commercial poultry have increased the exposure to diseases such as coccidiosis, which have short, direct life cycles. [3.] In contrast, parasitic diseases that depend on an intermediate host for transmission, such as cestodes and some nematodes, have been practically eliminated from commercial flocks because the specific invertebrates used as host are not present in poultry houses. [2.] Today only a handful of these parasites are important in commercial poultry, although many are found in small flocks reared in natural environments.

The aim of the research is to explore the prevalence of parasites in layer poultry farming.

The research took place in Latvia University of Agriculture, Faculty of Veterinary Medicine in the Food and Environmental Hygiene Institute, the laboratory of parasitology and cooperating with the biggest hen factory in Latvia “Balticovo”. Parasites were detected in fecal samples by flotation method with sodium chloride. [1.] “Balticovo” is a commercial poultry factory that uses the battery cage layer poultry rearing method, and birds are kept in battery rows and every row has 8 tiers. We took samples from 13 hen houses with different ages. Samples were taken in different parts of hen house in the third tier of the row, and all fecal samples from one hen house were mixed together and examined as a mixed sample. Mixed samples (n=12) were collected from small flock organic farms where birds get access to different kind of invertebrates that can contain parasites. All birds (n=25) were inspected for presence of any external parasite.

The results showed that only 4 of 13 samples were positive for coccidiosis in “Balticovo”. Only one of them showed a high number of oocysts in the sample. No presence of nematodes or cestodes was detected. In contrast, 6 of 12 samples from small flock farms showed positive results for nematodes. A high number of *Ascaridia* were detected. Also, the presence of *Heterakis* and *Protostongylus* was detected. No external parasites were found in small flock farms while 4 of 13 samples were positive for *Dermanyssus gallinarum*, having a high number.

In conclusion, the presence of parasites has been confirmed both in “Balticovo” and in small flock farms, and it would be recommended to use some anti-parasitic drugs in birds with high number of parasites.

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# ASSESSMENT OF FISH PARASITES IN SOME NATURAL WATER BODIES

Aleksandra Zvonnikova

Latvia University of Agriculture, Faculty of Veterinary Medicine, undergraduate, Latvia

Ruta Medne

Latvia University of Agriculture, Dr.med.vet., Latvia

**Introduction.** Fish parasites are widespread in natural water bodies. There are about 300 species of fish parasites registered on the Latvian territory, though most of them are not dangerous for human beings. Fish parasites are a necessary part of nature and mostly do not cause high fish mortality rates in lakes and rivers. Because of no control of fish diseases in natural water bodies there is a risk of spreading the infection: 1) by fishermen, who would likely put the caught fishes into their backyard pond, thereby infecting aquaculture species; 2) fish can be the intermediate host for some zoonosis [1]. There is an opinion that in nature fish are less infected with parasites than at fisheries, and the harm is not significant [2]. Nevertheless, some natural bodies of water seem to be severely infected with fish parasites that are noticed by fishermen and scientists.

Therefore, it seemed to be useful to estimate the parasitofauna of some natural water bodies and compare their infection rates.

**Materials and methods.** Fishes were caught in summer 2015 from June till August in 5 lakes: Baltezers, Engures Lake, Mazais Nabas Lake, Peipusa Lake, Usmas Lake, the River Daugava and the Baltic Sea Latvian seashore, and a group of fish from an unknown water body. Altogether, 206 fishes have been examined including: 65 perch (*Perca fluviatilis*), 13 ruffs (*Gymnocephalus cernuus*), 6 pikes (*Esox lucius*), 11 tenches (*Tinca tinca*), 11 breams (*Abramis brama*), 65 roaches (*Rutilus rutilus*), 9 rudds (*Scardinius erythrophthalmus*), 2 crucians (*Carassius carassius*), 22 herrings (*Clupea harengus membras*), 2 eelouts (*Zoarces viviparus*). Each fish was examined for ectoparasites and during the section for endoparasites. The species and number of found parasites were defined. Statistical data processing was done to determinate the IE (invasion extensity) and II (invasion intensity) using standard parasitological methods. Data analysis was made depending on water body, fish species and parasite species.

**Results and discussion.** A total of 771 parasites were found from 8 different species. 112 fishes of 206 were invaded with at least one parasite, which forms 54% (total IE = 0,54). The IE of each parasite in different water bodies was calculated and as a result, fishes from Engures Lake were the most invaded (IE = 0,81), but from the Usmas Lake least of all (IE = 0,25). Comparing the fish species, rudd was the most infected one (IE = 0,78). The most often found parasites were: *Posthodiplostomum cuticola* (II = 8,8), *Acanthocephalus spp.* (II = 5,9), *Trienophorus nodulosus* (II = 2.2). Other parasites found were sporadic: *Capillaria hepatica*, *Ligula intestinalis*, *Piscicola geometra*, *Argulus foliaceus* and *Ergasilus sieboldi*.

**Conclusion.** Fish from natural water bodies are under a severe risk of infection with ectoparasites and endoparasites. 54% of all examined fish were infected. The most often found parasite was *Posthodiplostomum cuticola*. The most infected water body in this investigation was Engures Lake. The most infected species – rudd.

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## **FOOD SCIENCE**

# SENSORY ANALYSIS OF BREAD WITH IMMATURE GRAINS

**Vincent van Anandel**

Latvia University of Agriculture, Faculty of Food Technology, post graduate student,  
the Netherlands

**Daina Karklina**

Latvia University of Agriculture, Faculty of Food Technology, Dr. sc.ing, Latvia

The development of food products that provide benefits beyond their traditional nutritional values has focus on public health interest. Health authorities recommend an increase in cereal intake, which is an important source of dietary fibre. It has been found that immature grains contain higher content of fructooligosaccharides than fully matured grains. These fructooligosaccharides are typical prebiotics and can supply nutrition for desirable bacteria in the gastro-intestinal tract of human organisms [1;2]. In this study, the three different bread with flour of immature wheat and barley has been made. Each of those three breads contained 20 % either whole grains, grinded grains or fine grains from either immature wheat or barley, respectively. One reference sample has also been made containing only matured wheat flour. All samples were evaluated by 9-point hedonic scale as well their taste, aroma, and porosity.

The results from this evaluation suggest that the bread made with immature whole grain barley would be the best type of bread, when counting up the points of each property. The best properties of this bread were its appearance, its crust colour and thickness, and its crumb structure and elasticity. The reference sample showed result slightly under the overall score of the bread with whole grain immature barley. The reference bread showed better results for porosity, aroma and taste than the bread with immature barley. Especially the properties of aroma and taste are very important in the evaluation. Therefore, the reference sample may have the best score. The bread that has obtained the lowest score in the sensory evaluation was the bread with fine grain barley. Typically its crust colour and crumb porosity were considered to be non-desirable.

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# SPARKLING WHEY DRINK DEVELOPMENT

**Līga Baumane**

Latvia University of Agriculture, Faculty of Food Technology, undergraduate student, Latvia

**Inga Ciprova**

Latvia University of Agriculture, Faculty of Food Technology, Dr.sc.ing. Latvia

Whey is a nutritious byproduct from cheese and cottage cheese, containing valuable nutrients like lactose, proteins, minerals and vitamins [3]. Latvian milk processing companies for decades faced with a huge problem, still a rational application of whey after protein separation is not found. The problem must be resolved by two reasons. Firstly, about 9l of whey is obtained –from every produced cheese kilogram. Secondly, whey containing lactose increases the biological oxygen demand of whey [1]. Sparkling whey drink is a simple and profitable solution for rational application of whey.

The sparkling whey drink developed in the framework of the research work contains 50% of sweet whey, water, sugar, lemon juice concentrate and syrup (quince, blackberry, cranberry, raspberry) for each type of the drink.

The major part of total solids of sweet whey contains lactose (46.0–52.0 g l<sup>-1</sup>) [2]. For successful activity of yeast (*Saccharomyces cerevisiae*) enzyme β–galactosidase was added. Before and after enzyme addition, using high performance liquid chromatography (HPLC), the content and concentration of sugars were determined. According to the results, concentration of lactose before the addition of enzyme was 130.396 g l<sup>-1</sup>. Fermented whey drink contains 3 types of sugars. Concentration of lactose was 20.239 g l<sup>-1</sup>, what is by 84.48% less than before fermentation. Added β–galactosidase hydrolyze lactose to glucose, which concentration is 17.502 g l<sup>-1</sup>. Fructose concentration is the highest – 28.560 g l<sup>-1</sup>, which gave the drink much sweeter taste compared to whey organoleptic properties before fermentation. It can be explained by the fact - fructose has higher sweetness than lactose. Fructose as the dominant sugar determines organoleptic properties of sparkling whey drink, which was recognized during sensory evaluation.

One of the most important indicators of product quality is pH. Fresh whey pH is 6.501. After the fermentation process pH is 4.962. Before maturation whey drink must be pasteurized at 72 °C for 10–15 s for yeast and enzyme inactivation, therefore after this process pH of a ready sparkling whey drink is 4.758. For the quality assessment, 28 evaluators in a special equipped laboratory made sensory evaluation for all types of sparkling whey drinks, using the hedonic scale (ISO 4121:2003 *Guidelines for the use of quantitative response scales*), which shows the liking degree. According to the results of sensory evaluation, sparkling whey drink with quince syrup got the highest rates.

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## USE OF MILLET FLOUR FOR PRODUCTION OF SPECIAL PURPOSE GOODS

**Tatiana Bazhenova**

St. Petersburg State Polytechnical University «University of Trade and Economics», Department of Technology and Nutrition of SPbGTEU, postgraduate student, Russian Federation

**Irina Bazhenova**

St. Petersburg State Polytechnical University «University of Trade and Economics», Department of Chemistry and Biotechnology of SPbGTEU, Associate Professor, Ph. D. in Engineering, Russian Federation

The purpose of this work was to study possible use of millet flour, which does not contain gluten, in recipes, and to develop technology for gluten-free culinary items for nutrition for people with coeliacia diagnosis. The object of the study is the cultivated millet crop *Panicum miliaceum* L. of Russian selection sorts Alba, Sputnik, Regent and Kazachye. They are characterized by high yield, resistance to diseases and logging, good commodity indices of the crop quality and high outcome of the crops.

This work studies the composition of fatty acids of the crops, the content of carotenoids, general amount of phenol compounds and acidity of the flour. At the analysis of the fatty acids composition the highest for all sorts was the content of acids 18:2 $\omega$ 6,9c – about 67%; 18:1n9 – about 21%; 16:0 – about 9%. Also, the sort differences in the content of stearic acid and minor fatty acids were found.

Pigmentation of the crops correlates with the content of carotenoids. The highest content of carotenoids was found in the Sputnik sort – 0.45 $\pm$ 0.05 mg/100 g, the lowest content – in Alba sort, where the crops have the lightest color – 1.15 $\pm$ 0.11 mg/100 g.

Within the research the possibility to combine the millet flour with amaranthine and cotton flour was studied. The recipes of shortbread biscuits, shortbread biscuits with pumpkin, pancake dough and pies with carrots were developed. All the samples were tasted and evaluated. Traditional recipes were altered and used only as control samples. In the experimental samples the following ratios were used: 50% of millet flour and 50% of wheat flour, 50% of wholemeal millet flour and 50% of wheat flour, 50% of millet flour and 50% of amaranthine flour, combination of three flour types – millet, amaranthine and cotton in equal ratio.

The substitution of wheat flour improves the nutrition value of the products: the content of fiber, carotenoids, nonredundant fatty acids, mineral elements and bioflavonoids increases.

Nevertheless, the substitution of wheat flour to the alternative flour types deteriorates the rheologic properties of dough significantly, as well as the quality of the final product. This happens because the proteins in the flour cannot form gluten of good quality.

The final products gained good esteems of the tasters. Some disadvantages of consistency and texture require attentive selection of structure forming agents and aerating agents.

Therefore, the use of millet crops has high potential for enlarging the assortment of gluten-free flour bakery items and other special purpose products. The suggested flour mixtures can be used for production of dough products, where good gluten quality is not required (shortbread, hard-dough, biscuit, pancake dough). The addition of vegetable, fruit and berry purees to the recipes allows to enrich the products with vitamins and other biologically active substances.

# POPULARAZATION OF FOOD WITH HEALTHY INGREDIENTS

**Anna Gončarienė**

Kauno Kolegija/ University of Applied Sciences, Faculty of Technologies and Landscaping,  
undergraduate student, Lithuania

**Vilija Karbauskienė**

Kauno Kolegija/ University of Applied Sciences, master degree, Lithuania

The paper gives an overview of biological benefits of food, enriched with healthy ingredients, for the human body, and nutritional properties. Chia seeds (*Salvia hispanica*), tapioca pearls, quinoa grains (*Chenopodium quinoa*) are examples of health-friendly ingredients. A variety of recipes with chia seeds is provided. The paper contains experimental results of a sensory analysis of chia seeds, producing a variety of dishes.

Over the past decade, a new concept that distinguishes some of the food products in a separate group was developed and described as food products fortified by health ingredients. These potentially health-friendly food components provide health benefits in addition to traditional nutrients (protein, fat, carbohydrates) present in the composition. Creating new recipes with health friendly ingredients for cafes and restaurants would help the customer to get acquainted with this food and enjoy it more often.

According to Norlaily Mohd Ali (2012), chia seeds are high in vegetable protein - 19-23% by weight of seeds. In turn, there is another seed protein percentage: corn - 14%, rice - 8.5%, oats - 15.3%, barley - 9.2%. Chia contains the highest level of polyunsaturated fatty acids such as omega-3, natural antioxidants [1]. Such nutritional composition affects the atherosclerosis, diabetes, protects the body against cardiovascular disease, lung cancer and gastric venous thromboembolism (as characterized by strong anticoagulant function), and slows down the aging process.

As J. Lūžaitė-Kajėnienė (2016) states, quinoa grain has almost ideal proportion of amino acids, high in calcium and iron. The quinoa is easily digested. And simply speaking, quinoa is a bread, a milk, a potato and an egg together [2]. Quinoa grain is a seed, it does not contain gluten – so it could be consumed even by patients who have a celiac disease. It is a perfect food for losing weight, as long as it gives the feeling of satiety. It is a valuable food for diabetics – as it has a very low glycemic index (35), so it does not raise blood sugar levels.

Accomplishing the sensory analysis, three recipes with chia seeds were created: breakfast chia seeds pudding with seasonal fruits, chia seeds cracker, and Bundino pom chia dessert. These dishes are very nutritious and easily digested. There is a slight nut aftertaste. More liquids containing dishes consistency is smooth and solid. The crackers flavor is dominated by bread - peanut flavor. The palatability is completely acceptable and attractive even for children.

Catering companies, seeking to attract more customers, could include some health friendly foods by dedicating a part of main menu to healthy courses. This way, they could attract those customers, who are taking care of their health and are very careful on what they are taking for their meal.

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# PLANT-BASED SPREADS AND THEIR AVAILABILITY IN THE LATVIAN MARKET

**Asnate Kirse**

Latvia University of Agriculture, Faculty of Food Technology, doctoral student, Latvia

**Daina Karklina**

Latvia University of Agriculture, Dr. sc. ing., Latvia

Plant-based spreads are becoming important for health conscious people who are seeking attractive products from other sources than dairy and meat. Plant-based spreads/pastes have been studied and categorized into three main groups: carbohydrate-based, protein-based, and lipid-based spreads [4]. There is a strong demand for healthy (cholesterol free and low in saturated fat) and religious (halal) food, and for economic reasons, there is a pressure for the direct consumption of vegetable proteins in food products. Protein with a vegetable origin is an alternative to animal protein for food applications due to the widespread variety of sources, such as legumes, oilseeds, cereals, and fungi [1].

Majority of plant-based spreads are made from pulses. Pulses are crops harvested solely for the dry grain, thereby excluding crops harvested green for food (e.g., green peas, green beans) which are classified as vegetable crops. Also excluded are those crops used mainly for oil extraction (e.g., soybean) and leguminous crops (e.g., clover, alfalfa) that are used exclusively for sowing purposes. Pulses (beans, pea, lentil, etc.) contain high amounts of lysine, leucine, aspartic acid, glutamic acid, and arginine and provide well-balanced essential amino acid profiles when consumed with cereals and other foods rich in sulphur-containing amino acids [2]. Chickpea spread ‘hummus’ is the main plant-based protein spread worldwide [3].

Plant-based spreads in the Latvian market vary a lot in nutritional value and ingredients. There are less than ten producers represented with a total of about twenty plant-based spreads (as some spreads are with different flavours). About two thirds of the available spreads are oil, yeast or seed based, the rest are pulse spreads. Fat content in pulse spreads ranges from 5 g to 29 g per 100 g, while protein content is similar in all spreads (5.2 to 7.5 g). Carbohydrates available for digestion by human enzymes account to less than 15 g per 100 g of spreads. Energy value of spreads ranges from 107 to 335 kcal per 100 g product. Latvian-produced spreads are more accessible to consumers in terms of price; however, they contain additives to ensure the texture or improve the structure of the product (e.g., E407a, E412, E481), improve the taste (e.g., E621) and extend shelf life (e.g., E200, E202, E270). Some of the spreads are certified organic products, therefore their price is higher.

Pulses growing in Europe are not represented in commercially available plant-based spreads. Therefore, pulses which are a great source of nutrients and popular among Latvian consumers could be used as a raw material to develop new plant-based spreads.

## Acknowledgements

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# SENSORY PROPERTIES OF WAFFLES WITH PEA AND BUCKWHEAT FLOUR

Gita Krumina-Zemture

Latvia University of Agriculture, Faculty of Food Technology, doctoral student, Latvia

Ilze Beitane

Latvia University of Agriculture, Dr.sc.ing., Latvia

Healthy food is a priority of our state, and therefore food producers develop new products with high nutritional value and reduced energy. One of the possibilities could be to use regional and rarely used pseudo cereals and legumes, for example, buckwheat and field pea.

Buckwheat products are known for their resistant starch and as an important source of anti-oxidative substances, vitamins B<sub>1</sub>, B<sub>2</sub> and B<sub>6</sub>, trace elements and dietary fibre [1]. Buckwheat protein shows high biological value due to a well-balanced amino acid pattern and is rich in lysine and arginine [2], but field pea, like most grain legumes, is relatively high in protein and lysine [3].

**The aim** of research was to evaluate the sensory properties of pea and buckwheat waffles.

As materials, buckwheat flour (BF) and pea flour (PF) were used) in following BF:PF ratio order: 80:20, 60:40, 40:60 and 20:80. Sensory evaluation of waffles was carried out by experts (20 women, aged 20–56; 5 men, aged 20–24) according Line scale (ISO 4121:2003) for determination of five sensory properties – aroma, taste, colour, hardness and structure. In the second part of sensory analysis ranking test (ISO 8587:2006) was used with the aim of ranking pancake samples in the following order: the most pleasant – the most unpleasant.

Good quality waffles should possess pleasant pea or buckwheat taste and aroma as well as soft and crunchy structure. The changes of sensory properties of waffles were affected by the amount of buckwheat flour replaced by the pea flour. By increasing the amount of buckwheat flour the structure of waffles became softer and denser, colour became darker and buckwheat taste as well as aroma – predominant.

The changes of sensory properties were affected by the amount of added buckwheat flour in pea flour waffles, where significant differences existed in terms of intensity of pea and buckwheat taste and aroma, colour and hardness ( $p < 0.05$ ), but there was no significant difference in structure ( $p > 0.05$ ). Sensory analysis showed that by adding buckwheat flour to the waffles dough pea taste and aroma decreased – predominance of pea taste and aroma by experts was evaluated as not very acceptable.

The sensory analysis of ranking showed that the most pleasant waffles samples were with 40% PF+60% BF and 60% PF+40% BF and differed significantly from other waffles samples ( $p < 0.05$ ).

Pea and buckwheat waffles could be a good alternative product to wheat waffles. They could be characterized as gluten- and lactose-free.

## Acknowledgements

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# POSSIBILITIES OF DRY KVASS FOR FOOD FLAVOUR ENRICHMENT

**Ivo Lidums**

Latvia University of Agriculture, Faculty of Food Technology, doctoral student, Latvia

**Daina Karklina**

Latvia University of Agriculture, Professor, Dr. sc. ing., Latvia

Kvass is a traditional Slavic and Baltic fermented beverage commonly made from black or regular rye bread [3]. Naturally fermented bread kvass is made from dried rye bread by soaking it in hot water for a few hours. After separating water-bread extract from soaked bread, it is fermented by adding bread yeast *Saccharomyces cerevisiae* [2]. The colour of the bread used contributes to the colour of the resulting drink. It is classified as a non-alcoholic drink by Russian standard, as the alcohol content from fermentation is typically less than 1.2%. Generally, the alcohol content is low (0.5–1.0%). It may be flavoured with fruits such as strawberries and raisins, or with herbs such as mint.

It is especially popular in Russia, Latvia, Lithuania, Belarus and Ukraine, and also well-known throughout Estonia and Poland, as well as in other states such as Georgia, Kazakhstan and Armenia. Many kvass vendors there sell the drink in the streets. Kvass is also popular in Harbin and Xinjiang, China, where Russian culture has had an influence.

Kvass is an aromatic drink which in form of a powder could be used in dairy or bakery products, or sugar confectionary to expand the diversity of flavours.

Dry kvass could have several benefits and economic potentials over liquid kvass such as reduced volume or weight, reduced packaging, easier handling and transportation, and a much longer shelf life. Powdered products provide a stable, natural, and easily dosable ingredient, which generally finds usage in many foods and pharmaceutical products such as flavouring and colouring agents [1].

Dry kvass was obtained from Ltd Liepkalni naturally fermented non-pasteurised, non-filtered bread kvass 'Liepzeme' by spray drying method at the Institute of Process Engineering and Equipment, The University of Warmia and Mazury in Olsztyn, Poland. Preliminary research of possibilities of dry kvass for food flavour enrichment is ongoing at the Department of Food Technology, Latvia University of Agriculture. Several food items are being investigated for flavour enrichment with dry kvass such as milk candy 'Gotiņa', 'Plombir' ice-cream, biscuits, meringue cookies, éclair filling and cupcakes. Recombined kvass from dry kvass is also being researched.

Preliminary results show that consumers like the taste and flavour of different food products enriched with dry kvass. Kvass flavour was confused with chicory, cappuccino and bread flavours. When informed about enrichment with dry kvass, they noticed the flavour of kvass.

Consumers should be informed what kind of flavour to expect in new food products. One way of getting the information to the consumers could be an illustration and a description on food packaging, so consumers know what to expect.

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# INTEGRATED ASSESSMENT ON VARIETIES OF *VIBURNUM OPULUS*

Liene Ozola

Latvia University of Agriculture, Faculty of Food Technology, graduate student, Latvia

Solvita Kampuse<sup>1</sup>, Ingmārs Cinkmanis<sup>1</sup>, Jana Apše<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Dr.sc.ing., <sup>2</sup>postgraduate student, Latvia

The growing interest in natural food ingredients has been an important factor in expanding the studies of less known horticultural plants in recent years. For instance, *Viburnum opulus* consisting of more than 230 species, which are grown for ornamental purposes and for their edible fruits [1]. European cranberry bush, also known as guelder rose and other names, (*Viburnum opulus* L.) belongs to *Caprifoliaceae* family that originated in Europe, North Africa and North Asia, and it is also frequently found in the central zone of Western Russia. In late autumn, it produces pendulous clusters of bright red berries that contain one seed [2]. The fruits have been used to treat different health problems, also used in foods, mainly as an ingredient in sauces, jellies, marmalades and drinks [1].

Fruits of some *Viburnum* species have been reported to contain a high amount of polyphenolics, including phenolic acids and anthocyanins, as well as organic acids-ascorbic and L-malic acids. Bioactive substances of *V. opulus* fruits were also reported to possess antimicrobial effects against a wide range of human pathogenic bacteria [2]. The formation of bioactive substances and their content in fruits depends on various factors, such as genotypic differences, environmental conditions (climate, temperature, soil) and cultivation practices [1]. **The aim of this study** was to evaluate physico-chemical indicators and conduct integrated assessment of several guelder rose fruit varieties for potential use in production of sauces. The study was conducted in the laboratories of LUA, Faculty of Food Technology and Department of Chemistry. Seven varieties and hybrids of frozen guelder rose fruits were used, grown in Latvia on two different farms and harvested in the fall of 2015. For all samples, integrated assessment was carried out according to the following physical-chemical parameters: amount of ascorbic acid (iodometric method), soluble solids (Brix%), titratable acidity, juice colour evaluation (CIE L\*a\*b\* color system), anthocyanins, total carotene, total phenolic content, antiradical activity (determined by spectrophotometric method), amount of chlorogenic acid (gas chromatography method), and the quantity of juice of each fruit variety.

Differences between the amounts of analysed compounds and growers were found, but the varieties that showed the highest and lowest amounts of these compounds were similar. The lowest amount of ascorbic acid was detected in the variety *Otbornaja iz Ļeņingrada* (grower no.1: 9.87±0.62 mg 100 g<sup>-1</sup>; grower no.2: 13.41±0.74 mg 100 g<sup>-1</sup>), but the highest in *Kijevskaja sadovaja* (no.1: 31.04±1.23 mg 100 g<sup>-1</sup>; no.2: 57.15±0.31 mg 100 g<sup>-1</sup>). The highest amount of total phenols was found in hybrid 2-30-K ranging from 1038-6185 to 567.3489 mg 100 g<sup>-1</sup>. The major part of conducted polyphenols were Chlorogenic acid, up to 758.272 mg 100 ml<sup>-1</sup> were found in hybrid no. 2-30-K. **The research revealed** that: 1. There are differences between the amounts of several bioactive compounds depending on the grower. 2. Fruits of *Viburnum opulus* are rich in different bioactive compounds especially in phenols. 3. After integrated assessment, for both growers, the most perspective hybrids of guelder rose for food production are 2-45-K, 2-30-K; but, regarding the varieties, for grower no.1 -*Kijevskaja sadovaja*, and for grower no.2-*Krasnaja grozdi*.

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# EXTRUDED PEAS IN SWEET BARS

Evija Puiškina

Latvia University of Agriculture/Faculty of Food Technology, undergraduate/ Latvia

Sandra Muižniece- Brasava

Latvia University of Agriculture /Faculty of Food Technology/ Assoc.Prof.,Dr.sc.ing./ Latvia

Sweets are an integral part of our life. People consume sweet foods almost every day. Nowadays, it is important to broaden the range of confectionary with new healthier products.

Latvian grey peas are one of the most popular traditional foods, well known for its high nutritional value. Usually, we eat grey peas as a salty dish after many hours of cooking, because of their hard structure that softens only after heat treatment. It is important to find how to treat the product in such a way that it could be consumed fresh. After extrusion, the peas retain their natural characteristics and can be consumed in different flavour variations. The product preserves grey pea taste qualities, but they are no longer so explicit, so it is possible to make sweet bars [1].

The purpose of this work was to develop novel protein-rich candy bars in different packaging materials. Confectionery packaging and packaging technology must meet strict standards to protect the product from the sanitary, toxic and various external factors and ensure content protection. Today, sweet bars are usually packed in polymers laminates to ensure the necessary protection [2].

The study was carried out in Latvian University of Agriculture, Faculty of Food Technology. The extruded peas from Latvia and sugar were mixed together, and bars were made and used in the research. Different materials were used for packaging the bars - Polypropylene (PP), metallized polypropylene (metPP), polylactide (PLA), to see which one is better for a longer shelf life [3].

The product development included testing to verify the safety of the product and the period of validity. One of the main tests for product safety was the microbiological analysis. The results showed that there is no hazard in the product and it is microbiologically clean. Other parameters: colour, hardness, pH, moisture and water activity during storage were tested and did not change at all, or changed within the allowable limits. We received clear indications that, within four months, which is the storage period, the product remains stable and its shelf life will continue.

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# QUALITY MANAGEMENT SYSTEM FOR EGG OIL SAUCES

**Olesya Ye. Rachevskaya**

St. Petersburg University of Trade and Economics, Faculty of Industrial Ecology and Biotechnology,  
post-graduate student, Russia.

**Tatyana Ye. Burova**

St. Petersburg University of Trade and Economics, Faculty of Industrial Ecology and Biotechnology,  
PhD, Associate Professor, Russia

**The aim of the research study** was to develop different recipes of Dutch egg oil suitable for freezing and that can be used for ready- to- eat meals. The traditional recipe was changed: instead of broth, milk serum was used, and sautéed wheat flour has been changed for rice flour. These changes were made to simplify the sauce-making technology and to make it cheaper.

Ready-made sauces were homogenized, container packed and frozen at -18 °C. The sauces were stored in the frozen condition for 75 days with the investigation interval of 15 days. Organoleptic, physicochemical (pH; moisture, fat and salt content, lactic acid level, peroxide value, viscosity, density) and microbiological (quantity of mesophilic aerobic and facultative aerobic microorganisms, pathogen bacterial count including coliform bacteria, salmonella, staphylococci, moulds and yeasts) indicators have been analyzed.

**The experimental results** confirmed the safe and high quality of the products during their shelf life. The absence of separation proved the system stability of the freezing process and storage of the frozen products. Physicochemical characteristics had changed within experimental error limits. Microbiological indicators of frozen products during their storage also met the standards that proved their safety.

The management systems for food product safety exemplified by the Dutch sauce were proposed.

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# RHEOLOGICAL PROPERTIES OF CHOCOLATE DEPENDING ON THE ADDED SWEETENER

**Ingūna Strode**

Latvia University of Agriculture/Food Science, Faculty of Food Technology, post-graduate, Latvia

**Ruta Galoburda**

Latvia University of Agriculture / Faculty of Food Technology, Dr.sc.ing., Latvia

The **aim of the study** was to compare a usual chocolate with saccharose and sugar-free dark chocolate with natural intense sweeteners (stevia and agave syrup) on the flow (rheological) properties, microstructural properties and textural characteristics of the derived products. Replacement of sugar with intense sweeteners such as stevia or agave syrup may pose a serious challenge in chocolate confections, because sucrose fulfils both a structural and sweetening function in these products.

A light microscope, coupled to an image analysis system, was employed in order to evaluate the particle size of sugar crystals. Rheological parameters (viscosity) were evaluated by using a rheometer, while textural properties (bite force, hardness) were analysed using a texture analyser.

By changing chocolate components and relations between them chocolate textural and rheological properties change too. [1]

To reduce bad influence of chocolate on health, manufacturers should not use suchroosa or synthetic sweeteners. If chocolate does not contain sucrose or synthetic sweeteners, it is more appropriate for diabetics. Chocolate is rich in antioxidants, which help decrease the level of free radicals and make this product reduce obesity. Added sweeteners change chocolate texture and can make a lower quality of it. [2]. Usually, chocolate viscosity depends on cocoa amount in it; if there is more cacao, then viscosity of chocolate is lower. But, if there is a higher content of emulgator (lecytin of soya been) and sugar, viscosity is higher. [3].

The **results** showed that chocolate with agave syrup, with the highest amount of fat in formulation, had sugar crystals of the smallest size and less sugar in chocolate, but the lowest yield stress, highest viscosity, because it was too high to measure with the used rheometer. Syrup has a different influence on cocoa fat, and it makes suspension, not emulsion like in usual chocolate. In turn, manufactured chocolate with saccharose presented the highest aggregate structure because of the number and size of the sugar crystals, with smaller spaces between particles that involved the highest rheological parameter values. Chocolate with stevia rheological parameters of sugar crystals exhibited intermediate microstructural and rheological characteristics compared to chocolate with saccharose, and chocolate with agave syrup. Chocolate with stevia or sucrose has more similar textural and rheological parameters because they are manufactured in a factory, but chocolate with agave syrup is made at home from raw cacao been.

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# INFLUENCE OF SODIUM CHLORIDE CONTENT ON SENSORY AND PHYSICAL PROPERTIES OF SAUSAGES

**Roberts Reinis Šļaukstiņš, Viktorija Vorobjova**

Latvia University of Agriculture, Faculty of Food Technology, undergraduate students, Latvia

**Ruta Galoburda, Evita Straumīte, Ilze Grāmatiņa**

Latvia University of Agriculture, Dr.sc.ing., Latvia

Salt has been used since ancient times for the preservation of meat products and is one of the most commonly used ingredients in processed meat products. Sodium is essential for the maintenance of cellular membrane potential and the absorption of nutrients in the small intestine. Furthermore, its presence determines the volume of extracellular fluid, thereby maintaining blood volume and blood pressure. However, excessive consumption of sodium has been associated with negative health effects, the most alarming being elevated blood pressure (BP) [1]. According to the survey [2] conducted in 2009, adult daily sodium intake in Latvia was approximately 7.3 g which is little above recommended (5g). The situation in other EU countries was much worse reaching up to 13.5 g. On 7 December 2007, the Council of Ministers of the European Union welcomed the initiative of the European Commission to propose salt reduction as a first priority for discussion within the High Level Group. Following two salt expert workshops that were chaired by the European Commission in January and June 2008, Member States agreed to the creation of a common European Union Framework on voluntary national salt initiatives [2].

Processed meat products comprise one of the major sources of sodium in the form of sodium chloride (salt). In the modern meat industry salt is used as a flavouring or flavour enhancer and is also responsible for the desired textural properties of processed meats. Salt imparts a number of functional properties in meat products: it activates proteins to increase hydration and water-binding capacity; it increases the binding properties of proteins to improve texture; it increases the viscosity of meat batters, facilitating the incorporation of fat to form stable batters; it is essential for flavour and is a bacteriostatic [3]. Lowering salt content in meat products is possible from a technological and sensorial point of view, although little information is available about the consumers' attitude and acceptance of these products [4].

Our goal was to find if reducing or increasing the amount of salt in sausage manufacture is notable for customers and what particular physical attributes are mostly affected. Our research was based on the evaluation of three experimentally made types of beef sausages filled in natural casings with addition of salt in amount of 10, 14, and 18 grams per kg of meat, respectively. The ratio of lean beef and pork was 80: 20. Sensory characteristics were evaluated using duo-trio test and ranking tests. Physical characteristics were determined by instrumental methods using a colorimeter and a texture analyser. According to sensory evaluation, panellists did not clearly ascertain a reduced amount of salt in any of the tests performed. On the other hand, increased amount of salt was easily noted by panellists. Salt's influence on physical characteristics like firmness and water binding capacity also was observed.

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# THE INFLUENCE OF BARLEY SOURDOUGH ON WHEAT BREAD QUALITY PARAMETERS

**Donata Vizbickienė**

Lithuania University of Health Science, Department of Food Safety and Quality, post-graduate student,  
Lithuania

**Elena Bartkienė**

Lithuania University of Health Science, Department of Food Safety and Quality, Professor, Dr.,  
Lithuania

Consumer awareness of the health benefits of wholegrains has led to a growing demand for healthier cereal products. Incorporation of nutrient-rich wholegrains into bread is a promising way of producing a healthy alternative staple food product. [1]. Barley  $\beta$ -glucan has received considerable research attention due to its health benefits. Several studies have shown that barley  $\beta$ -glucan has significant blood cholesterol-lowering effects, it also increases the viscosity of intestinal fluid and thereby reduces the rate of sugar/starch absorption, which is beneficial in the management of diabetes [2]. A number of different enzymes and sourdough technology have been used to improve the breadmaking properties of flours. Sourdough technology combined with enzyme treatments can be also used for nutritional and product quality implications. Sourdough fermentation is known to have a positive nutritional effect in terms of increased mineral bioavailability and vitamin stability, reduced postprandial glucose and insulin and possible prebiotic effect [3]. Combination of sourdough and selective enzymes was shown to have positive effects on bread loaf volume, shelf-life and crumb structure [1].

The influence of barley sourdough saccharified by cellulase and fermented with *P. acidilactici* on wheat bread quality parameters was evaluated. To prepare sourdough, before fermentation barley flour was saccharified with different quantities (100  $\mu$ l, 150  $\mu$ l, 200  $\mu$ l, 250  $\mu$ l, 300  $\mu$ l) of cellulase. The control sourdough was produced by spontaneous fermentation. A sourdough with the highest content of LAB was used for wheat bread production. Different amounts of barley sourdough for bread making were used (2.5; 5.0; 7.5; 10.0; 12.5; 15.0; 17.5 and 20.0 perc. from wheat flour. The control breads were prepared without sourdough.

It was found that enzymatic hydrolysis before fermentation and *P.acidilactici* starters could improve sourdough properties in comparison with spontaneously produced sourdough (higher amount of LAB CFU/g). Major lactic acid isomer produced by *P.acidilactici* in barley flour substrate was L(+) (from 4.5 to 23.2 times higher than D(-)). Different sourdough technologies had different effects on the sourdough parameters: the highest  $\beta$ -glucan content was found in sourdough produced by using 200  $\mu$ l of cellulase (7.40 $\pm$ 0.06 perc.); the highest amount of phenolic compounds was found in sourdough made by using 250 $\mu$ l and 300  $\mu$ l cellulase (140.05 $\pm$ 0.13 and 142.02 $\pm$ 0.16 mg GAE/100g sample, respectively); the lowest antiradical scavenging activity was found in spontaneous sourdough (20.0 $\pm$ 0.09). In conclusion, it could be stated that for improving the nutritional value of wheat bread 5 per cent. of barley sourdough could be recommended, because with 5 per cent. of barley sourdough no negative impact on a specific volume of wheat bread was found (the specific volume increased by 6.4 perc.), and the texture changes during wheat bread storage were found lower in comparison with control breads.

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## **ENGINEERING**

# WORM GEAR APPLICATION AND ADVANTAGES

**Dairis Ozoliņš**

Latvia University of Agriculture, Faculty of Engineering, undergraduate student, Latvia

**Maris Kirsis**

Latvia University of Agriculture, Dr. sc. ing., Latvia

A worm drive is a [gear arrangement](#) in which a worm meshes with a worm gear. There are few reasons why one would choose a worm gear over a standard gear. The first one is the high reduction ratio. A worm gear can have a massive reduction ratio with little effort - all one must do is add circumference to the wheel. Thus you can use it to either greatly increase torque or greatly reduce speed. It will typically take multiple reductions of a conventional gear set to achieve the same reduction level of a single worm gear – meaning users of worm gears have fewer moving parts and fewer places for failure. The second reason to use a worm gear is the inability to reverse the direction of power. Because of the friction between the worm and the wheel, it is virtually impossible for a wheel with force applied to it to start the worm moving. On a standard gear, the input and output can be turned independently once enough force is applied [3].

There is one particularly glaring reason why one would not choose a worm gear over a standard gear: lubrication. The movement between the worm and the wheel gear faces is entirely sliding. There is no rolling component to the tooth contact or interaction. This makes them relatively difficult to lubricate. The lubricants required are usually very high viscosity (ISO 320 and greater) and thus are difficult to filter, and the lubricants required are typically specialized in what they do, requiring a product to be on-site specifically for that type of equipment [1].

Worm gears are widely used. For example, tuning instruments – most guitars, basses, banjos and other stringed instruments use a worm gear for the tuning mechanism to work. The gear's force reduction is the main reason for this, coupled with the locking capability that keeps the desired string tightness in place. This type of worm gear is different to most as you can tune both up and down; whereas most worm gears can only be turned in one direction.

Worm gears can often be found in the machinery of common elevators/lifts because of their compact size and non-reversible properties. As the gear/load cannot transmit motion back through the worm/hoist, using this type of gear can act as a secondary braking system. This means the load cannot free fall and load speed is easily regulated [2].

Large trucks or off-road vehicles, such as the Hummer, often need to deliver different amounts of torque to each wheel, depending on what action the vehicle is performing. For example, wheels need to spin at different speeds whilst turning a corner as the inside wheels travel a shorter distance. A vehicle's Torsen differential will handle this movement via a combination of worms and worm gears that separate each individual wheel's performance [1, 3].

Worm gear will always have a few complications compared to a standard gear set, however, it can easily be an effective and reliable piece of equipment. With a little attention to setup and lubricant selection, worm gears can provide reliable service as well as any other type of gear set.

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# EXPERIMENTAL AND THEORETICAL STUDY OF MOMENT RESISTING CONNECTIONS

**Edgars Zeltiņš**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering,  
Master student, Latvia

**Jānis Kreilis**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering,  
Dr.sc.ing., Associate Professor, Latvia

Moment resisting bolted connections are often used in steel structures because of economic considerations and ease of erection at the building site.

The design of non-preloaded bolted connections is described in Eurocode 3, Part 1-8 [1]. The behaviour of the connection is affected by mechanical properties of the components – tension resistance of the bolts, bending resistance of the column flanges and the end-plates of beams.

In accordance with EC3-1-8 the adopted model for “hand calculation” is based on so called component method, where the joint is sub-divided in separate T-stubs for each bolt row [2]. For numerical analysis the MathCad programme is used to calculate tensioned equivalent T-stub flange resistances. In addition, Dlubal Software and Add-on Module for RFEM/RSTAB [3] also were used.

To study the beam-column joint behaviour, three series of the experimental specimens were made using HE140A as columns and IPE180 as beams. The tests were carried out by hydraulic equipment Zwick-Roell using software program TestXpertII.

Comparing the numerical and actual test results can be seen relatively significant reserves of bearing capacity. Furthermore, the moment resistances calculate for connections using software were obtained higher than ones using „hand calculation” method.

Analysing the results, there were obtained the main factors, which affect the differences between tests and numerical methods.

## Acknowledgements

*The authors are much obliged to the company CSK Steel SIA for providing the specimens for the tests and computer software for calculations.*

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## **INFORMATION TECHNOLOGIES**

# TWO SEQUENCE ALIGNMENT ALGORITHMS IMPLEMENTATION

Jānis Eiduks

Latvia University of Agriculture, Faculty of Information Technologies, MSc student, Latvia

Līga Paura

Latvia University of Agriculture, Assoc. Prof., Dr.agr., Latvia

Bioinformatics is a science, where mathematical, statistical and information technology methods are used to solve various problems related to biology. Typical research problems are development of database for the measured biological sample information and manipulation of biological data. Thereby the most common problem is DNA or protein sequence alignment. The sequences are compared, determining their similarity in each position. There are two algorithms for sequence alignment: dynamic programming and heuristics algorithms. Dynamic programming algorithm will give the optimal sequence alignment, whereas heuristics algorithms are not guaranteed to find the optimal alignment [3].

There are two categories of pairwise sequence alignments: global and local alignments, which are based on dynamic programming algorithms. Needleman–Wunsch is a general method for the global, and Smith–Waterman algorithm is a general method for the local two sequence alignments. By the term of global comparison we understand that two full-length sequences are compared. In turn, by the term of local comparison we understand that one sequence segment is compared with sequence of another segment [1]. For optimal sequence alignments should be inclusion a gap (g) (insertions or deletions) to one of the sequences, and there are different methods to calculate gapped alignment. Depending on the size of the gap (L), the total gap penalty is the product of the g by L in linear sequence alignment case, whereas in affine sequence alignment case the total gap penalty is the  $h+(g*L)$ , where h is the number of the gap opening penalty [2].

During the research program the animal productivity data and sequence data was acquired. The aims of the study were to create a database that stores information about productivity and genotypes of animals and to implement two sequences alignment by dynamic programming algorithms. The implementation of database was made by PostgreSQL database management system (release 9.4.). The dynamic programming algorithms were implemented using Microsoft Visual Studio C# (release 2010). The functionality of the software is to store phenotypical and genetic data about animals and compare DNA or protein sequences according to Needleman–Wunsch and Smith–Waterman algorithms. The software provides global–linear, local–linear, global–affine and local–affine DNA and protein sequence alignment algorithms. One of the directions of the software development is to include multi sequence alignment algorithms for phylogenetic trees construction.

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# THE ANALYSIS OF INFORMAL SOFTWARE TESTING METHODS

**Sandra Konavko**

Latvia University of Agriculture, Faculty of Information Technologies,  
undergraduate student, Latvia

**Rudīte Čevere**

Latvia University of Agriculture, Dr.sc.comp., Latvia

Nowadays, software testing is one of the most important processes in terms of software quality. Most of the customers and also developers are interested to start testing as soon as possible, and that is the main reason for the usage of early testing approach. However, testing can be very formal or less formal, therefore it is significant to organise testing for every project individually.

The authors of the research have proposed a hypothesis that there are many benefits of informal test management: the more tests are executed, the higher number of bugs is found, and testers can take part in business analysis.

Testing varies in degrees of formality. A very formal testing is well-controlled and includes all kinds of testing documentation, whereas informal testing may have no documentation at all, but the right level of formality depends on the system context or organization. Mostly informal test strategies or approaches are risk or experience based. [1]

Exploratory testing can be used for functional or non-functional testing. If software is not well-understood before testing begins, the exploratory testing approach can be used. It is the most useful when not much is known about the system under test, as well as, when the specifications are informal or when there is not enough time to make a detailed design and documented test procedures. [2]

Nowadays, it occurs more often when a scripted manual testing is too rigid for some applications. It is necessary to test processes and for the testers to use a less formal approach. Instead of documenting every input, a script may be written or told as a short scenario that gives some flexibility to the testers while they are running a test. Exploratory testing could be the only way of testing, but to improve effectiveness testers often use it after scripted testing is executed. Exploratory testing is especially suited for fast software development methods, such as agile testing. [3]

The authors have carried out the analysis of testing use in the most popular life cycles of software development and have compared the aspects of using different approaches of testing that varies from very formal to informal.

During the research the authors have worked with five groups of students and have used different levels of testing approaches. In the research study, the authors compared the test results in all groups, as well as, formality levels. Within the time constraints, exploratory testing was more effective in finding defects than testing by specification because it is a more informal method with less documentation.

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# **A NEW EASY-TO-USE PROGRAM APPLICATION FOR EXTRA-READING VOCABULARY ACQUISITION**

**Konovalov Igor**

Peter the Great Saint Petersburg Polytechnic University, Institute of Computer Science, undergraduate student, Russia

**Tatiana Panysheva**

Peter the Great Saint Petersburg Polytechnic University, Russia

Self-study is an essential part of students' professional foreign language acquisition where extra-reading leads to lexical competence. But the choice of the papers to be read should be reasonably based on the texts with the most frequent words within your area of study.

We have assessed several Internet programs providing the key information about words in the articles and the major words to study so as to decrease useless reading. When we speak about extra-reading at university the successful activity should be based on the ability to choose the words to study and understanding what words to put on the vocabulary list.

Having assessed the Internet sites providing different methods of words frequency and words use analysis we put them into the following categories: word frequency analysing sites, vocabulary and derivation sites and concordances sites. A good example can be AntLab – multifunctional application with block-created interface which shows results as a wordlist (by word frequency), or as a list of concordances for the selected words[1]. Another site for word processing is WordCounter[2]. You just enter the text, click on “Go” button, and see the word list on the next page. However AntCons seems to be too complicated with a lot of features and will be more useful for professional users than by students. WordCounter processes texts of limited size. Both programs need the Internet access to evaluate the texts.

We developed a new easy to use a multifunction application to evaluate the most frequent words with a simple interface and functionally balanced application. At present it can carry out texts words analysis and shows the most frequent ones on the display. The user can put the displayed words into a special field. Moreover, you can store results in output file and go on with further texts. Then all results can be combined automatically. Application can save the results of analysed text by its topic and then show the statistics of all frequently used words for the desired professional area (by clicking on toggle button).

We have analysed a number of papers on computer science and agriculture topics for frequent words, and compared our results with AntConc and WordCounter – and got perfect 100% coincidence, but we have better results at work speed, We hope that our development will be beneficial for students, where it is necessary to select the key information in texts and select words to study. Hopefully, there will be some more functions in future, like working with full texts and showing concordances.

## **Acknowledgements**

*We thank the organizers of conference “Students on their way to science” from Latvia University of Agriculture for the possibility of exchanging ideas.*

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<http://www.laurenceanthony.net/software/antconc>
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# TOR ANONYMITY NETWORK AGAINST TRAFFIC ANALYSIS ON THE INTERNET

**Georgiy Kubrin**

Peter the Great St. Petersburg Polytechnic University, Faculty of Computer Science, undergraduate student, Russia

**Alena Bondarevskaja**

Peter the Great St. Petersburg Polytechnic University, Russia

In the modern world more and more information is passing through the Internet, which has become very integrated with all domains of our society. Nowadays most people are using the Internet in their daily life. Due to Internet services, such as social networks, online shops and others, the Internet network has accumulated a lot of data about its users. That information could be used against a personality or entire corporations, therefore, the information security problems on the Internet are very important.

This paper examines the anonymity network Tor, which is well described in the work of R. Dingledine and N. Mathewson, in order to find the ways of increasing its efficiency and connection speed. The mentioned article provides information about onion routers in general and about the design of the Tor network. This information was used to understand the design of the anonymity network and to find the essential parameters which determine the speed of connection. [1]

The Tor network is able to provide a good defence against passive attacks such as traffic analysis. Although, it does not grant an absolute defence against more serious threats such as a global passive adversary, it is a good instrument of preventing servers from collecting the data which can be used for traffic analysis. [2]

The speed test results that we have obtained were compared with the official statistics from the Tor Network's website. The results obtained during the work differ from the official statistics. This paper also explores several possible reasons for this fact. [3]

According to the research results, Tor's speed might be improved by including more servers in the network for routing traffic through. The number of Tor Network's servers does not tend to increase fast because the project does not have a steady income. Other ways of increasing the efficiency of the network are based on reducing each server's load with the help of rational user's policy and by using an algorithm of building paths which could effectively divide network's resources between clients. The last option could reduce each server's load, and, therefore, increase the average server's connection speed.

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# **SOFTWARE – HARDWARE SYSTEM DEVELOPMENT CREATING SECURE CONNECTION WITH EXISTING CONNECTION METHODS**

**Sergey Lappo**

Peter the Great St. Petersburg Polytechnic University, IUS, undergraduate, Russia

**Alena Bondarevskaja**

Peter the Great St. Petersburg Polytechnic University, Master of Linguistics, Russia

Most of us use a personal computer every day: at work, at home, and in a public transport. Using it we can do a lot, but is it safe to store private information on our device? Even if you follow basic safety concepts, you need to have an up-to-date antivirus, reliable passwords. Does that mean that you can store anything on a PC or send confidential information via public services? In 2011 an article was published in the journal “Xaker”, where the author writes about the hypervisor detection of unknown origin in new Intel motherboards [1]. In the paper the author points out that a hypervisor in serial motherboards was only from China. It was not revealed in testing motherboards from Canada. We started thinking about the device which could be reliable in operation and at the same time the information would be secure. In our opinion, the most important things in any cryptosystem are encryption algorithms. We have chosen RSA as an asymmetric cipher. It is one of the oldest asymmetric ciphers which are still impossible to hack. We did not test its durability ourselves, but studied several books to find the confirmation of its theoretical potential. Salomaa, a famous programmer, states that there has been no formal proof that factorization is hard to compute, and factorization is necessary to analyse RSA, but there are a lot of empiric proofs [2]. As a symmetric cipher we have chosen AES (rijandel), an extremely widely used block encryption algorithm. Reinhard Wobst states that despite of all sophisticated functions, it looks simple and can be analysed easily, however, it can resist all the existing crypt-analysis methods in a block[3]. The next step was the selection of an appropriate device. We have chosen the Raspberry Pi. The most obvious advantage of this selection is the fact that it has a low price and works on Linux based open sourced OS. A joystick is used as a text input device and 2 – lines display for the user’s interface. As a result, a prototype of the device has been obtained that is reliable in operation, simple and easy to design. This device can be used in sending and receiving information with much more privacy than most of the offered portable devices.

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## OVERVIEW OF DIETING MOBILE APPLICATIONS

Peter the Great St. Petersburg Polytechnic University, Faculty of Applied Mathematics and Mechanics,

**Samosudov Yuri**

undergraduate student, Russia

**Alena Bondarevskaja**

Peter the Great St. Petersburg Polytechnic University, Master of Linguistics, Russia

Nowadays, our mobile phones are becoming smarter rapidly and help people in different scopes of life. The control of our weight is not an exception: there are a lot of different applications, which help people to monitor their nutrition and physical activity. Each of the most successful applications has gained more than 1 million of users by now, so we think they are worth studying.

Different companies produce their own applications, and you choose one or another depending on your OS, on your ability to fill a lot of forms, or your level of user skills. We installed a couple of them and found out that they looked exactly as we had imagined ourselves: at first, one needs to register and then every day you need to complete a lot of data about what you have eaten and what exercises you have done. So, once you have installed one of these applications you write down your age, height, current weight and the desired one. After it, in a diary you put down facts on the food consumed this day searching by name or just scanning the bar code of the product, if possible. If some exercises have been done this day, you also choose them from the list of activities and then the program counts the amount of calories gained, fats, proteins etc. consumed and estimates how far you are from your goal.

The main advantage of these applications is that one does not need to deal with a doctor to lose weight, the device is smart enough to calculate amounts of different substances you need to eat or better not. And for many people it is a way out of their problem, because it may be really difficult for them to face a living doctor being afraid of blame of laziness and weak will. Another psychological factor is that once you have registered all consumed food the number of calories is shown to you, and you face the truth about your nutrition, and this helps you to decrease amount of food you eat. Our survey showed that keeping a food journal doubles your weight loss. This application comments on your food sometimes: for example, if you eat cakes, it reminds you that you need to eat less fats, and when you eat apples it states that apples are rich in vitamins and that you have done a good job. And even if everybody knows these facts, it is a great psychological effect helping you to reach your aim.

Among the main disadvantages people state that it is difficult for them to register the food they ate. Moreover, it is also difficult sometimes to estimate the weight of food you have eaten. This problem could be solved, if some kind of scales would be installed in this application. The bar code reader really helps sometimes, when you deal with products bought in a shop and eaten the way they are but it is more difficult to include a homemade food in this diary.

So, if you want to get fit easily and for free, you just need your phone and patience to follow the rules of the program. There are some shortcomings regarding these applications, but progress goes forward, and we are looking forward to the development of architecture of these programs.

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## **RURAL ENGINEERING AND ENVIRONMENT**

## LAND USE EFFICIENCY

**Dagmāra Arkliņa**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering,  
Master student, Latvia

**Vivita Baumane**

Latvia University of Agriculture, Dr.oec., Associate professor, Latvia

To determine the efficiency of land use initially, it is necessary to understand the concept of land use in Latvia and other countries, as well as the reasons that influence agricultural land use and its efficiency. Agricultural land use is affected by geographical situation, rural area configuration and artificial or natural obstacles. These factors increase or decrease a specific type of land used.

In Latvia there are some regions where agricultural land has been abandoned and is not processed. Rough proportion of agricultural land is relatively large, therefore we need to analyse the reasons why these lands are not used. The reasons why the agricultural land is not being used are: greater understanding of the future value of the other types of land use, policy obstacles, social behaviour and economic constrain [1].

Currently in Latvia it is not set how effectively the land should be used and what criteria should be taken into account, it is not determined how to evaluate the efficiency of land use, the land use determination method which can be used to determine land-use efficiency in Latvia has not been developed either. Based on the works of foreign authors and experience it would be possible to develop a methodology that could be proper for Latvian lands, and could be used to determine land-use efficiency. Such methods should be based on the owner's needs and interests, as well as state and local interests [2].

The land is one of the most important production resources and agricultural land use is of great importance for national development. Not only in Latvia, but also in Finland, Lithuania and other countries the agricultural land is one of the key inputs. Analyzing the Latvian agricultural land use it is important to study the foreign practice. In Latvia agricultural land takes 25.5% of the total country area, in Finland 7.3%, because there is a large area occupied by forest land and in Lithuania agricultural land takes 54.5% of the total country area. Thanks to the land management package in Finland and Lithuania, the main use of agricultural land, protection and increasing areas of agricultural land is maintained by using land consolidation. With land consolidation farm configuration adjustments are promoted, reducing land fragmentation, making it easier for land management and increasing the efficiency of land use [3].

Land in rural areas is the main production resource, thus it is important to ensure the sustainable development of land which could be achieved by land-use efficiency. Land resources affect the efficient functioning of agriculture as well as economic, social and political stability. In the face of land use and its increasing need to think about it, it is necessary to be able to ensure a balance between land use efficiency and environmental protection without significantly increasing the cost of land use.

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# FACTORS INFLUENCING CADASTRAL VALUES OF AGRICULTURAL LAND

**Santa Belkus**

Latvia University of Agriculture/ Faculty of Environment and Civil Engineering Sciences undergraduate,  
Latvia

**Vivita Baumane**

Latvia University of Agriculture, Dr.oec., Associate professor, Latvia

One of the main profits-making sources in our country is agricultural lands cultivation, tillage and utilization. There are a lot of people in Latvia who are involved in agriculture. Yearly the holding peasant pays a real property tax to municipality which is determined by the cadastral value. The cadastral value is calculated each year by the State Land Service of Latvia (the SLS) [2]. Cadastral valuation process includes: cadastral value foundation development and the cadastral value calculations, but farmers have a question – how that bases value is originating. Farmers are dissatisfied with the property tax payment, it changes every year and is not constant.

The cadastral value is calculated considering the following dates from the Cadastre information system register: 1) cadastral value base 2) data characterizing the cadastre object 3) use of real estate goals 4) real estate object burden [3].

The main purpose of the study is to acquire and analyse farmers' views on the cadastral value and the real estate tax. For the questionnaire two types of questions were created - opened and closed. Respondents had to provide a concrete answer to the question or give their own answer. Microsoft Excel offered data processing functions were used in data processing [1]. The questionnaire was placed on the incorporated company "Latraps" website where 44 farm owners from all over Latvia provided their answers.

Respondents holding area ranged from 3 to 1200 hectares. The questionnaire helped to find out the indices of respondents' holdings, which are included in the cadastral valuation formula. These indices were: management area, if soil analyses had been carried out and one of the main issues - whether it is necessary and what changes would be desirable for the cadastral valuation model. 73% of respondents said that changes are needed in the cadastral valuation formula.

After examination of each proposal on the necessary changes it was concluded that one of the factors that could affect the cadastral value of the model could be the land use: whether the appropriate unit of land is obtained for some products, or it is used for production purposes.

On the basis of farm owners replies it is concluded that the current cadastral valuation model satisfied only 27%, but almost 80% of the respondents had suggestions for the real estate tax rate.

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# GNSS MEASUREMENT METHODS IN FOREST TERRITORIES

**Elita Eglāja**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering,  
Master student, Latvia

**Armands Celms**

Latvia University of Agriculture, Dr.sc.ing, Latvia

Real-Time Kinematic (RTK) surveying using Global Navigation Satellite Systems (GNSS) is now a common method used for both cadastral and engineering surveys. In order to verify accuracy and precision of measurement methods in forestry environment, field measurements were done. Measurements were done using Trimble R1 - GNSS Receiver, which is small, rugged and it has Bluetooth connection [3]. It was chosen for a variety of measurement methods such as RTK, EGNOS and Autonomous method (Uncorrected data). To save the measurement data the program TerraSync was used. EGNOS (European Geostationary Navigation Overlay Service) is the European satellite-based augmentation system (SBAS) for Global Satellite Navigation Systems. It has been deployed to provide safety of life navigation services to aviation, maritime and land-based users over most of Europe. EGNOS transmits wide area differential and ionospheric corrections and associated integrity information to users by means of geostationary satellites, delivering enhanced navigation performance [1].

Measurements with the EGNOS method were carried out with the accuracy of 70 centimeters to 1 meter and even higher, which is assessed as satisfactory taking into account that the measurements were made under the trees. RTK - [satellite navigation](#) is a technique used to enhance the precision of the position data derived from satellite-based positioning systems. It uses measurements of the [phase](#) of the signal's [carrier wave](#), rather than the information content of the signal, and relies on a single reference station or interpolated virtual station to provide real-time corrections [2]. Measurements with the RTK method were carried out with an accuracy of 40 centimeters to 70 centimeters, which is assessed as better featured than the second method. Using R1 Receiver, various difficulties had to be dealt with, such as getting accurate position data under tree canopies - because of multipath, block of signal and other disturbances. Measurements were done in one of the random forest massifs on several previously surveyed points.

Research results show that Trimble R1 Receiver provides higher – accuracy data than other GNSS receivers in forest territories. During network processing, the standard deviation, the coordinate and height differences, connection of the instrument fixation indicators and instrument initialization parameters were found, also the factors affecting the accuracy of measurement - ionosphere, a satellite location were analyzed. It is concluded that the influence of high trees and their canopies cause big errors of position and the inaccuracy of measurements.

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# MODELLING AND TESTING OF MOMENT RESISTING TIMBER CONNECTIONS

**Jānis Fabriciuss**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering,  
4th-Year undergraduate student, Latvia

**Lilita Ozola**

Latvia University of Agriculture, Department of Structural Engineering, Dr.sc.ing., Latvia

Portal frame structures have been gained an increasing popularity in a modern construction industry. They take less time for assembling comparing with traditional truss-column type structural systems. Because of the demands of aesthetics and the continuing need to achieve structural efficiency and cost competitiveness, portal frames are steadily evolving.

Creation of moment resisting connection (knee joint) between portal frame elements is the core problem in design. It is necessary to avoid any rotation between the members of the connection. Withstanding this condition, the connection may be classified as a rigid one and the bending moment produced by external loads can be transferred. Normally, steel profiles are very popular material for portal frames, where rigid joint has been made using bolted connections or welds, but steel may be replaced by much more environmentally friendly alternative material – glue laminated wood.

By current research author would like to examine available information and calculations methods used for semi-rigid connection design and to prove consistency with the experimental results of connection model tested under static loading.

Specific test model has been created, made of softwood lumber boards connected with dowel type semi-rigid connection (Fig.1). It is good practice to use a large number of dowels for hard loaded joints. Transferring of the shear forces produced by bending moment through many small fasteners provide the minimizing of local stress concentration. It is important to check if the theoretical load carrying capacity is compatible with the experimental. Theoretical value of the bearing capacity is the maximal force  $F$  up to which the rotation between timber elements in semi-rigid connection does not take place.

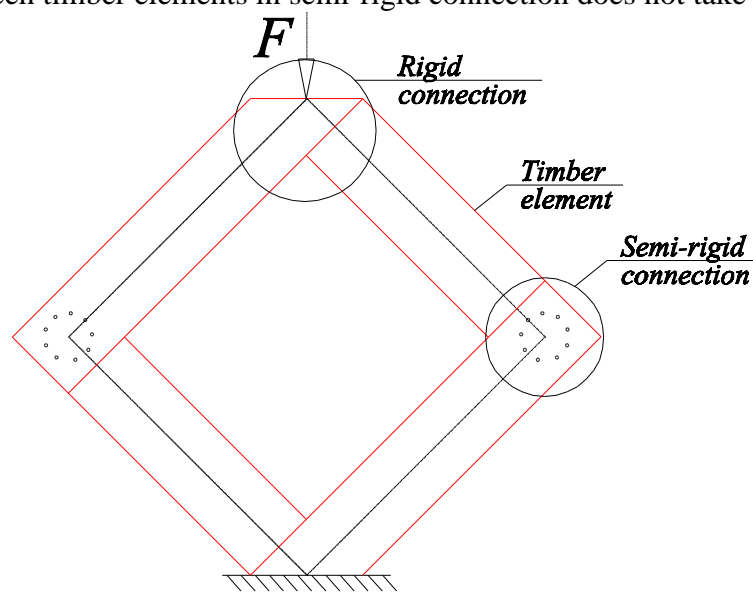


Figure 1. Test model with semi-rigid connection

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# THE ASSESSMENT OF THE SANATORIUM LANDSCAPE IN BALDONE

**Rūdolfs Feldmanis**

Latvian university of agriculture ,Latvia

**Aija Ziemeļniece ,**

Latvian university of agriculture, professor, Dr.arch, Latvia

**Una Īle**

Latvian university of agriculture, assist.professor, Dr. arch ,Latvia

The research of the area of the sanatorium in Baldone is important for the development of the city of Baldone and the attraction of the tourist infrastructure. The sanatorium is an important cultural and historical heritage, with regard not only to the architectural values of the building, but also to the green areas that serve as recreation for the overall image of the city of Baldone. In the course of the research, the functional zoning of Baldone is carefully analyzed, the resort resources of the city, the assessment of the proportion of the green areas and the indicators of the environmental quality are identified. The elite nature of the resort city and the nearby polluted areas - they are two opposites that are not permissible if the municipality wishes to promote the development of tourism. The study refers to the attraction of tourist and sporting activities in the suburban areas.

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(05.01.16)



# RESEARCH OF ABANDONED BUILDING AREAS

**Anta Freiberga**

Latvia University of Agriculture, Latvia

**Vivita Baumanė**

Latvia University of Agriculture, Dr.oec. Associate professor, Latvia

Brownfields in the Baltic States are a relatively new problem, therefore the terminology has not yet been fully developed, recognised or used in political documents, legislation and education [1].

There are several definitions for the concept of brownfield.

Brownfield - a territory of completely destroyed or damaged surface layer of earth, or building areas, useful mineral mines, industrial or military territories that have been abandoned [3].

The author also wants to address the most popular definition in Europe concerning brownfields. Brownfields are places, that:

- have been affected by a previous use of given or adjacent areas;
- are abandoned or unused;
- are polluted or are considered to be contaminated;
- are, mainly, situated in a developed city environment;
- with interference, can be returned to a useful state [1].

Degraded building - a building (situated in a living or rural area), that has currently been completely or partially abandoned (unfinished, unused, uninhabited, not maintained) and has become dangerous, decomposed, damaged by human actions or force majeure. The current state of the building is dangerous to people and adjacent construction sites, and it leaves a negative impact on the landscape [2].

In terms of this research the author surveyed 50 randomly selected abandoned or unused building areas in Latvia. The main criterion applied to all objects was abandonment. These building areas were abandoned, unused, overgrown or crumbled. The author took pictures of these places.

The next step was making a table, containing data collected at the abandoned building areas. While working on the table, the author researched these objects even further. The author compared her data with the information provided by the internet page of State Land Service. The comparison showed the author that 8 abandoned buildings, 5 of which have crumbled and 3 are abandoned construction projects, were not registered. 8% of surveyed objects are in Kurzeme, 16% are situated in Vidzeme, Latgale contains 30% of these objects, but Zemgale has 46%. Mostly these abandoned building areas are situated in rural areas. Only 19 out of 50 objects were situated in populated places. More than a half of these abandoned building areas were near rural, regional or main roads. At least 18 out of 50 are historical buildings that have been abandoned because of the changes in the society and authorities.

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# DETERMINATION OF THE TERRAIN OBJECT CHANGES

**Anete Geduševa**

Latvia University of Agriculture, Latvia

**Aivars Ratkevičs**

Latvia University of Agriculture, Mg.sc.ing., Latvia

Changes of terrain objects happen continuously, caused by natural conditions and as a result of economic activity.

Terrain is represented in a map where terrain objects are objects of map content. These objects are represented using cartographic language, or cartographic system of signs and symbols. Map is directly related to the situation of nature, because the map is a representation of the geographical reality [3].

Maps are used for various information acquisition which is in general about the location of some geographical object. Urban and regional planners make their use to unravel the planning problems and to show the progress made. Map is a visual material, showing a variety of significant differences that reflect the processes in the nature, the political and social sphere and other areas of research [2].

Topical issue is a map's duration of usefulness in which the map has to be used in order to solve various problems. Maps' duration of usefulness is influenced by how rapidly terrain changes.

Terrain object layers duration of usefulness can be predicted by measuring the amount of appropriate terrain objects layer changes in a number of time cycles and evaluating their importance and dynamics.

Determining the amount of terrain objects changes the content of maps using graphoanalysis – cartometry has been analysed. As a result numerical value measurements – amount of terrain object layers using descriptive statistics for processing of obtained data have been obtained [1,3].

After researching the amount of layer changes of terrain objects in the first and the second edition in the topographic map sheet of Cēsis in scale 1:50 000, it has been concluded that the most important changes of amount have occurred in the taken area of young forest stand where they have increased by 79.95 %, comparing to existing young forest stand areas in different editions of maps. Building territories have increased noticeably (about 10.39 %). These data show that these layers of terrain objects change more rapidly than in those layers where the amount of terrain objects is smaller. These layers become ageing and unusable sooner than the others.

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# REAL PROPERTY MASS VALUATION IN LATVIA

**Madara Grundmane**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering,  
graduate student, Latvia

**Vivita Baumane**

Latvia University of Agriculture, Dr.oec., Latvia

What is mass valuation and why is it used by so many countries in Europe for real property valuation? The need for mass valuation evolved when governments started to apply property tax that has required a large number of properties to be valued at the same time while maintaining low valuation costs.

Mass valuation of real property is a systematic valuation of groups of real property units performed on a certain date with the help of standard procedures and statistical analysis while individual valuation is focused on determining the value of individual property units and it is performed in public interests [1].

In Latvia the synonym for mass valuation is cadastral valuation.

The responsible institution for mass (cadastral) valuation of real property in Latvia is State Land Service (development of value zonings and determination of indexes of cadastral value basis – base values and correction coefficients). State Land Service performs mass valuation according to procedures determined by The Cabinet. The State Land Service registers and analyses the prices of the real property market and lease payments and determines the price level [3].

In Latvia the first mass valuation for the purpose of real property taxation took place in 1997. In 1998 the law “On Real Property Tax” came into force, and mass valuation procedure obtained obligatory status.

The legal framework for mass valuation in Latvia is the law “On Cadastre” (2006) and Regulations of the Cabinet of Ministers “Regulations on Cadastral Valuation” No.305 (2006).

The cadastral value is calculated taking into account the data which are registered in the Cadastre information system – the base of cadastral value; data characterising the cadastre object; purposes of use of the real property; encumbrances of the real property object [2].

The main applications of cadastral (mass) values are for real property taxation; determining the stamp fees, for example, Land Book fee; determining the land rent or privatization of land under constructions and there are many more tasks for real property cadastral value.

Objective mass (cadastral) value can serve as a basis for real property tax policy; as a result, proportionate, balanced and fair property taxes can be calculated.

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# ANALYSIS OF MARKET PRICES OF APARTMENTS IN KAZAKHSTAN AND EU COUNTRIES

<sup>1</sup>Marco Iaconianni, <sup>2</sup>Yryssaldy Khamitova

<sup>1</sup>Tuscia University of Viterbo, bachelor student, Italy

<sup>2</sup>Sh. Ualikhanov Kokshetau State University, master student, Kazakhstan

**Vivita Baumane**

Latvia University of Agriculture, Dr.oec., Latvia

The need for housing is topical for everyone all over the world. In different countries there is different understanding of the types of property, of their composition, as well as on the possibilities to obtain ownership [1, 2]. The opportunities of real estate acquisition are largely dependent on the available financial resources and real estate prices. The aim of the paper is to analyse the prices of apartments in Kazakhstan, Italy and Latvia. Average housing market prices in Astana, Rome and Riga were selected as the research object.

Monitoring shows that the average level of the equilibrium prices in tenge for housing market in Astana, in Kazakhstan is 340-350 thousand tenge/m<sup>2</sup>. The transition to tenge prices contribute certainty to pricing for all participants in the housing market [3].

Table 1.

Marker prices of apartments

	Riga			Astana			Rome		
	m <sup>2</sup>	EUR/m <sup>2</sup>	Price	m <sup>2</sup>	EUR/m <sup>2</sup>	Price	m <sup>2</sup>	EUR/m <sup>2</sup>	Price
With 1 room	35	857	30000	30	1026	30769	40	4500	180000
With 2 rooms	55	1090	60000	88	1195	105128	60	4250	255000
With 3 rooms	70	1428	100000	129	1650	212821	90	3777	340000

Considering all of the above, in the table examples of prices for 1, 2, 3-room apartments are given, and these prices are compared for capitals of Latvia, Kazakhstan and Italy. In the table it is seen that in Rome prices are the highest. For example, one room apartments of 30-35 m<sup>2</sup> in Astana cost 1026 EUR / m<sup>2</sup>, while in Riga 857 EUR / m<sup>2</sup>. The highest price is accounted for Rome – for 40 m<sup>2</sup> apartments the price is 4500 EUR / m<sup>2</sup>. It can also be observed that the difference in quadrature between Riga and Rome is only 10 m<sup>2</sup>, between 55 and 60 m<sup>2</sup>, but the price difference is more than 6 times. If we consider the 3-room apartments, the price of 70 m<sup>2</sup> in the capital of Latvia is 100 000 EUR, while the price in the capital of Kazakhstan for 129 m<sup>2</sup> is 212 821 EUR, and in Rome, the capital of Italy – 340 000 EUR per 90 m<sup>2</sup>, on average. Summing up the results it is evident that the highest housing prices at the moment are in Rome, following by Astana and the lowest prices are in Riga. The above mentioned prices are average.

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# **WATER CONSUMPTION EVALUATION IN THE CITIES OF JELGAVA AND VENTSPILS**

**Anete Kalnina**

Latvian University of Agriculture, Latvia

**Linda Grinberga**

Latvian University of Agriculture, Latvia

Water is used for different household needs - washing dishes, washing clothes, cooking, flushing toilets, showers and other needs. Bath, shower, toilet and laundry together spend around 80% of total water consumption. In recent years a change in "green-minded" population growth has been seen, this means that people increasingly choose more economical use of water resources, such as installing faucets with aerators. Drinking water consumption is calculated according to regulations issued by the Cabinet of Ministers No. 326 - Provisions of Latvian Construction Standard LBN 222-15 "Water Structures" paragraph 2.1. Drinking water consumption for household needs per day per capita (average per year) is determined by Table 1 of Construction Standard. The table shows that in apartment buildings with centralized water supply, water consumption per day per capita is between 150-200 l/day [1].

Comparing data on water consumption per capita in the period of 1996 - 2013, it is noticed that overall consumption is dropping - for example, if in 1996 an average resident consumed 186 liters of water a day (data analysis used 12 indicators of Latvian towns), then in 2013 estimated daily consumption was 65.8 liters (data from 15 localities) [2]. When looking at water usage, pipeline design may be overbuilt. If the pipeline is sizeable, then there is stagnant water and bacteria can grow there. Small flow rate results in more deposits and pipelines need to be rinsed frequently.

Scientific research shows water consumption dynamics of 1 capita per day in the cities of Jelgava and Ventspils. In this research the average water consumption volume and its changes are evaluated and compared looking at 1 capita per day in 2013 and 2014 multi-family house districts in Jelgava and Ventspils, as well as the differences between the factors are analyzed. The actual water consumption volumes are compared with the Latvian legislative norms specified and recommendations for updating the regulations are given.

The work is based on the SIA "Jelgava udens" (Ltd.), SIA "ŪDEKA" (Ltd.) and the apartment houses managers' data. The obtained data were processed by descriptive and analytical methods of mathematical statistics. Variation lines were used to describe averages and dispersion characteristics. Arithmetical mean, mode, median, range, or distribution range, variance, standard deviation, coefficient of variation and the sample average standard error were all calculated.

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# THE EVALUATION OF EXPROPRIATED REAL ESTATE FOR PROJECT RAIL BALTICA IN THE DISTRICT OF BAUSKA

**Laila Kampāne**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, undergraduate, Latvia

**Dace Didrihsone**

Latvia University of Agriculture, Mg.sc.ing., Latvia

Rail Baltica is a rail transport project with a goal to integrate the Baltic States in the European rail network. The project includes four European Union countries – Poland, Lithuania, Latvia and Estonia. Rail Baltica is one of the European Union's priority projects and falls under the Trans-European Transport Network (TEN-T). The project is important to Latvia, because the most of the European countries use the track width of 1435 mm, Latvia as well as the other Baltic States use the rail tracks width of 1520 mm. This is the reason why the current Baltic railway network and train carriages cannot be used to connect to the railway network of Poland and Germany. Rail Baltica railway would ensure independence to the transport system of the Baltic States and mobility of the inhabitants by using a safe, modern, fast and environmentally friendly transport which would in turn create a potential for new development, jobs and increased competitiveness [3].

For many years Latvia has been actively involved in the execution of this project. Designed railway zone crosses many real estate properties that are wholly or partly subjected to expropriation in the interest of public. This research is intended to evaluate the expropriated real estate properties within the district of Bauska for the purposes of Rail Baltica project. The district of Bauska has been chosen, because it is one of the regions where the largest land area has to be expropriated, as well as it is the only region in which the proposed railway corridor crosses agricultural areas of national significance, thus the district of Bauska is considered to be a very relevant subject of the research [2].

According to the overall project implementation plan in the region of Baltic, in Latvia expropriation of land has to take place from 2016 to 2019. Very soon the phase of property identification, gathering of information, research and design will begin [1]. This highlights the necessity and actuality of the research topic. One of the research objectives is to evaluate the appropriates of the expropriated real estate according to the local government spatial plan of Bauska's district, since if the public needs require only part of the real estate and the remaining part of it cannot be used according to the local government spatial plan, due insufficient size, the expropriation of whole real estate is proposed and executed if it has not been agreed otherwise with the owner of property [4].

Only one unit of land in the district of Bauska is entirely – required for the public need, the other 160 units involved are necessary only partly. In 25 of those units it is not possible to create a new land unit due to insufficient size, it would be possible to achieve the effective use of them in the process of consolidation. The consolidation process or any other approach would be needed because of these 25 units of land with a total area of 57.04 hectares, the project implementation requires only 13.82 hectares of land but, due to inefficient use, the state would have to expropriate the remaining 43.22 hectares, too. 12 of the above mentioned 25 units of land are agricultural areas of national significance.

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## DIVISION OF JOINT-PROPERTY INTO ACTUAL SHARES

Felicita Karkluvalka<sup>1</sup>, Tobylay Mukatova<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Faculty of Environment and Civil Engineering, undergraduate student, Latvia

<sup>2</sup>Kazakh National Agrarian University, Faculty of Forest, Land Resources and Horticulture, postgraduate student, Kazakhstan

Velta Parsova<sup>1</sup>, Elmira Mursalimova<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Dr.oec., Latvia

<sup>2</sup>Kazakh National Agrarian University, Candidate of Biological Sciences, Kazakhstan

In every European country there is such a property form as joint-property. In the Republic of Latvia joint-property appeared due to Land Reform, when land properties were assigned to former landowners as an object of inheritance. Nowadays, it is possible to become a co-owner also through a transaction (purchase – sale), or a result of the gift [2]. According to the Latvian legislation co-owners shall have the rights to create new joint-property or exit from joint-ownership if one has different purpose of land management. Division of real property with joint-ownership can be done by submitting an application to local government with a request of division from one of the co-owners. If the land is located in a protected area or in a territory which has a specific legal status, land division can be restricted or even prohibited [1].

In Latvia there are no available data on the total number of joint-properties in the Cadaster information system, because they are not registered separately.

Investigation was chosen in real property “Sunisi” which is located on the Coast of Sunisu Lake in Garkalne municipality in the village Sunisi. Property is encumbered by water protective zone and tow-path. Total area of property is 4 683 m<sup>2</sup> and almost half of it is flooded (land under water), but the rest area is a meadow (Fig.1.).

The real property has 15 co-owners – all of them, except one which is a legal person, are natural persons. Undivided shares owned by co-owners are:

- each of 13 persons owns 1/250 shares which are equal to 18.7 m<sup>2</sup>;
- one person owns 1/25 share which is equal to 187 m<sup>2</sup>;
- another person owns 227/250 shares which is equal to 4 252.9 m<sup>2</sup>.

If one of co-owners would like to divide particular property into actual shares, it is necessary to observe local government regulations of Garkalne municipality. In

Garkalne municipality spatial plan (designed for 2013-2024) has determined that local government should give permission for dividing a real property into shares, in each case individually depending on the specifics of the territory [3]. According to the Garkalne municipality spatial plan, division of property “Sunisi” into actual shares is not possible. So the co-owners must agree on property management by signing property management agreement and register it in Land Register (Land Book).

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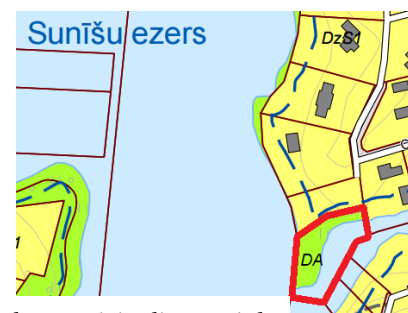


Fig.1. Garkalne municipality spatial plan (designed for 2013-2024)

# **BUILDING INSULATION WITH TIMBER FRAME PANELS - ADVANTAGES, DISADVANTAGES AND OTHER IMPORTANT FACTORS**

**Matīss Keivs**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering, graduate student,  
Latvia

**Andris Vulāns**

Latvia University of Agriculture, Mg.Sc.ing., Latvia

Nowadays more and more actual becomes the problem of saving the energy used for building indoor heating. One of the options is the building insulation.

At the times when legislation and specific regulations were not defined by high requirements, and their observance was not strictly controlled, there were constructed many energy-inefficient buildings.

To improve the situation, engineers are searching for more effective and more inexpensive solutions for building insulation and improving the energy efficiency.

Building insulation with timber frame panels allow to accomplish more qualitative insulation work even in the winter season. It is because the timber frame insulation panels are produced indoors. So the process of panel manufacturing is not disturbed by weather.

Timber frame panels are possible to embed with different types of insulation, for example – mineral wool, rock wool, glass wool, depending on usage type and customer needs.

Building insulation with timber frame panels allows to do insulation work in a very short time even in winter and it also allows to reduce building costs, because construction time is much shorter.

Aim of the work: explore the timber structure panel construction, mounting and attaching solutions. Analyse their constructive advantages and disadvantages, as well as conditions that must be taken into account in construction and mounting time.

Tasks of the research:

- Do literature analysis;
- Analyse wind load influence to timber frame panels;
- Analyse differences between different types of timer frame panels;
- Analyse timber frame possible attachment ways to buildings;
- Find out, which of the timber frame attachment ways is the most effective and advantageous.

Expected Conclusion:

In the result of research, it is planned to explore and compare a different timber frame panels construction solutions, conclude what are the advantages and disadvantages of different construction solution types. Conclude what is the influence of external load to panels mounting solutions and which of them is more advantageous.

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# THE IMPACT OF LAND PLOT FORMATION AND REFORMATION PROJECTS ON LAND USE

**Dovilė Kučinskienė**

Aleksandras Stulginskis university/Institute of Land Management and Geomatics, Faculty of Water and Land Management, master student, Lithuania

**Jolanta Valčiukienė**

Aleksandras Stulginskis university/Institute of Land Management and Geomatics, lecturer, doctor of technological sciences, Lithuania

The **aim** of this research is to carry out the analysis of the impact of land formation and reformation projects on land use.

**Materials and methods.** Scientific literature, legislation, online sources analysis, data cataloguing, graphic modelling, generalization and logical abstract methods were used during the research. Two Lithuanian municipalities (Kaišiadorys and Elektrėnai), were selected as the object of the study. These are two bordering municipalities, which differ strongly enough in number and size of farms as well as in the volumes of preparation of land forming redevelopment projects. The study analysed land plots formation and reformation projects prepared within the boundaries of the sub-districts of the above-mentioned municipalities over the last three years (2013, 2014 and 2015), as well as a detailed analysis of agricultural land plot sizes formed with the help of these projects, and sizes of land plots used in farms in general prevailing in these areas.

**Results and discussion.** 248 projects were prepared in both municipalities during the analysed period. The majority of the projects, i.e. more than 64.9 percent were prepared in Elektrėnai municipality. Most of the projects consisted of divisions – 114. According to the data of January 1, 2016, Elektrėnai municipality has registered 1473 farms. The area of all cultivated fields of farms covers an area of 7,247.73 ha. The land area per farm consists of 4.92 ha, it is by 4.45 ha smaller than the average in Lithuania. According to the data of January 1, 2016, 2834 farms were registered in Kaišiadorys District, they occupied an area of 21533 ha [1]. The average farm size in this area is 7.60 ha, it is by 1.77 ha smaller than the average in Lithuania. Compared with neighbouring countries, Lithuanian farms are much smaller than in the entire European Union. In Latvia, the average area of land per farm is 12.4 ha. In Estonia, the average farm size is 12.7 ha and in Poland – 8.4 ha [2]. According to the nature of the analysed areas, farms are similar, i.e. virtually all of them are engaged in plant-growing activity. An analysis of the size of farms and the prevailing soil productivity score in cultivated parcels as well as the calculation of the correlation coefficient show that the size of the farm is not dependent on agricultural land productivity scores.

**Conclusions.** The major part of the prepared land plots formation and reformation projects in the analysed areas consists of the projects designated for the division of land plots. It follows that quite intensive agricultural land crushing happens, it is partly contrary to the legal rational land use principles, because there is no control of land size and shape, as well as it is contrary to the provision that in order to be competitive in agricultural activities land holdings need to be enlarged. The average farm area in Kaišiadorys district covers 3.15 ha more than the farm area situated in the municipality of Elektrėnai, though in Lithuania the average farm area is 9.37, it is no match for the neighbouring countries. The farmers' farm size does not depend on the productivity score of the cultivated agricultural land.

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# OPTIMISATION OF SUSTAINABLE WATER LEVEL MANAGEMENT: CASE STUDY OF LAKE USMA

**Anna Kuduma**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering,  
graduate student, Latvia

**Inga Grīnfelde**

Latvia University of Agriculture/Head of Scientific Laboratory of Forest and Water Resources, Latvia

There are many discussions about sustainability, but how does it all work in real life? This study is aimed to see and compare economic benefits from each sustainability element (environment, society and economic) and to find the optimal water level in the lake.

The conditions in Lake Usma conform the study aim. Interests of strict nature reserve Moricsala, local society and culture, tourism industry and the Grava's and Vecdzirnavu HPS on the only outflow river from the lake are discussed.

The study focuses on the water level observations in Lake Usma [4] and the water level observations in the Grava's and Vecdzirnavu's HPS reservoir [2] in the time period from 12.07.2012 to 30.10.2014 are compared.

To estimate the financial profit from each element involved, calculations are made based on public information of electricity prices, the Grava's and Vecdzirnavu HPS technical project's [3] technical calculations, the method of calculating the power generation in the HPS [1] and publicly available information about prices of campings around Lake Usma.

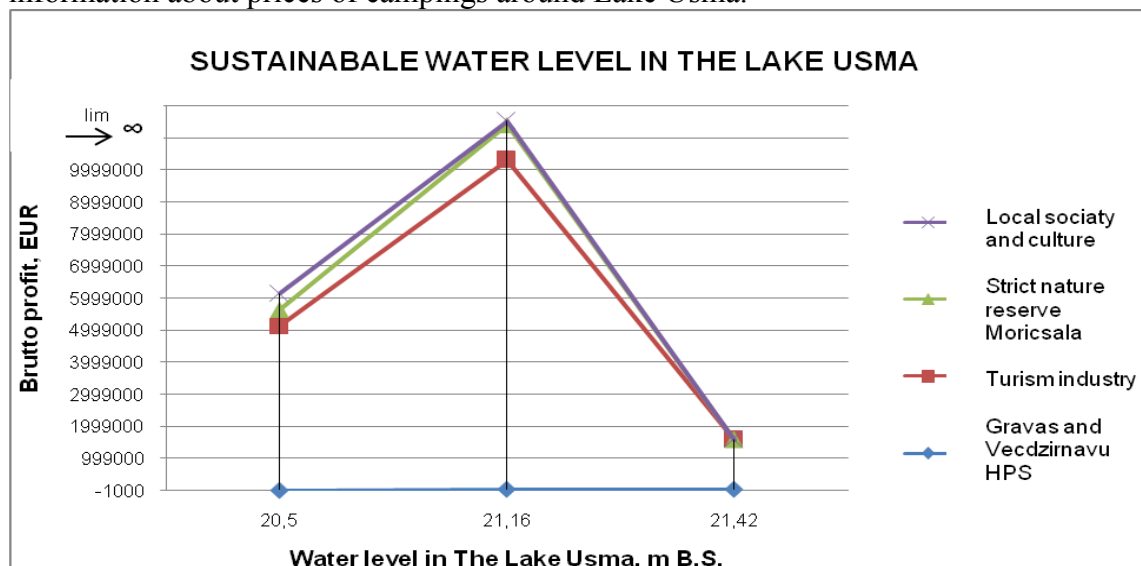


Fig.1 Sustainable water level in Lake Usma

The study results show that the optimal water level in Lake Usma to achieve the sustainability is the average water level – 21.16 m B.S.

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# DEVELOPMENT OF PURPOSE OF USE REAL PROPERTY USE IN MUNICIPALITIES OF LATVIA

Irena Kukule<sup>1</sup>, Ayaulym Nurymbay<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Faculty of Environmental and Civil Engineering Sciences, postgraduate student, Latvia

<sup>2</sup>Kazakh National Agrarian University, Faculty of [Forest, Land Resources and Horticulture](#), postgraduate student, Kazakhstan

Vivita Baumanė<sup>1</sup>, Elmira Mursalimova<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Dr.oec., Latvia

<sup>2</sup>Kazakh National Agrarian University, Candidate of biological sciences, Kazakhstan

One of the cornerstones of land resources sustainable use is the use of land resources for the identified needs. In every country it is needed to list the land after the type of land use. Such function of land classification in Latvia is maintained by the classification of real property use purpose. In a certain period of time needs of the specific purposes for which the land resources are used are changing, so the aim of this study is to research changes of areas of purpose of real property use in municipalities of Latvia [4, 2].

In the regulation No.496 of Minister Cabinet it is defined that the purpose of use of real property is determined to a land unit or a part of land unit for purposes of cadastral evaluation according to a detail plan, to a territorial planning of municipality or to a current use of land or building initiated within the procedures specified in regulatory [3]. According to this regulation 12 groups of purposes of use of real property are defined.

In this study data with a public availability about time period from 2009 to 2014 were used. These data show that the largest land areas are covered by two groups – Agricultural land and Forestry land. The first of both groups covers 59,0% and the other covers 34,1% from the territory of Latvia.

Analysis on changes of land areas in groups of purposes of use of real property between 2015 and 2009 shows that there are some major changes between them. For example, Agricultural land area has reduced by 1,8%, but Forestry land area has increased by 2,3%.

In order to obtain a more precise explanation to these changes, the analysis of relative and absolute indicators of dynamic rows of areas of Agricultural land and Forestry land in 110 municipalities about the time period of 2009 to 2014 was made [1]. It revealed the tendency that if the area of Agricultural land group in municipality or other researched territory has reduced, then there is an approximate increase of the area of Forestry land group in the same territory.

The analysis of the purpose of use of real property in Latvia municipalities demonstrates the trend of decrease of Agricultural land resource areas in proportion to the increase of Forestry land resource areas, excluding the region around Riga, where the area of Agricultural land and Forestry land resources is decreasing, but Residential land resource area for the needs of development of the capital is increasing.

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# LAND USE IN THE GAUJA NATIONAL PARK

**Daiva Lisovska**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering, Latvia

**Anda Jankava**

Latvia University of Agriculture, Professor Dr. oec., Latvia

The Gauja National Park (GNP) is the largest and oldest national park of Latvia. The park is located in Vidzeme – its territory is situated in Pārgauja, Priekuļi, Cēsis, Līgatne and Sigulda municipalities.

The Law on GNP sets out that the park was established in order to protect little transformed nature territories that are characterized by rich biodiversity, rock outcrops, relief forms, boulders, springs, typical landscapes and natural and cultural monuments as well as to promote nature tourism and sustainable development of the territory. The park is divided into 5 functional zones: the nature reserve (strict regime), restricted nature, landscape protection, cultural and neutral zones. Restrictions apply for economic activities that are allowed or prohibited in each zone. The strictest restrictions apply for the nature reserve, but the least restricted is the neutral zone. The zones influence types of land use, for instance, there are mainly forests in the strict regime zone in Pārgauja municipality, but in the landscape protection zone – agricultural land.

The territory of GNP that occupies the nature reserve zone is predominantly owned by the state, and the most part of it is covered in forests. The most of agricultural land can be found in the landscape protection zone and is owned by natural persons. The greatest part of the territory of GNP is located in the landscape protection zone.

The goal of the research was to explore and evaluate land use in the territory of GNP Pārgaujas municipalities Raunas parish. The research object was 10821.11 ha large territory of the park located in the former Cēsis district. It consists of Pārgauja, Priekuļi, Cēsis, Amata and Līgatne municipalities.

By using a cadastral map and orthophoto, land units of the mentioned territory were inspected and their areas, ownership statuses and land use types were analysed. According to the division by ownership status, the most land units in the mentioned territory of the park belong to natural persons (814), slightly less is owned to legal persons (88), the municipalities (84), but the least the state owns (81).

The largest part of the state-owned land in the analysed territory is covered in forests; a small part is found also under roads. Municipality-owned lands are mostly land under roads and land under water. The most of land units owned by natural persons are agricultural land.

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# ASSESSMENT OF LAND FRAGMENTATION IN DOBELE MUNICIPALITY

**Linda Mičure**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering Sciences,  
undergraduate student, Latvia

**Velta Paršova**

Latvia University of Agriculture, Dr. oec., professor, Latvia

Since 2009, as a result of administrative territorial reform, the former Dobeles region has been divided into three administrative units - Auce, Dobeles and Tervete municipality. The territory of Dobeles municipality consists of its administrative centre – town Dobeles and ten municipal territories (Annenieki, Auri, Berze, Biksti, Dobeles, Jaunberze, Krimunu, Naudite, Penkule, Zebrene).

The total area of Dobeles municipality is 89 thousand hectares [2]. As a result of land reform, land properties were established and land was subdivided between physical and legal persons, state authorities and municipalities.

The investigation shows that almost a half (44%) of Dobeles municipality structure consists of small sized properties, with total area of less than 1 hectare. A significant part (22%) of the municipality structure is taken with properties of total area between 1 and 5 hectares. In the group of total area between 5 and 50 hectares the distribution of properties is 9% and 11% - accordingly. Only 3% of properties are large sized - with total area between 50 and 100 hectares. There is about 1% of properties with total area of over 100 hectares.

The analysis made according to interval groups of property area shows that the largest number of relatively small properties (by 20 hectares) is mainly located in Auri, Berze and Krimunu municipal territories. Medium sized (from 21 to 100 hectares) properties are mostly located in Naudite and Zebrene municipal territories, while the largest number of properties with total area over 100 hectares is located in Zebrene municipal territory. It means that property structure in Zebrene municipal territory is more suitable for agricultural production.

Also, it is important to analyse land fragmentation of real properties. One of the characteristics of land fragmentation is the number of land parcels in real property. In Dobeles municipality real properties with 1 land parcel mostly are located in Auri and Krimunu municipal territories, which proves the fact that those are single pieced and non-fragmented real properties. The number of real properties, which consists of 2 land parcels, in Dobeles municipality does not differ drastically. However, more of such properties are located in Auru and Krimunu municipal territories, but fewer in Zebrene municipal territory. Similar situation can also be seen with 3 land parcels, but in this case the number of real properties in each municipal territory does not exceed 6 and is not fewer than 3 properties [1].

It can be concluded that about 66% of the total area of Dobeles municipality is occupied with real properties of total area by 5 hectares, so this area can be considered as small-area properties territory. According to statistics, the largest number of real properties with total area over 100 hectares is located in Zebrene municipal territory, where land is mainly used for the aim of agricultural production.

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# THEORY AND EFFICIENCY OF STATE CONTROL OF LAND USE AND PROTECTION IN THE REPUBLIC OF BELARUS

**Tatiana Moskaleva**

Belarusian State Agricultural Academy, Land Use Planning Faculty, undergraduate student, Republic of Belarus

**Oksana Gargarina**

Belarusian State Agricultural Academy, Candidate of agricultural sciences, docent, Republic of Belarus

State lands use and protection control is one of the land use management functions. The main task of state control is to observe the legislation of the Republic of Belarus, to prevent its violation and to punish the guilty in case of committing this offence. This means that government control spreads onto all areas of land resources management.

State lands use and protection control is of constant nature and it is not limited by the time framework, and it is implemented on the whole territory of a definite area irrespective of whose use, possession or property the land plots are [1].

Effective land use continues to be a challenge. It is confirmed by the results of the analysis of the situation based on the results of implementation of the state control of use and protection of lands, and also inspections of the territory when performing land management works in various regions of the country, studying of data of remote sensing, including aerial photographs.

Unfortunately, different kinds of land degradation take place because of nonobservance of ecological requirements and restrictions which are regulated by law. Intensive use accompanied by mineralization (destruction) of drained peat-bog soils keeps going on and as a result the volume of water and wind erosion does not decline. There are cases when farm lands are polluted by effluents from farms (where treatment facilities do not exist or do not function), irrational use of a fertile layer of soil, setting up of unauthorized dumps and careers, unsystematic placement of various functional objects, unauthorized occupation, inappropriate and thrifless use of the land plots, emergence of the empty waste lands, etc. These facts can discredit the governmental policy in land use and its protection.

One of the main directions of the increase of land use efficiency and protection is further improvement of state regulation and management mechanisms in land use and protection. This mechanism includes:

- creation and development of legislation in land use and protection;
- perfection of public administrative system;
- implementation of state land cadaster and state registration of real property, rights of it and deals with it;
- supplementation by the development of economic and market methods.

The goal of land control is to provide scientifically grounded, rational and effective use of land. If this goal is achieved the control system is effective. Efficiency of state control can be described as the relation between the number of offences that were revealed by the state control agency and the number of offences that were removed.

Efficiency of state control index is defined as:

$$E = \frac{N}{N_{rem} + N_{pr}}$$

where N is the number of offences that were removed;  $N_{rem}$  is the number of offences that were revealed and  $N_{pr}$  is the number of offences from previous year. While determining this index it is necessary to consider the data of land area. It has the same formula [2].

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# FORMS OF LAND OWNERSHIP AND THE BASIS OF THEIR REGULATION

**Tobylay Mukatova<sup>1</sup>, Felicita Karkluvalka<sup>2</sup>**

<sup>1</sup>Kazakh National Agrarian University, Faculty of Forest, Land Resources and Horticulture, postgraduate student, Kazakhstan

<sup>2</sup>Latvia University of Agriculture, Faculty of Rural Engineering, undergraduate student, Latvia

**Elmira Mursalimova<sup>1</sup>, Velta Parsova<sup>2</sup>**

<sup>1</sup>Kazakh National Agrarian University, Candidate of Biological Sciences, Kazakhstan

<sup>2</sup>Latvia University of Agriculture, Dr.oec., Latvia

In Constitution of the Republic of Kazakhstan it is determined that the land, entrails of the earth, flora, fauna and other natural resources are state-owned. The land may also be privately owned on the terms, conditions and within the limits established by law.

Terms, conditions and limits of land transfer to private ownership are regulated.

According to the Land Code of the Republic of Kazakhstan, in the private property of citizens of the Republic of Kazakhstan may be land for farming, private subsidiaries, forestry, horticulture, single-family housing and summer cottages, as well as land provided for construction or built-up areas for industrial and non-productive structures, including dwelling houses, buildings (constructions) and their complexes. The land intended for maintenance of structures in accordance with their purposes may be private property as well.

Agricultural land in Kazakhstan may also be assigned for use. There may be two types of land use – permanent and terminable land use which may be on payment or free of charge base. Terminable land use may be for short-term (up to 5 years) and long term (5 to 49 years).

The subjects of permanent land use are all state institutions and subjects of terminable land use - citizens and non-governmental legal persons, and foreign physical and legal persons as well. Rights of terminable land use (lease) may be transferred to physical and legal (non-governmental) persons and international organizations. Short-term lease may be assigned only to citizens and legal persons of Kazakhstan [1].

Problems of land relations regulation are related not only to land legislation itself, but also often are politically motivated, e.g. unsettled state system, economic situation, social conditions, etc. Solution of such problems requires long and scrupulous work in the process of creating a new system of land use, which would allow the freedom to fulfil ownership rights and social justice in the use and redistribution of the land [2].

Not only the form of the ownership and land use determines efficiency of land use and agricultural production, there are other factors, too. An important role in the efficient use of land is played by financial conditions of enterprises, material and technical supply, good management, active governmental support by stimulating of the improvement of quality of land plots [3].

In current circumstances there is a need for combination of state and private ownership of the land and their coexistence. Ownership as an economic category is the fundamental basis of any type of property relations. Form of land ownership determines the essence and character of the development of land relations. Land ownership has been and will remain a factor in the political and socio-economic development of society in the agricultural sector.

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# EFFECTS OF MORATORIUM OF AGRICULTURAL LAND MARKET IN UKRAINE

Nataliia Nesteruk<sup>1</sup>, Kristine Stendzeniece<sup>2</sup>

<sup>1</sup>Lviv National Agrarian University, Faculty of Land Surveying, graduate student, Ukraine

<sup>2</sup>Latvia University of Agriculture, Faculty of Environmental and Civil Engineering Sciences, undergraduate student, Latvia

Roman Stupen<sup>1</sup>, Velta Parsova<sup>2</sup>

<sup>1</sup>Lviv National Agrarian University, PhD, Ukraine

<sup>2</sup>Latvia University of Agriculture, Dr.oec., Latvia

At present moratorium for sale of agricultural land is established in Ukraine. Now discussions are going on on canceling or to prolonging this moratorium on agricultural land market in Ukraine. Opinions of different social layers differ, but most of the population is for prolongation of the moratorium. At present, living standards in rural area of Ukraine are at a critically low point and need improvement. Rise of well-being of the poorest layers of the Ukrainian population is one of the positive effects of the moratorium cancellation. It is also an obligatory condition for rural development by means of local small farming and entrepreneurship growth. It is necessary to keep in mind that liberalized land market considerably rises the value of land in comparison with a closed market [3].

Such consequences of the moratorium prolongation on purchase-sale of agricultural land can be mentioned as negative :

- 1) prevention of optimization of agricultural land ownership and land use, impossibility to improve technological conditions of agricultural land use because of irrational sizes of land ownership, cross-striping, insertion of tiny plots of other owners into a large land area of farms, etc.;
- 2) concentration of a large share of agricultural land in ownership of the least economically efficient part of rural population (retired people and people near retirement age);
- 3) inheritance of agricultural land plots by people living in cities, other countries, not intending to deal with agricultural production and manage the land assets;
- 4) obstructing of the processes, aimed on establishing large-scale farms of market type;
- 5) fall of investment attractiveness of Ukraine's agrarian sector [2].

Summing up, one should note that considering all positive and negative effects of the moratorium mentioned, it is of great importance to pass the law of Ukraine "On land market", providing legal preconditions for agricultural land market introduction and approving limited state regulation of the transfer procedure by owners of property right for agricultural land plots. It will secure the introduction of market economic circulation of property rights for agricultural land plots with minimization of its potential negative social-economic effects [1].

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# PREDICTION AND PLANNING OF LAND RESOURCES RATIONAL USE

**Ayaulym Nurymbay<sup>1</sup>, Irena Kukule<sup>2</sup>**

<sup>1</sup>Kazakh National Agrarian University, Faculty of [Forest, Land Resources and Horticulture](#), postgraduate student, Kazakhstan

<sup>2</sup>Latvia University of Agriculture, Faculty of Rural Engineering, postgraduate student

**Elmira Mursalimova<sup>1</sup>, Vivita Baumane<sup>2</sup>**

<sup>1</sup>Kazakh National Agrarian University, *Candidate* of biological sciences, Kazakhstan

<sup>2</sup>Latvia University of Agriculture, Dr.oec., Latvia

Science-based prediction plays the role of extreme importance in the current economic conditions in improvement of land relations and land management. Prediction of the land resources use allows solving tasks of effective and rational use of land, to balance supply and demand on the land. It allows revealing the perspective on nearest and more distant future in the use of land and facilitating development of optimal long-term plans, based on structured prediction. Solution of these problems at different administrative levels has a high practical significance for the country as a whole [1].

In Kazakhstan in market economy conditions the need for forward-looking development in all spheres of the national economy has increased. The main purpose of planning the land use in the agricultural sector of economy of Kazakhstan is to predict the future needs of agricultural sector in land resources, to determine to what extent they can be met, to reveal differences between the demand for productive land and their presence in the country.

The emerging picture from such a forecast will be useful for anyone who is responsible for the management of land resources and the future development of agriculture.

Rational use of land resources is of great importance in the agricultural economy and the country as a whole. Inventory and assessment of land resources is of great importance, since the land is the basis for agricultural production. In recent years the increase of area of arable land has stopped, suitable for agriculture land already is involved in agricultural production, only solonetz, salt marshes and sand have remained. Despite this, agricultural land still has been assigned for non-agricultural purposes – for the construction of roads, industrial plants, housing and other facilities.

Taking into consideration current trends, that land is removed of agricultural use and the solution of the problem of food security is necessary, there is an urgent need in preservation and development of agricultural land [2].

For this purpose it is necessary to perform qualitative evaluation of land, monitoring and prediction of its possible use. This will expand the base for sustainable and long-term relations between economic subjects and state authorities. It is necessary for developing long-term economic policy. Many countries have successfully used national and regional programs and strategic development plans of land management, based on development predictions.

Prediction of agricultural land development use should be taken into account as a reserve of agricultural production. It is necessary to select priority areas for financing the development of agricultural production and to identify trends in qualitative characteristics of land [3]. Rational use and improvement of the land resources of Kazakhstan would make it possible to ensure production of various agricultural products in quantities that meet domestic and export needs.

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# THE IMPACT OF CATCHMENT AREA LAND MANAGEMENT ON LAKE WATER LEVEL FLUCTUATIONS

**Sabine Oficiere**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, undergraduate

**Inga Grinfelde**

Latvia University of Agriculture, Head of Scientific Laboratory of Forest and Water Resources, Latvia

The growing world population requires additional food production increase and living space development. Human activities rapidly cause changes to the land use, and they also change the hydrological response units in the catchment area, which significantly affects not only drainage hydrology, but also the hydrological regime of lakes and reservoirs. This results in changes of natural habitats in protected areas, biodiversity loss, as well as gives negative impact on tourism industry development opportunities [1]. All the largest lakes in Latvia face similar challenges; and therefore a case study was made for Lake Usma catchment area.

Lake Usma is unique in terms of its fascinating natural appeals that attract tourists and water resources used for electricity generation, recreation and fishery. To find an optimal model for the lake management and sustainable development of the catchment area, there was a need for a thorough research study. Thus, the study aim was to evaluate the impact of land management in the catchment area of Lake Usma on fluctuations of the lake water level. The main tasks of this study were to identify and analyse Lake Usma catchment area land use structure and to compare it with the historical types of land use, using the mathematical model METQUL2012 to adjust the hydrological response unit structure for each period.

Another task was to model water levels of Lake Usma using a hydrodynamic model, assuming that there are no obstacles in the lake outlet bed. Lake Usma, as an object of the study was chosen because monitoring in this lake has been taking place since 1927 that is a sufficient period of time to be able to assess the impact of the land use changes on the hydrological regime of the lake. According to free maps available on the Internet, areas of farmlands, swamps, wetlands, lakes, urban areas and forest areas during different time periods are grouped in respective categories. Percentage of these data are calculated and used in the METQUL2012 model. The mathematical model METQUL2012 was created at the Latvia University of Agriculture for the purpose of hydrological calculations of unexplored river catchments as well to predict the hydrological regime changes through future climate scenarios [2].

The research results showed that land use changes were significant in the period from the beginning of the 20th century to the present day, which explain the rapid rise of Lake Usma medium water level during 70ties and 80ties of the 20th century. The obtained results showed a significant impact of anthropogenic components associated with the lake outlet hydraulic regime, especially during periods of low and high water levels and flood periods. Lake Usma water level regime changes were associated with Lake Usma catchment area land use changes, but the most significant changes were caused by the lake outlet bed obstacles.

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## **CURRENT STATE OF LAND REFORM IN UKRAINE**

**Olga Oliynyk**

Lviv National Agrarian University, Faculty of Land Management, undergraduate student, Ukraine

**Oksana Stupen**

Lviv National Agrarian University, Candidate of Economics (PhD), Senior lecturer of the Department of Land Resource Management, Ukraine

An objective necessity in the implementation of land reform has appeared since Ukraine's independence and the launch of market transformations. All Ukrainian land is declared as an object of land reform in 1991. A great work of its implementation has been carried out during these years. Such main stages as denationalization and privatization of lands are done.

49.7% of the land remains in public ownership in the result of the redistribution of land resources. About 6.7 million citizens, who were members of collective agricultural enterprises, received certificates for the land plot (share). 11 million citizens privatized their land plots of an area of 3.2 million hectares. Payment on land is introduced. The monetary valuation of agricultural land is conducted. Its cost is about 307 billion UAH. The monetary valuation of non-agricultural land is implemented, too [1].

The area of agricultural land decreased from 1990 (42.0 million hectares) to 2015 (41.5 million hectares) for 518.6 thousand hectares. The reason for this change is due to the significant use of non-agricultural land, first of all urban one. The land area for building increased from 1990 (0.6 million hectares) to 2.0 million hectares in 2015 and has amounted for 2.55 million hectares. The total area of woodland increased from 10.2 million to 10.6 million hectares (on 408.8 thousand hectares) during that period [1].

There are also disadvantages of the land reform. A final delimitation of state land and municipal property is not done. The mechanisms of land plots free circulation do not operate, including mortgage lending. The issue of forming agricultural land market is not resolved. Virtually measures on land protection are not conducted. 13.4 million hectares of agricultural land are damaged by water erosion, including 10.6 million hectares of arable land (32% of their total area), about 68 thousand hectares of which have lost their humus horizon [2].

The final stage of the land reform will be the removal of moratorium on agricultural land's sale. An important condition is the improvement of the legal framework of land relations regulation in order to avoid "speculations" of agricultural land and the monopolization of the market of these lands.

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# VERTICAL MOVEMENT OF EARTH'S CRUST IN CARTOGRAPHIC MATERIALS

**Harijs Pavelčuks**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, undergraduate student,  
Latvia

**Armands Celms**

Latvia University of Agriculture, Dr.sc.ing., Latvia

Nature is in an evolutionary process - a continuous movement. Everything moves, changes and transforms. The planet Earth is no exception. In one place Earth's crust rises, but in another it sinks, creating mountains and valleys, changing coastlines, sea levels, etc. [3]

The movement of the Earth's crust is mainly related to historical natural processes in Latvia, and in the Northern European region as a whole. Various Ice Ages, especially the most recent, have left irreversible effects on the Earth's crust. The thick ice that covered this territory, exerted enormous pressure on the Earth's surface, which caused Earth's crust depression. When the ice melted, with a resultant decrease in pressure, the Earth's crust could rise again. This effect is known as *Fennoscandian land uplift* [2].

The speed of the land uplift is determined by comparing repeated precise leveling, GNSS or other measurements of different time periods. In the territory of Latvia the uplift speed reaches 1-2 mm/year, but in the central part of Scandinavia can be as big as 11 mm/year [1]. In other words, in 100 years it is 10-20 cm in Latvia, but 110 cm - in Scandinavia. There is a clear evidence of this in Scandinavia, where as a direct result of land uplift, harbours and even entire cities had to move closer to the sea, because harbours were no longer possible to reach by boat [2].

One of the ways to research the vertical movement of the Earth's crust can be by aligning or georeferencing historical cartographic materials and comparing them with most recent cartographic materials. Comparing seashore, road networks, inland navigation development and even formation of lakes gives us information about how the vertical movement of the Earth's crust has tended to happen in different regions. For example, if in a specific place the sea fallback is discovered, then, quite possible, in this exact place Earth's surface is moving downwards.

When we know what the Earth's levels were 100, 200 or 500 years ago, then using discovered tendencies it is possible to predict what they can be 100, 200 and even more years in the future. A well-founded understanding of future tendencies makes it possible to plan appropriate long-term spatial development. This is essential to ensure sustainable and rational use of territories and other resources.

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# **BUILDING MATERIAL COST AND QUALITY COMPARISON**

**Laura Platace**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering, graduate student,  
Latvia

**Sandra Gusta**

Latvia University of Agriculture, Associate professor Dr. oec., Latvia

One of the most important parameters in building process that is used in public and private procurement, is the lowest price. [2] In other words – legislation of Latvia permits that in estimate forming process does not include criterions of quality, durability, the potential high cost of maintaining the building during the exploitation time. That allows the builder reduce the cost of estimate using the cheaper product or technology and let not to provide highest possible quality and the basic principle of sustainable construction. [1] One of possible construction cost reduction solutions is replacement of building material with equal building material, at the same time assessing the quality and replacement impact on the estimate direct costs.

Key words: Estimate. Construction products. Quality. Technical characteristics. Costs.

Aim of the work: Reduce estimated costs by replacement of the existing building materials with analogue materials, at the same time respecting the Latvian Republic legislation.

Hypothesis of the research: Direct construction costs can be reduced by the replacement of the building materials with analogous materials.

Tasks of the research:

- Do literature analysis (what is estimate, what include estimate, on what basis it is made);
- Analyse existing building estimate, figure out which building materials is used, search for technical characteristics of materials, also explore specific junction of construction;
- Replace selected building materials with analogues, thus reducing the direct costs of estimate;
- Assess the impact of the building material price to quality;
- Compare obtained estimated costs with current estimate costs;
- Do laboratory research and compare the building materials and analogue materials technical characteristics, are they performing parameters that is definite in the declaration of performance.

Expected conclusion: It is planned that in the result of the research hypothesis will not be proven. It is possible that estimated costs will even increase and it can be explained by the fact that the estimate was created using the least expensive building materials so it can be competitive in public procurement process.

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# IMPACT OF THE TOWPATHS ON THE MANAGEMENT OF COASTAL TERRITORIES OF WATER BODIES

Justīne Poļņija<sup>1</sup>, Zhanna Tsyhanenko<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Faculty of Environmental and Civil Engineering Sciences, graduate student, Latvia

<sup>2</sup>Lviv National Agrarian University, Faculty of Land Surveying, postgraduate student, Ukraine

Velta Parsova<sup>1</sup>, Nataliia Stoiko<sup>2</sup>

<sup>1</sup>Latvia University of Agriculture, Dr.oec., Latvia

<sup>2</sup>Lviv National Agrarian University, PhD, Ukraine

Currently there is a number of legislative documents in force in Latvia, whose main task is to organize and regulate public and private property rights. Nowadays the concept of property is absolute, and society tends to assume that property rights are so sacred that the public interest should always be to make concessions. So it is very important to know regulations, mainly if it relates to the ownership of the land and water bodies and especially important to be aware of ownership rights of every water body and existence of towpaths and specific restrictions, because each citizen of Latvia can have a desire and rights to stay close to nature and enjoy recreational facilities provided by water.

It requires clarity about towpath – what people and property owners may or may not do there. Research "The legal status of towpath", made by I.Čepāne and S.Meiere confirms that state institutions and local municipalities have great power to ensure legal regime of towpath, and their realization is necessary to fulfil legal aspects of the towpath [2].

By the Civil Law of Latvia, the towpath is determined just regarding public waters (rivers and lakes). Names of public waters are included in a special list, which is annex of the Civil Law. According to the Civil Law and Fishery Law, fishermen and anglers have rights not only to use the public water, but also a towpath [1; 4]. According to the Fishery Law, a towpath is a land strip (band) along the water shore for fishing or navigation, or related activities and movement of pedestrians. In land boundary plans towpath is restriction on the right of use, so landowner must expect that every person there has the right to walk along water body [4].

As a whole, in the research on the coast of the lake Rāzna, a towpath is fixed in seven places where, from the view of the Latvian Republic law perspective violations have been identified, that impact the management of the coastal territories of water bodies. On these sites fences have been constructed which restrict the freedom of movement in the coastal zone of the lake Rāzna.

The Land Management Law states that local government, to provide public access to public waters towpath, needs to fix a way in spatial plans where pedestrians can get to the coastal zone [3]. Municipalities of Kaunata, Čornaja and Mākoņkalns adjacent to the lake Rāzna have not included the conditions prescribed by the Land Management Law in their spatial plans, so at the moment each citizen must put up with the access opportunities which is now available.

Analysis of the towpath regulatory provisions, the available scientific literature and field studies on Rezekne municipality public waters found that the towpath affects possible watershed use. Watershed towpath is difficult to access; landowners whose land includes towpaths disregard certain restrictions on the towpath. Watershed management problems affect both landowners whose land is located in the towpath and any Latvian citizen's right to free use of the towpath.

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# ECOLOGICAL RATIONING OF PHOSPHOGYPSUM AND COAL ASH APPLICATION ON CHERNOZEM SOILS IN THE CONTENT OF HEAVY METALS

**Altynay Rakhimova**

Sh. Ualikhanov Kokshetau State University, S.Sadvakasov Agrarian-economic Institute,  
graduate student, Kazakhstan

**Abilzhan Khussainov<sup>1</sup>, Inga Grinfelde<sup>2</sup>**

<sup>1</sup>Kokshe Academy, Director of SRI ESD, Dr.sc.biol., professor, academician of AACS of RK,  
correspondent member of RANS, Kazakhstan

<sup>2</sup>Latvia University of Agriculture/Head of Scientific Laboratory of Forest and Water Resources, Latvia

Last decades the total amount of applied mineral fertilizers in cultivation of crops has been considerably reduced which caused lower average agricultural yields in Kazakhstan [1]. The main reasons are expensiveness of fertilizers and weak financial opportunities of agroformations [2]. Applying of phosphogypsum and industrial ashes for fertilization of chernozem improves soil moisture regime, chemical and biological conditions, increases crops yield by 20-22%, decreases production cost of crops by 30-35%.

The experiment of phosphogypsum and industrial ashes impact on soil quality was done during 2015 in "Umai Zher" LLP, Akmola region. There were arranged three experimental fields with 10 ha area with similar climatic conditions and the steam system of crop rotation. The first field was without additional fertilizers, the second field was fertilized with industrial ashes 200 kg/ha, and the third one - with phosphogypsum 1 t/ha. The fertilizers were applied in July 2015 and the analysis of soil was taken in October 2015 to identify the amount of Cu, Zn, Cd, Pb in the soil and the work was carried out by the accredited "Scientific Analytical Center "Biomedpreparat" LLP laboratory; the content of heavy metals in the soil was defined by the method of an inversion voltampermetriya, GOST # 50686. The results of the analysis are shown in Table 1.

Table 1 *The gross and mobile content of heavy metals in soils with different fertilization plans*

The experiment variants	Pb (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Zn (mg/kg)
<i>Maximum concentration value by legislation</i>	32.0	5.0	50.0	50.0
<i>The gross / mobile content of heavy metals in soils</i>				
Control	16.2 / 1.70	3.0 / 0.04	46.4 / 0.96	22.6 / 1.10
Coal ashes	17.3 / 2.90	3.2 / 0.03	44.6 / 1.90	23.4 / 1.24
Phosphogypsium	15.0 / 1.50	2.8 / 0.06	50.0 / 8.40	23.8 / 0.55

There is no strong evidence of ecological risks related to the application of coal ashes for fertilization of chernozem, however there are raised concentrations of Cu in soils with phosphogypsum fertilization plan. Thus, application of industrial ashes and a phosphogypsum have not had significant effect on the content of heavy metals in the soil, their value was at the level of control option and was lower than maximum concentration limit. It means that, application of industrial ashes and phosphogypsum on chernozem soils in the Akmola region as fertilizers does not constitute ecological danger and meets sanitary and toxicological standards. There is a need for future research in Cu, Zn, Cd, Pb concentration data during crop rotation to investigate the cumulative effect of heavy metals on chernozem soils.

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# CAPITALIZATION OF LAND RESOURCES AS A STRATEGIC DIRECTION OF A REGION DEVELOPMENT

**Zoriana Ryzhok**

Lviv National Agrarian University, Faculty of Land Surveying, post-graduate student, Ukraine

**Ruslana Taratula**

Lviv National Agrarian University, Ph.D. in Economics, Ukraine

Land resources take an important place in the production activity of regions. On one hand, land resources enable developing of agricultural production and services; on the other hand, under conditions of irrational land use and fall of soil fertility, focus on land resources makes threat for economic development of a region. Capitalization of land is one of the necessary and principal preconditions for development of social relations as to use, protection and reclamation of land resources in terms of support of spatial social-economic development. Thus, issue of a considerable rise of land resources importance in reproduction of balanced ecological-economic environment, including increase of capitalization level, is an urgent one.

Dorosh Y.M. considers that special attention should be paid to the issue of establishment of such economic relations of land ownership, which can rise the value of land capital or capitalization of land resources, but are still not sufficiently studied [2]. Ibatullin Sh.V. writes that capitalization is used for a land plot and a region, reflecting integrity of social-economic, organizational, institutional, political and other processes, being carried at a state, regional and local level. It mainly depends on efficiency of market relations and development of market infrastructure, on the applied model of state management of the economy in general and land relations in particular [1]. In a broader sense, land capitalization is a process of gradual rise of land capital value, resulting from effects of objective regulations of spatial development, and directed impact of a system of economic, planning and administrative-organizational measures on its growth.

Capitalization process should deal with different forms of land ownership, including attraction of investments, new technologies and establishment of conditions for rise of land assets value. Model of establishment of capitalization level can be presented as a system of two interdependences: amount of capital investment into land use and income from land use under conditions of favorable ecological environment, directed at increase of population standards of living [3].

Application of methodological approaches to land capitalization enables establishment of goals of strategic development of a region, indicators of local resources and their potential use efficiency, determine directions of land investment attractiveness increase in case of making tasks of spatial regional development. Calculation of current and future money flows by means of their discounting helps more complete land capitalization. Assessment of land and its capitalization should consider not only conditions of its use, but also the potential from land relations transformation, investment attractiveness of territories, make income forecast in the field of land use. Land capitalization helps establishment of efficient regional taxation system, lease payment, as well as investment attractiveness of territories and clusters as objects of spatial and sustainable development.

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# LIDAR TECHNOLOGY AND BUILDING RECOGNITION PROGRAM USE IN CADASTRAL INFORMATION SYSTEM

**Gatis Skrebelis**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering,  
graduate student, Latvia

**Aivars Ratkevics**

Latvia University of Agriculture, Mg. Sc. Ing., Latvia

Illegal construction is a problem that many government institutions face and it is a challenge to prevent. Such illegal practice makes the acquisition of credible data about buildings difficult. Every year several such constructions are discovered in Latvia and they are neither found in data of local government building authorities, not in the State Land Service of the Republic of Latvia data register – cadastre. It happens because actualization of databases is a rather difficult and time consuming task and acquisition of data is not systematic.

To ease the actualization process of buildings cadastre a Rezekne Higher Education institution student together with faculty have developed a software that can recognize such structures and filter out buildings from LiDAR data [1]. In collaboration with students of Latvia University of Agriculture and faculty, this software is further analysed and developed, so it should be approbated for possible use in the State Land Service of the Republic of Latvia and other institutions. The aim of this paper is to compare the data this software has produced with real situation on the field and cadastre database to evaluate this software as a tool to speed up the cadastre data actualization process. For software approbation a territory in Ozolnieki district sized 131,23 ha (2035 x 345 m<sup>2</sup>) was selected.

Building recognition software identified 230 polygons in the selected territory, while surveying in the field 404 building units that were registered in the cadastre and 12 that were unregistered (which were found by the software) were found. 12 buildings registered in the cadastre were found to not exist in reality and therefore were also not found by the software.

From 404 units registered in the cadastre the software did not find 45% of all buildings (182 units), but when inspecting the results in the field it was found that most of these objects are small sheds or greenhouses. The total area of these objects was found to be rather insignificant – 35 m<sup>2</sup>, taking up about 12% of total building surface area.

To objectively evaluate this software in comparison with the cadastre data, this data should be renewed and optimized before eliminating the inaccuracies found while inspecting the area in field.

This software should be further optimized to recognize buildings with smaller surface area (20 – 50 m<sup>2</sup>) which would allow a greater precision and results.

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# RESEARCH ON SUSTAINABILITY IMPROVEMENT OF FOAM GYPSUM ACOUSTIC PANELS

**Santa Soloveiko, Kristaps Pulkis**

Latvia University of Agriculture, Faculty of Environmental and Civil Engineering, graduate students,  
Latvia

**Juris Skujans<sup>1</sup> Sandra Gusta<sup>2</sup>**

Latvia University of Agriculture, <sup>1</sup>Professor Dr. sc.ing., <sup>2</sup>Associate professor Dr. oec., Latvia

Construction and all related activities consume 40% of all the planet's energy resources. By knowing this, sustainable building and urban environment planning and construction is already common practice across Europe and elsewhere in the world, and this has become industry standard. Currently the building evaluation and certification standard BREEAM (British Research Establishment Environmental Assessment Method) developed by the British research institute BRE is the standard most used in Europe and all over the world. This standard involves a comprehensive, objectively measurable, transparent and dynamic criteria system. Latvia is the only small market countries, which has its own criteria version called „Latvia Appendix”. The BREEAM Latvian version for analysis of commercial buildings includes 69 criteria, which are split into 9 categories. The category for „Construction materials” dictates the evaluation of the impact of construction materials on the environment during its full life cycle (extraction of raw materials, manufacturing, packaging, installation, use and recycling/disposal). If possible natural resources should be used, which after their use can be easily recycled or disposed of, preferably as recyclable materials, etc.

Gypsum is a local resource; effective use of it should play a vital role in the construction sector in Latvia. Manufacture of various acoustic construction materials is characterized by large primary energy consumption and CO<sup>2</sup> emissions, but the temperature required for thermal processing of gypsum is very low - 150°-180°C when processing raw materials containing gypsum minerals (natural gypsum) until obtaining calcium sulphate hemihydrate.

To improve the sustainability of foam gypsum acoustic panels, research of gypsum content was carried out using construction gypsum, high tension gypsum and their mixture; the effect of surfactants on gypsum tension and compressive strength characteristics was observed.

To improve the tensile strength and fire resistance characteristics of foam gypsum acoustic panels, research was carried out using plasterboard slabs to strengthen the panels.

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# THE ADMINISTRATIVE-TERRITORIAL DIVISION OF LATVIA FROM THE 18<sup>TH</sup> TO THE 21<sup>ST</sup> CENTURY

**Kristine Stendzeniece<sup>1</sup>, Nataliia Nesteruk<sup>2</sup>**

<sup>1</sup>Latvia University of Agriculture, Faculty of Environmental and Civil Engineering Sciences, undergraduate, Latvia

<sup>2</sup>Lviv National Agrarian University, Faculty of Land Surveying, graduate student, Ukraine

**Velta Parsova<sup>1</sup>, Roman Stupen<sup>2</sup>**

<sup>1</sup>Latvia University of Agriculture, Dr.oec., Latvia

<sup>2</sup>Lviv National Agrarian University, PhD, Ukraine

The territory of Latvia has been affected by different political powers from the 18th to the 21st century. The administrative-territorial division in this time period has changed at least six times: in the empire of Czarist Russia; from 1918 to 1940; from 1941 to 1945; from 1945 to 1990 in Soviet times; from 1990 to 2011; after 2011.

In the empire of Czarist Russia, 3 territories (Vidzeme, Kurzeme, Latgale), where Latvians lived, were incorporated in 3 different administrative-territorial basic units - provinces of Russia (Vidzeme, Kurzeme and Vitebsk). The provinces were divided into 17 regions. The regions were divided into municipality territories. Municipality territory was the lowest administrative-territorial unit [1].

The territory of Latvia from 1918 to 1940 was divided into four administrative territories. Previously mentioned administrative-territorial unit included the territory of Zemgale as well as 19 regions. The lowest administrative unit was municipality territory [2].

On July 25, 1941 when Nazi Germany occupied Baltic countries, Reichkommissariat of Ostland was developed as the structure of military and civil administration. As a result, the Baltic countries (Ostland) were divided into four general regions. Each general region was divided into regional territories. Latvian general region consisted of five regional territories, namely Daugavpils, Liepaja, Jelgava, Riga, Valmiera [2].

In the territory of Latvia, from 1945 to 1990, significant administrative structural reforms were carried out at least 10 times. In 1946, the territory of Latvia was divided into 19 regions, which consisted of 510 municipality territories [4].

From 1990, the Republic of Latvia was formed by four regions: Vidzeme, Latgale, Kurzeme and Zemgale, and was divided into 7 cities and 26 regions, which consisted of 424 municipality territories [2].

From 3 January, 2011, the territory of Latvia was divided into 110 municipalities and 9 cities, namely Daugavpils, Jekabpils, Jelgava, Jurmala, Liepaja, Rēzekne, Riga, Valmiera, Ventspils. Latvia currently has 497 municipality territories [5].

Now again the Government of Latvia has an idea to implement new administrative-territorial reform in 2021. The new administrative-territorial division will provide two possible options: 49 municipalities and 9 cities or the establishment of 29 cooperation areas around national and regional development centres [3].

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# ANALYSIS OF THE CULTURAL INSTITUTIONS' COURTYARDS OF KLAIPEDA CITY

**Rūta Šilgalienė, Norgailė Verbaitė, Gabija Petrauskytė**

Klaipėda State University of Applied Sciences, Faculties of Technologies, Landscape Design,  
undergraduate students, Lithuania

**Vida Gerikienė** Lecturer, Master

**Diana Baravykaitė** Lecturer, Master

**Raimonda Sūdžiuvienė** Lecturer, Master

Spaces for public purposes are really important in order to keep a mutual bond between people. While planning new territories and reworking already built ones, it is necessary to keep the same number of public spaces which would meet the recreational and social needs of the inhabitants. An inner courtyard is a space near the building belonging to the structure and it is at least in a way enclosed from the rest of the city or other space for public use. Newly designed inner courtyards lose their most important traits: comfort, stylistic unity, environmental individuality, uniqueness.

In Klaipėda, the origin of inner courtyards could be linked to the second half of the 18th century, when on the right bank of the river Dane, the rich people of the city started forming decorative gardens. They were based on a simple geometric design, in which there was a round or oval shaped flower garden with a surrounding round or rhombus shaped courtyard. Even today, in this part of the city, it is possible to find one of these inner courtyards – the yard of the Museum of Clock, which these days is being used for public visiting and gatherings.

The analysis of 10 cultural establishments in Klaipėda show that out of those 10 there are courtyards in the previously mentioned Museum of Clock and Klaipėda County I. Simonaityte Public Library, as well as in the Lithuania Minor's history museum, Klaipėda concert hall, the Ethnocultural centre and the National culture centre. The Cultural communication centre, which is in the old city, has just a general, transitional yard, while the Public Institution, the Cultural centre "Žvejų rūmai" and Klaipėda city public library branches, which are in Klaipėda city, do not have any inner courtyards belonging to them. The analysis of these institutions' inner courtyards reveal greenery, small architecture forming the unity of the surrounding elements with the institution's performed functions.

Analysing the surroundings of Klaipėda city's cultural institutions' inner courtyards, we can come to the conclusion that not all of the inner courtyards of the cultural institutions reflect the functions which the establishment performs. Also there are those establishments which do not have their own inner courtyards. Some inner courtyards are poor, they need constant care. However, there are courtyards, which resemble the activity of their institutions. The Museum of Clock in Klaipėda and Klaipėda County I. Simonaityte Public Library courtyards are good examples as their courtyards are oriented to the activity of the establishment. This helps visitors understand the functions of the institution through small architectural elements. For example, in the courtyard of the Museum of Clock there are art pieces that have time symbolism, while greenery forms an environment for interaction and general recreation.

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# IMPLEMENTATION OF FISH WAY SOLUTIONS FOR LATVIAN SMALL HYDROELECTRIC PLANTS

Zane Šņore

Latvia University of Agriculture, Faculty of Environment and Civil engineering, Latvia

Kārlis Siļķe

Latvia University of Agriculture, Mg.sc.ing., Latvia

Fish ways of small hydroelectric plants need to ensure a possibility for fish to migrate to spawning places, but majority of fish ways, as confirmed by specialists, are working unsatisfactory.

Experience shows that in many Latvia's small hydroelectric plants implemented fish ways fulfill their intended purpose only partly. There is a small number of fish ways in Latvia's HPS sphere, therefore the question of fish way efficiency is left under control. Hence in this scientific work research will be conducted to find the most accurate technical and hydraulic solutions of fish way for small hydroelectric plants.

**Objective of scientific paper:** to define the most accurate solutions for efficient fish way operation in small hydroelectric plants.

**Task of scientific paper:** to identify existing fish way operation; analyze the experience of other countries in using fish ways; prepare conclusions about the most accurate solution of fish ways for Latvia's small hydroelectric plants.

To attain objective of this scientific research emphasis is on determining the most appropriate fish way solution and its implementation for a specific situation. In this work the exploration and description of most frequently used fish ways are carried out as well as other countries' fish way solution examples and methods that are used as guidelines for experts to sort out appropriate constructive solution to ensure fish migration from constructions top to its bottom. Most frequently two types of fish ways are built: vertical slot fish way in which baffles are set out in one or two vertical ails. This type of fish way is used when there is a high water level difference in baffles and in resembles of a natural structure. In the construction natural materials such as wood and rocks are used. Bypass fish ways require a much broader terrain for its construction. They also use considerably more water [1].

Objects used in this work were inspected in February 2016, but gathering information was processed. Description of small hydroelectric plants in Latvian territory:

- Ligatne on the Ligatnes river (there is no HPS there);
- Karlu dam HPS on the Amatas river in Amatas district;
- Karvas HPS on the Vaidavas river in Aluksnes district;
- Aiviekstes HPS on the Aiviekstes river in Madonas district;
- Vezu HPS on the Aiviekstes river on Plavīnu district.

After gathering and analyzing the information it was concluded that the most accurate fish way solution is implemented in the newest – Vezu HPS complex, that uses bypass fish way with natural formations.

The Vaidavas River was recognized as the most inaccurate fish way from all inspected. Unfortunately we need to admit that its functionality lacks efficiency for the most optimal fish migration.

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# ENERGY EFFICIENCY IMPROVEMENT MEASURES OF BUILDING ENVELOPES OBSERVING ETAG 004 SYSTEM

**Eduards Šulcs**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, post-graduate student,  
Latvia

**Sandra Gusta**

Latvia University of Agriculture, Architecture and Construction, Head of the Department, Associate  
Professor, Latvia

Buildings are responsible for 40% of energy consumption and 36% of CO<sub>2</sub> emissions in the European Union. By improving the energy efficiency of buildings, we could reduce total EU energy consumption by 5% to 6% and lower CO<sub>2</sub> emissions by about 5%. [1] It is important to research any energy efficiency improvement measures of buildings, which can provide less energy consumption to benefit not only people living in exact building, but also climate we live in. In this research ETAG 004 system [2] is being studied, its impact and its application usefulness to the apartment buildings energy efficiency improvement measures. In this research will be found out whether buildings that have received ETAG 004 certificate, have reached the forecasted energy efficiency results. There are ten apartment buildings selected for the research, which are designed by specific company and which have been carried out energy efficiency improvement measures. During the research selected apartment buildings are being examined with the help of thermal camera.

**The aim** of the research is to ascertain whether usage of ETAG 004 system in heat insulation of buildings can increase energy efficiency and long life of construction.

**Hypothesis of the research:** ETAG 004 system certificates issued by material suppliers do not provide Envelope's forecasted energy efficiency.

After researching simplified renovation projects of the apartment buildings it is possible to conclude that energy efficiency is achieved, but not in full amount, because the important is not only choice of ETAG 004 systems certified materials, but also the quality of incorporation of materials according to technological requirements. With the help of thermal camera common mistakes in construction process has been determined. Data indicates places where energy is loss, specifically, window jambs heat insulation (Fig.1.), inside corners of building, socle profile connections to facade (Fig.2.), balcony connection knots

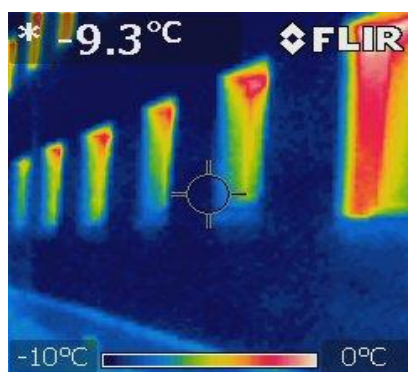


Fig.1. Energy loss in window jambs heat insulation

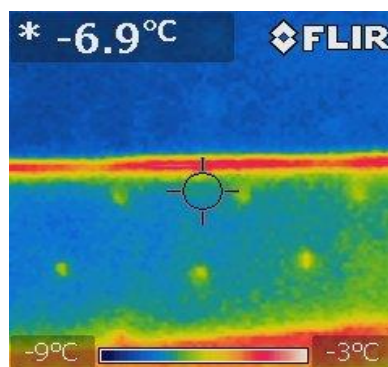


Fig.2. Energy loss in socle profile connections to facade

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# LEGAL REGULATION ON SUSTAINABLE USE OF DEGRADED LAND IN LATVIA AND UKRAINE

Zhanna Tsyhanenko<sup>1</sup>, Justine Polnija<sup>2</sup>

<sup>1</sup>Lviv National Agrarian University, Faculty of Land Surveying, postgraduate student, Ukraine

<sup>2</sup>Latvia University of Agriculture, Faculty of Environmental and Civil Engineering Sciences, postgraduate student, Latvia

Natalia Stoiko<sup>1</sup>, Velta Parsova<sup>2</sup>

<sup>1</sup>Lviv National Agrarian University, PhD, Ukraine

<sup>2</sup>Latvia University of Agriculture, Dr.oec., Latvia

One of the tasks of land management is to ensure sustainable use of the land. On September 25, 2015, Summit of the United Nations Organization on sustainable development accepted a resolution “Transforming our world: the 2030 Agenda for Sustainable Development”. One of the goals of the resolution is “to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”. Therefore, the legal regulation of the use of degraded land is pending matter both in Latvia and Ukraine.

Due to existing soil degradation risks in Europe, sustainable use of the land is restricted. Latvian Land Administration Law has been implemented since January 1, 2015 to promote sustainable land use and protection [2]. Even till 2015, there was not a common soil protection policy document. Some issues about soil protection have been included in several legislative acts. Land Administration Law has been based on several conditions of the use and protection of the land. Until now in Latvia a framework on land degradation criteria has not been developed, on order in which to establish a fact of land degradation and its feasibility, and assess it, as well as on determination of land and soil degradation prevention measures. Also, starting with 2018, the government is obligated once every 5 years to prepare the overview on land use, which should include information on degraded territories and their areas [1].

Ukraine has already developed a certain regulatory basis concerning determination of principal indicators, characterizing soil conditions and involving land conservation, as well as a complex of measures on land protection against erosion. The legal framework is the Law of Ukraine “On Protection of the Land”, governmental Regulation “On procedure of land conservation” and the Land Code [3; 4; 5]. However, there is a need to specify kinds of land degradation indicators, forced by unreasonable use of land resources under current conditions. Scientific argumentation of degradation processes on reclaimed lands and on land shares of erosion-hazardous agrarian landscapes is an actual issue.

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# THE INTRODUCTION OF UNIFIED LAND BOUNDARY SIGNS IN LATVIA

**Krista Tumova**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, Latvia

**Armands Celms**

Latvia University of Agriculture, Latvia

The only way to locate your legal boundaries is to obtain a deed description or a registered survey map that accurately includes angles and distances for each boundary line [2].

Boundary marking or redefinition surveys (called "monumentation surveys" in Landonline) are required in both urban and rural areas. A boundary marking survey is to retrace the tracks of the original surveyor and place the boundary marks in their original position. Some old surveys have no metal marks and the old pegs have since rotted away, or have been disturbed or removed. Such surveys are difficult and time consuming [1].

In 2013 Lithuania introduced new land boundary marking rules of land boundaries and landmark standard, which provide boundary signs simple installation and new boundary signs types – steel and iron pipe monuments come with a plastic cap [3].

For Cadastral survey in Latvia different types of boundary signs are used, such as an iron rod, wood stake, stones with a cross, plastic tube, concrete stake and others.

The purpose of current scientific research is to examine destroyed boundary signs in the territory of Latvia and based on Lithuania's experience, to develop a methodology for the introduction of unified land boundary signs in Latvia.

In the scientific research the data is used from land cadastral surveying documents in the period of 2013 to 2015.

The findings from the research show that the most of the land boundary signs have been destroyed and could not be found in the nature. It means that destroyed land boundary signs should be renovated. For land cadastral surveying most frequently used types of boundary signs are an iron rod, a wood stake and stones with a cross. The data analysis suggests that often are destroyed iron rod and wood stake boundary signs. Above – mentioned are the main reasons why in Latvia unified land boundary signs are needed which will provide easy boundary signs installation and unified land boundary signs type.

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# REMOTE SENSING MATERIAL USAGE FOR BUILDING DATA UPDATE IN THE CADASTRAL INFORMATION SYSTEM

**Inese Upīte**

Latvia University of Agriculture/ Faculty of Environment and Civil Engineering Sciences, undergraduate,  
Latvia

**Aivars Ratkēvičs**

Latvia University of Agriculture, Mg.sc.ing, Latvia

The Cadastral Information System of Real Estate (hereinafter Cadastral Information System) is a State information system that contains official cadastre data. It is managed and held by the State land service. The main task of the Cadastral Information System is to provide actual cadastre information to the society [4]. According to the Latvian legislation, actualization of information in the Cadastral Information System is being made if it is suggested by the person mentioned in article 24 of the Cadastre law [1].

One of the segments where the actual Cadastre information is being used is the administration of taxes of the Real Estate. All the real estates that are registered in the Cadastral Information System are compelled to this process. There must be plausible and actual information about the buildings throughout the national territory to avoid a dishonest payment of the taxes.

All over the world technologies of the remote sensing are being used increasingly to run the segment of the real estate in the country. As an example, the Cadastral Regularization Plan of Spain is being mentioned, in which the remote sensing abilities are being expected to use for actualization of building [2].

At present the fastest changes concern building information, therefore the updating of the information by present procedures and data flows is not sufficient. New data sources and processing methods must be developed to improve the information capture process. The modern remote sensing technologies provide a fast data collection about some region using airborne vehicles and satellites, but the collected information must be classified and translated into the operational data format to be convenient for monitoring and planning tasks. As a result, there must be some system, which provides the recognition and interpretation of sensed data [3].

The research evaluates how high the level of plausibility is to automated acquired information about buildings from LiDAR data that are being processed by building recognition software. 1 m<sup>2</sup> big locality is selected as a sampling plot to methodology design, which includes likely varied territory of locality (including city type construction, cottage district, bungalow, separate buildings and afforested territories). Automated acquired polygons of buildings were compared to the buildings that are shown in Cadastral maps registered in the Cadastral Information System.

The results of the research show that the automated building recognition software has recognized 91% of registered Cadastral objects (buildings) of corresponding area in the selected sampling plot. Software has also showed polygons of buildings that are identified as new objects to register in the Cadastral Information System.

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# THE APPLICATION OF PHYTOREMEDIATION TECHNOLOGY IN LATVIA

Kristine Valujeva

Latvia University of Agriculture, Faculty of Rural Engineering, graduate student, Latvia

Inga Grinfelde

Latvia University of Agriculture, Mg.sc.env., Latvia

Phytoremediation is an environmentally friendly technology which can be used to clean up the environment by plants in a cost effective way without destroying the cleanup site [1; 2; 3]. Typical organic contaminants such as crude oil, diesel, pesticides, chlorinated compounds can be remediated by phytoremediation technology as well as inorganic contaminants like heavy metals [2].

Application of technology depends on the degree of concentration in polluted site. If the concentration of contaminant is toxic for living organisms, another remediation technology has to be used (see fig.1). Selection of plants depends on the type of contaminant, soil and water conditions in polluted area and depth of pollution. For example, *Salix viminalis* L. can be used in sites with lead (Pb), copper (Cu), cadmium (Cd), chromium (Cr), strontium (Sr), uranium (U), zinc (Zn), arsenic (As) and heavy crude oil pollution in depth from one centimeter to four meters [4;5].

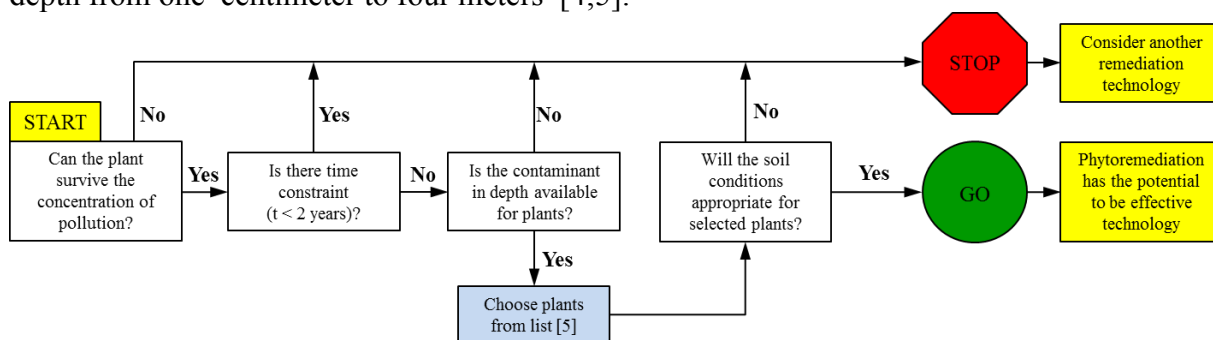


Fig.1. Decision tree diagram of phytoremediation method.

There is a need for future research to determine phytoremediation efficiency for most common plants in Latvia. More research is needed to develop scientifically based guidelines for phytoremediation project.

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# ANALYSIS OF THE CHANGES IN THE BALTIC SEA COAST BY THE HILL OF OLANDO KEPURE DURING THE PERIOD OF 2008-2016

Audrius Vaseris<sup>1</sup>, Jurgita Vasyte<sup>2</sup>, Mindaugas Kupšys<sup>2</sup>

<sup>1</sup>Klaipeda State University of Applied Sciences, Faculty of Technologies, undergraduate student, Lithuania,

<sup>2</sup>Klaipeda State University of Applied Sciences, Faculty of Technologies, students, Lithuania

Lina Kukliene, Indrius Kuklys, Dainora Jankauskiene

Klaipeda State University of Applied Sciences, Faculty of Technologies, lecturers, Lithuania

The Baltic sea sea line which belongs to Lithuania is only about 90 km. Special Lithuania seashore which is at Kursiu nerija - 97 km long (from which 51 km. belongs to Lithuania) and 3,8 km wide curved peninsula with the biggest in Europe pompous white dunes. Lithuanian coast part which is in the north of Klaipeda is only up to 300 m wide sandy shore: a very special coastal section is Olando kepure - 25 m high hill [1].

During the last two decades accumulation processes obviously changed the seaside zone: Lithuanian seashore is constantly being washed away by the sea. The reasons of coast changing are natural processes (the rising sea level, storms) and human economic activities (urbanisation, recreation, hydrotechnical machinery). The largest coast changes in continental coast line parts are at Butinge – 1.5-2.0 m/m, Olando kepure - 2-3 m/m, Karklininkais – 1.5 m/m.

The aim of the research - to determine Baltic sealine changes at Olando kepure hill in 2008-2016, specify and supplement the Baltic sealine spatial data collection.

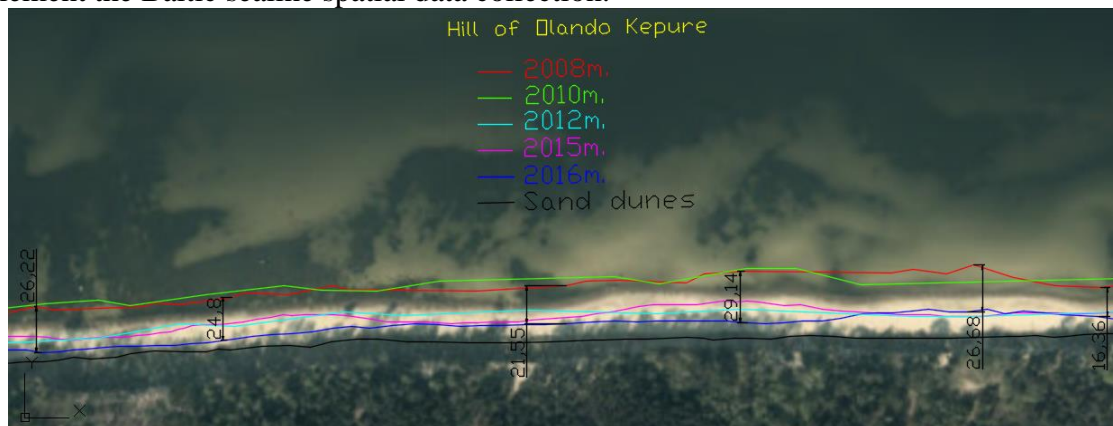


Fig. 1. Displacement of the Baltic Sea coast in the period of 2008 and 2016.

GPNS receiver GeoMax Zenith25 was used to conduct Baltic sea line section measurements.

Coast section at Olando kepure was measured 5 times in 2014-2016. To identify the sea line a GeoMap 2015 software was used.

According to available 2008-2016 sealine measurement data it was found out that in 2008-2016 the sealine moved to continent way and in conjunction the beach territory was reduced. At Olando kepure hill the sealine moved in average around 18.26 m. The largest change to continent way is 29.14 m, and the shortest – 7.38. Comparing the Baltic sealine boundaries in 2008 and 2016, it was noticed that the Baltic sealine moved to continent the fastest in 2016.

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# THE TRANSFORMATION PROCESSES OF THE CULTURAL LANDSCAPE IN OZOLNIEKI COUNTY

Pēteris Vorza

Latvia University of Agriculture, Landscape Architecture and Planning, undergraduate student, Latvia  
Professor, Dr.arch. **Aija Ziemeļniece**, assist.professor, Dr. arch. **Una Īle**, Latvia

The trends of the post-socialism time in politics and in the economic development have left serious consequences in the cultural landscape. This also applies to the values of the historical heritage of the Ozolnieki county, which is only partially preserved. The research refers to the present condition of a number of architectural monuments in detail, the infrastructure around them, as well as the green areas, which can be developed as green recreational landscapes. The lack of identity of the settlements impedes to attract the development of tourism.

The greatest benefit of Ozolnieki parish social life was the opening of the new parish house (now the People's House) in 1939, which was built on the basis of the design of the famous architect of public buildings, Professor Augusts Raisters [1]. As the parish center, this object is not highlighted and almost invisible.

The struggle for freedom and both world wars experienced severe battles leaving burials and of soldiers and civilians and memorial-battles [2]. Much of these historically significant memorials are very valuable but their situation is both physically and morally disappointing.

The sports center building is always ready for high-level international competitions in volleyball, basketball, football, rugby, street ball, athletics, fight sports, orienteering, tug of war, etc. A variety of high-level competitions and events, for example, Latvian Rural sports games, games of employees of many companies and institutions, Sports Contest, the selection games for the Olympic games in football, international football tournaments for children, etc. were held there [3].

The sporty activities have brought the name of Ozolnieki far away, but the current condition of the sports centre is very unsatisfactory because of the old equipment and the poor state of the existing grandstands.

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# THE EVALUATION OF THE USE OF HYDROENERGY POTENTIAL ON THE VIRGAS RIVER

**Laura Zainutdinova**

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, undergraduate student,  
Latvia

**Kārlis Silķe**

Latvia University of Agriculture, Mg.sc.ing., Latvia

As a result of the present day's rapid development of the society we are consuming more electric energy, and demand for it continues to grow. The effective use of renewable energy sources contributes to security of supply. It increases the energy self-sufficiency, and promotes the diversification of the supplies.

Unlike large hydroelectric power plants where large structures and reservoirs are significantly altered by natural river runoff and flooded areas, small hydroelectric power plants which are correctly designed, constructed and maintained do not cause practical damage to the environment [1].

Nowadays technology for the effective use of renewable energy resources is successfully introduced and also significantly advanced. The use of hydropower is more developed than other forms of energy production. Small hydroelectric plants can provide power to individual households or small businesses [2]. Therefore is stimulated the significant role of small hydroelectric buildings for the environment, the production of clean energy, alternative in the use of natural resources, the creation of new jobs and business development in rural areas.

The main study was aimed at finding out the water mills on the Virgas river, with an objective of the water power use resumption to generate electricity. To achieve the aim of the study, it is planned: to carry out the study of the renewal of the small hydroelectric power plants in the world and Latvia, to take a walkover of Priekules and Daļģu watermills, to find out the reasons, why watermills are not used any more, to find out how the management of the Virga river is performed in Priekules and Virgas counties, to make hydroenergy calculations of Priekules and Daļģu watermills.

In the study of objects, it was found out that Priekules and Daļģu watermill buildings are not demolished, however, it is necessary to restore them. In order to determine the most suitable hydraulic turbine, hydrological calculations of the Virga river are performed. Water levels marks at each site are consistent with the previous, creating a cascade, together with Prūšu hydroelectric power plant on the diversion channel.

On the basis of hydrological calculation results at each watermill, it is planned to set two hydraulic turbines on each watermill place. One is for the use in the flooding season and the second one is for the ecological flowrate in the low water periods.

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# ASSESSMENT OF BEARING CAPACITY OF “EASI-JOIST” STRUCTURES

Dana Žirnova

Latvia University of Agriculture, Faculty of Environment and Civil Engineering, post-graduate student,  
Latvia

Lilita Ozola

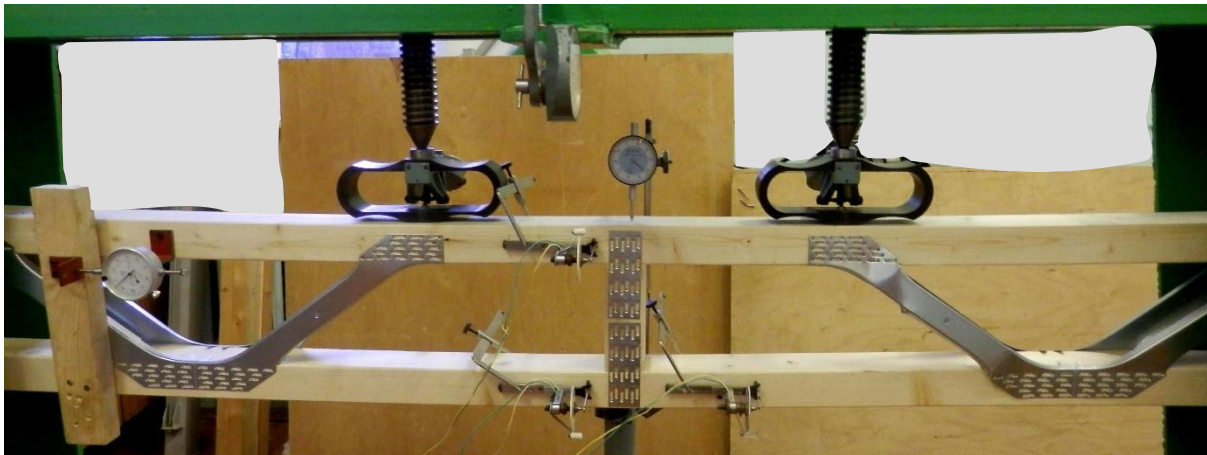
Latvia University of Agriculture, Dr.sc.ing., Latvia

“Easi-Joist” is new type of intermediate floor structure named so by manufacturers. The structure discussed consists of two parallel timber chords and metal diagonal elements thereby forming truss type structure. Easi-Joist specific structure has been created to satisfy demands for optimal arrangement and installation of pipe work, cabling and ductwork. Some more improvements of floor performance have been achieved using Easi-Joists - such as reducing of vibration, high sound absorption features and increasing of load bearing capacity of floor structure with less timber usage comparing with the solid timber beams of the same bearing capacity.

**The aim of the study** is to assess bearing capacity of intermediate floor structure “Easi-Joist” and to observe the behaviour of structure up to limit state. The research topic was initiated by the managers of the factory with the purpose to have well-founded information about quality of factory’s production.

**Methods.** Test models were produced at the factory “JMR-Frame”. Design bearing capacity of the models was calculated according to limit state method following Eurocode 5 and Eurocode 3 conditions [2].

Figure 1



Experimental testing of truss models (ten in total) was performed according four point bending model like beams (see Figure 1). Fiber deformations of top and bottom chord elements were measured by strain gauges, as well as mutual displacements between top and bottom chord were measured by indicators located around support part. Every truss model was loaded up to limit state in order to observe a fracture mode. Loss of stability of metal diagonal was recognised in limit state for greater number of models.

**Results.** It is established that bearing capacity of “Easi-Joist” structures recognized in tests conform well with the one obtained by codified design procedure. Fracture modes observed demonstrate with certainty that metal web members are the weakest ones in limit state.

**Acknowledgement.** *We appreciate sincerely the managers of factory “JMR-Frame” for material support with test models.*

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## **FORESTRY AND WOOD PROCESSING**

# INFLUENCE OF BIOTIC AND ABIOTIC FACTORS ON PHYSICAL PROCESSES OF SPRUCE STANDS GROWTH

**Alexander Andreev**

St.Petersburg State Polytechnic University,  
Department of Medical Physics, Russia

**Elena Boitsova**

St.Petersburg State Polytechnic University, Russia

The aim of the article is the establishment of abiotic and biotic factors interaction affecting the livelihoods of spruce stands in Leningrad region. The interest in this topic was caused by the consequences of the hurricane in Leningrad region, which occurred in the summer of 2010. As a result, more than 2.7 million m<sup>3</sup> of spruce forests were damaged. Some trees were laden down and uprooted, a large number of trees were broken. The problem of the forest destruction has caused great concern, because it affects every inhabitant of the region. The forests of this area are of great ecological importance. The percentage of pine trees in this area is approximately 38%, the second largest being spruce trees: 31% [3]. The spruce wood is a valuable building material. Its plantations form podzol soils, creating an acidic type of ground, good for tree growing. A spruce tree is a good source of oxygen. As it reaches the height of 40-50 meters, it forms the upper forest tier. The longevity is a distinguished characteristic feature of a spruce tree. One of the main enemies of the spruce forest is the spruce bark beetle, which is attracted by a feeder layer of the wood. The cause of the infection can be strong mechanical damage to the tree. The beetles infect the spruce within a period of 5-20 days, and then they move from one tree to another. The radius of expansion can be from 7 to 50 km. A high rate of infection and a broad range of expansion make the bark beetle a dangerous forest pest, although in normal circumstances the immune system of the tree is able to resist[1]. A completely different situation arises if the tree is weakened as a result of abiotic factors, for example a strong wind. Spruce has a shallow root system, the roots reach into the ground for 1.2 m, and the tree can easily fall down.

After the hurricane of 2010 the fallen trees were exposed to the infestation of the beetles. The trees have not been removed even now.. There are two controversial opinions regarding the solution to this problem. The first one asserts that all the trees should be removed from the infected area so as to not spread the infestation. The second one alleges that the forest as an ecosystem is restored after a certain period of time, and human intervention can disturb the natural balance. These points of view have a lot of supporters, and the choice of a definite decision has been delayed. In 1993 the territory of Belarus as a result of severe droughts suffered from a bark beetle infestation. It was stopped by 2004 with the help of sanitary felling. 14 thousand hectares of forest suffered from infestation. In 1993 in Lithuania, due to strong winds and dry weather the forests became the object of a bark beetle attack, and by 1998 the epidemic stopped by itself, damaging about 60 thousand hectares of wood [2]. It is clear that biotic factors are caused by a number of specific conditions related to inanimate nature. It is evident that there is less damage when the trees are removed.

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# THE USE OF WOOD WASTE AS AN ALTERNATIVE SOURCE OF ENERGY

**Nikita Belushko, Konstantin Minin**

Latvia University of Agriculture, Forest Faculty, undergraduate students, Latvia

**Aija Pētersone**

Latvia University of Agriculture, Mg.paed., Latvia

The economy of energy resources has become one of the most significant issues of our time. Wood waste can help minimize the use of prime natural energy resources. Companies can get maximum income and productivity thanks to the usage of wood waste. Present technologies give an opportunity not to use fossil energy sources. There is no need to cut out extra areas and resources. The maximum use of wood means an almost non-waste production.

The amount of wood waste, after the harvesting, ranges from 5 to 20% depending on the species of the tree, types of cutting and the type of forest. Most of the wood waste consists of branches and other tree residues as well as low quality trees that usually are left in the forest after cutting. At present, there are several companies using the technology of wood waste processing. For example, Ltd Latsin in Latvia uses wood chips to produce energy needed for the company [1].

Wood waste production technology and the scheme of the place of cutting is simple, since a lot depends on the place of cutting. Wood waste cannot be collected from all types of forests, for example, wet forests since all the waste will be used for the roads and the wood waste which has been used for the roads cannot be used in further processing. The same is true regarding the wood waste from poor types of forests, because branches are needed to enrich the soil.

Branches and wood waste need to be stored for no less than 3 months, but 6 months are preferable. It is necessary for the dirt, sand, and stones to settle and the branches to dry.

A special cover is put over the pile of branches to protect it against moisture from snow and rain, thus drying is faster and of a higher quality [1].

The wood chips are used all over the world, including the USA. The Indian River Center became the first large-scale plant in the United States to produce electricity and fuel from waste. In August 2013 it began producing cellulosic ethanol on a commercial scale. ZeaChem uses a combination of enzymes and heat to break down the cellulose from poplar trees grown on a nearby plantation as well as waste from local wheat fields. The sugars are then fermented in a process that releases no carbon dioxide.

In addition, scientists may be close to efficiently converting woody biomass into transportation biofuel. In the not too distant future, it is estimated that energy from biomass could displace 19 to 30 per cent of our fossil fuels use [2].

Every company wants to get the maximum out of production, therefore the development of wood waste processing technology has a great potential in the future.

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# FIRE IMPACTED ORGANIC CARBON IN FOREST SOILS

**Amaury Berthelot**

École Supérieure du Bois, undergraduate, France

**Solveiga Luguza**

Latvia University of Agriculture, Mg.silv., Latvia

We continue to add about 6 billion tons of carbon per year in atmospheric carbon cycle, thus significantly altering the carbon flux and therefore, the global climate. Faced with this increase in atmospheric carbon, many hopes were placed on the ability of trees, other plants and soil to temporarily absorb the carbon released into the atmosphere by burning fossil carbon. The Kyoto Protocol, the main instrument of the international community to halt global warming, does suggest that the absorption of carbon dioxide by trees and soil is one way to achieve the objectives of equally valid emission reduction that reduce emissions of carbon dioxide from fossil fuels. [1]

Each year, devastating forest fires occur in Europe and the world, destroying thousands of hectares of forest. The role of fire is shown explicitly, more specifically as regards the effects on the release of the carbon and the transfer thereof in the soil and forest products. Regrowth of biomass and changes in soil decomposition process after the disturbances are also simulated. Fire converts the soil organic carbon in CO, CO<sub>2</sub> during combustion, but 8% of the carbon is converted to carbon black. [2] Fire reduces the mass of the forest floor, reducing the stock of inorganic element, organic carbon, nitrogen and sulfur. However the frequency and intensity of fires have an influence on the damage of organic materials. Great intensity and frequency of fires could reduce the amount of organic matter in organic soil layers and increase the amount in mineral soil. [3] The organic mass of the carbon black is more resistant to degradation than organic carbon; this carbon black could act as an air well in the long term carbon. [2]

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# SILVER BIRCH (*BETULA PENDULA* ROTH.) AND DOWNY BIRCH (*BETULA PUBESCENS* EHRH.) GROWN TOGETHER AND THEIR MORPHOMETRIC DIFFERENCES

Dagnija Bērziņa

Latvia University of Agriculture, Forest faculty, undergraduate, Latvia

Imants Liepa

Latvia University of Agriculture, Dr.habil.biol, Latvia

In dendrology there are two permanent species of birch: silver and downy birch which differ from each other by morphological and wood properties, but in forest inventory and forest management these two species are not separated.

The aim of this research was to find morphometric differences of both birch species.

In a stand, where both birch species were found, a sample plot with an area of 0.18 ha (40 × 50 m) was established on forest site type – Mercurialiosa mel. in which regeneration has been natural. The mixed stand of both birch species is 65 years old. Growing conditions are similar regarding the total area, humidity, soil conditions and other environmental factors. Various measurements of forest were carried out.

The scientific literature confirms that silver birch can reach up to 30 m height, but downy birch - up to 25 m [1]. Up to 60 years of growth the height increases quite rapidly. The dominant height of a 50 year-old stand can reach up to 30 m. After this growth slows down and before the age of 100 years the vitality of birch trees decreases and they become more susceptible to diseases and insects. In even-aged stands the maximum stem number of silver birch reaches a diameter of 25 cm., but in naturally regenerated pure unmanaged birch stands - up to 80 year-old - the volume yield varies from 320 to 540 m<sup>3</sup> ha<sup>-1</sup> depending on the site productivity. In a managed 60 year-old birch plantation, it ranges from 360 to 560 m<sup>3</sup> ha<sup>-1</sup> [2].

In the surveyed plot the average height of silver birch is 30 m, but downy birch - 26 m. The average diameter, measured 1.3 m height from the root collar, silver birch has 31.6 cm and downy – 21.2 cm. The number of trees by diameter classes shows that the largest number of trees for downy birch is at the 17 cm diameter class. This is explained by the fact that the biological aging of this species is much faster than that of silver birch, where the largest number of trees is at the 32 cm diameter class, which also obtained the highest standing volume (m<sup>3</sup> ha<sup>-1</sup>). Mentioning the volume, from silver birch -188.8 m<sup>3</sup> ha<sup>-1</sup> were obtained, but from downy birch – 43.3 m<sup>3</sup> ha<sup>-1</sup>, which is 4 times less. Regarding the number of the surveyed trees of both species, it differed: silver birch - 178 trees per ha, but downy birch - 100 trees per ha. The first green downy birch has at 15.6 m height from the ground level, but the silver birch – 15.0 m the average height of the lower part, which is black and fissured, is 1.6 m.

Observations show that the morphological differences between these two species exist. Taking into account the measurement results downy birch has a tendency to lag behind in growth compared to silver birch.

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# GROUND VEGETATION SUCCESSION IN HYLOCOMYOSA FOREST TYPE DURING THE FOREST ROTATION CYCLE

**Edgars Dubrovskis**

Latvia University of Agriculture, Forest faculty, doctoral student, Latvia

**Aigars Indriksons**

Latvia University of Agriculture, Dr.silv., assoc. prof., Latvia

Forest typology in Latvia started at the beginning of the 20th century when I. Gutorovics for the first time distinguished forest types which were named after different forest growth and development stages in Latvian [1].

In 1920 K. Melderis divided several fundamental Latvian forest types with biological and silvicultural information included in them as the forestry experts needed to remember characteristics, the number of forest types was little [2].

K. Buss arranged all the information about Latvian forest site types and divided them into 5 parts according to a hydrological regime of forest stand – dry and wet mineral soil, peat and two drained (drained wet mineral soil and drained peat) forest site type rows [1].

Hylocomyosa is a dry mineral soil forest site type which characterises a well-aerated medium fertile sandy loam, loamy and clay soil depending on the soil parent material, geographical location and hydrological regime. Scots pine (*Pinus sylvestris* L.) is one of typical tree species growing in this forest site type [3].

Nowadays the main forestry activities are based on K. Buss's forest site type classification which in the course of time has been supplemented by other forestry experts.

The main problem for forest management and forestry experts working in forest for defining the right forest type is that there is descriptive information about ground vegetation of Hylocomyosa forest site type available only for mature stands and no information in the time period from a clear cut stand stage to a mature stand stage.

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# USE OF BIOLOCATION METHODS IN SILVICULTURAL RESEARCH

**Maris Eglite**

Latvia University of Agriculture, Forest Faculty, Department of Silviculture, doctoral student, Latvia

**Aigars Indriksons**

Latvia University of Agriculture, Forest Faculty, Department of Silviculture, Dr.silv, associate professor, Latvia

Biolocation is a method which allows the researchers to estimate the biophysical anomalies on the earth's surface, underground and in the air by considering the changes in the condition of the dowsing rod or other indicator in the hands of the dowser. The most popular version of biophysical anomalies is connected with flows of underground water. Water has an 81 times higher relative dielectric coefficient than air. However, structures of different networks suggest for another nature of radiation which does not connect with water flow.

There has been very little research carried out on this theme in Latvia. In 1979 there was the section of Bioelectronics established by the A. Popov's scientific-technical society of Radio engineering, electronics and communication, which in fact worked in the Institute of Physics in Salaspils [3].

The research carried out in Liepupe Forestry suggests that the pine (*Pinus sylvestris* L.) trees growing on biophysical anomalies are more vigorous and those growing on points of an intersection are with wider diameter [2].

However, the pine trees measured in the City Jelgava give a converse suggestion – the trees growing on places with biophysical anomalies are thinner and also have a lower density [1].

According to the Finnish forest scientist V. Altonen, during the 30s of the 20th century a number of scientists had tried to clarify if in the forest there was some influence of biophysical anomalies to the flora. K. Müller (1935; 1936) indicated that trees growing on points of an intersection of anomalies were decayed. He had observed that trees growing on the biophysical anomalies were more infected by diseases and the agents of diseases – parasitic fungi and bacteria were more abundant [3].

Up till now there is no scientifically proven evidence between any external physical fields and biophysical anomalies which has been obtained. However, if something cannot be proven or rejected in a scientifically proper way, it does not mean that it does not exist and has to be explored further with increasingly advancing technical resources.

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# FACTORS INFLUENCING PRODUCTIVITY OF HARVESTERS IN CLEAR CUTS

**Edgars Iecelnieks**

Latvia University of Agriculture, Forest Faculty, undergraduate, Latvia

**Solveiga Luguza**

Latvia University of Agriculture, Mg.silv.,Latvia

Productivity and time consumption in forest harvesting depends on the stand's conditions, characteristics of the forestry machinery, operators' skills and working techniques. Even if the basic methods and machine types of the cut-to-length harvesting system have not changed significantly in the last 10 - 15 years, improvements in the operators' competence, technical solutions in forest machinery and changes in the working environment have undoubtedly taken place. The objective of this study was to discover the special characteristics in the time consumption when using forest harvesters in clear cuts.

A forest harvester is an expensive machine and for this reason all non-productive time should be minimized and concentration should be focused on productive work. Non-productive time and time out is often when the operator plans the next work phase. If the plan is good, delay times are minimized and the harvester work flows forward steadily. A productive operator does not need to stop and think about the next work phase, he can plan while working [3].

To design a successful man-machine system both the technical and the human components must be understood. Predicting the performance of a machine component is relatively straightforward compared to modeling human behavior. The latter becomes particularly important in the forest machinery where site conditions are highly variable giving the operator a major influence on the machine's performance [1].

Tree size is the most important measurable variable that affects productivity of the harvester. Single-grip harvesters are very sensitive to tree size because they generally handle only one stem at a time. Productivity increases with tree size and harvesting costs decrease accordingly [2].

These are only a few factors that affect the productivity of forest harvesting. Since there are no two identical felling sites, there will always be one or several different factors that influence forest harvesting operations. Since each one of these factors is different it is important to be aware of them and try to avoid them or lessen their role in forest harvesting.

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# **EXPERIENCE IN FOREST STAND FERTILIZATION IN LATVIA**

**Toms Kalvis**

Latvia University of Agriculture, Forest Faculty, undergraduate, Latvia

**Solveiga Luguza**

Latvia University of Agriculture, Mg.silv., Latvia

Forest stand fertilization is a new concept in forest management. The main fertilizer used in forest stands is wood ash. Wood ash contains calcium, magnesium, potassium and phosphorus which should improve the conditions of mineral nutrition for trees. Forest stands which had been fertilized with various nutrient combinations have a faster growth rate than unfertilized forest stands. It is necessary to evaluate the ecological benefits and disadvantages - tree increment and changes in soil. It is quite a complicated question to calculate the optimal amounts of the fertilizer to be used in forest stands. Also economic factors should be evaluated - whether it is beneficial to perform this procedure or not. All of the factors should be analysed over quite a long period of time to gain more accurate results [2].

There are several factors to be considered before fertilizing. First and foremost is the forest owner's management objective. If one's primary management goal is to produce timber, fertilization can be an important management tool. Secondly, it is important to take into account the area someone is going to fertilize [1].

In previous long-term studies wood ash treatments have lasted up to 40–50 years. This makes wood ash a cost effective option from the forest owner's point of view, since the need to repeat fertilization probably will not occur [3].

Knowledge about forest fertilisation in Latvia is quite incomplete, a full understanding of forest fertilization and using it in forestry in Latvia could lead to more productive forest stands.

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# ESTIMATION OF THE BIOMASS STOCK FROM GROWING STOCK VOLUME

Jānis Liepiņš

Latvia University of Agriculture, post-graduate student, Latvia

Kaspars Liepiņš, Andis Lazdiņš

Latvian Forest Research Institute “Silava”, Dr. silv., Latvia

The interest in the assessment of forest stand biomass for different tree species and components has increased since the mitigation of climate change became the highest priority at a national and worldwide level. Tree biomass is the second most important forest carbon pool after the soil. In general, the estimates of forest carbon stock are obtained from the calculations based on the growing stock volume. Conversion from stem volumes into biomass is commonly achieved through factors known as biomass expansion factors (BEF) or biomass models. Studies have proven that BEF vary depending on the stand's characteristics and geographical location [1–2]. As a result, the use of BEF developed abroad, may lead to biased estimates. A more accurate method to calculate forest carbon stock is the direct estimation of biomass through country specific biomass models [2]. Our study is aimed to elaborate functions for predicting forest stand biomass for different tree components (AGB - above-ground biomass, BGB - below-ground biomass, SB - stem biomass, BB - branch biomass) using stand growing stock volume as the variable.

Table 1

Parameter estimates of the model

	AGB			BGB			SB			BB		
	a	b	R <sup>2</sup>	a	b	R <sup>2</sup>	a	b	R <sup>2</sup>	a	b	R <sup>2</sup>
Scots pine	0.884	0.914	0.997	0.231	0.898	0.987	0.500	0.977	0.993	1.057	0.587	0.701
Norway spruce	1.193	0.864	0.994	0.296	0.881	0.995	0.232	1.091	0.996	3.785	0.429	0.900
Silver birch	0.563	1.008	0.999	0.215	0.937	0.986	0.526	0.989	0.994	0.082	1.024	0.824
Common aspen	0.427	1.022	0.997	0.143	0.952	0.976	0.327	1.035	0.999	0.129	0.922	0.901

General form of model  $B = a \times V^b$ ; where: B denotes dry biomass of stand component ( $\text{Mg ha}^{-1}$ ), V – growing stock volume ( $\text{m}^3 \text{ha}^{-1}$ )

The study material consisted of 124 stands (27 Norway spruce, 34 Scots pine, 35 silver birch and 28 common aspen) covering all age classes and representing the largest part of forest stand types in Latvia. Stand volume and above-ground biomass were computed through species specific biomass models elaborated by a destructive sampling method from three sample trees in a  $500 \text{ m}^2$  established sample plot in every selected stand. In a comparative analysis with other models we found that the simple power function (Table 1) performed best in predicting biomass stock of different tree components. The obtained model demonstrates a very tight relationship between growing stock volume and biomass of tree components. These models can be used for the calculation of stand biomass in order to evaluate forest carbon stock.

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# SOIL COMPACTION IN YOUNG STANDS DURING MECHANIZED LOGGING OF BIOFUEL AND ROUNDWOOD ASSORTMENTS

**Uldis Prindulis**

LSFRI"Silava", doctoral student, Latvia

**Andis Lazdiņš**

LSFRI"Silava", Dr.silv, Latvia

Soil compaction during the logging process has been studied since the early 1970s. During the first trials it was assumed that soil compaction can have a negative impact to future stand development and health [1]. Since that time many new studies have appeared; however, till nowadays there is no common view about all the processes interacting with soil compaction and the relationships between the stand growth and soil compaction. The studies carried out in Latvia demonstrate that soil compaction has a long lasting effect and there is a considerable difference depending on the type of machines used. The most important type is: the forwarder used in the operations. The use of tracked forwarders results in a considerably smaller impact appearing only at the topsoil layer, but wheeled machines in the same conditions can compact soil down to a depth of 80 cm, even without visually identifiable signs of rutting [1-2].

The impact of a variety of forestry machine types on soil compaction is evaluated in this study according to measurement of soil penetration resistance at 0 to 80 cm depth. It has been concluded that soils with poor bearing capacity (comparably small penetration resistance) and an organic layer thicker than 5 cm are less vulnerable to soil compaction. The use of the small size forwarder Vimek 610 allows soil compaction to be reduced to an insignificant level in comparison with control sites and most of the ruts disappear within a few days in poor bearing capacity soil conditions. Whereas John Deere 810E forwarder, which belongs to a middle-size class of forest machines significantly compacts soil through the whole measured depth in similar conditions. Rottne F10B and John Deere 810E forwarders represent the same weight category and soil compaction due to the use of these machines on soils with moderate bearing capacity is similar too; however, on soils with weak and good bearing capacity results are different, mostly due to the different amount of extracted roundwood in both trials. A tracked forwarder was used only in good bearing capacity conditions and the results demonstrated significant compaction only down to a depth of 22 cm. It was found in the study that significant soil compaction ( $p < 0.05$ ) is more of a common issue in soils with good and moderate bearing capacity soil conditions.

The trials prove that the depth of the intensity of impact depends on the weight of the machine and the amount of material extracted; however, additional measurement data are necessary to characterize the impact quantitatively in different conditions.

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## LOG RAFTING IN LATVIA

Āris Pūseps

Latvia University of Agriculture, Forest Faculty, undergraduate student, Latvia

Aija Pētersone

Latvia University of Agriculture, Mg. paed, Latvia

Industrial timber rafting on the River Daugava can be traced back to the 16th century, and especially in large amounts timber was floated two or three hundred years later. The real glory days of the Latvian raftsmen began in the late 19th century when there was a rapid economic development of the Russian Empire and Riga became the most developed city in many areas[1]. Timber rafting was a relatively cheap mode of transportation[2]. The work was dangerous but lucrative, so a lot of people wanted this work. People needed special knowledge to make rafts. Until the 20s and 30s of the 20th century, logs were tied together with specially treated and twisted wickers. Later wires were used instead of wickers. From the landing site logs were pushed into the water one after another. Then they were arranged by using a crook and tied - with the thinner end first to have less resistance. In the big raft there could be as many as 30 or 40 logs in one line. The binding place was limited with a small “fence” – the boom that was made from four logs, not to let them flow away before they were tied. There were times when the logs were already tied on the ice when the river was frozen. This greatly facilitated the work. The man who was responsible for making the raft had to see that using light logs, pine, alternate with heavier trees like birch or other deciduous trees, which quickly became wet and pulled the raft to the bottom. At one time the raftsmen could even float up to 10 or 11 rafts, which could easily reach up to 70m in length. Then 10 experienced rafters were needed, but each raft helmsman needed 2 or 3 assistants. Also women tended to work on the raft, but the raft in one convoy usually had no more than two women. Immediately as the ice had melted the raftsmen’s season began and it ended in the late autumn. In the the first decade of the 20th century, around 15 000 rafts were floated on river Daugava[1]. Rafts were floated not only on Latvian rivers, but also in the Baltic Sea, for example, from the Lithuanian border to Kolkasrags. A small amount was floated from the Užava river’s mouth to Ventspils and from Liepaja to Pavilosta. This kind of rafting was encumbered by independent sea winds. In the 50s, 45 000 – 50 000 m<sup>3</sup> timber were rafted on the sea where one raft contained on average from 300 to 600 m<sup>3</sup> timber [2]. Timber rafting is an ancient and cheap way to transport a large amount of timber. This is evident by the lengthy period, about 400 years, during which logs were floated on Latvia’s rivers as well as in the Baltic Sea, and also the fact that the number of logs floated up to the early 19th century increased and contributed to the development of the economy.

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## THE FAMILY OF *NECKERACEAE*

Irina Sietiņa

Latvia University of Agriculture, Forest Faculty, Department of Silviculture, post-graduate, Latvia

Aigars Indriksons

Latvia University of Agriculture, Forest Faculty, Department of Silviculture, Dr. silv, assoc. prof., Latvia

The aim of the paper is to describe bryophytes as an important part of flora and show *Neckeraceae* family as an example. This aim was reached by studying and analyzing available literature sources, researches, morphological descriptions, photographs and maps.

The bryophytes are one of the oldest *phylum* that is known and evolved from an aquatic species. Bryophytes are valuable from a perspective of ecology and eco-services. They are an important investigation subject for multiple applied sciences such as medicine and construction [2].

Taxonomically bryophytes are close to algae and pteridophytes. The taxonomical division into classes has been a topic of discussions for scientists for many decades. There have also been doubts that the phylum is monophyletic – its genesis comes from one ancestor [4]. This question is complicated due to the 400 million year long history of evolutionary development (2). The *Neckeraceae* family in Latvia is represented by four species: *Neckera pennata*, *Neckera complanata*, *Neckera crispa*, *Homalia trichomenoides* [1]. Morphologically they are very similar, for example, all four species have glossy and flat leaves.

The *Neckeraceae* family is widespread mainly in the Northern hemisphere, from Iceland to Costa Rica [3].

The species that are found in Latvia are mainly epiphytes or epiliths and they grow in shaded areas. These species are indicators for natural forest biotopes and are listed in the Red Book. They grow in groups and therefore can become an esthetically attractive element of a landscape [2].

There are potential negative effects on *Neckera* population expected due to “*Chalara fraxinea*” which is causing ash (*Fraxinus excelsior* L.) dieback, a tree disease currently spreading in Europe” [5].

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## **SOCIAL SCIENCES**

# AGRICULTURE AND NATURAL LANDSCAPE OF KOCAELI

**Seyda Akbaş**

Nigde University, Faculty of Agricultural Sciences and Technologies, Agricultural Genetic Engineering,  
Undergraduate student, Turkey

**Dina Popluga**

Latvia University of Agriculture, Faculty of Economics and Social Development, Institute of Business and  
Management Science, Dr.oec., Assistant Professor, Latvia

Turkey is located where the three continents making up the old world, Asia, Africa and Europe are closest to each other and straddle the point where Europe and Asia meet. Turkey, which has 81 administrative provinces, is divided into seven geographical regions; the Black Sea region, the Marmara region, the Aegean region, the Mediterranean region, Central Anatolia, the East and Southeast Anatolia regions. Turkey is surrounded by the sea on three sides, by Black Sea in the north, the Mediterranean Sea in the south and the Aegean Sea in the west. In the northwest, there is an internal sea, the Sea of Marmara, between the straits of the Dardanelles and the Bosphorus, which are important waterways that connect the Black Sea with the rest of the world. The coastline of Turkey (excluding islands) is 8,333 km [1]. Kocaeli is a city located in the East Marmara region. Kocaeli is surrounded by Sakarya on the east and southeast, Bursa on the south, İstanbul and Yalova provinces, İzmit Gulf, Marmara Sea on the west, Black Sea on the north. The acreage of the province is 3.505 km<sup>2</sup>. The area of agricultural land takes up to 36 % of the total area of Turkey. The region's climate is quite suitable for both animal and vegetative production. Kocaeli has a precipitation rate which is quite above the average of Turkey demonstrating why agriculture in the region is very practicable and productive. The region also provides 25% of the hazelnut production of Turkey. When TÜİK's agricultural production values of the year 2010 are examined, the province of Kocaeli ranks the 6th (1,016 tons) in kiwi production. Due to the landscape of Kocaeli with mountains and the sea, it is an attractive place for tourists. Winter tourism, sports tourism, wellness and spa tourism, traditional tourism and other alternative tourism opportunities that take their sources from these, and the touristic service infrastructure that these opportunities create are present.[2] The city of Izmit is mainly an industrial center in Marmara region of Turkey with numerous industrial establishments surrounding the Gulf of Izmit. However, there are also many tourist sites in this bustling province. Kartepe is a winter sports resort that reaches a height of 1,600 m, Kerpe and Kefken on the Black Sea coast have fine beaches, while Golcuk and Karamursel in the Gulf of Izmit are other beautiful sea resorts.

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# **AGRICULTURE IN CAPPADOCIA AS ONE OF TOURIST ATTRACTIONS OF TURKEY**

**Aslınur Çavdar**

Nigde University, Faculty of Agricultural Sciences and Technologies, Agricultural Genetic Engineering,  
undergraduate student, Turkey

**Dina Popluga**

Latvia University of Agriculture, Faculty of Economics and Social Development, Dr.oec., Assistant  
Professor, Latvia

Republic of Turkey is the cradle of cultures and civilizations connecting Europe and Asia and the capital of civilizations that have reigned the lands of Anatolia for many centuries. Turkey is divided into seven regions and the Central Anatolia Region is the one of them. This area has a great tourism potential due to such a significant area for agriculture as Cappadocia. The aim of study is to gives an insight into the nature of the Cappadocia zone, landscape and agriculture.

Thousands of years ago a group of ancient volcanoes, Erciyes Mountain, Hasan Mountain and Melendiz Mountain, spewed out layer upon layer of thick tuff which blanketed the countryside for miles around. Over the centuries the wind and rain worked on the soft rock, carving out spectacular gorges and leaving behind the dramatic pinnacles of rock. They are called the 'fairy chimneys' creating the Cappadocian moonscape.[1] Soil of this district is quite fertile and has interesting geographical formation because of past volcano activities. For this reason approximately 1.8 million tourists in 2013 visited Cappadocia region.[2] Potatoes, sugarbeets, cereals, legumes, apples, pears, walnuts, apricots, almonds and grapes for viticulture and wine are the most important products of this region.

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# **PERSONNEL MOTIVATION IN COMPANY "LATVIAN RURAL ADVISORY AND TRAINING CENTRE"**

**Vineta Cukura**

Latvia University of Agriculture, Faculty of Economics and Social Development, undergraduate student,  
Latvia

**Uldis Ivans**

Latvia University of Agriculture, Assistant Professor, Mg.oec., Latvia

The theme of this research paper is "Personnel motivation in company "Latvian Rural Advisory and Training Centre". This theme is topical because motivation has always been and always will be in the center of each employee's interests. The aim of this paper is to analyze the personnel motivation in the company "Latvian Rural Advisory and Training Centre". To prepare proposals for "Latvian Rural Advisory and Training Centre" employee motivation improvement the following objectives were set: 1) understand the nature of the personnel motivation, its types, methods and aspects, 2) to provide the characteristics of the company "Latvian Rural Advisory and Training Centre", 3) to conduct a survey among the staff members and analyze its results, 2) to draw conclusions and develop proposals for improving of personnel motivation in the company "Latvian Rural Advisory and Training Centre".

This research paper consists of three chapters. The first chapter contains theory about the nature of motivation, different models of motivation. The second chapter is about the general characteristics of the company "Latvian Rural Advisory and Training Centre". The third chapter contains information about the evaluation of the staff's motivation in the company "Latvian Rural Advisory and Training Centre".

In conclusion, the author of the research paper has developed conclusions and proposals on the basis of the obtained information for improving the staff motivation in the company "Latvian Rural Advisory and Training Centre".

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# RISK MANAGEMENT IN THE FARM "BIRZNIKI"

**Zanda Dombrovska**

Latvia University of Agriculture, Faculty of Economics and Social Development, graduate student, Latvia

**Lasma Dobele**

Latvia University of Agriculture, Dr.oec., Assistant Professor, Latvia

Each company, if its goal is profit-driven, has to face the risks associated with internal and external factors. Theoretical aspects of risk management has been analysed by several researchers [1,2]. The farm "Birznieki" is subject to various risks. By identifying and assessing the risks affecting the operations of the farm, it is possible to establish measures to mitigate the risks, or to remove them, therefore the aims of the research is perform the risk management analysis of "Birznieki". The risk assessment uses a special coefficient method and point scale method, but in order to characterize the financial risks of the farm, the balance horizontal and vertical analysis and financial ratio calculations were carried out.

The farm "Birznieki" was founded in 2007, it is located in district of Ikskile, Tinuzi. Farming activities include dairy farming, pig farming and cropping.

The analysis of "Birznieki" activities identified the following risk groups: production risk, nature risk, market risk, financial risk, political risk and the human factor risk. The assessment of identified risks was carried out on the basis of risk possibility, potential losses and risk exposure of the time. After the risk assessment, it was found out that the farm activities are mainly influenced by production and financial risks (score of 56 and 55 points). Production risks included obsolete equipment, equipment damage and low-quality products. The financial risk included unpaid bills, fines and errors in business calculations. By taking into account the financial risk importance, bankruptcy probability by Altman method was calculated. In 2012 the farms' bankruptcy probability was 1.01, in 2013 – 1.02, but in 2014 – 3.02. It can be concluded that "Birznieki" bankruptcy risk might exist, but it is not high. This means that the farm should make a regular financial activity coefficient calculation to determine development opportunities and minimize the financial risk. It can be concluded that the production and financial risks are most likely to affect "Birznieki" existence and the farm's long-term development. The nature risk (27 points) and political risk (20 points) are also important but the probability is relatively lower.

In order to reduce the production risk, it is necessary to have household insurance and carry out diversification of products. In order to reduce financial risks, the owner of the farm has to make financial reserves (10% of the company's annual profit after tax). The authors calculated that "Birznieki" must accumulate 4,430 EUR in case of risk occurrence. In order to reduce market risk, the owner of the company has to look for new partners (largest milk processors) by identifying the milk purchase prices as well as to assess the long-term contracts with suppliers. It is also recommended to make the wiring test (once a year) by placing smoke detectors and alarms, thus reducing the fire occurrence risk.

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# HUMAN RESOURCE MANAGEMENT IN “LDZ CARGO” LTD

**Julija Dudorova**

Latvia University of Agriculture, Faculty of Economics and Social Development, graduate student, Latvia

**Lasma Dobele**

Latvia University of Agriculture, Dr.oec., Assistant Professor, Latvia

Competent and qualified human resources are precious asset for the company's development [1]. This is justified by the fact that very often costs of human resources make up to 70% of the total costs of the company. This means that an effective human resources management can be one of the most important factors influencing the competitiveness of the company [2]. Human resource management includes a wide range of issues – personnel planning, recruitment and selection, employee evaluation and motivation [3, 4]. Taking into account the human resource management importance nowadays, the study aims to analyse “LDz Cargo”, Ltd, personnel management and develop proposals for its improvement. The author used several research methods – monographic method to describe the importance of human resource management nowadays; an interview with “LDz Cargo” human resources manager and the survey of employees.

“LDz Cargo”, Ltd, is the fifth biggest rail freight carrier in the European Union and the largest in the Baltic States. The company provides trucking for more than 3,800 customers and its trucking volume reached nearly 56 million tonnes in 2013. In 2013 the British market analysis company Plimsoll has included “LDz Cargo” in Europe's leading transport and logistics company list TOP 500.

In 2013 “LDz Cargo” employed 2,794 workers. The employee rotation ratio is low, which can be explained by the job stability, competitive salaries and business specifics. In order to comprehensively describe and assess “LDz Cargo” human resource management, the employee survey was conducted. The author found out that the planning process, recruitment and selection are carried out efficiently. The results showed that problems in adaptation process were mentioned as negative aspects of human resource management; as a result employees faced the difficulty of learning the new job responsibilities (40%), getting used to the work rhythm and the working environment (26%), as well as understanding the priorities of the tasks and deadlines (21% of the respondents).

The author also identified problems with staff aging and the threat of new workers. The largest group of employees in “LDz Cargo” were at the age from 40 to 62 years. This means that the company should think about generation change, as there will be need for new railway professionals. It was also found that there are problems with staff competence assessment and development.

On the basis of the research findings the author recommended the human resource manager to introduce regular staff surveys, so that managers could learn about their employees' needs. Besides, the company has to introduce a motivation system for employees. The company has to improve employee training planning process through the establishment of each employee's individual career development plan within “LDZ Cargo”.

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# **SOCIO-ECONOMIC EVALUATION OF LAND RESOURCES IN INDIA**

**Parag Ganesh**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
Master student, Latvia

**Madara Dobele**

Latvia University of Agriculture, MBA, Lecturer, Latvia

India is a newly industrialised country, and no wonder that one of the national targets is to be in the list of developed countries with the help of youth resource and natural resources available in India. This target strategy is "Vision 2020". According to Dr. A. P. J. Abdul Kalam, the plan is "transforming the nation into a developed country, five areas in combination have been identified based on India's core competence, natural resources and talented manpower for integrated action to double the growth rate of GDP and realize the Vision of Developed India."

Land resources in India enclose approximately 1.3 million square miles, and it is a cape, protruding into the Indian Ocean, in between the Bay of Bengal on the east and Arabian Sea on the west. Indian land resources are segmented into varied relief features, 43% of the land area is a plain region; the Indian mountain region constitutes 30% of the area, where as plateaus account for 27 % of the total surface area on the nation [1].

India constitutes 18% of the world's population, 15% of the livestock population and only 2% of the geographic area, and 2% of the forest area. According to the data 2011-2015 of "World Bank" agricultural land in India is 60.6%. Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures [2].

For the moment, India, as the BRICS country, is relying on its natural resources, and for any country it is important aspect to have abundance of natural resources to utilize them for the national benefit, both in social and economic aspect. And India is rich in natural resources. But still there are a lot of problems and challenges because land is a resource that cannot be reproduced, and India is the 2<sup>nd</sup> populous country in the world and the 7<sup>th</sup> largest country in the world by area, so that shows an imbalance problem. Day by day the population is increasing and imposing a lot of pressure on the resource which mankind cannot reproduce.

As per the provisional population totals of Census 2011, the population density of India has gone up to 382 persons per km<sup>2</sup> from 324 persons per km<sup>2</sup> in 2001. On an average 58 more people inhabit every km<sup>2</sup> in the country as compared to a decade ago [3].

Today, with increasing urbanisation as well as industrialisation, an increased pressure has been witnessed on land, water and other environment resources, mainly in big metropolitan cities. The country is in the midst of a massive wave of urbanization as some 10 million people move to towns and cities each year in search of jobs and opportunities. It is the largest rural-urban migration of this century [4].

Currently, India's one of the biggest challenges is to maintain and develop the socio-economic value of land resources, so we can learn from the past mistakes and act it in such a way that our future will be secure, sustainable and still productive. But while doing that we have to be completely practical rather than ambitious. Population is something that someone cannot control overnight, but can plan the use of resources for sure.

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# APPROACHES TO RESEARCHING SUBJECTIVE WELL-BEING IN OLD AGE

**Svetlana Gribanova**

Latvia University of Agriculture, Faculty of Economics and Social Development, Master student, Latvia

**Jolanta Millere**

Latvia University of Agriculture, Assist.prof., Dr.sc.soc., Latvia

During XX century both the structure of the population and life longevity have changed significantly. The average life longevity has increased, the health state has improved which lead to the fact that the amount of older population increased as well. According to Ageing Report 2015 by Euro Commission we can see that fertility rate as well as life expectancy in Latvia is among one of the lowest in the EU, also it is mentioned that Latvia is in the second place in the list of the sharpest decline in the population by 2060 (reduction of the population – 31%). There is a the tendency that working age population amount will continue decreasing while elderly and very elderly population will continue increasing. The share of the population aged 65 and over increased by just over a third in Central Europe and the Baltics over 1990-2010 compared to a rise of 24 percent in the EU-15. In Latvia in 2015 based on Ageing Report the population older than 65 is 19.4% of entire population [1].

Nowadays it is important to analyze the subjective well-being (SWB) of older population as an indicator of how the society is ready to satisfy the needs of its members. The research on subjective well-being might be useful for suggesting possible activities or measures to enhance SWB. It is important to go above the traditional stigmatized understanding of older ages when we think that old people are sick, physically and emotionally inactive and try to find common traits of life of older people.

Subjective well-being “is a broad category of phenomena that includes people's emotional responses, domain satisfactions, and global judgments of life satisfaction” [2]. It is also necessary to mention that studying subjective well-being the researcher needs to look in four dimensions: social, material, physical and emotional. However, for every group these dimensions can include different factors. It is crucial to find the identifying predictors of SWB for the later life period. In this case the following basic points for corresponding dimensions need to be considered: satisfaction with income, possibility to satisfy needs and position in society for material well-being; state of health, safety from violence, level of satisfaction with healthcare offered in the area, transport accessibility, physical activity for physical well-being; relationship with children, participation in social activities, attending cultural/sport/political events for social well-being; stress and anxiety, sense of control, emotion health, spirituality for emotional well-being.

Taking into consideration different theories such as discrepancy theory, social comparison theory, T. Parsons systems theory, P. Bourdieu capital theory as well as the results of World Value Survey by R.Inglehart and C.Welzel, we came to the conclusion that studying subjective well-being of older population is a process where all factors of subjective-wellbeing such as social, emotional, material and physical well-being have to be taken into account.

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# THE COST OF YOUTH UNEMPLOYMENT

**Liva Grinevica**

Latvia University of Agriculture, Faculty of Economics and Social Development, PhD student, Latvia

**Baiba Rivza**

Latvia University of Agriculture, Faculty of Economics and Social Development, *Dr.hab.oec.*,  
academician, Latvia

Youth unemployment is one of the most pressing economic and social problems confronting those countries whose labour markets have weakened substantially since 2008, following the near-collapse of worldwide financial markets. There is an element of “deja vu” around this development: youth unemployment first became a serious problem for industrialized countries during the 1980s. While labour markets were booming in the early part of this century, youth unemployment was still a concern [1].

The rate of unemployment is one of the most important indicators of success or failure in economic policy. At the same time unemployment has well-known costs at the individual level in the form of loss of human capital and lower wellbeing for the affected persons and their families. At the aggregate level the cost is lower production in the economy [3].

Youth unemployment rate in Latvia increased to 19.8 % in January from 18.2 % in December of 2015 [2]. Youth unemployment in Latvia in January 2015 was lower than in December 2015, but it is still a major challenge addressed to the government of Latvia.

The aim of the research was to calculate the cost of youth unemployment in Latvia.

To achieve the aim, the following tasks are set: 1) to evaluate the theoretical aspects from different authors to identify the practical approach to the methodology; 2) to calculate the cost of youth unemployment in Latvia.

The findings in this article point to the relevance of cost of unemployment measured and evaluated in different ways. In this paper the cost of youth unemployment were calculated using the rate of gross domestic product.

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# AGRICULTURE HOLDING “ZĪLES” ACTIVITY DEVELOPMENT

**Andris Gruduls**

Latvia University of Agriculture, Faculty of Economics and Social Development, undergraduate, Latvia

**Anita Auziņa**

Latvia University of Agriculture, Faculty of Economics and Social Development, Associated Professor,  
Dr.oec., Latvia

The situation in the dairy farming sector in Latvia at the moment is very difficult because the purchase price of milk is below the cost [1]. And that leaves many of farmers in a difficult situation, because they have to choose whether to continue to work with losses or whether to start something new in another sector of agriculture.

It is a tough time even for big farms having 100 and more cows, therefore some of these farms are considering changing the sector of agriculture in which they work [2].

Considering this situation and on the basis of financial indicators of agriculture holding “Zīles”, it can be concluded that the above mentioned farm is also in a difficult situation, because income from dairy farming has been decreasing. If the average income from dairy farming in the holding “Zīles” was more than 29 cents per litre from 2012 till 2014, then in 2015 it was 22 cents per litre. Reductions of income per litre have been 7 cents, and that makes pretty big difference from the anticipated income.

For this reason the business plan for “Zīles” activity development includes branching out of dairy farming to growing vegetables like potatoes, starch potatoes, onions and winter garlic. The aim for the business plan is to show that it is financially profitable to change the sector of farming.

The business plan shows that if events and activities are realized and vegetables are sold for the predicted price, the first year will be finished with profit of almost 10,000. Profit in the first year is planned to be so large because some machinery used for dairy farming will be sold. The second and third year will be finished with the profit of over 10,000 EUR, or 13,845 EUR in the second year and 10,460 EUR in the third year, respectively.

Thus, it can be concluded that it is financially profitable for “Zīles” to change the sector of farming from dairy farming to growing vegetables.

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# CONSUMER VIEWS ON THE QUALITY OF VEGETABLES IN LATVIAN SUPERMARKETS

**Liene Gruņiere, Laura Jansone**

Latvia University of Agriculture, Faculty of Food Technology,  
undergraduate students, Latvia

**Līga Paula**

Latvia University of Agriculture, Mg.sc.soc., Latvia

Vegetables take a very important part of a healthy diet. Exactly vegetables positively affect metabolism, provide the body with vitamins, as well as keep the body resistance against various diseases. According to a healthy eating pyramid, vegetables should comprise approximately 35% of a diet [1]. The society “5 a Day” and GFK conducted a survey in Latvia which revealed that 60% of the respondents on daily basis eat less than 400 g of fruits and vegetables. That is below the standard of 400 g a day defined by The World Health Organisation and healthy eating initiative the society - “5 a Day”. One of the reasons why people do not eat enough vegetables could be the bad quality of vegetables available in supermarkets. Therefore, the **aim of the study** was to find out, if the quality of vegetables in Latvian supermarkets is assessed by the consumers as satisfactory or not.

A quantitative survey of economically active population in Latvia was conducted, and 89 consumers participated in this pilot study. The questionnaire was inserted in a web page [www.visidati.lv](http://www.visidati.lv) (02.11.2015), and respondents were asked about the quality of imported and organic vegetables in Latvian supermarkets and about the quality factors which they take into consideration in the shopping process.

The data showed that more than a half of the respondents believe that the quality of vegetables in Latvian supermarkets (“Rimi”, “Maxima” and others) is good, meanwhile almost 40% consider that it is not. Cucumbers, tomatoes and sweet pepper more frequently were reported by the respondents as vegetables having bad quality. 31% of the respondents enjoy shopping at the chain store “Rimi”. The choice of vegetables is determined by a number of factors. Around 31% of the respondents at first pay attention to the maturity degree of vegetables, after that they evaluate the price. Only one respondent pointed out the country of origin as the most important criteria. 48% of the respondents assessed the quality of imported vegetables as average, 25% evaluate as poor bad, and only 17% considered the quality to be good. The bad quality of imported vegetables could be explained by the fact that in the process of transportation and storage products lose their quality (colour, maturity degree). According to the study, only 6% of respondents have reported to food control authorities about the bad quality of vegetables in Latvian supermarkets.

The authors of the research concluded that, in general, people are satisfied with the quality of vegetables in Latvian supermarkets; however, the supermarkets have to pay more attention to the quality of cucumbers, tomatoes, and sweet pepper.

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# INFLUENCE OF E-COMMERCE TOOLS ON HOME PRODUCTION DEVELOPMENT IN LATVIA

**Ina Gudele, Edite Bisere**

Latvia University of Agriculture/ Faculty of Economy and Social Development, /doctoral students, Latvia

**Dr. habil. oec. Baiba Rivza**

Latvia University of Agriculture/Institute of Economy and Regional Development, Latvia

Authors analysed home production development in Latvia and different factors influencing it. The comparison of the Latvian situation with trends in this field in other EU countries discovers interesting results and highlights several problems. The main problem is that home production in Latvia in rural areas and farms is much less developed than in average in the EU.

In some other countries development of home production has started as a hobby or a possibility for additional income and has become the regular work and basic economic gain [1]. A lot of positive examples show that home production can be a start-up for serious business projects with added value and an accelerator for further development [2].

As the unemployment level in Latvia and especially in rural areas is very high (8-11%), development of home production could be one of the solutions to decrease unemployment, increase added value for agriculture products and to become a positive factor for retention of national traditions and development of cultural and culinary tourism in rural areas. Several factors influence development of home production between farmers; the main one is education and access to information about production and marketing. In this case several electronic commerce tools are useful containing information about home production, online professional education, forums to exchange experience and official information from governmental bodies. There are a lot of online marketing tools available for home producers.

The authors offer several activities for governmental and municipal bodies to intensify development of home production in rural areas of Latvia, starting from complex solutions for professionals and general education of potential audience.

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# SIGNIFICANCE OF OCCUPATIONAL SAFETY AND HEALTH IN LATVIA

**Madara Ģenderte**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
post-graduate student, Latvia

**Aina Dobeļe**

Latvia University of Agriculture, Dr.oec., Latvia

Occupational safety and health is safety and health of employees at work. It should be given serious attention because of a growing number of enterprises in Latvia. Employees are the most important capital, and labour protection must be one of the priorities of the employer.

It is an obligation for an employer to organize an occupational safety system in the company and ensure it works [2]. Labour protection provides multiple acquisitions such as increase in productivity, positive image of the company, less mutable labour force, less cases and missed days due to illness, a decreased number of accidents and occupational diseases [1].

In contrast, if the company does not have the occupational safety system, the risk of higher expenses and potentially losses must be taken into consideration. Some of costs are easy to understand - expenses for accidents and compensations. Some are difficult to measure, such as the cost of human suffering [3]. Estimates vary, but for most countries, the costs of accidents at work and occupational illness range from 2.6% to 3.8% of GDP [3]. Also, the employer is liable for not fulfilling the obligations; it is civil or criminal liability.

In the last 5 years, in Latvia the number of occupational accidents has increased from 1,232 in year 2010 to 1,763 in 2014. [4]. The author of this paper has done calculations between the number of people who suffered from occupational accidents and due to this reason missed at least three working days, and the population of different European countries in 2013. The calculation shows that Greece, Latvia and Bulgaria have the lowest figures (In Latvia 0.07% of the population). The main factor of this situation is the level of development of the country's regulation institutions, implemented measures and the knowledge of employees.

State Labour Inspectorate (SLI) of the Republic of Latvia during the period from 2008 till 2014 inspected 48,502 companies [5], and it is only 9.9% of the total number of economically active companies per one year. SLI has not increased the number of inspected companies despite the increase in the total number of economically active companies. It shows the limited resources of SLI. But at the same time, SLI detected 10,815 transgressions of non-observance the labour protection regulatory acts in 2014 [5].

The research by the European Agency for Safety and Health at Work in 2014 discovered that the most common obstacle to realize labour protection is the complexity of the regulations (recognized by 40% of the respondents in 28 EU countries). The lack of funds was mentioned by less economically developed countries such as Lithuania, Latvia, and Montenegro [4].

The level of development of the labour protection in Latvia is low, which is caused by poverty and lack of information – every company wants to save funds and, unfortunately, sometimes it is on the employees' account. Some of the employers do not know that the creation and maintenance of the occupational safety system costs less than transgressions of occupational safety.

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# FACTORS INFLUENCING FURTHER EDUCATION CHOICES OF CLASS 12 STUDENTS FROM SECONDARY SCHOOLS OF JELGAVA CITY

**Lauma Hauka**

Latvia University of Agriculture, Institute of Social Sciences and Humanities, Faculty of  
Economics and Social Development, undergraduate student, Latvia.

**Ginta Kronberga**

Latvia University of Agriculture, Institute of Social Sciences and Humanities, Assistant Professor,  
Latvia.

Currently in Latvia the need is felt for educational guidance to the fields of exact sciences, because specialists from these fields are mostly demanded in the labour market. But specialists in humanities and social sciences are not demanded so much in the labour market, in the government's opinion. The aim of the course project was to explore the reasons influencing further education choices of Class 12 pupils from secondary schools of Jelgava city. The quantitative approach with surveys was used in the study and all four hypotheses set out at the beginning of the study were confirmed.

The results of the survey showed that most of respondents have decided what they will do after secondary education completion and they have clear future plans. Most of their future plans include studying in Latvia (84%) or in another countries (28%), but 18% respondents want to start working, others want to make a family (14%). Respondents are more inclined to seriously consider their further education choice. Most popular professions among respondents refer to economy and finances (39%), insurance, health care and rehabilitation (17%), art and culture (15%), information technologies(14%), communications and media (14%), management and administration (13%), tourism, recreation (13%), nature and environment sciences (9%), humanities (9%). The respondents' further education choices are not influenced by factors like spontaneous choice (47%), teachers' opinions and tips (47%), parents' occupation (41%). Factors influencing their choices mostly are: to gain advanced knowledge and skills (37%), grants opportunities (36%), a profession's demand in the labour market (35%), becoming a highly qualified specialist and this profession always will provide a chance to find a job (34%). The respondent's further education choices influenced such factors like fitting to own interests (75%) and the desire to achieve something in life (45%), a good salary (52%) and career opportunities (50%). The trend among respondents to choose the humanities and social sciences exists, but interest about exact and nature sciences has increased among respondents.

Respondents choices are influenced by news in media (21%) and national and local priorities about the required specialists (22%); profession demand (35%) and contribution in society development and growth (29%) influence their choices, because national priority is to promote pupils' interest about exact sciences, emphasizing that specialists of exact sciences will promote the state's development and they are demanded in the labour market.

The respondents' action in choosing further education is mostly based on self-oriented action, which refers to the behavior typical of modern society. However, such action types appear as action oriented to close relations, specific action, group oriented action and emotionally neutral action.

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# NATURAL RESOURCES PROTECTION AND ITS LEGISLATION

**Pēteris Kalniņš**

Latvia University of Agriculture, Faculty of Economics and Social Development, doctoral student, Latvia

**Ingūna Leibus**

Latvia University of Agriculture, Professor, Dr.oec., Latvia

Each company's production activity is linked to the natural resources, which determine their availability - geographical location, transportation and its cost. Today different types of natural resources models develop for their acquisition, recycling and decreasing of pollution (anthropogenic impact on the environment). Various studies and scientific calculations have determined that current resource use practices will continue environmental degradation and depletion of natural resources and increasing waste generation. To make efficient use of resources, the European Union has developed a strategy "Europe 2020", which supports the transition to sustainable growth based on resource-effective use, low-carbon emission economy. There are a number of directives that are associated with various forms of waste management and recycling.

In relation to the legislation of the European Union, Latvia along with the restoration of independence in 1990 created a new tax system by adopting the first Act, which entered into force on 1 January 1991. Over time the Latvian legislation has undergone many significant changes that have changed the natural resources tax. Now certain laws aim to promote economically efficient natural resources use, limit the pollution of the environment, to reduce polluting the environment in the production and marketing of products, to promote the use of new environment-friendly technologies, to support the sustainable development of the economy, as well as financially ensure environmental protection measures. In relation to the statutory purpose, Latvia has a number of laws and regulations that govern natural resource tax calculation procedure and its application for natural resources and water, waste disposal, air, water, and environmental pollution, various types of packaging, coal, brown coal, coke, and radioactive substances.

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# CONCENTRATION OF RADON IN LIVING SPACES AND CONSTRUCTION MATERIALS

**Yryssaldy Khamitova**

Sh. Ualikhanov Kokshetau State University, Faculty of Science, master student, Kazakhstan

**<sup>1</sup>Inara Jurgena, <sup>2</sup>Anuarbek Kakabaev**

<sup>1</sup>Latvia University of Agriculture, Faculty of Economics and Social Development, Dr.oec., Latvia

<sup>2</sup>Sh. Ualikhanov Kokshetau State University, Faculty of Natural Sciences, Candidate of Biological Sciences, Associate Professor, Kazakhstan

A person gets most of the radiation dose from radon with the inhaled air while being in a closed unventilated room. In areas with a favourable climate, the concentration of radon indoors is about 8 times higher than, on average, in the outside air.

The radioactive situation in Kazakhstan is characterized by large areas with high terrestrial radiation and the radioactive noble gas radon from underground sources due to the large deposits of uranium in Kazakhstan's interior. Kazakhstan has not completed a full study on the radon situation and the places of high natural radioactivity. To date, more than 700 such "anomalies" have been identified, and it is estimated that studies on elevated radon concentrations in rooms are required for about half the territory of the Republic [1].

At the moment, the State Environmental Service takes measurements of radiation intensity in Latvia to assess the situation and identify the areas with potentially high radon content [2].

Radon is heavier than air, therefore, raised from the depths; it can build up in the basement of the building, getting out on the lower floors. Elevated levels of radon indoors are often related to the type of construction and finishing materials used in the construction or repair of houses (or apartments). Radon is also produced by floors and walls, and the reason is the radioactivity of building materials - the presence of Ra-226 in elevated concentrations [3].

Getting radon out of building materials into the atmosphere depends on the emanating capacity of the walls, which is determined by the porosity, temperature and pressure drop. In terms of radon entering the premises, porous concrete is very dangerous, especially if made of slag from coal-fired power plants, the emanating capacity of which is close to 100%. In this sense, granites are less dangerous: though radium is present in greater quantities in them, their emanating capacity is equal to only fractions of a per cent. Therefore, radon from granite practically does not enter the premises. The presence of plaster usually lowers the emanation of radon from the walls.

The emanation of radon is greatly suppressed by wall coverings such as wallpaper (specifically designed to block radon), paints and varnishes based on epoxy. Good results are obtained by using composite coatings.

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# POSITIVE INFLUENCE OF STRAIGHT EDGE IDEA

Valentine Kiselev

Peter the Great St.Petersburg Polytechnic University, Bachelor, Russia

Alena Bondarevskaja

Peter the Great St.Petersburg Polytechnic University, Master of Linguistic, Russia

Straight edge firstly appeared in the 1980s in the USA as a result of changes in the punk-rock society. Sexual revolution, speech freedom became a starting point for lots of movements in youth of 70s. Punk-rock was one of them. It gave the freedom of being: everyone decided himself how to live and lots of young punks came to a self-destruction. While the slogan for those punks was “Live fast, die young”, the slogan for straight edge was “I’ve got straight edge” [1], saying about considering freedom as a freedom of choosing the better way of living.

The founder of Straight edge is Ian MacKaye, a leader of the hardcore-punk band Minor Threat. In 1981 the band made a song called “Straight edge”, where the maintaining idea was brought. It came in such words: “I’m a person just like you. But I’ve got better things to do than sit around and smoke dope. Because I know that I can cope.”[1] I am, as a person of a new generation of young people, watching my peers, who are allowed to buy and drink alcohol, make it one of the greatest ways to relax and entertain. It is not thought to be completely wrong. The worst thing is that there's nothing else left for relaxing and entertaining. The social position on drinking is least negative. It's available and normal, but it does lead problems and kill potential of lots of young people. There are many numbers of crime related to drinking too much alcohol. There is a fact, that alcohol is a drug, it kills the brain and destructs the nervous system. But it's about physiology. Mentally, alcohol is a way not to think about life, leave it and come into happy feeling, but that feeling is strictly different from happiness. It's not long, and people, in fact are not feeling any state of happiness, they just feel pleasure I think living a life and loving a life is not about feeling pleasure, it is about creativity of acting and self-improvement. It is about bringing something positive in life making something that can lead to the best future. At last, it leads to happiness, when you've done a lot, when you've created a lot, approved that you are a human.

The bad side of this movement is aggression, straight-edgers have onto people who don't share their views. On this point Ian MacKay said in his interview: “Straight edge is an individual way and it shouldn't be forced. It's very ridiculous when one person begins pressing on another just because he is different.”[3] Aggressive behavior is a result of wrong interpretations of straight edge conception. I want to distinguish it: straight edge is an idea of freedom, so there is only a free choice of being or not being in straight edge. This idea is like an effort to make the life better, to change something for a good. It's not about fighting with destructive things, it's about refusing to do these things. That's a kind of a humanistic idea, I guess.

So why straight edge idea is positive? “... I want to do something, improve my mind and I want to do it in a certain direction. I need an aim in life. I want my life to be valuable for me, for something else. I'm here not just to have a good time.”, answers Ian MacKaye [2]. Straight edge becomes not only a refusing way; it becomes a directed way to a full and happy life, as I consider it. It is trying to change the social conformist sight on life and show that a human is responsible for his life. And it is only himself who can change something for the best.

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# FREE ECONOMIC ZONES AND INTERNATIONAL EXPERIENCE

**Alisa Kovaļova**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
post-graduate student, Latvia

**Aina Dobeļe**

Latvia University of Agriculture, Dr. oec., Professor, Latvia

Free economic zones (FEZ) are becoming an increasingly popular way to promote the growth of countries' export today. Increasingly, strategic plans, which are oriented towards export development are mentioned and updated in FEZ. Literature definitions and scientific publications analysing FEZ are different, but mostly they consider that FEZ are enclosed areas where some privileges regarding taxes on goods are granted.

One of the most popular synonyms of FEZ is free trade zone (FTZ). D. Ball suggests that FTZ is a geographic area, which is located outside the customs territory. Goods of foreign origin enter the area for possible transshipment, re-export or import into the country. While the goods are in the area, there is no need to pay import duties [1].

FEZ activities and role in the economy help to explain the lack of classification features.

R. Zimenkov quotes H. Guangwen FEZ who classifies FEZ into three types: enclave type, open type and mode type [3].

A number of factors influence the success of FEZ activities, but one of the main factors is investments. F. Frobel points out that FEZ activities are related to the existence and inflow of investments into the given area [2].

Nowadays, FEZ is a common element in the international arena worldwide. Today the world has more than 3,000 different free zones in approximately 135 countries and territories. FEZ can be one of many instruments in the strategic planning, not a universal instrument of the development.

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# VOCABULARY ACQUISITION AND SELF-STUDY

**Vladislav Kuzmin**

Peter the Great Saint Petersburg Polytechnic University, Institute of Computer Science , undergraduate student, Russia

**Tatiana Panysheva**

Saint Petersburg Peter the Great Polytechnic University, Russia

Foreign language lexical competence is one of the major communication factors in the modern world of collaboration between countries. However, when we speak about vocabulary learning, it is important to pay attention to many aspects like word form, pronunciation, word meaning and word use [1, 2, 3]. We also need to read texts with new words and listen to tapes. The aim of this paper is to analyse how students learn new words in their self-study time and to try to find some new options which can facilitate foreign vocabulary acquisition.

We conducted the survey among 82 students of engineering department of Saint Petersburg Polytechnic University asking them to answer the question how often they do tasks aiming to study new vocabulary and to comment on their attention to different aspects of vocabulary acquisition and words learning methods, described in literature [3]. We also observed the use of monolingual and bilingual dictionaries on mobile phones and computers.

The survey revealed that 99% of students surveyed regularly use mobile phones and computers to get information about words translation, but pay less attention to pronunciation practice, still 52 % of those surveyed listen to word pronunciation on mobile phones and computers and only 1 % write out transcription. However, 10% produce lists of new words on computers and some students put lists of new words on the wall and 17% try regularly to repeat new words several times loudly.

As for new facilities, 50% of students regularly study new words with the help of online monolingual dictionaries and 29% of surveyed consider this approach to be productive but do not use it. Students who use monolingual dictionaries highlight the fact that they significantly expand their knowledge about words as monolingual dictionaries provide the learner with a number of word definitions, idioms and phrasal verbs and, what is more, with a lot of word use examples.

The results of the survey demonstrated that students have positive approach to the mobile phones and computer sites as useful facilities which help them to expand their vocabulary and increase knowledge about words. We consider that further introduction of new methods of vocabulary acquisition based on features of computer and mobile phones can stimulate students to learn new words efficiently and will help to avoid monotonous tasks.

## **Acknowledgements**

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# PERSONNEL MOTIVATION IN COMPANY JSC "SPODRĪBA"

**Marta Laimīte**

Latvia University of Agriculture, Faculty of Economics and Social Development, undergraduate student, Latvia

**Uldis Ivans**

Latvia University of Agriculture, Assistant Professor, Mg.oec., Latvia

Employee activity in a company is dependent on three factors: skills and abilities, resources, and motivation. Motivation - it is always a complex of initiatives: needs, motives, ideals, goals, values orientation, etc. All these initiatives are interrelated and form a system which then also provides a seamless human behavior, give it a direction and intensity. In process of motivation employees choose one of the alternatives of action in order to achieve personal goals.

To be able to find out what employee motivation and satisfaction with working conditions are, the author conducted a quantitative research. The method of survey was used by the author finding out the opinions of JSC "Spodriba" employees. In addition, the author used the company's 2013 and 2014 reports, legislative acts of the Republic of Latvia, general literature of personnel motivation and theories as well as internet resources. 56 employees at the age of 29-58 including 14 women took part in the research. The author concludes that most of JSC "Spodriba" employees are satisfied with work. The greatest dissatisfaction refers to the growth opportunities, working conditions (premises, office location, the decor), employee support initiatives as well as the system of remuneration (wages, bonuses, bonuses). Employees have different opinions on satisfaction regarding "the available information for a successful job" question. In order to motivate employees, the company should think about remuneration system as well as changing the attitude of the line manager (praise, recognition).

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# ANALYSIS AND REDUCTION OPPORTUNITIES OF YOUTH UNEMPLOYMENT IN JELGAVA CITY AND JELGAVA MUNICIPALITY

**Tatjana Lejava**

Latvia University of Agriculture, Faculty of Economics and Social Development, post-graduate student, Latvia

**Baiba Rivza**

Latvia University of Agriculture, Dr.habil.oec., professor, Latvia

The present research used such important information sources as macroeconomic policy research studies by 2006 Nobel prize winner Edmund Strother Phelps who analysed the association between inflation and unemployment. His research was performed in the late 1960s and early 1970s; yet, the key trends are characteristic of the 21<sup>st</sup> century as well. E. Phelps continues focusing on this problem; for example, in 2015 in the portal ProFinance.ru he pointed that “the key cause of the deep recession in the European economy – decrease in job participation, low satisfaction with the job and insignificant wage increases – lies in the catastrophic decrease in labour productivity, which began in the late 1990s and encompassed almost the entire Europe. In this way, Europe as a continent loses its best talents”. [1]

The research has also reviewed the research studies by Līva Grīneviča and Raimonds Kovalecs “Integration of Young People into the Latvian Labour Market” (the years 2012-2016). In the opinion of the authors, the best scenario for improving the situation in the youth labour market involves financial support and entrepreneurship instruments aimed at the start-up of self-employment and small businesses.

The third information source is the research studies on unemployment by Peter A. Diamond, Dale T. Mortensen and Christopher A. Pissarides that focus on high unemployment rates as one of the most important economic problems. Already in the late 1970s and early 1980s scientists developed a DMP model, which helps to explain why unemployment remains and does not decrease even if the economic conditions improve.

The authors conducted a survey and distributed 250 questionnaires to youths aged 15-29 (inclusive), of which 233 were filled in. The respondents answered 15 questions. The research showed that the most important factors in the choice of a job by youths were wage, knowledge and skills and information about job vacancies, whereas the least important factor was the status of unemployed individual. 57% of respondents found a job by sending their CV or with the help of their friends and acquaintances. Only two respondents were offered a job by an employer, while 13 youths continued working in the same job after completing their practical training.

The respondents mentioned the following unemployment reduction factors as the most important: the provision of training placements, which offer a job to youths after they complete their training (57%), and the perfection and availability of appropriate support programmes (10%). However, a less important factor was a more detailed structure for the attraction of finances to start up a business (4%). The survey (observation) of experts was designed based on the findings of the survey of youths and theoretical analysis.

The authors suggest designing the following strategies/programmes: first, students who have been granted government-funded study places have to work in their profession in a government institution after completing their studies; second, enterprises should offer a job to youths after they have completed their practical training, while the government has to grant tax relief to the enterprises in the first year of employment for youths.

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## NEW YORK EXAMPLE FOR SUSTAINABLE LIVING

**Ieva Locmele**

Latvia University of Agriculture, Faculty of Economics and Social Development, post-graduate, Latvia

**Modrite Pelse**

Latvia University of Agriculture, Dr.oec., Professor, Latvia

Sustainable development has been defined in many ways, but the simplest definition is Our Common Future. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Worries about sustainable development suggest that meeting the needs of the future depends on how well we balance social, economic, and environmental objectives or needs when making decisions today. [4]. Sustainable development will not be brought about by policies only. Everybody should take part and educate the new generation to make right decisions for sustainable future.

Examples of sustainable development goals for people and planet are: thriving lives and livelihoods, sustainable food security, secure sustainable water, universal clean energy, healthy and productive ecosystems, governance for sustainable societies [3]. There are a lot of different examples how to provide sustainable living and lifestyle. Global sustainability objectives are: maintain a stable climate; reduce biodiversity loss, safeguard ecosystem services, maintain global hydrological cycle, maintain clean air, universal education, reduce greenhouse effect. If we are talking about reducing carbon dioxide and greenhouse influence, then we can talk about many examples all around the world. New York City is one of those examples – the city in the United States of America.

The economy of New York City is the largest regional economy in the United States. The city is full of skyscrapers, trade centers, factories. Buildings make almost three-quarters of New York City's emissions, but it doesn't mean that citizens of New York don't think about sustainable living [2].

The ambitious goal was set to reduce citywide greenhouse gas emissions. New York City enacted a comprehensive effort, called the Greener, Greater Buildings Plan (GGBP) to reach its aggressive sustainability goals. [1]. The structured plan how to achieve the target was designed. Nowadays we cannot live like irresponsible and uneducated inhabitants and believe that others will care about our future. We have to learn from good examples, how to connect modern manufacturing with sustainable living.

Since 2007, 17 of New York City's leading universities, the 11 largest hospital organizations, 11 global companies, and 18 residential management firms have accepted the NYC Carbon Challenge: they have agreed to voluntarily reduce their building-based emissions by 30 percent or more in just ten years. The progress was seen quite soon. What did they do? They aggressively cut their energy use and emissions. The Carbon Challenge works by inspiring a high-level commitment within organizations, creating a platform for the exchange of information and ideas. [2]. So, here is an excellent example – voluntary initiative to think about our next generations.

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# GROSS MARGIN ANALYSIS IN FARM "STRĒLNIEKI"

Lāsma Luža

Latvia University of Agriculture/ Faculty of Economics and Social Development, undergraduate student,  
Latvia

Andra Zvirbule

Latvia University of Agriculture, Professor, Dr.oec Latvia

Agriculture is one of the leading business and industrial sectors in Latvia. One of the largest agricultural sectors is dairy farming. There is suitable climate and available financial support to practice dairy farming. Dairy industry is highly developed. There are 8,086 thousand herds with 162,463 thousand cows. There is a large number of dairy farms, 21.8 thousand dairy farms, respectively. In 2015 the purchase of raw milk was 807,633 tonnes.

In the last few years, dairy industry has been affected by different factors such as economic situation, financial support of the state, export restrictions and others. [1]

Dairy farms need a large amount of financial resources to develop. Dairy farms have a chance to receive financial support from the government, for example, single area payments, the support for export. Also dairy farm owners can apply for the European Union support payments that means applying for projects to get the financial support for starting dairy farming, to get new machinery and other activities that would contribute to develop farms. [2]

To calculate economic efficiency in dairy farming, gross margin needs to be calculated. It consists of income that is income from basic production and side production, government and the European Union support payments. It includes calculation of fixed costs that include electricity, buildings and machinery repairs. And also variable costs, that consist of fodder, veterinary and insemination costs. To calculate gross margin, fixed costs and variable costs are subtracted from revenue. Gross margins accounting allows to analyse farming efficiency, to explore best business directions. [3]

As small dairy farms are at danger, the goal of the research was to compare gross margin of the farm "Strēlnieki", a small farm, with Latvia's average gross margin.

The farm "Strēlnieki" is a small dairy farm. There are eight dairy cows and eight young calves. The farm's dairy products are realized in marketplace in Liepaja and sold to cooperative "Alpini".

The analysis of gross margin shows that small dairy farms are most endangered by milk purchase prices in the country because of small amount of animals and low yield, a small price of milk would not pay off. To reach average results of Latvia, an important factor is the government and the European Union support that covers a part of costs and allows to generate income. This dairy farm has found alternative to generate income from other products; it sells ecological cheese in a wide range of farmers' markets and trade shows.

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# **DREAM PILLOWS LTD BUSINESS PLAN FOR THE TIME PERIOD OF 2017-2019**

**Diāna Macanova**

Latvia University of Agriculture, Faculty of Economics and Social Development, student, Latvia

**Ināra Jurgena**

Latvia University of Agriculture, Faculty of Economics and Social Development, Dr.oec., Latvia

The ability to establish an effective specific company is affected by any businessman and the individual's capacity to plan the company's future and anticipations of the changing conditions. In today's changing market conditions, the planning process is too difficult because many aspects of the market are not controlled, for example, inflation, crisis, strikes or other unforeseeable circumstances. A business plan is considered a comprehensive type of planning, which gives a notion of the prospective company's future operating efficiency and profitability both to the prospective entrepreneur as well as to potential business investors and creditors [1].

The business plan is a blueprint of business and will provide an entrepreneur with the tools to analyse and implement changes that will make the business more profitable. It will provide detailed information on all aspects of the company's past and current operations, as well as its projections for the next few years [2].

The company's "Dream Pillow, Ltd" main activity is related to different types of pillows intended for sleep and the production and marketing of decorative pillows. The idea of sewing a pillow came to the author when she was faced with the problem that name pillows were not available in Rezekne, which recently have become one of the most demanded products in the Russian market and were also promoted in Latvia.

The problem of the research: no specialised pillow shop is available in Rezekne where consumers can buy pillows of various types and sizes, so Rezekne residents have to purchase pillows in other cities or order them on the Internet. The aim of the project: to make a realistic business forecasts in order to identify the viability of the company Dream Pillows.

The following hypothesis was set out: the company starts its operations in January 2017 and its business is profitable only in the third operating year. At the moment, the author of an idea has enough resources to ensure the successful opening of the business and the economic activity of the company for at least a year. The target market of Dream Pillows Ltd includes all Rezekne city residents who are 60,000 in number and are potential customers of the company. If providing the company Dream Pillows with financial support, the author predicts faster development of the company, so the company's funds invested in its economic activity will pay off earlier and bring greater profits for the company in the future.

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# JELGAVA CITY RESIDENTS' VIEW ON ASYLUM-SEEKERS' RECEPTION IN LATVIA

**Valeria Malyavina**

Latvia University of Agriculture, Faculty of Economics and Social Development, undergraduate student,  
Latvia

**Līga Paula**

Latvia University of Agriculture, Dr.sc.soc., Latvia

In comparison to other countries of the European Union, the problem of asylum-seekers was not topical in Latvia before the European refugee crisis began in 2015. Therefore the public opinion and attitude towards asylum-seekers was not widely studied in Latvia until now. However, results of one of these studies envisage that respondents with higher income are more open to reception of asylum-seekers as well as women, Latvian and respondents in the age group 35-44. In general, the majority of society in Latvia is against asylum-seekers reception in Latvia [2]. The asylum seeker is an alien person or a person from a third country, who flees from unsafe situations in his/her country or from political, economic, or other threats and whose claim must be evaluated to become a refugee [1]. Taras in his work about xenophobia mentioned, that fear and aversion from foreigners can be outcome of opinion, that they are a privileged group with special rights, just a few obligations and a willingness to stay independent from the rest of society; he also mentions that strangers are "always uninvited guests" [3].

The aim of this study was to find out the views of Jelgava city residents' on asylum-seekers reception in Latvia. In order to achieve the aim, the following tasks were defined by the author: to carry out the literature review about the factors that influence society's opinion and to elaborate a survey and collect data about Jelgava city residents' view on reception of asylum-seekers in Latvia and Jelgava. There were three hypotheses tested in the research: (1) women are more tolerant to asylum-seekers than men, (2) the youngest respondents are more open and flexible than the oldest ones towards asylum-seekers; (3) respondents with a higher level of education are more tolerant and knowledgeable about asylum-seekers reception in Latvia. In order to collect the data, the quantitative survey was carried out. There were 156 male and female respondents representing different age, education and income groups. As the factors that influence society's opinions were considered prejudice, discrimination, racism, stereotypes, identities, groups, tolerance, cross-culture competence and ethnocentrism.

All of 3 hypotheses were confirmed, also it can be noted that the majority of the respondents does not support the reception of asylum-seekers in Latvia. Jelgava city residents are open to representatives from other nations, cultures, faiths and respondents also considering that Latvia's culture, norms and values are inappropriate for asylum-seekers.

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## **DEVELOPMENT OPPORTUNITIES OF “PIE CEZARA” LTD**

**Guna Meija**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
graduate student, Latvia

**Lasma Dobele**

Latvia University of Agriculture, Dr.oec., Assistant Professor, Latvia

For each company's successful development it is necessary to elaborate a business strategy [1]. Development planning is important for new companies as well as for those companies that have been operating in the market for several years [2]. “Pie Cezara” Ltd was founded in 2014 and it deals with wholesale of sophisticated, premium quality Arabica coffee bean. The company's target group is business-to-business customers (offices, public authorities, retailers, and retail chains), but in the future, the company plans to serve the private individuals as well. For the first year of operation the company had EUR 2063 losses. To expand the business, the company has to set its development opportunities. Therefore, the aim of this study was to explore development opportunities of “Pie Cezara” Ltd.

The main development opportunity for the company “Pie Cezara” is associated with attracting new customers to provide regular income which is an essential prerequisite for the company's next steps in the future. There are plans to expand exports to Estonia and other foreign markets by encouraging the turnover growth by 10-20% in 2016 and 2017, and to reach up to EUR 90 thsd. It is planned to set up a café-shop. In this way, the company will attract new customers to increase the turnover of “Pie Cezara” Ltd. The costs of a café-shop account for around EUR 21 thsd, of which the largest part comprises the area improvement (EUR 12 thsd.). The company plans to create a website with the ability to purchase goods through an online store. The development of a website costs up to EUR 2 thsd., but the internet store costs up to EUR 3 thsd., due to a relatively large nomenclature of goods. At present, the company has developed an electronic business card website which is connected to the Google Analytics to analyse the weekly changes in the number of visitors.

According to the SPACE matrix, the “Pie Cezara” Ltd is in a competitive position: currently, the company does not have a high competitive advantage which can be explained by the fact that the company is unknown and is in the development stage. This means that the company needs to stabilize its assortment, attract a sufficiently large number of permanent clients, as well as regular advertising is necessary. The company plans to reach EUR 75 thsd net turnover in 2016, in 2017 - EUR 90 thsd., and in 2018 - EUR 150 thsd. net turnover by introducing above mentioned activities. The company plans to invest its profit in the development of marketing activities which could constitute around EUR 2.1 thsd. in 2016, and EUR 1.5 thsd. in 2017. It can be concluded that the company has a very good potential for growth, it is explained by the fact that at the moment “Pie Cezara” Ltd is new and still unrecognized, but through various marketing efforts it can capture a larger market share.

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# **INFLUENCE OF MARKETING COMMUNICATION ON THE TEAM SPORTS FEDERATION POPULARITY**

**Ieva Opolska**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
Post-graduate student, Latvia

**Līga Proškina**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
Dr.oec., Assistant Professor, Latvia

An in-depth study in Latvia has never been carried out on the impact of marketing communication for a successful functioning of team sports federations and attracting athletes. Public policies (2014 - 2020) provide that citizens have to do sport at least 1-2 times a week. [3] Sport is a promoter of a healthy society. Sports directly affect people's lives. People are living longer, they are happier and enhancing the national economy of their country for a longer period of time. According to the Euro barometer survey (2014), in Latvia 40 % of the population do not do physical or sports activities at all, while the average percentage in the EU is 39%. Also, in Latvia physical or sports activities at least 1-2 times a week are done by only 28% of the population, while the average percentage in the EU is 40%. [1]

An important role of physical activity promotion is played by sports organizations. In 2014, in Latvia 101 professional sports educational institutions and sports clubs, 869 sports organizations were registered, of which: 88 were state and local government institutions, 749 sports associations and 32 capital companies. [2]

Nowadays, marketing communication is a powerful tool for sending information. Using successful marketing communications and integrating its elements will help federations to improve popularity and encourage new athletes to practice regular team sport activities.

Healthy lifestyles for the young people should be promoted through education in schools. The promotion activities of healthy lifestyles should be directed to the families and parents, because they are the factors that affect children's health.

The authors conclude that medium and, especially, small team sports federations do not use marketing communications sufficiently to promote their organization visibility and attract athletes to practice their sports. The study shows that a successful use of integrated marketing communications for team sports federations will encourage citizens to do regular physical activities.

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# ENTREPRENEURIAL COMPETENCY INDICATORS IN REGIONS OF LATVIA

**Evija Otaņķe**

Latvia University of Agriculture, Faculty of Economics and Social Development, post-graduate, Latvia

**Aina Dobeļe**

Latvia University of Agriculture, Faculty of Economics and Social Development, Dr.oec., Professor,  
Latvia

Entrepreneurial competency is a resource without which the market economy cannot effectively develop and it is valued as a special and rare type of the resource. Development of entrepreneurial competency has become one of today's most decisive issues in Latvia and in Europe because it is important for the survival in the competition not only at the national level, but also in the competition between countries [1].

Entrepreneurial competency consists of number of components including creativity and innovation creation capability, communication and organization proficiency, project management skills, business planning and risk-taking ability, as well as the knowledge and skills that are necessary to form a new company and embody practical ideas in the successful development of that company [2]. Looking at the concept of entrepreneurial competencies, it can be concluded that this concept is multifaceted as it includes both - the provision of the personal qualities and characteristics, an innate ability and variety of acquired skills, knowledge and attitudes. Today it has a broad meaning and includes a set of characteristics, abilities and skills that should be developed in a person from an early age.

Summarizing various authors' views on entrepreneurial competency, it must be concluded that entrepreneurial competency can be learned and developed. There are various factors that influence this process, like education, innate abilities, cultural environment, social conditions and closest people [3]. The author highlights education as the most important factor.

Comparing indicators of entrepreneurial competency from different regions in Latvia, the author concluded that it would be fundamentally important to provide the opportunity for young people to gain the knowledge and skills which are needed to start a business. This should be done both - in universities and at schools by encouraging young people to develop their own ideas as well as providing them with an opportunity to attend courses which include elements of management and economics. In this context the emphasis should be on vocational schools at the secondary education level and on engineering and natural sciences programmes in higher education.

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# ACCOUNTING QUALITY IN SMALL AND MEDIUM SIZED ENTERPRISES

**Daila Pastare**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
post-graduate student, Latvia

**Inguna Leibus**

Latvia University of Agriculture, Dr. oec., Latvia

Small and medium-sized enterprises (SMEs) represent 99% of all businesses in the European Union (EU) [6]. An enterprise is considered to be any entity engaged in an economic activity, irrespective of its legal form. This includes, in particular, self-employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in an economic activity. The main factors determining whether an enterprise is a small and medium-sized enterprise are staff headcount and either turnover or balance sheet total. A company in Europe is considered a SMEs if it has fewer than 250 persons and an annual turnover not exceeding 50 million EUR or an annual balance sheet total not exceeding 43 million EUR. [3] But in Latvia that is slightly different. A company is considered a SMEs if it has fewer than 250 persons and an annual turnover not exceeding 40 million EUR or an annual balance sheet total not exceeding 20 million EUR [4].

Organisations are facing ever more diverse challenges in managing their enterprise systems as emerging technologies bring both added complexities as well as opportunities to the way they conduct their business. Underpinning this ever-increasing volatility is the importance of having quality data to provide information to make those important enterprise-wide decisions. Numerous studies suggest that many organisations are not paying enough attention to their data and a major cause of this is their failure to measure its quality and value and/or evaluate the costs of having poor data. [5]

Business rules are an effective way to control data quality. However, not all business situations and possible data quality problems can be considered in advance. In situations where business rules have not been defined yet, patterns of data handling may arise in practice. [1]

Litigation risk mitigates agency problems promoting greater accounting quality in turn, enhancing capital allocation efficiency [2].

Successful development of the enterprises is a joint effort between business managers and professionals with the appropriate qualifications. Quality accounting administration in enterprises takes place in accordance with the legislation of the accounts. Accounting quality is negatively affected by: 1) low levels of education and unwillingness to learn; 2) failure to follow up with legislative changes; 3) unfamiliarity with accounting systems and computer programmes; 4) disorganized and changing legislation; 5) the administrative burden; 6) work overload etc.

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# THE CURRENT STATE OF THE WORLD MEAT INDUSTRY

**Kseniya Pavlova**

Belarusian State Agricultural Academy, Economic Faculty, Master student,  
Republic of Belarus

**Aleksandr Gridushko**

Belarusian State Agricultural Academy, candidate of economic sciences/docent,  
Republic of Belarus

Meat forms an important part of the diet for most people around the world. Twenty years ago the global demand for meat was 173 million tonnes. Today the annual global demand for meat stands at 285 million tonnes [1].

Current trends indicate that by the end of the century 80% of the world's population will be living in the under-developed countries and a significant number of these will have large food deficits. An increased production of animal protein would make an important contribution towards filling this deficit.

Demand for meat is likely to increase significantly as incomes throughout the world increase. The global demand for meat is estimated to increase by 44 per cent to over 400 million tons by 2030 to support the world's growing population and its increased appetite for meat. "According to recent FAO work using longer term population and income projections, global food production needs to increase more than 40% by 2030 and 70% by 2050, compared to average 2005-2010 levels." Currently nearly 42 kilograms of meat is produced per person worldwide, but meat consumption varies greatly by region and socioeconomic status. In the developing world, people eat about 30 kilograms of meat a year [2].

In 2011 every citizen in the UK consumed an average of 82 kilos of meat, while US citizens consumed 118 kilos. In general, men eat more meat than women. In the EU, meat consumption has stagnated recently; there is also a growing number of vegetarians and vegans. The favourite meat of the average European, however, is pork. The Chinese also share this appetite for pork. Per capita, meat consumption in China has increased six-fold over the past 40 years. Since the population almost doubled to 1.3 billion people over the same period, global demand for meat and animal feed has exploded. Consumers in the industrial world eat more than 80 kilograms per person each year.

The strongest increases in production have been in the developing world since 1995. More meat and dairy products have been produced in developing than in industrial countries, and this trend has continued ever since. In fact, in 2011 at least 60% of meat was produced in developing countries [2].

Global meat consumption is on the rise. As their middle classes expand, populous countries like China and India have seen an increased demand for meat products. And although growing concerns about the undeniable health and environmental impacts of meat-heavy diets have led to the meatless Monday trend in the U.S., Americans still eat more meat than almost anyone else in the world—an average of 270.7 pounds per person every year.

Food producers face a monumental task. At current consumption rates, the world would need to generate 455 million metric tons of meat annually by 2050, when the global population is expected to reach 9.7 billion, from 7.3 billion today.

Increases in meat production can be encouraged by stable profitable outlets in connection with improved processing and handling facilities and consequently large-scale investment.

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# DEVELOPMENT OF VALUE ADDED TAX IN THE VISEGRAD GROUP

**Jan Procházka**

Czech University of Life Sciences Prague, Faculty of Economics and Management, undergraduate student, Czech Republic

**Vineta Tetere**

Latvia University of Agriculture, Faculty of Economics and Social Development, Faculty of Economics and Management, Mg.oec., Latvia

The economic significance of value added tax (VAT) has been increasing in recent years. The main reason why the value added tax is important is because this tax represents the biggest income for state budget from the tax system. It is thus very important what type of tax policy the government chooses because impacts of the value added tax significantly influence macroeconomic indicators which affect conditions of society [2].

The VAT is really important for the regulation of monetary and fiscal policy and through them the economic situation of the state [1].

The purpose of this study is focused on how tax rate of value added tax influences revenues of the state budget, inflation, gross domestic product (GDP) and tax burden. For this purpose the technique of collection and studying documents and analysis of the institutions and authors from the Visegrad Group was used. The researched period begins with an introduction of the VAT and finishes in recent years.

It is possible to observe tax rates above their average in last years, especially by the reduced rate. For this reason, both tax rates are near the same value and the tax burden is growing.

However, revenues are at historic maximum. The impact on GDP is difficult to measure because this indicator is influenced by many other aspects. But the Polish tax systems shows that stability of tax rates positively affects the growth of GDP.

A significant influence is possible to observe with a link between tax rates and inflation. A difficult situation occurs when VAT is introduced into the tax system because this situation represents an important change for the state's economy. This study also observed an impact of the change of the tax rate on inflation. Results show that the standard rate of VAT has a stronger impact on the inflation than the reduced rate. Also an increase of VAT rate has a more significant effect on inflation than its reduction.

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# INFLUENCE OF PHOSPHOGYPSUM AND COAL ASH ON THE NUTRITIOUS MODE OF CHERNOZEM SOILS IN “UMAI ZHER” LLP IN NORTH KAZAKHSTAN

Altynay Rakhimova

Sh. Ualikhanov Kokshetau State University, S. Sadvakasov Agrarian-economic Institute, master student, Kazakhstan

Abilzhan Khussainov<sup>1</sup>, Inara Jurgena<sup>2</sup>

<sup>1</sup>Kokshe Academy, Director of SRI ESD, Dr.sc.biol., professor, academician of AACCS of RK, correspondent member of RANS, Kazakhstan

<sup>2</sup>Latvia University of Agriculture, Faculty of Economics and Social Development, Dr. oec., Latvia

In recent years, the decalcification problem, which is one of the main reasons for a humus decrease, has a particular importance in connection with strengthening of intensive use of soils and degradation of lands. It causes the necessity of development and introduction of practical and scientifically based recommendations on the application of various calcium-containing additives. According to the data of many scientists from Russia and the CIS countries, the wastes of the industry promote improvement of soil structure and enrichment by minerals. The application of phosphogypsum, which contains a significant amount of mineral colloids, in appropriate combinations with organic wastes, leads to intensive soil aggregation and creation of a soil structure that is favourable for crops [1].

The project "Crop fertilization with industrial wastes in chernozem soils in Akmola Region" is carried out by the association "Ecological Center "Eco-Kokshe" within the programme of distribution of innovative experience in the agro-industrial sector. The research is held on the lands of Umay Zher LLP, the total area of 262 hectares. The project purpose is the introduction of an effective and ecologically safe technology for crop fertilization with phosphogypsum and coal ashes on chernozem soils in Akmola region.

The result of the experiment is shown in Table 1.

Experiment indicators	Nutrient concentration, mg/kg			Humus, %	pH
	P <sub>2</sub> O <sub>5</sub> (mg/kg)	K <sub>2</sub> O (mg/kg)	N (mg/kg)		
Control	14.1	457	37.6	3.1	7.53
Coal ashes 200 kg/ha	14.3	452	38.1	3.3	7.60
Phosphogypsum 1 t/ha	14.5	449	38.8	3.5	7.73

Table 1 – The content of humus, pH and nutrient elements in soil, 2015.

The content of humus in the ordinary chernozem on a control site was 3.1%, which characterized the soil as low-humus; with the application of phosphogypsum and ashes, the value increased respectively to 3.3 and 3.5%. The low concentration of mobile forms of phosphorus is also the main characteristics of soils. The concentration of mobile phosphorus on Machigin's gradation was 14.1 mg/kg for control, with an increase up to 14.3 and 14.5 mg/kg if applying fertilizers. The content of the easily hydrolyzed nitrogen in soils was average (37.6 mg/kg for control, with an increase up to 38.1 and 38.8 mg/kg). The research needs to be continued for establishment of the influence of the fertilizers on productivity of crops, with further introduction and distribution of this innovative experience in the region.

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# DETERMINATION OF THE MOST EFFECTIVE DECONTAMINATION OPTIONS FOR AGRICULTURAL RUNOFF IN LATVIA USING SOLUTIONS INCLUDED IN HELCOM BALTIC SEA ACTION PLAN

**Ieva Siksnāne**

Latvia University of Agriculture, Faculty of Economics and Social Development, post-graduate student,  
Latvia

**Aina Dobele**

Latvia University of Agriculture, Dr.oec, professor, Latvia

The meaning and usage of water resources are fundamentally important for the nature and human life. Water is a life source and is irreplaceable in human life.

The hydrosphere is the total amount of water on the planet; it takes up to  $\frac{3}{4}$  of all space on the planet Earth. It includes all water systems, all surface and underground water, interacting in a non-stop cycle that is called the water cycle [1]. Each stage in the water cycle is important, not only on the level of oceans and seas but also on the level of rivers and ditches, that's why it is very important not to pollute small water systems.

The HELCOM Baltic Sea Action Plan defines agricultural runoff as the main source of nutrient inputs to the Baltic Sea, it creates biogenic pollution (most important pollution sources are nitrogen N-NO<sub>3</sub> un phosphorus P-PO<sub>4</sub>) [2,4].

The HELCOM defines 30 actions to reduce phosphorus and nitrogen runoff from agriculture. Three most relevant and effective actions that are adequate for the territory of Latvia and its ditch system in it [4] are described in the research.

First: the usage of nutrient balance for planning fertilizers and an optimal dosage for each cultivated plant. It has a long-term impact and also rationalizes costs for land owners [4].

Second: avoiding fertilizers and manure in highly irritable territories. In Latvia these territories are defined in the Regulations No.834 issued by the Cabinet of Ministers "Regulations on water and soil protection from pollution with nitrates that is caused by agricultural actions" [4,5].

Third: creating wetlands that detect water and purify it from biogenic pollution [4].

Even though in Latvia the amount of precipitation exceeds evaporation, it is crucial to be aware of the importance of the water system in the water cycle that affects purity of the Baltic Sea and oceans. The research defines most effective treatment forms that can be used by agricultural land owners that are concerned about environmental cleanliness and long-term gain for maintaining clean water resources on the regional and planet level.

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# **BUSINESSES REGISTERED IN AIZKRAUKLE PROVIDING SERVICES FOR TOURISM AND IN-BETWEEN DISTRICTS MIGRATION**

**Ieva Siksnāne**

Latvia University of Agriculture, Faculty of Economics and Social Development, post-graduate student,  
Latvia

**Aina Dobele**

Latvia University of Agriculture, Dr.oec.,Professor, Latvia

Aizkraukle region is located in the Republic of Latvia and is included in Zemgale Planning region [1]. Until 2001 Aizkraukle town and Aizkraukle parish existed as two independent municipalities, but in the end of 2001 it was decided to merge both municipalities and to form Aizkraukle municipality as the consequence of the territorial reform [2]. The total area of Aizkraukle municipality is 102.18 square meters, the number of inhabitants at the beginning of 2015 was 9,114 people [2]. Aizkraukle municipality is crossed by the Daugava, the largest river in Latvia, the region is characterized by multipurpose economics [2].

Development of business activities is the foundation of economic growth and welfare not only of the country but also municipalities. Business activities promote economic growth in municipalities wherewith it has a determinant role of regional and national economic progress. Business development in Latvia most frequently is analyzed at the national level and not so much in the context of municipalities.

Business activities often are connected with tourism development in regions. The research focuses on the businesses that are located in Aizkraukle and offers services connected with tourism or in-between districts migration, when people are going to Aizkraukle for services like car maintenance because this service is not provided in the place where they live.

The analysis of the research results show that 47% of all the businesses in Aizkraukle municipality categorized with NACE classifier (statistical classification of economic activities) includes 5 sectors: maintenance and repair of motor vehicles; restaurants and mobile food service activities; holiday and other short-stay accommodations; hairdressing and other beauty treatment and freight transport by road.

The largest proportion, approximately 20% of all businesses, relate to accommodation business, including 8% of holiday and other short-stay accommodation businesses and 12% of restaurants and mobile food service activities. Other businesses included in the research represent many types, including museums and taxi operation.

Businesses that are needed or have to be expanded in Aizkraukle municipality include tourism and in-between districts migration services.

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# ANALYSIS OF ECO-INNOVATION CAPACITY AND DEVELOPMENT LEVEL IN LATVIA IN THE CONTEXT OF EUROPEAN UNION

**Karīna Tihonova**

Latvia University of Agriculture, Faculty of Economics and Social Development, graduate, Latvia

**Anita Auziņa**

Latvia University of Agriculture, Associate Professor, Dr. oec., Latvia

The world is facing serious environmental challenges such as climate change, depletion of natural resources and biodiversity loss. Increasingly severe environmental challenges and resource constraints have led to growing worldwide demand for eco-innovation and have facilitated the emergence of eco-industries. “Eco-innovation is the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organisation (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives.” [4].

Latvia belongs to the group of modest eco-innovators. Currently the Eco-innovation Scoreboard places the country 24th in the EU28 ranking. In almost all the components of the Eco-innovation Scoreboard composite indicator Latvia’s performance rates significantly lower than the EU average. This modest performance can be associated with the lack of political commitment to research and innovation in general; the weaknesses of cooperation between science and industry in Latvia and a limited number of eco-innovative enterprises, especially in the medium and high-tech fields. The most important barrier to eco-innovation development in Latvia are the lack of targeted policy framework and the small number of enterprises from the eco-industry. In addition, the low societal awareness about the potential of green growth maintains eco-innovation as a rather underdeveloped business sector in Latvia [1].

The analysis of Latvian Environmental Performance Index shows that the country is placed in 40th rank (out of 178) with the overall score–64.05, and Latvian 10 year trend is positive (+5.69%) [2]. Eco-innovation activities in Latvia were also analyzed through patent analysis and green grows indicators [5]. The main document (on the EU level) which enhances eco-innovation value and establishes that green innovations are key to Europe’s future competitiveness and sustainability is Eco-innovation Action Plan. Eco-AP focused on boosting innovation that results in or aims at reducing pressures on the environment and on bridging the gap between innovation and the market [3].

Nowadays a sustainable future, green and circular economy can only be achieved by decreasing waste of natural resources and energy, by producing and consuming moderately and responsibly. Therefore, eco-innovation can help European, including Latvian businesses come up with sustainable solutions that make better the use of precious resources and reduce the negative effects of economy on the environment.

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# ECO-CONSTRUCTION CONCEPTS AS SUSTAINABLE HABITAT MODEL WITH LOW OR NO UTILITY COSTS

**Artjoms Ustinovs**

Latvia University of Agriculture, Faculty of Economics and Social Development,  
doctoral student, Latvia

**Baiba Rivza**

Latvia University of Agriculture, prof. Dr. hab. oec., Latvia

The study explores several eco-construction concepts and introduces an efficient and sustainable habitation model. Low environmental impact, full or partial independence from utility costs / energy price, therefore less spending are just several out of plenty of advantages which eco-construction is able to contribute for the benefit of an individual and the society.

“Eco-constructed house” is a “Sustainable Building” which is the practice of creating structures using resources that are environmentally responsible and energy-efficient. [1]

The aim of this research is to foster the spread of eco-construction business ideas and to find the best or a better solution for the housing problem, providing citizens of Latvia, the Baltic States and other interested parties with the confidence in the better future with less resource consumption, financial, tax, banking loan and real estate maintenance related burdens. [2]

It is the myth that many green technologies cost more. It has been demonstrated by the United States Environmental Protection Agency that many green strategies and technologies actually cost the same and even less than traditional “not-so-green” technologies. [3]

The process of the research has revealed that the green-building and eco-village themes are well treated by the foreign organisations. [4] However, local Latvian government do not pay enough attention to promoting eco-friendly lifestyle and do not support and protect green building ideas in terms of legislation. It has to take over foreign experience and to formulate an eco-construction focused legislation system based on the international experience. [5]

Sustainable building is taking hold around the world despite the global economic downturn, it is accelerating as it becomes viewed as a long-term business opportunity. There is a strong demand for eco-construction projects, and the related businesses will make more profit.

The application of eco-construction principles allows to reduce housing maintenance costs up to “0”. Therefore, population could easily cover their mortgage loan payments by simply saving on utility bills. As an example: If the conventional house mortgage payments account for 300 EUR/month and utility bills account for 300 EUR/month, by applying eco-construction principles we could save roughly 300 EUR/month, which is the same as the monthly mortgage payment.

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# **YOUTH EXPERIENCE WITH FAST CREDITS: PROBLEMS AND SOLUTIONS**

**Kristīne Valeika**

Latvia University of Agriculture, Institute of Social Sciences and Humanities, Faculty of Economics and Social Development, undergraduate student, Latvia

**Ginta Kronberga**

Latvia University of Agriculture, Institute of Social Sciences and Humanities, Assistant Professor, Latvia

The course project "Youth experience with fast credits: problems and solutions" analyses the experience of young people with fast credits which have caused urgent problems in relation to this specific form of financial services, as it is very common and affordable.

The aim of the research was to explore the experiences of young people with fast credits to find out which are the main problems and existing solutions. The following objectives were posed to reach that goal: 1. provide characteristics of young people as a social group; 2. to study the theoretical perspective of experience formation; 3. describe fast credits as alternative financial service outside traditional banking institutions; 4. Conduct an empirical research of young people's experiences of the most troublesome problems and solutions in relation to fast credit.

The course project consists of four chapters. In the first chapter, the author analyses young people as a social group; the formation of young people's identity. The second chapter explores the most important aspects of the formation of experience. The third chapter includes characteristics of fast credits as alternative financial service outside traditional banking institutions; the characteristics of the industry and the development of economic indicators. The theoretical part is concluded with the summary. The fourth chapter includes the description of the methodology of the research, the results and their analysis.

The overall result of the empirical research shows that young people use fast credit service to solve money problems, but the experience of returning money back is negative. Most young people do not advise their friends to use fast credits.

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# **PROBLEMS AND SOLUTIONS OF COOPERATION IN THE FIELD OF SOCIAL INCLUSION OF PEOPLE WITH DISABILITIES IN THE REGION OF TUKUMS**

**Baiba Zaperecka**

Latvia University of Agriculture, Institute of Social Sciences and Humanities, Faculty of Economics and Social Development, undergraduate student, Latvia

**Ginta Kronberga**

Latvia University of Agriculture, Institute of Social Sciences and Humanities,  
Assistant Professor, Dr.sc.soc., Latvia

In the last five years there is a 8% rise in the number of people with disabilities [4]. Therefore important issues arise for the institutions involved in cooperation with people with disabilities to integrate them better in society. The aim of the study is to identify problems and find solutions for cooperation in the field of social inclusion of people with disabilities in Tukums region, in the view of the stakeholders. In order to achieve the objective, the author raised four research questions: 1) Is there any cooperation in the field of social inclusion of disabled people in the region of Tukums? Which institutions cooperate and what are the main issues? 2) What are the problems and possible solutions of cooperation in the field of social inclusion of people with disabilities in the region of Tukums? 3) What is the best model of inter-institutional cooperation in the field of social inclusion of people with disabilities in the region of Tukums?

The author uses qualitative research methods and partly structured interviews. Overall ten of the interviewed – national and local government representatives and non-governmental organizations represented people with disabilities. For theoretical framework, the theory of cooperation and stakeholder theory were used

Disability is restrictions in varying degrees that affects mental or physical ability to participate in everyday society. [3]. It should be ensured by various involved parties that disabled people can access all the services and resources needed to fully participate in the everyday society. Stakeholders are persons or groups directly or indirectly involved or having a positive or negative impact on an organization [1]. These stakeholders may be local authorities and public bodies, non-governmental organizations, as well as companies. In order to achieve effective integration of people with disabilities in society, it is important to develop good cooperation between the parties involved. Cooperation is when partners work together by investing resources in order to achieve common objectives [2].

The main conclusions are: 1) The most important problems: cooperation is not well organized to reach the planned; there is a lack of information and motivation for organizations to cooperate; also, negative attitude towards people with disabilities is very common. 2) In order to succeed in cooperation, it is necessary to develop a single model of cooperation. 3) It is necessary to establish a group of inter-institutional cooperation. Stakeholders must be able to address specific issues and achieve common goals in the field of social inclusion of people with disabilities in the region of Tukums.

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# IS LOWER PRICE REALLY BETTER? HEMOPHILIA CASE IN LATVIA

**Baiba Ziemele**

Latvia University of Agriculture, Faculty of Economics and Social Development, PhD student, Latvia

**Lāsma Dobele**

Latvia University of Agriculture, Dr. oec., Latvia

Hemophilia is a rare congenital disease in which blood doesn't clot normally. Missing factors should be replaced with specific drugs – factor concentrates – to prevent internal bleedings, that cripple joints in long-term or may be lethal in some cases. Treatment expenses for hemophilia A and B are reimbursed 100%. The goal of reimbursement system in Latvia is “to ensure medicinal products and medical devices necessary for as wide range of patients as possible, to achieve the lowest possible price, and to direct the resources obtained as a result of saving for the ensuring of needs of patients”[1]. National Health Service regularly publishes reimbursement statistics [2], which were gathered and analyzed for period of 2010 – 2015 for all bleeding disorders.

The data showed that during this period the number of hemophilia A patients that received state reimbursed care decreased from 78 to 57, but hemophilia B patients remained between 12 and 11. Spending on hemophilia A treatment increased from 1.33 to 1.45 M EUR, but on hemophilia B treatment – from 561 to 782 thousand EUR, reaching 1.2 M EUR in 2013 and 2014. Apart from inhibitor treatment (922 th to 1.5 M EUR in this period), clotting factor purchases were analyzed. Total purchase of factor VIII concentrates for hemophilia A treatment grew from 3.6 M international units (IU) to 4.2 M IU, or 16%. Meanwhile, the purchase of plasma derived FVIII (pdFVIII) concentrates decreased by 22%, but recombinant factor VIII (rFVIII) purchases for children increased from 0.5 to 1.5 M IU since introduction to system in 2012. It was possible to buy 4.8 IU/EUR of plasma FVIII in 2010, but it decreased to 3.9 IU/EUR in 2015. 3.2 IU/EUR of recombinant FVIII were bought during the period. Price of pdFVIII factor increased from 0.21 to 0.23 EUR/IU. Price of rFVIII stayed around 0.31 EUR/IU. Average factor consumption increased from 48th IU to 76th IU/patient.

The purchase of factor IX (FIX) concentrates for hemophilia B treatment increased by 22%, from 0.5 to 0.6 M IU. Spending efficiency increased from 2.3 IU/EUR in 2010 to 3.9 IU/EUR 5 years later. Average FIX consumption by patient increased from 45 th IU to 60 th IU, although from 2011 to 2013, hemophilia B patients used between 13 and 38 th IU of FIX annually. Prices of FIX concentrates were between 0.24 and 0.64 EUR/IU.

Therefore the conclusion is that the number of served hemophilia A patients has decreased in past 5 years. Lower prices not necessarily mean more treated patients or better treatment level for patients. For hemophilia A, a cheaper factor in general meant less factor per patient for more patients, but more expensive factor meant more factor per patient for less patients. When the total average price was lower, less factor was bought. Higher plasma FVIII prices meant less factor. The amount of purchased recombinant FVIII factor does not depend on the price. For hemophilia B, cheaper factor meant more factor per patient and more FIX concentrates in total, but also adequate access to treatment was not ensured for a long period of time.

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