



Latvia University
of Life Sciences
and Technologies

**17th International Scientific Conference
STUDENTS ON THEIR WAY TO SCIENCE
(undergraduate, graduate, post-graduate students)
Collection of Abstracts
April 22, 2022**

**Jelgava
2022**

ISSN 2255-9566

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Collection of abstracts from the 17th International Scientific Conference. – Jelgava, 2022. –119 p.

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AGRICULTURE

COMPARISON OF INTERBEEF AND NATIONAL BREEDING VALUES OF BEEF CATTLE

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The purpose of this study was to investigate the benefits of international genetic evaluation of beef cattle. In previous researches, the authors have determined the benefits of international evaluation for small populations, including the accuracy of estimation, that increase the precision of the breeding value for bulls which have genetic links in other countries [1, 4]. Latvia joined the international genetic evaluation in 2020 for trait weaning weight, as a result Latvia received international breeding values for bulls participating in the evaluation.

In this study International and National breeding values for the 200-day weaning weight of Latvian Charolaise (CHA) bulls were compared. The study contains 1726 bulls' data from the Agricultural Data Centre of Latvia. (Co)variance components and heritability were estimated by a single trait animal model that includes fixed effects of sex*type, parity*lactation, calving year*season, random effect of herd*year, and maternal genetic effect of the dam. VCE software was used for genetic parameter estimation [2]. In National evaluation BLUP method [3] was used to obtain breeding values with single trait animal model. Direct heritability was $h_a^2=0.13$ and maternal heritability was $h_m^2=0.02$ for the weight of weaning at 200 days. Direct maternal genetic correlation for 200-day weaning weight was weak, negative ($r_{am} = -0.03$). 1726 Latvian CHA bull direct estimated breeding values (ebv_d) and ebv_d reliability were compared by correlation using Statistic Analytical System (SAS) software. An average increase in international breeding value reliability was observed for 22.21 % of Latvian Charolais breed bulls. An average increase in the international direct breeding value for Latvian Charolais breed bulls (ebv_d) was equal to 1.82 kg. The correlation between the national and international breeding values of the bulls was 0.89. The correlation between national and international ebv_d reliabilities was 0.78. Correlations between national and international ebv_d and ebv_d reliabilities are strong and positive. An average bigger increase of reliability (10%) was observed for imported bulls than Latvian born bulls due to a stronger genetic links in other countries.

The international evaluation showed an increase in the reliability of the bull breeding values and a larger genetic variation for the breeding values. Results implies that international evaluation will benefit Latvian breeder for making a better choice when selecting their breeding bulls in Latvia as well as abroad on the same scale.

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STRATIFICATION PERIOD AND GERMINATION RATE FOR QUINCE (*CIDONIA OBLONGA* MILL.)

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Seedling rootstocks are still widely used for grafted plant propagation. To obtain a large amount of qualitative and strong rootstocks, high-quality seeds and knowledge of seedling development biology are necessary. In our laboratory, we have been testing a possibility to use quince (*Cydonia oblonga* Mill.) seedlings as rootstocks [2]. Like many temperate fruit crops, quince seeds require a certain chilling period to ensure their germination, and this process is called stratification [1]. In order to get qualitative plants and organize seedling production, it is essential to know the exact time needed for stratification. Therefore, our study was aimed to identify a period of time necessary for quince seed stratification and their germination rate.

Seeds were collected from a quince seedling, which was winter hardy under Jelgava conditions. For the first experiment, the seeds were collected at the end of January 2020 (it was possible due to the untypically warm weather), then cleaned and immediately placed in a cold store for stratification. For the next experiments, the seeds were collected in October 2020 and 2021. Then they were cleaned, dried and stored for future tests to be carried out in October 2020, February 2021 and November 2021. Prior to the tests, the seeds were soaked in water, then mixed with moist peat (pH 2.8–3.5) and placed in a dark, cold store at the temperature of 4 ± 1 °C. The seeds were treated until 10% of them were showing germination activity by visible small, white germs on their surface. That time was assumed as the end of the stratification period, it was recorded, and the total period of time for the treatment was calculated. The next step was a germination test, using 100 seeds in three replications and keeping them at 20 ± 2 °C for 7 days. Confidence intervals for arithmetic means for the germination tests and stratification time were calculated.

At the first test, which started in January 2020, the seeds germinated after 38 days, and their germination rate was $93 \pm 8\%$. In that case, the experimental conditions were different from the other three tests because the seeds had been collected from partly decayed fruits that were still outside under a tree in January, and they were not dried and stored before the test. Therefore, that result was not included in the final calculation. The shorter period of stratification could be explained by some chilling received under natural conditions prior to the start of the laboratory test.

The seeds that had been collected in October 2020 and placed for testing in the same month started to germinate after 83 days, at the end of January 2021. The seeds tested from February 2021 germinated after 77 days in April 2021, and their germination rate was $86 \pm 13\%$. The seeds collected in October 2021, which had been tested from November 2021, germinated after 100 days in February 2022 with a germination rate of $80 \pm 52\%$. Those differences could be explained by the different growing conditions prior to harvesting and by the different fruit and seed maturity levels. The variations in the germination test results could also be impacted by the various seed quality (non- calibrated seeds), cleaning and storage conditions etc.

Altogether, the average period of time for stratification was 87 days, though the calculated confidence interval was 87 ± 30 days, and the average germination rate was $86 \pm 11\%$.

For practical use, more research is needed to find the best seed extraction, cleaning and sorting methods, and to adjust stratification regimes for more uniform results.

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CAROB (*CERATONIA SILIQUA* L.) SEED GERMINATION IN RELATION TO PHYSICAL SEED DORMANCY BREAKING METHODS

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Carob (*Ceratoniasiliqua* L.) is an evergreen tree widely cultivated in the Mediterranean region. Interest in carob seeds and pods having a high content of biologically active compounds is growing. Experiments in other countries have shown that scarification and soaking of seeds in boiling water improve germination of carob seeds [2]. No extensive research has been conducted on carob seeds in Latvia. Therefore, our study examines the effect of seed treatment methods on the germination of carob seeds, and the dynamics of germination and cotyledon opening. The experiment was conducted in 2021 at the Laboratory of Horticulture and Beekeeping. Six treatment methods were used for seeds of different genotypes: Method 1- mechanical scarification of seeds, soaking in boiling water and leaving for 10 min, then soaking in cold water (20°C) for 64 h; Method 2 – chemical scarification (soaking in 80% sulfuric acid for 30 min), then rinsing thoroughly for 10 min under running water and soaking in cold water (20°C) for 64 h; Method 3 – mechanical seed scarification only; Method 4 – mechanical seed scarification, soaking in boiling water and leaving for 1 h; Method 5 – soaking in boiling water and leaving for 1 h; and Method 6 – control (without treatment). Seed germination was performed in a climate chamber at the temperature of 23°C under 24 h lighting. The seeds were germinated in Petri dishes and placed on damp filter paper. To assess the dynamics of the cotyledon opening, the germinated seeds were sown in Nutro Garden peat substrate (pH KCl 5–6) in plastic boxes (dimensions: 390 × 290 × 55 mm) in 5 mm depth, and placed in the climate chamber at the temperature of 23°C. The weighted arithmetic mean marginal error analysis in MS Excel was used for mathematical processing of the results. Physical dormancy was observed for untreated seeds (germination 0% in the control variant). The following germination was observed in the other treatments: 100% (variants 3 and 5), 95% (variant 1), 92% (variant 2) and 67% (variant 4). After the mathematical processing of the data, a significant impact of the treatment method on the seed germination dynamics was found. With 95% confidence level, the seeds germinated faster in Variant 1 (all seeds in 4 days) and in Variant 2 (4–5 or, on average, 4.98±0.03 days). On the other hand, in the variants where the seeds had not soaked for a long time, they germinated in a significantly longer period of time: 7–11 or, on average, 8.86±0.66 days in Variant 3, 6–14 or, on average, 11.9±1.86 days in Variant 4 and 7–13 days or, on average, 10.47±1.14 days in Variant 5. This situation can be explained by the high content of alkaloids (56.51±1.02 mg 100 g⁻¹), which inhibited the germination of carob seeds [1]. On the other hand, the treatment method had no significant effect on the dynamics of cotyledon opening. The cotyledons opened in 13–24 days or, on average, 17±1.6 days in Variant 1; in 13–26 or, on average, 14.87±0.9 days in Variant 2; in 14–20 or, on average, 17.27±1.10 days in Variant 3; in 14–23 or, on average, 20.14±2.64 days in Variant 4; and in 14–24 days or, on average, 18.5±1.63 days in Variant 5. Further studies are required to clarify regularities between the seed genotype, treatment method and dynamics of germination and cotyledon opening.

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MORPHOLOGICAL DIVERSITY OF *BOTRYTIS* SPP. IN TOMATO

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Tomato (*Solanum lycopersicum* L.) fruit is one of the most essential vegetables worldwide. In Latvia, tomato is the most commercialized vegetable, reaching 10.91 million euros export value and 32.81 million euros import value in 2021 [1]. *Botrytis* spp. is one of the most devastating pathogens in tomatoes with necrotrophic infection strategies, since it causes grey mould [2]. A complex of pathogens causes this disease in tomatoes, and two causal agents that vary in cultural morphology and virulence – *Botrytis cinerea* and *Botrytis pseudocinerea* – are mentioned in the literature [3]. Particular species of *Botrytis* responsible for grey mould in tomatoes are unknown in the conditions of Latvia. The present research aims to determine the rate of mycelium growth in medium and describe the morphology of different *Botrytis* spp. isolates obtained from tomatoes.

The samples were collected from infected tomato leaves, stems, and fruits in the central part of Latvia in 2021. Pure cultures of *Botrytis* spp. were obtained on potato dextrose agar (PDA). Eleven isolates were obtained and purified using isolation of 3–4 mm long hyphal fragments. Isolates were incubated at 20 °C for a 12-h illumination period for seven days. An experiment on the growth rate of *Botrytis* spp. isolates was made with five replications. The growth rate of colony diameter (in mm) was recorded after 24 h, 48 h, 72 h, and 96 h. Morphological traits of *Botrytis* spp. isolates were recorded two weeks after incubation. The colour, structure, and type of the growth of mycelium and the presence of sclerotia were evaluated. Levene's test for homogeneity of variance, a one-way analysis of variance, and Tukey' contrasts were performed using R-free software.

Botrytis spp. isolates were morphologically diverse; the colour of mycelium varied from greyish-white, grey to brownish-grey. Most of the colonies produced short tight mycelium; some colonies produced unevenly fluffy or fluffy mycelium. The types of mycelium growth were even or concentric. For most of the isolates, sclerotia formation was observed, varying from few or many small (<4 mm) to few or many big (>4 mm) sclerotia. The arrangement of sclerotia was either scattered or they formed circles. This study demonstrated a significant difference between the growth speeds of isolates in the medium: after 48 h the growth speed of isolates varied from 0.030 to 0.064 units ($p<0.001$); after 72 h it varied from 0.035 to 0.047 units ($p<0.001$); and after 96 h it varied from 0.090 to 0.111 units ($p<0.05$). Isolates obtained from tomato leaves grew significantly faster than those obtained from tomato fruits. The results showed high morphological diversity of *Botrytis* spp. isolates, and also the growth speed varied; therefore, further studies are required to identify the species of *Botrytis* spp. in tomatoes.

Acknowledgement

The research was supported by the research programme's project "Biological traits of causal agents of tomato diseases".

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WASTE VS RESOURCE: A PERSPECTIVE OF VALORIZING BY- AND CO-PRODUCTS OF THE AGRI-FOOD SECTOR

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The best waste is waste not generated. If it cannot be achieved, the key to effective waste management lies in creating a separate hierarchy for food waste. As a pyramid chart, it would have strong prevention of waste generation as its basis, and waste disposal would only be the smallest tip of it [1].

In every step of the food chain, food waste is generated. Of this waste, some is not suitable for human consumption, for example eggshells, bones, hooves etc. However, some waste products, if they are not high risk products (Category 1 and 2 according to (EC) 1069/2009), are suitable for further processing. For example, skins, cartilage, blood, guts, organs and other products from the animal carcass can be a valuable resource for non-food or even food purposes. This means that these by- and co-products of the meat processing industry should not be seen as waste at all [2].

Processing of by- and co-products is used to sterilize and stabilize products, and to separate proteins from fats. Then proteins and fats can be used in different industries as ingredients in edible or non-edible products, for example, bioplastics, biofuel, cosmetics and functional foods. Proteins can be hydrolysed by proteolytic enzymes to generate bioactive peptides, for which the safety of use is not very clear yet. However, they can be prospective functional foods and taste enhancers. Blood is another source of proteins called plasma proteins, which have diverse gelling, foaming, emulsifying and water binding properties. They can be used as ingredients not only in meat processing industry, but also in pharmaceutical industry [5]. By-products with more mineral content, like eggshells, can be used to partially substitute limestone in the production of cement clinker [3]. Bones and bone sludge, which are high in calcium and phosphorus content, can be incinerated by the calcining process. The resulting hydroxyapatite ashes can be used as substitution for phosphorites in the production of food grade phosphoric acid, or food grade feed phosphates [4].

As we can see, waste from the agri-food sector can be a valuable source of secondary raw materials not only for the agri-food industry, but also for pharmaceutical, cosmetic, biotechnology and fuel production industries. In addition, the use of waste for food production provides an excellent opportunity to address the issue of the global food shortage.

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INFORMATION TECHNOLOGIES

DIGITAL MATCHMAKING PLATFORM FOR INTERNATIONAL COOPERATION IN THE BIOGAS SECTOR: PRACTICAL ASSESSMENT

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In accordance with natural evolution of web and cloud-based solutions and microservices, matchmaking platforms have become a tool providing developers and entrepreneurs with decision support regarding selection of the said services [1, 3]. With growing interest in the biogas sector, the matchmaking platform is a solution that can link biogas and biomethane technology providers with emerging and developing markets. While there are various matchmaking platforms, there is currently no biogas related matchmaking platform on the market [5].

Matchmaking platform in the biogas sector is a sophisticated tool that functionally encapsulates requirements of both providers and consumers and promotes collaboration between the following parties: publishing company's profile, proposing business opportunities, linking profiles and opportunities with needs, etc. The goal of this system is to increase the biogas technology uptake and international cooperation for green economic growth.

The Digital Matchmaking platform, the concept of which was previously presented in [4], was successfully developed in the framework of the DiBiCoo project [2] and later evaluated by consortium representatives, stakeholders and end-users. As a result, comprehensive feedback was received and analysed for further improvements of the platform. This is the first publicly (<https://biogasplatform.eu/>) available matchmaking platform for the biogas sector. In accordance with initial literature and market research, as well as feedback analysis, multiple challenges of developing similar platform were identified.

The following work aims to 1) present the complexity of matchmaking platform's functionality, 2) assess evaluation results and their impact on final product, 3) demonstrate the typical behaviour algorithm of an end-user.

Acknowledgement

The authors would like to thank the European Commission and the INEA for the support of the DiBiCoo project. DiBiCoo has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 857804. This paper reflects only the author's view and neither INEA nor the Commission are responsible for any use that may be made of the information it contains.

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AUGMENTED AND MIXED REALITY IN CULTURE LEARNING

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Augmented Reality (AR) and Mixed Reality (MR) are becoming increasingly popular because of their engaging properties allowing information to be learned in a more interesting way. It could be a useful tool for cultural immersion for children as well as others who would normally not be so interested in cultural exploration with common methods and tools.

Studies show that learning using virtual technologies may not be accomplished if the user interface has been placed as more important than the content itself. Therefore, to allow for intuitive interaction with the virtual environment to occur it is important that a contextual relationship is formulated between users, virtuality, and reality: how the virtuality is superimposed on reality, and how the user sees the content and engages with it. Engagement methods are just as important – they should not be a hindrance to learning but easily and intuitively understandable [1].

AR technology in culture learning is used the most as on-site augmentation experience. It uses location-based AR to simulate old buildings or parts of the city. In 2021 study an application was created for an immersive learning experience at Cisneros market square, Medellin, Colombia. Significant difference in learning and knowledge after using the application was determined compared to the control group which did not use the AR application. Also, 80% of the application users fully agreed that “it allows for appropriation and learning of cultural heritage” [2]. It is important to note that most respondents also agreed that “it is easy to understand how AR works in the application” [2], further emphasising the importance of good user experience.

In culture learning, marker-based AR also can be used. It allows for users to experience augmentation regardless of the location. In 2018 study an AR-based application was created to create an immersive experience about Italo Svevo’s life where augmentation was activated by target image recognition. Upon recognition, different assets were visible in the application — videos, animations, and additional information. In a user study, it was determined that aesthetics and ease of use are greatly appreciated. Very high levels of satisfaction were reached for interest in the proposed content which shows that the visitors are eager to learn, and the application is an effective tool to provide the information [3].

Further research in AR technologies that interact with users could be beneficial. It would allow for the experience to be even more immersive and engaging. This could be achieved with marker-based AR and MR technologies where, for example, the human face is a trigger for augmentation.

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HIVEOPOLIS - ENHANCING MIGRATORY BEEKEEPING PRACTICE USING THE DIGITAL FLOWERING CALENDAR

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Beekeeping is an important agricultural activity globally that contributes to sustainable rural area development in two main ways—economic (income) support and ecological support from honeybee activity [1]. Apiculture has gained worldwide interest because of its contribution to economic incomes and sustainable environmental conservation; in view of this, migratory beekeeping, as a high-yielding technique, is extensively adopted [2].

Selection of a good foraging location for bee colonies is an important task for beekeepers, especially for migratory or traveling beekeepers [3]. Optimal location will allow bee colonies to forage higher amounts of resources with minimal effort from bees. The lack of pollinated plants, as well as their non-optimal distribution between colonies, can lead not only to a decrease in the productivity of bees, but also to starvation and even death.

To make the apiary location planning more efficient and predictive, information about the crop and plant flowering can be used. One of the usable solutions would be to create and visualize a plant-flowering calendar. To make the flowering calendar more user friendly and simplify the application of this tool, it can be combined with spatial information and GIS data. To complete this task, several steps should be taken, starting from the preparation of the flowering data then selecting the area of interest and converting this area into polygons, which correspond to plant fields and, finally, assigning the plants to target fields.

The proposed solution provides a flowering simulation where the fields are encoded by colour based on flowering information throughout the year. Having information about the potential amount of foraging resources in specific locations, beekeepers can select and plan foraging places [4].

This work was supported by the project HIVEOPOLIS which has received funding from the European Union's Horizon 2020 research and innovation programmes under grant agreement No. 824069.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE IN DAILY LIFE

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Nowadays, Artificial intelligence (AI) technology plays a very important role in daily life. Often, when people hear about Artificial intelligence, it might be easy to assume it has nothing to do with them. In reality, artificial intelligence is encountered by most people from morning until night.

Artificial intelligence technology is already used in a lot of a spheres. Artificial intelligence assists in every area of our lives, whether trying to read emails, get driving directions, or find music or movie recommendations.

One of the most popular everyday examples of artificial intelligence is smartphone use. Every morning, the first thing that many people do is open a smartphone with face ID. When a device gets unlocked using biometrics such as with face ID, it is using AI to enable that functionality. Artificial intelligence in phones is also used for many different technologies. For example, AI is used in cameras to improve the quality of photographs, as well as to read text from photographs [2].

Also, artificial intelligence is used by Digital Assistants. Nowadays, a lot of digital assistants exist. For example, there are Siri, Google Now, Alexa and a lot of other. Digital assistants help users perform various tasks, from checking their schedules and searching for something on the web, to sending commands to another app. Artificial intelligence is an important part of how these apps work because they are a base of this apps. Digital assistants learn from every single user interaction to improve their work.

Artificial intelligence is used to show the user ads based on their interests. Artificial intelligence collects and analyzes the statistics of each user and based on the analysis, chooses which ads will be most relevant for a particular person. Also, this technology is used to recommend music, videos, games, and various products. Companies use artificial intelligence to gather information about preferences and buying habits. Then comes the personalization of shopping experiences, offering new products tailored to consumers' habits [1].

The next area where artificial intelligence is used is navigation. Artificial intelligence calculates traffic and take into roadworks to find the quickest route to your destination.

Artificial intelligence has had a significant impact on the future of driving and cars. Self-driving cars make roads safer and rides more comfortable. Smart cars reduce the chance of accidents due to human errors and can also automatically adjust settings based on the likes and dislikes of their owners, such as turning on heated seats on a cold winter night.

There are a lot of areas where we can see artificial intelligence every day. For example, AI is used in banking, smart home devices, online search, sending messages, social media and a lot of other spheres.

Further research about this topic could be very useful, because the development of this technology in the future could become a powerful tool for everyone in all areas. As can be seen, artificial intelligence makes life more efficient every day. AI powers many programs and services that help facilitate everyday tasks such as connecting with friends, using an email program, or using a navigation app.

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HOW CAPTCHA CAN BE SOLVED BY HUMAN EXPRESSION

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Today's solving a CAPTCHA (Completely Automated Public Turing Test) has become very complex for humans. For a long time, we have been using CAPTCHA to tell computers how to differentiate between humans and robots. In 2003, Luis von Ahn, Manuel Blum, Nicholas J. Container, and John Langford used the term CAPTCHA [1]. Traditional CAPTCHA is based on image, audio, and text. But what about people who are differentially abled? They are not always capable to solve the CAPTCHA, and due to OCR technology, attacks on traditional CAPTCHA are increasing rapidly, and humans have to face problems to solve CAPTCHA successfully. Hence, a new CAPTCHA system is proposed that works on the principle of facial expression detection [2]. The motive of this research is to use the human expression to overcome the CAPTCHA challenge so that everyone can use it. In this, I am combining human expression and Deep Vision to change the whole base on which traditional CAPTCHA works. I am trying to make CAPTCHA based upon human gestures and expressions. Given the condition or challenge in terms of a simple gesture, humans must pass the challenge in some specified time; otherwise, humans will fail the test. For example, the system will ask a human for a particular gesture or expression, like blinking the eyes, moving your face left, right, up, or down, In the given condition, the person must act the same gesture. In case, if a person fails to complete the gesture in, for example, 5 seconds, the system will measure it as failed instead of passed. Also, the system provides a new gesture to perform after 5 seconds. The system will also store the number of CAPTCHAs solved and failed, which can help to train the system to decide what kinds of gestures humans can pass and what kinds of gestures humans have problems with. The whole project is divided into a set of modules: face mapping, head pose estimator, face and body posture recognition [3]. The expression CAPTCHA is simple, accurate and can reduce solving time. Day by day, the numbers of spammers and bots are increasing, and traditional CAPTCHA is unable to stop them. Therefore, the use of the expression CAPTCHA is very necessary to distinguish between humans and robots.

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APPLICATION OF INTELLIGENT TECHNOLOGIES IN THE TRANSPORT PROCESS

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The ever-increasing flow of traffic, accidents, inefficient public transport, ineffective traffic control and increasing pollution are forcing the urgent search for new means and solutions to meet the demand for mobility, with a strong focus on intelligent transport technologies. The aim of the research is to present the possibilities of application of intelligent technologies (IT) in transport business processes, highlighting their advantages and disadvantages.

Intelligent technologies (IT) are defined as the common application of integrated communication, control, and information processing technologies in the transport system. Areas for the application of intelligent technologies in transport include optimal road traffic management, reduction of traffic jams, information on road obstacles, automatic speed and weight control, and the improvement of traffic management and safety services. [1]

IT is an information and communication technology that is integrated into transport infrastructure or vehicles and performs specific functions. This author also highlights the benefits of these technologies in reducing pollution. The main advantages of IT are related to the prevention of road accidents, increasing mobility, reducing the negative impact on the environment, faster response to emergency situations, improving flexibility, and increasing safety. [2] [1]

For any intelligent technology system to work, it needs three main components: data collection, data analysis, and data / information transfer. The efficient operation of the system is affected by technological and cultural constraints and cross-border IT interoperability. [3]

In summary, IT not only covers all modes of transport, but also takes into account infrastructure, vehicles and users. Intelligent technologies also create value for passengers, developing innovative services related to modes of transport, which enables them to obtain better information on how to use the improved transport network more efficiently.

The results of a survey of transport and logistics companies show the importance of IT in transport business processes, particularly in fleet management, information transfer to drivers, route planning and improved customer service. Although all respondents to the survey emphasize the importance of IT, they also highlight a number of problematic areas in transport processes whose digitization is slow and not in line with current market trends and needs.

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FORESTRY

TREE NURSERY GREENHOUSE RETRACTABLE ROOF VENTILATION TYPES AND HEATING

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Ventilation and heating are one of the most important factors in tree nurseries. Greenhouse nurseries have unique needs when it comes to controlling temperatures and heating vast spaces during not ideal weather. The aim of this work is to research options before buying expensive heating systems or cooling fans for tree nursery greenhouses.

Ventilation in greenhouses provides a natural environment for tree growth when the ventilation is applicable during suitable weather outdoor or when artificial environment in the greenhouse is too hot or cold. An opening in the roof over the tree plants increases light intensity, which helps to control the growth habit. It also reduces electricity costs because cooling with expensive fan systems is not needed. Natural ventilation systems operate on the principle that heat is removed by a pressure difference created by the wind and temperature gradients. Natural ventilation systems also reduce energy costs of electricity needed to operate a fan system [1].

Besides ventilation, good heating in a tree nursery greenhouse is a must since most seeds need consistently warm temperatures to germinate and produce a strong root system. Reducing the heating cost is a major challenge for greenhouse growers especially those located in cold regions [4]. Wood is a renewable resource and can provide a source of low-cost heat throughout the season. Wood-fired outdoor furnaces are becoming popular alternatives to heating greenhouses since outdoor furnaces have a number of advantages over other sources of heat. An outdoor furnace removes the danger of structure fires caused by indoor wood stoves [2].

During the past years, waste oil has become a commodity. Some nurseries have started to use stove oil, cooking oil and waste oil that will burn in the stove. In the burner, the oil enters through an injector, and shoots heat into a baffling system. Water is heated in a large aluminum tank and then pumped out to heat the greenhouses. The water needs to be treated to prevent corrosion. All pipes carrying heated water are insulated with Styrofoam. All fittings are placed above ground for easy access and maintenance [3].

In the future, further research about low cost and enviornmentally friendly heating and more effective ventilation should be carried out.

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DEVELOPMENT OF VEGETATION AFTER GROUP SELECTIVE FELLING IN URBAN PINE FOREST

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Several anthropogenic or natural disturbances can have an impact on the development of vegetation in forest ecosystems. Also, urban forests are also affected by various human activities, such as water disposal, campfires and trampling therefore indirectly promoting the dispersal of invasive and adventive species. In addition, urban forests are characterized by synantrophication which promotes the contamination and eutrophication of soils, as well the anthropogenic pressure increases [1]. There is currently a very intensive immigration of plant species from southern regions in the moderate European area to Latvia, followed by a gradual movement of plant species from south to north [2].

The aim of the research was to evaluate the development of vegetation and Scots pine *Pinus sylvestris* L. regeneration after group selective felling in urban *Hylocomiosa* type forest.

The study was conducted in Riga, Bikernieku forest. The forest area is managed by the forestry company SIA "Rīga Meži". In 2017 the area was thinned, thus creating a total of 37 openings (small clear cuts, where each opening area is 0.2 ha). In spring of 2018, more than 20 000 Scots pine plants were planted. For this study, 10 openings were selected with a total of 170 sample plots. In each plot, Scots pine plants and seedlings were counted and measured, and ground cover vegetation was detected according to the Braun-Blanquet method. The data were collected in 2020.

The total number of 76 species were found in the study sites: 12 tree species, 15 shrub and 49 herbaceous species. The most common species were *Pinus sylvestris*, *Acer platanoides*, *Sorbus aucuparia*, *Trientalis europaea* and *Luzula pilosa*. The following invasive species were also found: *Acer negundo*, *Sambucus racemosa*, *Impatiens parviflora* and *Cotoneaster lucidus*. Totally 518 Scots pine young trees and 532 Scots pine seedlings were counted and measured. The average height of Scots pine young trees was 1 m and that of Scots pine seedlings was 0.36 m. The most important problem in urban forests is the synantrophisation (the growth of shrubs, grasses and weeds), it is caused by eutrophication.

Acknowledgements

The study was supported by the grant of project of Latvia University of Life Sciences and Technologies 'Implementation of LLU research programme'.

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EFFECT OF CONTAINER TYPE AND GROWING MEDIA ON MORPHOLOGY OF BLACK ALDER CONTAINERIZED SEEDLINGS

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Black alder (*Alnus glutinosa* (L.) Gaertn.) is widely distributed broadleaves tree species in Europe north regions, which can grow in diverse conditions, and the areas occupied by this species continues to grow. Alders have unique ability to effectively fix nitrogen with roots and sufficiently increase soil fertility. This is the reason why this tree sometimes is used to improve soil condition for other tree species [1]. Black alder regeneration so far is preferred by bare-root seedlings, while containerized seedlings are not that widely used yet. The target size of seedlings, species-specific requirements and crop rotation determines the type of containers that are used for cultivation. The size of the container trays, cells and growing density have a significant impact on the tree seedling shoot and root development [2]. The aim of this study was to evaluate and compare black alder growth in different containers and with different substrate properties. Seedlings were grown using two different containers: *Plantek 25* with 25 cells per tray and *Plantek 36F* with 36 cells per tray, and using peat substrate (Peat) and a substrate mixed soil from common alder forest stand (Peat+Forest soil). In total four different experiment variants were established (Fig.1). After one growing season in all experiment variants survival rate is considered as good (77.3% to 99.5%). Lowest rate 77.3% (*Plantek 25*) and 82.9% (*Plantek 36F*) found in variants where peat substrate was enriched with soil from natural common alder stands, nevertheless seedlings in above mentioned variants had highest mean height (34.7 ± 1.03 cm; 32.0 ± 0.93 cm), and mean seedling diameter at root collar height (respectively, 6.19 ± 0.45 mm; 4.13 ± 0.12 mm). Statistically significant difference were found only between seedling diameters at root collar ($\alpha = 0.05$, $p=0.004$) in experiment variants which were grown in *Plantek 25* trays. Seedlings grown in *Plantek 25* trays with less growing density showed higher mean height and diameter after one year growth, comparing to seedlings in *Plantek 36F* trays. Even though seedling survival rate for both container types are similar, highest survival rate was for seedlings grown in *Plantek 36F* trays, on average 91.2%, while for *Plantek 25* – 87.7%.

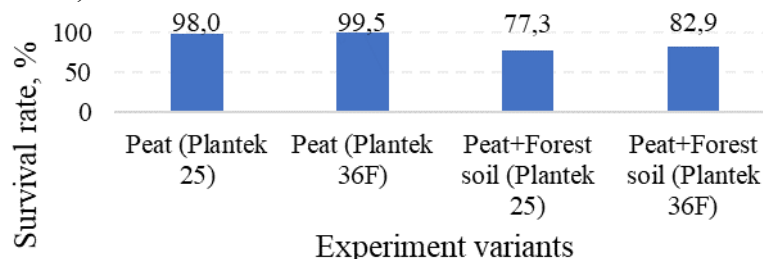


Fig.1. Survival rate of black alder seedlings by experiment variants.

Although the use of forest soil has a positive effect on black alder seedling height and diameter increments, variants where only peat substrate were used also showed satisfactory results, so it proves that there is no need for additional costs that occur from adding forest soil to peat substrate. Our results also confirm that seedlings have bigger height and diameter increments in trays with bigger cells (*Plantek 25*) thus providing more space for growth [2].

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PEDUNCULATE OAK (*QUERCUS ROBUR* L.) FOREST STANDS' HEALTH CONDITION

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The area of pedunculate oak (*Quercus robur* L.) forest stands in Latvia makes up less than one percent of the total forest area. Oak stands are known for their biodiversity and values, that is why they are protected in Latvia. The wood of oak is very valuable. As a tree species, oak is not resistant to various biotic, abiotic and anthropogenic factors, so it is important to evaluate the future management of forest stands depending on their risk factors. The purpose of the research is to describe the main risk factors to oak forests stands. Recently *Phellinus robustus* (P. Karst.) Bourdot & Galzin has spread in oak stands in forests, parks and alleys which are common throughout Latvia. The fungus infects the most valuable part of the trunk causing heavy loss of wood. The infection occurs in frost cracks, twigs and mechanical damages [3]. *Ophiostoma roboris* Georgescu & Teodoru is one of the diseases of the trees' vascular tissue that damages a tree trunk, cells and the tree itself. The disease is caused by various *Ophiostoma* genus fungi. Its external symptoms are curling of the leaves around the central vein and a gradual change in colour from green to reddish-brown. The development of the disease is promoted by various abiotic factors, such as drought and groundwater level changes [3].

An acute oak decline is a dangerous oak disease that has appeared since the beginning of the 21st century. Bacterial species *Gibbiella quercinecans* Brady et al. and *Brenneria goodwinii* sp. nov. are considered to be the main pathogens of this disease. The development of the disease is very dynamic, and it can cause the death of a tree in 4 to 6 years. It mainly affects oak stands which are older than 50 years with trunks larger than 30 cm in diameter [3]. This disease currently is spreading all around the territory of Latvia.

In Latvia, a mass invasion of brown-tail moth (*Euproctis chrysorrhoea* (Linnaeus, 1758)) occurred in 2021. The insect is dangerous not only to fruit- and forest trees, but also to human health. Moths' hair contains toxins which cause inflammation of the skin and eyes; besides, it causes dangerous breathing problems to people who have asthma [1].

One of the future opportunities to forestry is increasing the forest stands of pedunculate oak, but it depends on our own understanding and vision of oak tree forests as an enduring part of the Latvian landscape. Increasing the proportion of stands would allow to increase economic, ecological and recreational values of forests. The calculations show that growing pedunculate oak has economic perspectives, but risk factors worldwide are rather uncertain and difficult to predict [2].

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SANITARY CONDITION OF DIFFERENT AGES OF SCOTS PINE STANDS AND REGENERATION IN "STIKLI BOG" BURN

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In 2018, a forest fire occurred in the "Stikli bog", resulting in the death of a large forest area, a large amount of dead wood and vegetation. More than a hundred forest fires have been identified each year in Latvia's forests. The cause of fire mostly is hot and dry climate and the careless behaviour with fire. The aim of research was to explore the sanitary state and recovery of 60-120 year old Scots pine forest stands 3 years after the forest fire, which occurred in 2018 and was one of the largest forest fires that has happened in recent years.

Fire damage can pose a threat to both human health and nature. Fires may be a global ecological concern as carbon emissions are being created. Fires in wetlands often occur in deeper layers of soil. Such fires occur by burning organic soils. A fire on moist and marshy soils can also cause serious damage to trees if they occur in these types of soils. The heat at the roots of trees resulting from burning of organic soil can cause a significant damage and mortality to the trees [1].

In a swamp, like in the woods, the fire can be caused by low humidity in the soil or the air. Peat burning in swamps can result in hazards and natural pollution [2]. The resistance of a forest stand to fire and the damage it will leave depend significantly on the species of trees, since all tree species do not have the same resistance to fire and other disturbances. The density of planted trees is reduced by the impact of fire in newly restored forests [3].

The amount of dead wood and the area affected by the recovery depend on the type of a forest and the type of soil. The volume of dead wood has increased over the years and the forest stand has been mostly restored with deciduous trees.

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SHRUBBY BIRCH (*BETULA HUMILIS* SCHRANK) DISTRIBUTION IN LATVIA AND GROWTH IN AIZDUMBLE SWAMP

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Human-driven climate change, habitat fragmentation and degradation result endangered species extirpation [1]. Shrubby birch *Betula humilis* is a relict arctic species that was distributed in Eastern Europe and the central part of Europe. *Betula humilis* has been declining in all of the distribution area. For example, previously 350 sites were recorded in Poland, but only about 70 sites were recently confirmed [2]. The aim of the research was to study the distribution of *Betula humilis* in Latvia and to characterize its growth and influencing factors in the protected nature area "Aizdumble swamp". The hypothesis is: a smaller annual ring increase is expected for *Betula humilis* samples that grow near the lake due to a bigger amount of moisture in this place.

During the study, a map of the sites was created where the plant *Betula humilis* had been found on the basis of various literature sources. Various types of wetlands and bogs were inspected in Jēkabpils region. A more detailed study of *Betula humilis* was carried out in the protected nature area "Aizdumble swamp". 10 samples or shrubs were collected in Aizdumble swamp in two different habitats. The total number of collected samples was 20. The first collection site can be described as a typical transitional bog near a lake and the second one can be described as a marshy forest. Measurements of the length, diameter, annual rings and the determination of age of the collected samples were performed in the laboratory. The measurements from collected transition bog samples were compared with the measurements of the marshy forest samples. Sample groups were compared using a *t-test*. Average, maximum and minimum values were calculated for all measurements. Pointer years were calculated using a modified Skeleton plot method [3]. The correlation analysis was performed to determine which climatic factors affected the growth of *Betula humilis* and a statistically significant relationship between pointer years and climatic factors.

The width of largest annual ring was 1.08 mm, but the width of the smallest annual ring was 0.03 mm for the samples of the transition bog. The width of the largest annual ring was 0.97 mm, but the smallest width of 0.03 mm was for the samples of the marshy forest habitat. As regards the average annual ring width, it was 0.38 mm for the samples of the transition mire habitat, but 0.21 mm for the marshy forest habitat. The oldest age of *Betula humilis* was 24 years, the youngest age was 7 years, and the average age was 16 years. The pointer years were 2009, 2011, 2013, 2014, 2018, and 2019. As regards pointer years, the most intensive growth occurred in 2014 and the lowest growth intensity was in 2018.

A sufficient amount of rainfall is required for the normal growth of *Betula humilis*. Comparing the annual ring average measurements, it can be concluded that the samples from the transitional mire habitat show better growth, which can be explained by the higher amount of moisture and higher solar radiation in this area.

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REFERENCE REACTION OF SCOTS PINE (*PINUS SYLVESTRIS* L.) FOREST STAND AT *SPHAGNOSA* FOREST SITE TYPE TO DOLOMITE QUARRY ESTABLISHMENT

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There is a permanently increasing demand for minerals, including dolomite in the last three decades. The question about impact of dolomite mining on the nearby wetland environment is becoming more and more topical, especially, if mining of dolomite is performed under the groundwater level. It's important to evaluate its impact on nearby forest stands, forest reserves and on hydrological regime of the surrounding areas.

The goal of the research is to determine and describe reference reaction of Scots pine (*Pinus sylvestris* L.) forest stand to the nearby dolomite mining. The research was carried out using the analysis of Scots pine annual rings by the bioindication method, including the analysis of additional increment, the analysed reference reaction of Scots pine referred to the time period between 1983 and 2017, using the retrospection period between 1963 and 1982. The possible changes of growth course trend in the analysed forest stand (in the depression funnel of confined aquifer water of the Daugava horizon) were identified at the time of dolomite mining and compared with the possible growth course without the growth influencing factors.

It was proven that in the time period between 1983 and 2017, there was a progressive negative reference reaction (a cumulative periodic reduced additional increment of stock was $-3.00 \text{ m}^3\text{m}^{-2}$, but a cumulative periodic relative additional increment was -38.62%), negative values of the main dendrometric indices indicated this fact: the cumulative periodic additional annual increment and relative cumulative periodic additional annual increment.

In conclusion, a negative impact of dolomite quarries to increment dynamics of researched forest stand may be associated with the decrease of the water level in confined aquifer water of the Daugava horizon resulting in the disappearance of this horizon local discharge area. Also, it is not possible to exclude a negative effect of vibrations, caused by explosions at dolomite quarries that might have resulted in microscopic, but cumulative damage to small radices of trees. However, more research is necessary to confirm this hypothesis.

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IMPACT OF NORWAY SPRUCE (*PICEA ABIES* (L.) H.KARST) SEED QUALITY ON INITIAL GROWTH OF TREES

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Norway spruce (*Picea abies* (L.) H.Karst) is a species of spruce native to Northern, Central and Eastern Europe. It typically has downward-hanging branches and the largest cones of any spruce, 9 – 17 cm long. It is related to the freely hybridized Siberian spruce (*Picea obovata* Ledeb.) located east of the Ural Mountains. Norway spruce has a wide distribution as it is planted for its wood and is the species used as the main Christmas tree in many countries around the world. It was the first gymnosperm whose genome was sequenced. The Latin name *abies* means "fir-like" [1].

Artificial regeneration of Norway spruce (*Picea abies* (L.) Karst.) in the Nordic countries relies on planting containerized seedlings from collected seeds, either seed orchards or forest stands. There is a diversity in seed components of quality and seed weight variance between individual trees. The aim of the work is to describe the impact of seed quality on the initial growth of trees. The seed quality has reduced with increasing time in the experiment on 1 year old seedlings in the nursery. Fast germination is important because it will determine a continuous plant production. If it is difficult to germinate, this will cause stop continuation [2].

Fertilization of spruce seeds is produced by cross fertilization between the two neighbouring trees or distant individuals in nearby stands. Spruce pollen can travel long distances between them, which can cause significant gene flow population therefore the fact that this pollen is able to move over long distances makes it even more effective, therefore considerations of the best seed quality makes it easy for crossing breeding of this species. Seed development and maturation is impacting the seed quality we need. Most spruce seeds are dispersed near a mother tree, but some even from afar. The genetic variability in *Picea abies* has been studied based on the several sites where it has been planted [3].

Picea abies is widely used as a tree for timber therefore it is necessary to improve the regeneration of the Norway spruce. Different countries and societies have different choices and conditions for seed quality attributes and different tools for raising the quality. Not forgetting the main structures of Norway spruce seeds are the embryo which comprises the major part of the seed weight. It is of value to know the genetic relationship between mother and seed weight because the quantity and proportion of full seeds cannot be detected visually from the surface of the seed. The abundance of flowering is generally hypothesized due to seed predation avoidance which decreases the ability to produce seeds in large amount. The seed quality also depends on many factors both annual and geographic variation [3].

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SEED QUALITY OF SILVER BIRCH (*BETULA PENDULA* ROTH) IN DIFFERENT CLIMATIC REGIONS

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The purpose of this research is to provide the information about the seed quality of *Betula pendula* Roth in different climatic regions. The distribution of *Betula sp.* in the world is found in the high parts of the Eastern Anatolia Region [1]. This tree species, which can withstand up to -50 °C, has been the raw material of tools such as bows, arrows and whips for the Turks living in Central Asia [3].

Birch seeds ripen at different times in different climatic zones. Seeds may ripen in different periods, for example, seeds which ripen in September in mountainous and clay soils such as Turkey, may ripen in August in countries such as Germany. To understand that the birch seed is ripe, it is understood when the green hyacinths reach the level that they will open and disperse in brown-yellow colour. It should be noted that the seeds in every opened catkin are not usable since these may be damaged by insects. This situation deteriorates the quality of seeds and produces non-germinated seeds. Seeds should be collected after ripening. Early harvested seeds germinate late. The experiment conducted by the professor Schmidt in 1928 in Tyrol showed that the seeds harvested late are also stored longer and germination rates can reach 97%. Timely collected birch seeds show a very high germination ability, and under proper protection retain their germination ability for up to two years [2]. Birch seeds are small light-winged nutlets with a good dispersal ability [5].

Seeds usually develop as a result of cross-pollination due to a biochemical self-incompatibility mechanism [6].

The most crowded birch volume is in Russia with 11,023 million m³, in the Baltic countries this highest rate is in Latvia – 154 million m³, followed by Estonia – 101,06 million m³ and Lithuania – 69,4 million m³ [4]. Seeds in the Baltic climates grow faster. However, due to poor climatic adaptation, they are more prone to abiotic and biotic damage. This leads to quality problems [7].

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TAXUS BACCATA, MAIN CHARACTERISTICS AND USES DURING THE HISTORY

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Badly treated throughout history for its toxicity, *Taxus Baccata* seems to take a turn in its demography in Latvia [1]. The whole tree is toxic: from its brown to purple bark, through its soft and flat dark green leaves to the seed of the female plant except for the small red part which is edible [2]. It is a dioecious plant which cannot be reproduced at distances higher than 100m between two feet [2]. Its wood is of a great value was used to build bows of a very long range what explains in part their disappearance in Western Europe [3]. But its toxicity, used by ancient peoples to poison their swords is largely responsible for its decline in Latvia, farmers prefer to cut them to prevent their animals from dying or becoming infertile as, for example, sheep [4]. The toxic property of this plants was reused for abortions during the Middle Ages and this tree has been directly associated with the birth rate throughout the world as evidenced by its use by Guilaks [5] in Japan to evacuate the placenta post-natal. It is also linked to mortality and is very present in cemeteries where for a long time it was the easiest place to find it [3]. Today, Taxol, a toxic molecule from *Taxus baccata*, is used to treat certain forms of cancer but is gradually being abandoned in favour of Taxotere [6], a more powerful molecule for this type of treatment.

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PROPERTIES OF SEEDS, GERMINATION AND INITIAL GROWTH OF TREES

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It is known to everyone that a forest begins with a simple seed. But in order to provide the best result possible, it is necessary to understand the characteristics of the seed, the relationships formed by interacting with different factors. This can be achieved by analysing many conditions affecting the quality of seed which will affect the future forest, such as seed colour, mass, storage duration and temperature, the growth conditions of the parent tree. The aim of this paper is describe various conditions affecting the quality of seed researched previously.

An economically important tree species in Latvia is silver birch (*Betula pendula* Roth). However, birch seed yields tend to differ, so it is important to ensure their reserves. Researchers in Poland in 2012 attempted “to investigate the effects of seed moisture content and storage temperature in germinability and seedling emergence in container cultivation” [1]. The study showed significant differences in the storage of birch seed under different conditions. The longer the retention time, the lower seed germination, germination energy and quality. Many of the seed properties were also affected by storage temperatures. The quality of the birch seed decreased as the air temperature was rising in the storage unit [1].

The properties of woody plants are defined genetically. Similarly, the properties of the seed and the quality of genetic properties are also determined by the conditions of climate, as it was highlighted in the study “Seed quality and genetic polymorphism in Scots pine (*Pinus sylvestris* L.) seed orchards” carried out in 2012 [2]. The seed size was affected by climatic and edaphic conditions and its size depended on its initial growth. The use of seeds from seed orchards is essential, because the seeds are larger with more spare substances and far less likely to be self-pollinated [2].

For a long time it has been believed that the colour of the seed may indicate its properties, but it is not always possible to predict them precisely by the colour. The colour of the seed may indicate poorer quality, but seed trees in seed plantations produce light-coloured seed, which is used in tree nurseries. The colour is determined by both the genetic characteristics and the growth conditions. It can also be determined by the age of the tree. As part of the study, it was concluded that the colour affected germination, for example, Scots pine darker-coloured seeds had a higher mass and consequently, more accumulated nutrition substance [3].

It is difficult to create ideal germination and initial growth conditions, so it is particularly important to understand the limiting factors of each species. The quality of seed has an impact not only on germination but also on the growth and in the end on the future forest, therefore the use of plantation seeds is particularly important.

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USES AND PROPERTIES OF EUROPEAN IVY *HEDERA HELIX* L.

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European ivy *Hedera helix* L. is the one of the woody vines found in Europe. It is an evergreen perennial climbing vine with abilities to thrive in shady places. A representative of *Araliaceae* family, European ivy features two distinct forms. First, a juvenile form which produces lobed light green leaves with non-flowering stems and aerial rootlets, used to climb. Later, a heliophyte mature form use for reproduction in which unlobed dark green leaves appear on rootless stems that produce greenish-white flowers in fall, followed by black berries. These ivy berries play a key role in the ecosystem. An ivy only flowers from October to November, after the flowering of other plants, it is therefore an essential source of food for bees and other insects at the time when there are few flowers. Birds may also eat the fruits at the end of winter, when little food is available [1].

For a long time considered as a parasite plant for trees to which this plant clings, it is now recognized as a mutualist plant who attract helpful organisms for the tree, like ladybugs which can then rid it of parasites. It is also a protector for the bark against cold, warm and animals. In addition, it is able to depollute the ambient air, acting as a particle sink, absorbing particulate matter, particularly in high-traffic areas from adhering fine ($< 2.5 \mu\text{m}$) to ultra-fine ($< 1 \mu\text{m}$) particles at densities of up to 2.9×10^{10} per m^2 [2] [3].

Regarding biomimetic, we can transpose those properties to civil engineering, by using the ivy for insulation of buildings and harvesting of polluting particles in cities [4].

This plant can also be used for a medicinal application. Its medicinal properties are usually used in naturopathy medicine to improve the health of the respiratory system. The use of a treatment including *Hedera helix* for a viral infection of airways reduces the cough frequency and its virulence. Some properties of this plant could improve the quality of expectoration/pulmonary expulsions (quantity, colour). In different cases *Hedera helix* can help to drop fevers and the tiredness like improve sores throat, sneezing and stiffnesses [5] [6]. To sum up, European ivy *Hedera helix* L. has many applications from ecosystem to medicine to improve human health.

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FACTORS INFLUENCING THE CURRENT OCCURRENCE OF LONGHORN BEETLE *NOTHORHINA MURICATA* (DALMAN, 1817)

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Nothorhina muricata is a rare and poorly researched species in Latvia and Europe and is used as an indicator for natural forests. It is included in the protected species list of Latvia [1,2]. The longhorn beetle is the umbrella species of Latvia especially protected habitats – wooded coastal dunes, Western taiga, coniferous forests on glaciofluvial eskers and bog woodlands [3]. The longhorn beetle can inhabit the same tree for decades without causing it to perish. The resulting damage, resin, persists for a long time even after the death of the beetles [2,4].

The aim of the research is to find out the actual occurrence of *Nothorhina muricata* on Scots pine *Pinus sylvestris* L. trees and what factors might affect that.

Slitere National Park was chosen as the study area, because it has one the the best known populations of this species in Latvia. The location of the sample plots was based on the location of the habitats suitable for the species in Slitere National Park, the sample plots were situated evenly in the dry pine forest zone of this protected nature area along the sea coast.

The data were collected from 107 trees using visual accounting method, which is an indirect method for detecting the presence of the species. The visual accounting method was chosen because it does not damage the microbiotope inhabited by the species and does not affect the species themselves.

The presence and the number of new exit holes in tree correlates with the number of older exit holes and resin on the trees, which confirms that the species may still be present on such well-resined trees. The occurrence of *Nothorhina muricata* is related to a circumference of a tree, a trunks' exposure to the sun and a tilt of a trunk. Emergence traps would be an effective way to determine the current occurrence of the species.

Acknowledgements

The study was supported by the grant of project of Latvia University of Life Sciences and Technologies 'Implementation of LLU research programme'.

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IMPACT OF CHEMICAL COMPOUNDS OF *VIBURNUM OPULUS L.* ON ITS USES IN COOKING AND MEDICINE

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Deeply rooted in Eastern Europe culture and folklore, *Viburnum opulus L.*, called guelder rose in English or “*parastā irbene*” in Latvian, is a wild shrub species that is very common and popular in Latvia. It has red berries or white flowers depending on the season and leaves whose colour can be green, red, or yellow [1].

Its fruits (berries) are often used in cooking and medicine and are best picked after the first autumn frost. They can be eaten raw or used in jams, jellies, and cake fillings. *Virbunum opulus L.* is also used to help prevent kidney and heart diseases, digestives troubles, as well as menstrual and stomach cramps [2].

This presentation aims to disclose the reasons for such uses. To do so, it will cover studies that investigate chemical compounds and their benefits on health. The fruit contain antioxidants (phenolics and carotenoids) and ascorbic acid (Vitamin C) [3]. In addition, extracts such as fruit juices or ethanol are effective for reducing bacterial growth making them good against pathogenic microorganisms [4].

These studies indeed show why *Viburnum opulus L.* is used in cooking, but also how adding lyophilized fruits powder in homogenized meat products results in longer period before food spoilage due to chlorogenic acid, while increasing the cooking loss and possibly altering the smell and taste due to the bitterness of the fruit [5]. It can also have other uses, as shown in studies trying to make new materials such as hybrid fibres using cellulose acetate found in its fruits [6]. To sum up, *Viburnum opulus L.* is a plant with many good impacts on health that justifies its uses in medicine, cooking and making new materials.

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GROUND COVER VEGETATION SUCCESSION AFTER THE CLEARCUT IN *HYLOCOMIOSA* FOREST SITE TYPE

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Succession is a natural, gradual replacement of vegetation and biological structures over time as a result of a disturbance of growing conditions. Some of the disturbances include: fire, wind, floods and clear-cutting [1]. The area is first overgrown with herbaceous species, weeds, including annuals with a rapid biological cycle. The species that first enter these sites are called early succession, but the process is called the pioneer phase. Later, with the appearance of variations in shading and changes in the microclimate of the stand, perennial species with slower biological development begin to enter. These species form a more stable root system and a wider cover [3].

In the current forest typology's scheme of Latvia the descriptions of vegetation are based on corresponding forest type's ground vegetation in mature stand [2]. However, in practical forest management it is important to know forest ground vegetation's development through all the forestry cycle and value phytocoenoses state in every stand's age and succession's stage.

In total six permanent sample plots have been established in Kalsnava forest district (middle East of Latvia) in *Hylocomiosa* forest site type stand for determination of vegetation's parameters using point – square and Braun – Blanquet methods. The research object was established in Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.) H. Karst.) and silver birch (*Betula pendula* Roth) mature stands before the cutting. The tree stands were cut in November – December of 2015. The inventory in the same plots was performed six times – in 2015 (before clearcut), 2016, 2017, 2018, 2019 and 2020.

There are abundance and projective covering of vascular plants, mosses and lichens registered. The results were compared to those obtained by chronosequence method in Kalsnava forests [4]. The previous results suggested that Shannon – Wiener index value (vegetation's biological diversity) has increased after the clearcut: $H(s)$ in mature stand = 2.912, but after clear cut 3.202. Ellenberg's ecological indicators' values were also increasing: nitrogen's value has increased the most - by 2.62 units. The most significant changes in individual species occurrence were between the second and third years' and Chekanovsky coefficient value (0.19) is confirming that.

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THE MOST DANGEROUS PESTS IN FOREST TREE NURSERIES

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Pests in forest tree nurseries is one of the problems they face and there are still a lot of ways how pest management could be improved and researched.

Dumroese (2012) researched how integrated nursery pest management helps to protect seedlings from pests. The main factor for pests to spread is good environment so preventive measures should be applied to prevent creating good conditions. It can be achieved if sanitary measures are used in the nursery, for example, dead and diseased seedlings should be removed and burned or composed far away from growing area, nursery perimeter should be clean from weed and other junk, machinery, containers, tables and floors should be regularly cleaned. Screens over entry points into greenhouses should be used [1].

Prahodsky et al. (2018) described how the protection of Scots pine planting stock against pests in Belarus was achieved. The most dangerous pests for seedlings are pests of buds and shoots in greenhouses and cockchafer (*Melolontha spp.*) grubs on the field. Since pests cause enormous damage and economic losses, it is important to introduce more efficient protective and control measures both in local and international scale. Pests imported from other countries pose a significant threat not only in forest tree nurseries, but also in the forests. Pests can be managed with biological preparations if pests are present in small amounts or with chemical pesticides if there is a lot of pests or there are good conditions for rapid development [2].

Sukovata et al. (2015) analysed the performance of *Melolontha* grubs on the roots of various plant species. The most difficult to manage in forest tree nurseries were cockchafer grubs because a lot of insecticides and biological preparations that were previously used to control grubs had been banned. One of the ways to control cockchafer grubs are mechanical methods, such as deep plowing the soil, but these methods cannot always be applied. One of the novel alternatives, that is still being researched is to grow seedlings together with plants which pose detrimental effect on the development of cockchafer grubs. Those plants are of family *Brassicaceae* or *Cruciferae*, for example, buckwheat (*Fagopyrum esculentum* Moench), oilseed rape (*Brassica napus* L.) or white mustard (*Sinapis alba* L.). It is suggested that tannins and phenols have a detrimental effect on the development of grubs. However, the research about this management method needs to be continued [3].

It is important to regularly inspect plants in nurseries. It will be faster, more successful and economically beneficial to get rid of pests if they are noticed sooner rather than later.

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FOOD SCIENCE

INVESTIGATION OF CHEMICAL COMPOSITION OF PASTA MADE FROM PEAS AND CHICKPEAS

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The demand for plant foods in the European Union is growing. Legumes are widely consumed and regionally distributed; they have excellent nutritional value, but consumption is still low [1,3]. The global gluten-free market was estimated at USD 5.90 billion in 2021 and is projected to grow at a CAGR of 9.8% during the forecast period 2022-2030. Awareness of healthy eating and prevention of health problems such as heart disease, diabetes, stroke, obesity, and metabolic syndrome are expected to drive growth [2]. Following global dietary trends, demand for gluten-free products could also increase in Latvia, and the existing product offering, which is dominated by products made from rice, corn, and buckwheat flours, could be diversified with legume products grown and known in Latvia, such as pea noodles.

The aim of the present study was to investigate the chemical composition of gluten-free pasta made from large grey peas, yellow split peas, green split peas, and chickpeas and their sensory properties. *Xanthan gum* (E415) was used as the hydrocolloid. Extrusion was carried out using a single-screw extruder. The parameters to produce gluten-free spaghetti pasta were 80-94-100 °C, 0.5 ± 0.1 MPa, and the screw speed was 60 ± 2 rpm min⁻¹. After extrusion, the pasta was dried in a rotary convection oven at 70 ± 10 °C for 4 ± 1 h to a moisture content of $10 \pm 2\%$. Protein content was determined according to AACC-4620 method, lipids according to ISO 6492, total dietary fibre content according to AOAC 985.29, ash content ISO 2171:2007, carbohydrates, energy content and nutritional value were calculated. Determination of total phenolic compounds and antiradical activity with 2,2-diphenyl-1-picrihydrazil (DFPH) was also performed. Sensory evaluation was performed using a 7-point hedonic scale according to ISO 4121: 2003 by 18 untrained testers testing the degree of liking for cooked pasta, 11 women and 7 men. Commercial chickpea pasta was analysed as a control sample.

The results of research demonstrate that protein content was significant different ($p < 0.05$) between large grey pea and green pea pasta compared with control sample. Commercial chickpea pasta had statistically significant difference ($p < 0.05$) in fat content compared with all made pasta types. The highest content of total phenolic compounds was in the prepared chickpea pasta 0.34 ± 0.08 mg g⁻¹, while the lowest in the split pea pasta 0.15 ± 0.04 mg g⁻¹. Gray pea pasta and green pea pasta had the highest antiradical activity as $42.00 \pm 20.53\%$ and $65.20 \pm 3.35\%$, respectively. There was no significant difference ($p > 0.05$) in the degree of liking between analysed pasta samples.

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EVALUATION OF BIOACTIVE COMPOUNDS IN SPRUCE SPROUTS AND PINE BUDS

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The health of the world's population is visibly deteriorating in all age groups [1]. Pine (*Pinus*) and fir (*Abies*) needles, including pine buds and spruce (*Picea*) shoots, are known to be good sources of vitamins and minerals. Over the years, there have been clinical studies that have shown that products derived from conifers are essential and important for human health [2]. The aim of this study was to compare the chemical composition of fresh and dried pine buds and spruce shoots.

Fresh spruce shoots and pine buds were harvested in early spring 2021. They were convection dried at 40, 60, and 80°C and freeze dried. The dried samples were stored in glass jars in the dark. All samples were analyzed for ascorbic acid content, total carotene, phenols, free radical scavenging activity (DPPH), and moisture content.

The study showed that the content of ascorbic acid in fresh pine buds was 473.97 ± 14.26 mg 100g⁻¹ by dry weight (DW) higher than in spruce shoots 267.78 ± 10.23 mg 100g⁻¹ by DW. After storage for 9 months, convectively dried pine bud samples had lower ascorbic acid content than spruce shoots, except for freeze-dried samples. The moisture content of fresh pine buds was $78.76 \pm 1.88\%$, while it was $84.63 \pm 0.39\%$ for spruce shoots. The moisture content of dried pine buds ranged from $3.24 \pm 0.36\%$ for samples dried at 80°C to $10.59 \pm 0.37\%$ for freeze-dried samples. However, for dried spruce shoots, it ranged from $4.65 \pm 0.11\%$ for samples dried at 80°C to $11.50 \pm 0.73\%$ for freeze-dried samples, and after 9 months of storage, the moisture content had increased by an average of 1 to 2% for all samples. The total phenolic content in fresh pine was 104.27 ± 26.93 GAE mg 100g⁻¹ DW, but in fresh spruce shoots it was 161.79 ± 14.71 GAE mg 100g⁻¹ DW. In the dried samples, the total phenolic content was almost twice that in the fresh samples, but after 9 months of storage, the total phenolic content had decreased on average twofold. Total carotenoid content was 0.462 ± 0.005 mg 100g⁻¹ DW higher in spruce shoots than in fresh pine buds 0.070 ± 0.004 mg 100g⁻¹ DW. In the dried pine bud samples, total carotenoids were higher than in the fresh samples, but in the dried spruce shoot samples, total carotenoids were lower than in the fresh samples. After 9 months of storage, an increase of 1% on average was observed in all samples. The radical scavenging activity (DPPH) was higher in fresh spruce shoots 1097.37 ± 15.87 mg TE 100g⁻¹ in DW than in fresh pines 1064.575 ± 68.49 mg TE 100g⁻¹ in DW. In the dried samples, it was observed that DPPH value slightly decreased but increased in spruce shoots after 9 months of storage, while it decreased in pine buds, except in the freeze-dried samples.

In conclusion, the most favourable drying method for preservation of bioactive compounds was convectively dried samples at 60°C for both spruce shoots and pine buds. However, the content of bioactive compounds was higher in spruce shoots than in pine buds. Both pine buds and spruce shoots could be considered as promising ingredients for further development of other foods.

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CHEMICAL COMPOSITION AND CHEMICAL STABILITY OF SELECTED SPICE SEED OILS

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Spices are most used to enhance the flavour of foods and in traditional medicine [3]. However, in addition to flavouring molecules, they also contain other beneficial compounds, such as phytosterols and tocopherols (tocols), which in the case of tocopherols are important for the oxidative stability of oils, in addition to fatty acid and triglyceride proportions and other factors. α -Tocopherol [1] is the most studied tocol, tocotrienols [2] and other tocopherols [4] also have health-promoting and antioxidant capabilities. This study investigated the composition of triglycerides (TAG), fatty acids (FA), content of sterols and tocopherol (T) and tocotrienol (T3) homologues, antioxidant activity and peroxide value during storage.

Cold-pressed seed oils (SO) of commercial cumin, caraway, bishop's weed, lovage (Apiaceae), and nigella (Ranunculaceae) seeds were pressed at the Dobele Institute of Horticulture in May 2021, and species were selected based on initial analyses of their T and T3 content. Analyses of TAG, FA, and sterol composition were performed using HPLC-ELSD for TAG and GC-FID for FA and sterols, respectively. The oils were stored at room temperature (RT) and at 60°C and analyzed every month (RT) and every day (60°C) to determine the peroxide value (PV, ISO 3960:2001), antioxidant activity (DPPH radical test), and, using a HPLC-FD method, the changes in the content of T and T3 homologue in the oils during storage.

The dominant FA in Apiaceae SO are petroselinic acid (C18:1 cis-6) and linoleic acid. Petroselinic acid-containing TAGs also dominated in these samples. In Nigella SO, linoleic acid formed most of FAs (58.08%), followed by oleic acid and palmitic acid. The TAG profile was dominated by linoleic acid TAGs (LLL) and in association with palmitic acid (PLL) and oleic acid (OLL). In bishop's weed and caraway SO γ -T3 dominated, in lovage SO γ -T3 and α -T3, α -T3 was also dominant in cumin SO, but β -T3 dominated in Nigella SO. Tocol contents were stable during storage. β -Sitosterol and stigmasterol were present in high amounts in all analysed SO, except for bishop's weed SO, in which cycloartenol dominated over stigmasterol and β -sitosterol, lovage SO had the highest total sterol content, the lowest - Nigella SO. A decrease of antioxidant activity by 38% (RT) and 20% (60°C) was observed for Nigella SO, it decreased by 8.31% (RT) for bishop's weed SO but remained stable for the other samples. A very high PV was observed for Nigella SO (41.2 mg eq. active O₂ kg⁻¹) and did not change during storage. The PV of the other SO was much lower (10.9 - 13.7 mg eq. active O₂ kg⁻¹ for cumin and caraway, respectively SO), an increase was observed only for cumin (28.22% RT, 42.33% 60°C) and bishop's weed (3.56% RT, 1.48% 60°C) SO at the end of storage. The tested oils have high oxidative stability and contain various health-promoting compounds.

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EFFECT OF YEASTS ON THE QUALITY OF BEER

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Beer is one of the most popular beverages in the world, using different types of grains, hops and yeast. The aim of the study is to evaluate the physicochemical parameters of beer samples fermented with different yeasts.

The experiments were divided into two phases. In the first phase, three samples of a commercial ale beer from the Latvian company "Viedi" were analysed twice. The first analysis was performed after the first 14 days of fermentation, the second before bottling (after 28 days of fermentation). The following parameters were analysed: pH, ethanol content, extractives, colour, bitterness and the content of aromatic compounds. The second part focused on the production of three beer samples fermented with different types of yeast (high performance ale yeast, Safale S-04 Dry Ale yeast and Bavarian Lager M76). For the experiment, a must was also provided by the company "Viedi" and the pH, colour, density and aromatic compounds were analysed. Thus, each of the three samples was divided into three other samples (9 in total) and fermented, so that after the first 14 days the first analysis was performed and before bottling (after 28 days of fermentation) the second analysis was performed. The pH, colour, bitterness, total flavonoids content, aromatic compounds and ethanol content were analysed. The pH was determined according to the AOAC method (1996) using a Metler Toledo pH metre; the colour was determined according to the spectrophotometric AOAC method using the scale offered by the European Brewing Convention. Bitterness was analysed by the AOAC method by reaction of isooctane using the centrifuge as a device and spectrophotometric reading, flavonoids were determined by the method of Kim et al. 2003; and finally, alcoholic degrees content was analysed by distillation [1][2]. The results of the first and second part were as expected, noting the influence of the yeast strain: for example, the pH of the lager sample is between 4.2 and 4.6, while that of the ale is lower, between 3.9 and 4.1, and the colour of the lager is between 18-20 and that of the ale is between 28-30. In conclusion, the selected yeast strain has a significant influence on the final quality of the beer. The obtained results could help producers to select the most suitable yeasts for beer production. The objectives of the research were correctly fulfilled, the physicochemical parameters of the beers were studied in detail and the standard values for each of them were evaluated.

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SUPPLY OF PLANT BASED DRINKS IN LATVIAN SUPERMARETS

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Demand for alternative dairy beverages is increasing and is driven by human health, animal welfare, and environmental considerations. Plant-based beverages are recommended for people with high cholesterol, as saturated fats should be removed from the diet, and plant-based beverages are also suitable for vegans [2]. According to the data from the SKDS research centre, a total of 75% of people in Latvia are trying to include more plant-based products in their diet [1].

Plant-based beverages are made by extracting the plant material in water, separating the liquid, and formulating the final product [3]. Thus, plant-based beverages are vegan products. The largest supplier of vegan products and beverages in Latvia was Germany with 32.5%, followed by Italy with 11.7%, the Czech Republic with 10.2%, Latvia, Lithuania, and the United Kingdom - with 5% [4]. Plant-based milk is on the way to leave its niche position in Europe [1]. The main reason for this is that the major food manufacturers and large retailers are entering the market with their own brands. The research was conducted by visiting web stores of supermarkets such as "Rimi", "Barbora", "Lats". The research showed that the main brands of plant-based beverages offering milk alternatives in Latvian supermarkets are: "Alpro" (Belgium), "Valio Oddlygood" (Finland), "The Bridge Natural BIO" (Italy), "Oatly" (Sweden), "ICA" (Sweden), "Valsoia" (Italy), "Nemoloko" (Russia, until March 2022), "Sproud" (Sweden), "BERIEF" (Germany), "HAPPY" (Austria), "VEGA MILK" (Ukraine), "ECOMIL" (Spain), "JOYA BARISTA" (Austria) and "TERE" (Finland). Thus, the suppliers of plant-based beverages in Latvia are Sweden, Finland, Germany, Belgium, Austria, Spain, Ukraine, and Italy.

In conclusion, the research shows that the suppliers of vegan products and plant-based beverages on the Latvian market are diverse. It should be noted that all the above-mentioned plant-based beverage brands are imported into Latvia by Latvian companies (limited liability companies), which then resell them to local stores. The research also revealed that there are no Latvian brands and companies which produce plant-based beverages.

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INFLUENCE OF HONEY ORIGIN AND YEAST TYPE ON THE QUALITY OF MEAD

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Mead is one of the oldest beverages in the world and is the starting point for some of the most consumed beverages today, such as beer. Its consumption has decreased over time as wine and beer have become more popular. The production process of mead is a basic process consisting of the fermentation of diluted honey. The selection of the origin of the honey and the appropriate yeast strains are key factors in the development of a beverage with specific sensory characteristics. All the steps and variations that can affect the final product must be controlled, and this is where the key to this study lies [2].

The aim of the study is to evaluate how the use of different types of honey and yeast affects the final properties of mead, both in terms of physicochemical and organoleptic parameters.

The experiment is divided into two parts. In the first part, four mead samples prepared with four different yeast strains (sample A - Lalvin - 71B-1122 wine yeast, sample B - mead yeast, sample C - Lalvin K1-V1116 yeast, sample D - Lalvin K1-V1116 yeast) and aged for one year were analysed for the following physicochemical parameters: pH, °Brix, total phenolic content, radical scavenging activity DPPH and ABTS and total flavonoid content. For the analysis of these parameters, a measurement of absorbance in the spectrophotometer at different wavelengths was performed, depending on which compound was analysed. In the second part, meads were prepared from different honeys such as linden flowers, buckwheat, heather, multiflora, spring flowers and rapeseeds. In the experiment, the changes in chemical parameters were evaluated. For the sensory analysis of meads, a linear scale method was chosen, which is included in the standard ISO 4121:2003 for sensory analysis.

The results obtained show that sample D has a higher content of phenolics than the other samples. For the other antioxidant parameters, the values are similar, although the content of flavonoids is higher in sample A. When comparing the pH values, samples A and D obtained the highest values, 2.86 and 2.84, respectively. From this sensory analysis, it appears that honey-yeast combinations are the most appreciated by consumers [1,2].

The results of the second experiment consisted in the production of different types of mead with honeys of different origins and yeasts with different qualities, and the results showed differences in physicochemical parameters and sensory properties. The conducted experiments showed the perspective of mead and by using different yeasts and honey origins it is possible to give each mead its own identity.

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THE EFFECT OF HIGH-PRESSURE PROCESSING ON THE QUALITY OF SEA BUCKTHORN JUICE

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Sea buckthorn juice is rich in various health-promoting compounds, including vitamin C, carotenoids, especially β -carotene, and other antioxidants. High pressure processing (HPP) is a relatively new alternative treatment method that provides microbiologically safe products without the need for food additives or heat treatment [1]. The objective of this work was to compare the effects of heat treatment and high-pressure treatment on vitamin C content, soluble solids content, pH, titratable acidity, total carotenoids, and colour intensity of sea buckthorn juice. Sea buckthorn juice was treated at a high pressure of 300 MPa and 500 MPa with a holding time of 6 minutes. A control sample (fresh, raw juice) and pasteurised juice (90 ± 2 °C, 15-20 s) were used for comparison. The juice was analysed immediately after treatment and after one week (storage at 4 ± 1 °C).

The juice was analysed for soluble solids content, pH, titratable acidity, total carotenoids, colour intensity, and vitamin C content. Microbial parameters (number of mesophilic aerobic and facultative anaerobic microorganisms (MAFA), yeasts and molds, number of lactic acid bacteria) were determined according to the standard method LV EN ISO 6887 and the procedure described by Hou et al [1].

The experiments showed that high-pressure and heat treatment had no effect on the soluble solids content, pH, and titratable acidity of sea buckthorn juice. Total carotenoid content in fresh juice was 100.95 ± 1.22 $\mu\text{g g}^{-1}$. Heat treatment caused the greatest loss of carotenoids, which was 9.7%. HPP caused lower carotenoid losses, and there was no significant difference between samples treated at 300 MPa and 500 MPa. The changes in carotenoids were closely related to the changes in colour intensity of the juice. Immediately after treatment, the least colour change was observed in the juice sample treated at 300 MPa pressure and the greatest difference in the pasteurised sample. The colour change of the treated samples can be explained by the isomerization of carotenoids due to the heat and high-pressure treatment [2]. Moreover, a decrease in the brightness or L^* value of the colour component of the juice was observed after the HPP treatment, so the treatment did not inactivate the enzymes that can cause the enzymatic browning [3].

The vitamin C content of the fresh juice was 46.97 mg 100 g⁻¹. The highest loss of vitamin C was observed in the heat-treated sample, and the lowest in the high-pressure-treated samples.

Treatment at 500 MPa for 6 minutes was selected as the optimal method for sea buckthorn juice because it ensures microbiological safety of sea buckthorn juice even after one week of storage, compared to pasteurisation and high-pressure treatment of 300 MPa for 6 minutes. The selected high pressure treatment method (500 MPa, 6 minutes) can destroy MAFA microorganisms, yeasts, molds, and lactic acid bacteria in the juice. HPP caused smaller changes in the analysed parameters compared to the heat-treated sample. Less colour variation is observed after HPP treatment than after heat treatment, but the difference increases during storage.

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EXTENDING THE SHELF LIFE OF TRADITIONAL CURD CHEESE WITH INDIGENOUS *L. LACTIS* IMMOBILIZED ON ACID WHEY PROTEIN AND APPLE POMACE MATRIX

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Recently, consumers are increasingly interested in healthy and sustainable dairy products. Therefore, we used acid whey protein and a bioactive apple pomace matrix as carriers for indigenous protective *L. lactis* incorporated into traditional sour milk cheese to extend its shelf life and increase its biological value. The curd (control) was produced in a local dairy; the ricotta-like protein matrix was prepared from the by-product - sour whey - and used as a carrier for the indigenous *L. lactis* LL16 strain [1]. The matrix was immediately mixed into the curd, replacing 20% of it (experimental cheese 1). The other part of the matrix was enriched with freeze-dried apple pomace powder (experimental cheese 2), which was obtained from the Lithuanian Research Centre for Agriculture and Forestry. All cheeses were placed in muslin bags, pressed and later vacuum packed in flexible film.

Acidity (pH) of cheese and bacteria (mesophilic lactic acid (LAB, LST ISO 15214:2009), lipolytic and proteolytic [2]. The total number of yeasts and moulds was determined according to LST ISO 21527-1:2008, and the number of monocytogenic listeria (LST EN ISO 11290-1:2017) and coagulase-producing bacteria (LST EN ISO 6888-1+A1:2005) was determined on the first, eighth, 15th, and 21st days of storage. (The acidity of the control cheese increased ($p < 0.05$) at the beginning of the study and then decreased ($p < 0.05$), remaining higher than that of the experimental cheeses throughout the study. Storage time had no significant effect on the acidity of the experimental samples. Proteolytic, coagulase-producing bacteria and listeria were not detected throughout the storage period. The number of LAB was highest in the control cheese and in the cheese with *L. lactis* LL16 at the beginning of the study. Later, their content decreased in the control sample compared to the experimental cheeses and remained low until day 21 of the study ($p < 0.05$). The content of LAB in the experimental cheeses also gradually decreased ($p < 0.05$) as in the control sample, but in the cheese with apple pomace powder an increase of these bacteria was observed, exceeding the level of day 1 on the last day ($p < 0.05$). Although more lipolytic bacteria had invaded the experimental cheeses ($p < 0.05$) with the carrier, the supplement with *L. lactis* LL16 reduced their number to the level of the control cheese from day 10. Moulds were found in all cheeses only on the first day of the study, with no significant differences between samples. Although yeast counts were highest in the experimental cheeses at the beginning of the study, higher yeast counts were observed in the control cheeses from day 15 of storage.

In conclusion, the supplementation of traditional curd cheese with indigenous *L. lactis* LL16 can effectively control the growth of yeasts and lipolytic bacteria. The addition of apple pomace powder to the carrier supports LAB survival in cheese.

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VETERINARY MEDICINE

ANTIBACTERIAL ACTIVITY OF PHENOLIC COMPOUNDS: P-COUMARIC ACID, CAFFEIC ACID, CINNAMIC ACID AND GALLIC ACID

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Antimicrobial resistance is one of the most important human and animal health threatening issues worldwide. Therefore, one of the future perspectives to reduce the use of antibiotics might be natural bioactive materials [1]. Natural phenolic acids are known by their anti-inflammatory, antibacterial and antioxidant effect. However, just one research study has analysed the antimicrobial activity of gallic acid, caffeic acid and pyrogallol in isolated bacteria [2]. The aim of this study was to evaluate antibacterial activity of phenolic compounds (PC) in bacteria isolated from infected skin wounds.

The study was done at the Lithuanian University of Health Sciences, Veterinary Academy from December 2021 to March 2022. PC antibacterial activity was evaluated *in vitro* by the method *diffusion in agar*. Mueller-Hinton agar was used. Reference (*Staphylococcus aureus* (ATCC 25923), *Enterococcus faecalis* (ATCC 29212), *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27859)) and clinical (*Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli*, *Pseudomonas aeruginosa* isolated from dogs and cats wounds) bacteria were used. The Petri plates with different concentration (from 5 % to 1 %) of p-coumaric acid, caffeic acid, cinnamic acid and gallic acid were incubated at 37 °C for 24 h. 96° ethanol was used for positive control, and purified water for negative control. For each strain, 5 plates were used. After incubation the antibacterial activity was assessed by measuring the clear zone in millimetres around the well. Statistical analysis was done by SPSS 27.0 software, assessing median, minimum and maximum values; p values were counted by Mann-Whitney U test. All 5 % conc. PC presented antibacterial activity. P-coumaric acid presented the greatest effect in ref. *S. aureus* (27.50 [22-30]), *E. faecalis* (19 [14-22]) and clinical *S. aureus* (21.50 [12-30]), *E. faecalis* (16.50 [14-20]). Caffeic acid presented the greatest effect in ref. *S. aureus* (27 [11-30]), *E. faecalis* (18 [10-21]) and clinical *S. aureus* (23 [20-24]), *E. faecalis* (16.50 [14-20]). Cinnamic acid presented antibacterial activity just in ref. *S. aureus* (23 [20-28]) and *E. faecalis* (15 [14-15]). Gallic acid presented the greatest activity just in ref. *S. aureus* (12.50 [10-29]). P-coumaric acid and caffeic acid had no difference in antibacterial activity of reference *S. aureus* (U=34, p=0.4), *E. faecalis* (U=25, p=0.190) and clinical *S. aureus* (U=27, p=0.792), *E. faecalis* (U=24, p=0.562). P-coumaric acid presented 2.2 times higher effect in ref. *S. aureus* than gallic acid (U=8.5, p=0.003). The lower concentration of PC presented antibacterial activity just in *S. aureus* strain. 4 % conc. p-coumaric acid presented activity in ref. (20 [13-23]) and clinical (12 [11-19]) *S. aureus*. In ref. *S. aureus* p-coumaric acid, cinnamic acid and gallic acid had no differences in antibacterial activity (U=9, p=0.905; U=5, p=0.286). Of all PC just 1 % conc. gallic acid presented antibacterial effect in ref. *S. aureus* (15 [11-17]).

According to the findings, the tested phenolic compounds presented antibacterial activity. The highest effect was found in *S. aureus* and *E. faecalis*, both reference and clinical strains. For further tests more studies, such as cytotoxicity evaluation of substances, are necessary.

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EXERCISE INDUCED PULMONARY HEMORRHAGE IN SHOW JUMPING HORSES

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Exercise-induced pulmonary haemorrhage (EIPH) is a disorder occurring in horses during high intensity exercises, most commonly observed in race horses. Only up to 13% of racing horses suffer from epistaxis, but, in fact, blood in the trachea is found in approximately 75% - 85% of horses as shown by post-race endoscopic examinations [1]. EIPH also affects horses competing in other disciplines; however, most of the post-exercise endoscopic studies have been done on race horses [3]. Mechanisms and pathogenesis of the disease are associated with high transmural pressure, resulting in high pulmonary arterial and negative alveolar pressures, causing rupture of the small blood vessels and consequent alveolar haemorrhage [3]. Thus, the hypothesis of this study is that jumping horses are commonly affected by EIPH, and blood in the tracheal lumen after the jumping contest is present more often than epistaxis. The objective was to assess the occurrence of EIPH in show-jumping horses via post-exercise endoscopy examination. Tracheobronchoscopies were performed on 45 show-jumping horses (23 outdoor and 22 indoor competing horses), competing with the obstacle height from 135 cm to 160 cm. Tracheobronchoscopies were performed in the horse stall from 30 to 120 minutes after competing. A 1.5 meter "Tele-View" endoscope was passed into the trachea down to the level of carina; the nasopharynx and trachea were examined for the presence of blood. Four independent experts assessed the severity of bleeding using a 5-grade system [2],[4]. EIPH was observed in 15 (33%) of all examined horses. Using Pearson's Chi-square test, no statistical difference was found between the height of the obstacles and the occurrence ($p=0.260$) and severity ($p=0.174$) of EIPH, as well as the test result between "indoor/outdoor and EIPH" was statistically insignificant ($\chi^2 = 0,044$, $df=1$, $p=0.833$). However, there is a tendency that these factors could play a statistical role with higher numbers of horses. This study showed that EIPH in showjumping horses is commonly observed, and presence of blood in the trachea is more common than epistaxis.

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GERONTOLOGY IN CATS, PHYSIOLOGICAL CHANGES WITH AGING

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This study has examined physiological changes that occur in cats during their ageing. The old age of cats is considered to start when they are 7 years old, although physiological changes could appear later. The study aims to analyse research literature on cats' gerontology and identify essential data on physiological changes, including work of internal organs, musculoskeletal system and nervous system, functions of sensory organs, metabolism etc. These findings are compared with our experimental data of an 11- years-old domestic cat to confirm physiological changes and find out how ageing affects the cat's body.

Ageing is defined as a gradual inability to meet the body demands. Overall, ageing is characterized by exhaustion and degeneration of the body reserves. The speed of the ageing process depends on abnormal changes and the specific physiological processes in cells and, generally, in the body. Ageing processes influence absolutely all body structures and groups of organs. In old animals metabolism is observed to slow down together with their tissue dehydration. Cats become less active, so the amount of required calories drops by 30-40%. The percentage of the body weight, containing fat, increases. Old animals are more exposed to irregular sleep than young animals. They are more restless and their eye movements (REM) are less frequently observed. Changes in their hair are associated with cell hypoxia, and hormone and meal changes. Hair brightness is gradually lost, and in some body parts alopecia and blisters can be observed. Sometimes, in the finger pads hyperkeratinisation is present, and nails become fragile, the nail shape is deformed. With the age of elderly animals, diseases of teeth appear increasingly. At the same time, due to the dental stone and loss of teeth, cats may suffer from gum hyperplasia or periodontitis together with atrophy and retraction.

This research study uses several methods such as body palpation, diagnostics of oral cavity, hair, skin, and eyes. An 11-year-old cat has been examined for results. Diagnostics of the oral cavity was carried out, and such changes were found, which are described in research literature on the gerontology of animals. It was detected that a cat lost two teeth, and changes in the gums were noticeable in the places where the teeth had fallen out. Cat hair has become dull, and natural gloss has disappeared. Grey hair was found around its nose and above lips, as well as on several places on the back. Alopecia and blisters were not founded. The cat's hair has become greasier. The skin has become dehydrated. The cat's body undergoes physiological changes that affect each group of its organs. Ageing is part of every animal's life. Our study managed to detect almost all changes in cats described in the relevant research literature. In short, there are visible changes in the skin and oral cavity of the domestic cat. The results of this research study will be complemented by follow-up studies on cats.

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UTERUS MICROFLORA, ANTIBIOGRAM, EFFECTIVENESS OF TREATMENT PROTOCOLS IN THE ORGANIC DAIRY FARM

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Metritis is one of the most common disorders affecting dairy cows within the first 21 days postpartum [1]. Therefore, this study aims to identify the most common agents of metritis, the most effective antibiotics against these agents, and effective treatment protocols used on a Latvian organic farm. Our study was carried out using 20 cows with diagnosed metritis. The bacteriological examination was provided by uterine mucosal wipes. The samples were analyzed at the Department of Molecular Biology and Microbiology, Scientific Laboratory of Biotechnology, Latvia University of Life Sciences and Technologies. Ten cows with fever and systemic signs of illness received combined treatment: iodine consisting of intrauterine infusion and antibiotics applied parenterally (Group A). The other ten cows without systemic symptoms of metritis received the same intrauterine infusion and no systemic antibiotic treatment (Group B). The most prevalent uterine pathogens isolated from the groups were: *Escherichia coli* (8 cows), *Streptococcus dysgalactiae* (6 cows), and *Trueperella pyogenes* (6 cows). The analyses of antibiotic effectiveness showed that *E.coli* and *S.dysgalactia* were sensitive to Ceftiofur, but *T.pyogenes* sensitivity was variable among the cows. *S.dysgalactiae* and *T.pyogenes* were resistant to Neomycin and Novobiocin. These antibiotics were ineffective for all uterine pathogens found. At the same time, *S.dysgalactiae* and *T.pyogenes* showed sensitivity to Penicillin. However, *E. coli* was resistant to Penicillin and Erythromycin. Other antibiotics mentioned in this research study, except Ceftiofur, showed variable sensitivity to *E. coli*. There is a lack of research on fertility outcomes on those organic farms in which metritis has not been treated. The average period from calving to the first artificial insemination in untreated animals on the conventional farm was around 104 days [2]. In our study, the average first insemination day was 75 ± 11.9 days in Groups A and B. We did not find any significant differences between the groups. It means that the treatment protocols used were appropriate to the severity of the illness. In conclusion, on the experimental farm, the combined treatment protocol with Ceftiofur parenterally and iodine infusion in the uterus was effective in cows with systemic signs of metritis, and just iodine medicine infusions into uterus in cows suffering from metritis, but without systemic symptoms of illness, were effective in comparison to the research literature data obtained from practice where animals did not receive treatment at all. Our research study is still in progress.

Acknowledgement: This research is supported by the project "Implementation of the LLU Research Programme".

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HISTOLOGICAL CHARACTERISTICS IN DAIRY CATTLE (*BOS TAURUS*) ENDOMETRIUM ON THE SEVENTH DAY OF ESTROUS CYCLE AFTER HORMONAL STIMULATION OF MULTIPLE OVULATIONS

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The cow endometrium temporally undergoes local synchronized remodelling during the estrous cycle. The gland and luminal epithelium cells undergo specific morphologic changes to synthesize and excrete nutritious fluid substantial in the early stages of pregnancy. Estrogen (E) promotes endometrium cell proliferation, and progesterone (P4) stimulates the development and secretory activity of the endometrial glands and luminal epithelium cells [1]. Successful ovulation, embryo implantation and following pregnancy depend on many factors such as subclinical endometritis and low circulating P4 concentration. The uterine condition can be evaluated by histopathological examination of endometrium biopsy samples. On the 7th day of the oestrous cycle, the cow embryo enters the uterine horn and attaches itself to the endometrium; therefore, the endometrium condition during this period affects the probability of successful pregnancy occurrence [2].

Thus, the aim of our research was to describe and compare histopathological characteristics of the cow endometrium on the 7th day of the natural estrous cycle and in cases of multiple ovulations (MO). The biopsy samples of the endometrium (a total of 48 samples) were taken from clinically healthy cows with a natural reproductive cycle (n=11), and these cows constituted a control group (CG). The histological samples were prepared and evaluated at Latvia University of Life Science and Technologies, Faculty of Veterinary Medicine. The cows' ovaries of the other group were stimulated using hormonal steroid drugs (n=13), and these were MO cows. Our findings showed that the endometrium activity increased in the MO cows' endometrium. Stromal oedema in the endometrium was detected in 85% of samples in MO cows versus 64% of the samples in CG cow's endometrium stroma; supra-nuclear vacuolization of glandular epithelium cytoplasm was found in 88% versus 55%, respectively; sub-nuclear vacuolization of glandular epithelium cytoplasm 35% versus 0%; hemosiderin accumulation in endometrium 73% versus 36% of the samples. These morphological characteristics of the endometrium on the 7th estrous cycle day may increase the quality of embryos and promote successful pregnancy in multiple ovulated cows after their hormonal stimulation.

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SARS-COV-2 SEROPREVALENCE IN HOUSEHOLD DOMESTIC FERRETS IN LATVIA

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Corona disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was first reported in Wuhan, China, in December 2019 and has caused global pandemic [1], [2]. Bats might be the origin host of the SARS-CoV-2, which might have been transmitted via pangolin or other wild animals, sold at the Huanan seafood market, intermediation [3]. There have been reports that several mammals, including domestic ferrets are susceptible to SARS-CoV-2, and they can be infected either naturally and/or by experimental infection [1], [2].

Therefore, the aim of this study was to determine the seroprevalence of SARS-CoV-2 in household domestic ferrets in Latvia. During the time period 17.12.2021- 03.01.2022, 33 client-owned ferrets from 20 different households were brought to LTD “RIMAL” veterinary clinic for blood sampling. Blood samples were collected from *v.cava cranialis* with 2 ml syringe and 21 gauge needle. The presence of SARS-CoV-2 antibodies in serum samples was determined by ELISA. The study population included 22 (66.7 %) hobs and 11 (33.3%) jills. Twenty two animals had no prior history of disease and were considered clinically healthy, but 11 animals had history of previous diseases. The mean age of included ferrets was 3.3 years old (median = 3 y, standard deviation = 2 y, range = 6.3 y, minimum = 8 m and maximum = 7 y). Seropositivity for SARS-CoV-2 was previously detected in six owners (from 10 days to 12 months). The owners had reported that none of the ferrets showed COVID-19 clinical signs.

All tested samples were negative for SARS-CoV-2 antibodies. The negative antibody results showed that there was no SARS-CoV-2 sero-prevalance in the study population and they suggest that the incidence of the disease in domestic ferrets in Latvia is low.

Acknowledgements

The present study was funded by the *Vetfond* scholarship in the field of veterinary medicine for domestic animals.

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MYCOPLASMA SPP. PREVALENCE AND RISK FACTOR ANALYSIS IN FIVE DAIRY FARMS IN LATVIA

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Mycoplasma spp. is a bacterium that can cause a range of serious conditions in cattle, including mastitis, pneumonia, arthritis, otitis media and late-term abortions [1]. Practitioners should take into account that, in recent years, *Mycoplasma* spp., especially *Mycoplasma bovis* has spread to many countries where no outbreaks had been recorded previously. In many EU countries, studies of *Mycoplasma* spp. seroprevalence in dairy herds have already been conducted, while in Latvia data on *Mycoplasma* spp. seroprevalence is scarce.

This experimental study was carried out within the project “Possibilities of using *Mycoplasma bovis* autogenous vaccines to reduce antimicrobial resistance in dairy farming in Latvia (S391)”, project number 21-00-S0INV05-000027.

The recruitment of farms for the study was carried out on a voluntary basis, based on information provided by the service veterinarians on animal health problems caused by mycoplasmosis.

Five cattle herds were examined, with a total of 100 bovine animals, 20 animals per farm: 10 productive animals and 10 young animals, a blood sample was taken from each animal.

The aim of the study was to detect *Mycoplasma* spp. seroprevalence on five dairy farms located in different regions of Latvia. In order to identify factors contributing to the spread of *Mycoplasma* spp. on dairy farms, two questionnaires were developed. The initial survey was conducted prior to the experimental study, and relevant information was provided by a competent specialist. The second survey was conducted after the experimental study to clarify specific issues of interest. This anonymous electronic survey was conducted from January 6, 2022 to March 3, 2022. It was developed on the website *visidati.lv* and distributed with the help of the LVB (Veterinary Union of Latvia) directly reaching the Section for Farm Veterinarians. Although this questionnaire was distributed twice, only 7 livestock veterinarians responded.

The analysis of the findings showed that out of the total of 100 bovine animals tested in five holdings, four households tested positive. The number of positive animals in the households was 5% (1), 35% (7), 40 % (8), 0% and 5% (1), respectively. All farms had been tested for mycoplasmosis in the previous 5 years, of which only two farms had a positive status. Our study did not confirm positive serology tests on one farm, but confirmed them on the other farm.

In conclusion, mycoplasmosis is seroprevalent on small farms with around 60 cattle, and in large conventional dairy farms with around 4,100 cattle. A multifactorial approach to eradicating mycoplasmosis from a herd exists based mainly on the protection of breeding cattle and the eradication of positive animals, which can take years. Serology may be relevant for the detection of *Mycoplasma* spp. carriers or animals previously infected. Discarding animals based on ELISA results alone is not a logical approach to efficient mycoplasma control, ELISA results should be interpreted in conjunction with other innovative diagnostic methods.

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GENOMIC AND PHENOTYPIC TRAITS AS ZONOTIC POTENTIAL OF *ARCOBACTER BUTZLERI*

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Arcobacter butzleri is considered as an emerging enteropathogen, whose transmission has been associated with contaminated food of animal origin [1]. However, data on *Arcobacter* genomic characteristics and its overall zoonotic potential in relation to antimicrobial susceptibility is scarce. Therefore, the aim of our study was to characterize *A. butzleri* strains, isolated from human stool samples and raw milk, by combining whole genome sequencing (WGS) and antimicrobial susceptibility testing (AST) data.

A total of 46 *A. butzleri* strains isolated from human stool (n = 20) and raw milk (n = 26) samples were selected for AST. Antimicrobial susceptibility to erythromycin, azithromycin, ampicillin, ciprofloxacin, gentamicin and tetracycline was determined using the gradient strip diffusion method. The genomic sequences of 21 *A. butzleri* strains were obtained by Illumina MiSeq paired-end sequencing. All genomes were *de novo* assembled and annotated using SPAdes (v.3.12.0) and Prokka (v.1.14.6). The phylogenetic relatedness among the strains was determined by the single nucleotide polymorphism (SNP) analysis (CSI phylogeny v.1.4). The pangenome was evaluated using Roary (v.3.13.0). Custom *Arcobacter* databases were searched for known antimicrobial resistance (AMR) and virulence genes using ABRicate (v.1.0.1). The results of AST revealed that, regardless of the isolation source, most isolates (97.8%) were highly susceptible to ciprofloxacin with minimal inhibitory concentration (MIC) values distributed on the lower end of the tested concentration range (0.032 – 0.25 µg/ml). Surprisingly, different MIC distribution patterns were observed for macrolides (azithromycin and erythromycin). For erythromycin, MICs were distributed around the epidemiological cut-off value (ECOFF) (4 µg/ml) of *Campylobacter jejuni*. However, all determined MICs for azithromycin were above the ECOFF value (0.25 µg/ml). Furthermore, 45.7% of tested strains formed a subpopulation (MICs ≥ 8 µg/ml), which displayed reduced susceptibility to azithromycin. The WGS-based analysis showed that *A. butzleri* harbours an open pan-genome comprising 5636 coding sequences. An average of 82 potential virulence factors and 80 AMR/heavy metal resistance genes were detected in the examined strains. Regardless of the isolation source, from 13 to 17 (\bar{x} = 14) efflux pump (EP) systems belonging to different families were identified. Point mutations in domain V of the 23S rRNA (A2074G, A2074C, A2075G) or amino acid changes in the ribosomal proteins L4 (Gly-57-Asp/Val, Gly-67-Val, Ala-71-Asp, Arg-72-Ile, Gly-74-Asp) and L22 (Gly-74-Ala, Gly-86-Glu, Ala-88-Glu, Ala-105-Met) were not detected in the tested strains. The lack of the mentioned mutations/alterations explains the normally distributed MICs for erythromycin. However, the genetic mechanisms behind the reduced susceptibility to azithromycin are still unknown and require further investigation. The SNP analysis was based on 1,668,095 nucleotide positions that were common to all genomes. It revealed that one strain isolated from human stool and three from raw milk were phylogenetically closely related as an average pairwise distance of 3 SNPs were observed between these strains.

The current study revealed the zoonotic potential of *A. butzleri* by (i) identifying genetically closely related strains from milk and humans, (ii) detecting potential virulence factors (e.g. lipid A cluster, *oprF2*, *luxS*) and AMR/heavy metal resistance genes, that are present in the genomes of other pathogens, and (iii) by determining the reduced susceptibility to azithromycin.

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ENGINEERING

LOW ENERGY BUILDING CONNECTION SOLUTIONS FOR CENTRALIZED HEATING SYSTEM

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Heat supply in Latvia is provided using district heating (DH), local heating and individual heating solutions. Some of the goals of the National Energy and Climate Plan for 2021-2030 are to increase the number of users of DH and local heating systems, to increase the use of renewable energy resources and to improve the efficiency of DH system [1]. In Latvia, 26% of heat supply solutions use DH, but individual heat supply is used by 74% [2]. DH solutions are mostly used in densely populated areas, most in the heating of multi-apartment buildings, while single-family homes use individual heating solutions. In order to facilitate the connection of single-family houses to the DH, it is necessary to develop technically and economically justified solutions for the DH system. In the city of Jelgava, DH system supply temperature curve is 70 - 95 °C and return temperature is 65 - 42 °C, which is typical for the 3rd generation DH. Currently, more research is being carried out on the transition of existing DH systems of the 4th generation, where the supply temperature is 35 - 55 °C, but the return temperature is 25 - 30 °C [3]. The existing return temperature curve for DH system may be sufficient to meet heating needs, for example for use in floor heating solutions in buildings where an average supply temperature is 30 - 35 °C, and for hot water needs of the consumer who needs a more sophisticated solution, to maintain the temperature of 55 °C.

In Jelgava, DH consumers mostly are high-consumption buildings, such as multi-apartment buildings and factories. However, according to some scientific studies, it is possible to connect low-energy buildings, such as single-family homes, to DH system, successfully heating them with a low supply temperature and ensuring a low return temperature. [4] Connecting the consumer to the return system would also affect the overall performance of DH return system, such as the increase in temperature difference (ΔT), thus further reducing the return temperature in the DH network, this way reducing heat loss in the heating network and increasing the efficiency of the cogeneration plant and also reducing CO₂ emissions. Therefore, the aim of the study will be to investigate the possibility of connecting a single-family home to the existing DH return system by finding a theoretically, technically and economically feasible solution to connect a single-family home's hot water and heating system to DH system.

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IMPROVEMENT OF MOTORCYCLE K-175 EXHAUST SYSTEM

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Moto skijoring is a popular sport created in Latvia, in which both retro and motorcycles manufactured in recent years can participate [2]. In order for retro motorcycles to be competitive during races, their performance needs to be improved. There are various ways to adjust and influence the performance of street motorcycles in retro races, such as changing suspension components or gearboxes, improving intake manifolds, fuel mixture preparation or exhaust system modifications [4].

Exhausts, which consist of a header, a collector and a muffler or silencer, were discovered in the late 1800s and back then they were used only to put out the burnt gas from the motorcycle, but through the ages they underwent drastic modifications and became more functional. Exhausts come in different varieties that vary in their functions. Based on the type of exhaust you choose for your motorcycle, the exhaust weight, performance and noise varies [3]. Nowadays tapered pipes are common. The fundamental reason for this effect is that the tapered pipe acts as either a nozzle or as a diffuser, in other words, as a more gradual process for the reflection of pressure waves at sudden expansions and contractions [1]. To increase the exhaust gas return rate, which contributes to better fuel filling in the cylinder, many changes can be made, for example, the length of the first bend of the motorcycle exhaust system, the distance to the first cone and its diameter, as well as the length of the cylindrical part and the second cone. When improving the exhaust system, it is important to be aware of the engine speed at which the motorcycle will be operated, as the total length of the exhaust system is calculated from these data using a formula [5].

The aim of this study is to identify and develop the most efficient exhaust system for the K-175 motorcycle that improves engine performance.

The author's hypothesis is the following: Changing the length of the first bend of the motorcycle exhaust system, the distance to the first cone and its diameter, as well as the length of the cylindrical part and the second cone, increases the exhaust gas return rate, which contributes to better fuel filling in the cylinder.

The research methods include study of literature and previous solutions, design of an exhaust system for the K-175A motorcycle, calculations of the exhaust gas recirculation and speed and evaluation of efficiency of the designed exhaust system.

The research developed in the master's thesis can be used not only to model the exhaust system of the K-175A motorcycle, but also to increase the power, reduce costs and adapt it to the needs of any two-stroke motorcycle.

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ALTERNATIVE ENERGY POWERPLANT ON RURAL FARM

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For a farmstead in a rural region that deals with economic activity there might be difficulties in electric power supply. That could be related to long distance low voltage electric lines. To improve quality and reliability of these resources it is possible to set up wind generators and solar panels, which are alternative and environmentally friendly sources of power.

It is stated that some studies have proven that wind turbines cause annoyance of some degree and there might be two different reasons for that. One of the reasons might be the vibrations and noise that comes from the turbine (sound level at about 40 db and infrasound). Another reason is environmental change and how wind turbines affect the scene. Reported health effects are mostly caused by emotional stress [1].

For people living on farmsteads it is necessary to consider what kinds of health disorders could be possible. It includes sound pressure and visual stroboscopic effect that can cause emotional stress for people.

For urban environments the best solution would be vertical axis wind turbines (VAWT). Compared to horizontal axis wind turbines (HAWT), they could generate electrical power regardless of the wind direction. VAWT work with small power output from 0.5 to 6 kW. Many of the turbines work without integrated gearboxes, which means that they have direct drive and easier maintenance [2].

Although vertical axis wind turbines are mostly used in urban areas and for smaller power output multiple units could be set up on rural farms in many places.

In practice rotor designs suffer from accumulation of minor losses resulting from turbine tip losses, wake effects, drive train efficiency losses and blade shape simplification losses. It is proven that the most common, efficient and easily controllable wind turbine rotor designs are horizontal axis wind turbines with three spinning blades. HAWT with three blades has an efficiency of about 50%, compared to a vertical axis wind turbine with Darrieus Rotor design (40%) [3].

Horizontal axis wind turbines could be more reliable, powerful and more controllable than vertical axis wind turbines. They have more mechanical parts and their maintenance is more expensive. Also horizontal axis wind turbines are more likely to create low frequency stroboscopic effect, as was mentioned in the first article.

One of the ways to improve electrical reliability and independence is wind turbines. Depending on the number of turbines and power output they can be used to improve energy independence, which could automatically lower the cost for total energy consumed from the grid.

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TYPES OF BATTERIES USED IN ELECTRIC POWERED WATERCRAFTS

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Electrification is a changing paradigm shift in the transport sector towards more efficient, higher performance, safer, smarter and more reliable vehicles. In fact, there is a clear trend to change from internal combustion engines to more integrated electrified power units [1]. In order to reduce CO₂ (carbon dioxide) emissions, it is planned to replace internal combustion engines with alternative energy engines or electric engines, and solar energy can serve as one of the alternative energy sources used in watercrafts. In Austria a fully electric Yacht was made with implemented 150 kW electric engine powered by two Lithium-Ion battery packs with total power of 125 kWh [2]. The depth of battery discharge is an important aspect of the battery bank if used in a Photo-Voltic system. Rated as deep-cycle or shallow-cycle batteries, for example, deep-cycle battery will have a discharge between 50 - 80% [3]. However, the biggest problem now is the storage of unused electricity. An example is a solar-powered catamaran, the principle of which is to convert solar radiation into usable electricity using an electric motor as the source of propulsion. The most popular batteries used in transport are Lead acid-gel, Nickel Cadmium and Lithium-ion battery. As technology and costs have improved over the last 10 years, both household appliances and mobile vehicles increasingly use lithium batteries. The main advantage of lithium batteries is their high energy capacity per unit mass, fast charge, inability to discharge large amount of current while the vehicle is accelerating. Lithium titanate batteries have the fastest charge time out of lithium battery arsenal with charge time of only a few minutes. The author's hypothesis is the following: installing a more suitable battery in an electric boat will significantly improve the performance of the boat and overall prototype lifetime. The study methods include literature research, analysis of technical data and previous solutions.

As a part of the study, a catamaran was built, powered by 450 W photo-voltaic panel battery. Primary performance studies were done with lead acid batteries. Comparative trials will be carried out in the next phases of the study using higher performance solar controllers and LiPO₄ 40 Ah batteries.

Conclusions: 1) For the experimental prototype, after the installation of lithium-ion batteries, it is expected that the operating parameters such as battery charging speed, average cloud-time mileage and average speed are improved. 2) The expected lifetime of lithium batteries could be 3-5 times longer than the lead batteries used previously.

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DESIGN OF GAS FLOW MEASUREMENT DEVICE

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Gas flow measurement device, also known as an air flow bench, is a device designed to measure the volumetric air flow capabilities of devices hosting gas flow. Commonly it is used for testing internal combustion engine components, pneumatic system components, various air-conditioners, air filters, throttle valves, nozzles and other products. It operates by measuring the pressure differential between two sides of a calibrated orifice plate. The pressure differential is produced by mechanical means, such as electric blower or vacuum motor. The air flow source of gas flow measurement device creates a pressure differential across the test object that causes air to flow through the test object and the orifice plate. From the measured pressure differential, the volume of air that is flowing through the test object can be calculated from the pressure drop over the orifice and the test pressure itself. It is typically measured in Cubic Feet per minute (CFM) [1].

A company in Australia has developed a concept for an analogous, cost-effective gas flow measurement device that can precisely measure gas flow up to 210 CFM at test pressure of 15 inches of water column or 3.73 kPa [2]. The flow test bench comprises a stable airflow source, an air channel test bed, a sensing system, a test object, control and display monitors and vacuum pumps. [3] The aim of the research is to study the design and the manufacturing of a simple and cost-effective gas flow measurement device. The study methods include theoretical research, analysis of analogous solutions and their technical parameters. As part of the study, a 3D CAD model of the gas flow measurement device has been created and a computational fluid dynamics simulation has been studied.

Changes and improvements will be carried out to complete the design of the modeled device. By using flow simulation data, the placement of pressure sensors will be determined as well as placement of laminar flow rails and the required vacuum motor power.

Conclusions are the following: 1) The first designed prototype is expected to accurately measure gas flow from 50 to 200 CFM at test pressure of 5 kPa, 2) gas flow data will be collected by digital measurement instruments and displayed on monitors, 3) the economic gain is expected to yield lower manufacturing costs, compared to analogous devices found in the market.

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PASSENGER MINIBUS LUGGAGE COMPARTMENT EXPANSION MECHANISM

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Every year there are hundreds of cars being rebuilt and reconstructed in Latvia. One of the most common transformations is conversion into passenger vehicles. With this type of conversion there is always a slight problem. High occupancy automobiles such as passenger vehicles require a seating system capable of rapid reconfiguration of the seating layout in their vehicles. For that reason, it is very time consuming to remove 4 or even more seats in the back of the bus. The aim of this research is to develop a mechanism for expanding the luggage compartment of a passenger minibus by connecting rear row 4 seats together and relocating them simultaneously.

The most important thing when converting a vehicle is safety for passengers. Improving rear seat belt geometry, shortening cushion lengths, and reducing injury potential from contact with the front seatback are proposed countermeasures for improving rear seat occupant protection [2].

These are the 3 key points that need to be considered when designing an expansion mechanism. If it is necessary, improvements in seat constructions can be made to further improve safety of rear seat occupants. Design of the mechanism should evaluate not only seats that are being relocated, but also seats in front of them, therefore seat arrangement is important.

Study shows full seat sliding system development based on the existing rail system. While many existing products accomplish the basic function of sliding a seat without a configurable seating system, existing products fail to do this in an ergonomic, rapid, repeatable motion [1].

The paper provides all necessary information for designing a seat sliding mechanism, therefore it is used to analyse mistakes in design, construction methods and seat testing, as well as to improve time consumption and ergonomics.

The selected articles show that it is important to focus on passenger safety and applied construction methods so the mechanism can be produced multiple times without unnecessary expenses. The analysis and suggested improvement implementation will ensure a safe and cost-efficient expansion mechanism.

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PARAMETRIC DESIGN USING AUTODESK INVENTOR ILOGIC PROGRAMMING

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A designer's main activities while developing a product is to adapt existing designs or offer additional options to customers' demands. The original designs are rarely used. The task is to offer variants for the design and modify it to the new requirements. This often takes a lot of time to adapt a sample to small changes and it is a routine since the basic structure of components remains the same [1].

The parametric design can be useful only when it is known that the model will be used mainly as a serial production with changes [2]. Linking the model with parametric properties can be time consuming, but once it is completed the future models and changes can be changed more easily thus reducing overall time to model adapting for each specification and making manufacturing files. Generative parametric design (GPA) requires modeling strategy to create dynamic and highly modifiable models. There should be a plan about how and what is going to adapt in future models and which part of the model should be made customizable. The challenge there is that the model needs to be customizable both parametrically and topologically to get the best possible outcome [1].

The study will represent an Autodesk Inventor based technique for designing a frame with varying components, main dimensions, and profile sizing. Autodesk Inventor is a computer aided design software which allows to create 3D models where designers and engineers can create models, visualizations, and simulations.

The main goal of this research is to study and compare designers' work time from a design to ready manufacturing files and calculating the total expenses during the project.

To achieve this goal, a frame design will be created at same time inserting iLogic programming in Autodesk Inventor and using parameters to link the needed parameters into a table for easy adaptation. Also, the manufacturing files will be made. The total time used will be compared with the time necessary for doing the same procedures manually. In conclusion, this solution could reduce a large amount of time designers spend adapting models, thus reducing the cost with minor changes in each project.

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POSSIBILITIES OF CO₂ EMISSION STORAGE AND UTILIZATION IN CAR SERVICE COMPANIES

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CO₂ emissions have an impact on global climate change. CCS (Carbon Capture Storage) technology is a key to reducing CO₂ emissions produced by the use of fossil fuels in transportation. There are three different ways in carbon capture cycle: before combustion; post-combustion and generating oxyfuels [1]. Post-combustion removal of carbon dioxide from the exhaust gas stream can be accomplished using three ways: absorption, membrane separation and adsorption. Absorption is used for carbon capture on small scale operations [2]. The following hypothesis has been formulated: using the developed technological scheme for CO₂ storage or utilization in car service companies, the main emphasis is on the quality of emission filtration and the technological solution of the storage.

The main goal of this research is to study carbon capture devices in the European and the world market, their operating principles and to develop a post-combustion technological scheme for CO₂ storage or utilization in car service companies.

To achieve this goal, a kind of cyclone will be created, in which the car flue gases flow into a specially designed separation tank and at the same time a spray of calcium hydroxide through the nozzle will be given, which will result in the formation of a mist in the separation tank. Reaction of CO₂ with calcium hydroxide produces sodium carbonate at the bottom of the separation tank. The amount and concentration of calcium hydroxide will be calculated and the amount of CO₂ from each car exhaust will be measured. In this way you can determine how much sediment will be extracted from each car exhaust gases. These car exhaust gases will be taken from multiple light passenger cars in Latvia. Each parameter from these results will be analysed, and a graph representing the changes will be created. By combining these test results, as well as analysing the possible impact of CO₂ in car services overall, necessary recommendations will be made.

The CCS is still a developing technology, expenses and uncertainties of large-scale projects make it difficult to obtain financial support without governmental participation. However, among the capture mechanisms reviewed, post-combustion technologies were given focus because these mechanisms are most likely to be readily adaptable to operate with existing internal-combustion engines. In conclusion, the above described solution can be considered a success in car service companies, reducing emissions on a small scale from each workplace.

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USE OF TRAFFIC WIND FLOW FOR ENERGY GENERATION

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In recent years, there has been a considerable increase in the emphasis on Renewable Energy Resources due to rising environmental pollution, rising energy consumption and price, and decreasing amount of fossil fuel resources. Among all alternative energy sources, wind has shown to be the most cost-effective, and as a result, substantial research efforts have been made to enhance the technology of wind-powered electricity generation [1].

Wind energy recovered in the wakes of fast-moving automobiles on roads has a significant potential but has to be utilized yet. A vertical axis wind turbine (VAWT) is used to recover energy from the wake of vehicles on highways. The VAWT is intended to be installed on highway roadsides and medians to generate power from car wakes [2]. Technology of using vertical axis wind turbines in generating electrical energy can be spread across countries where wind energy is less feasible.

Based on traffic clusters and traffic related wind speeds during different daytime and weekday hours, an energy conversion beyond the 1.4 kW is possible. The moving vehicles produce wind speed that may reach 24 m/s depending on its speed and size, where it can hit the wind turbine blades at speeds up to 6 m/s [3]. Experiment results reveal that the surface roughness of turbine rotor blades has a substantial influence on performance. A smooth rotor surface finish degrades turbine performance below a threshold wind speed (Reynolds number of 30,000) but improves turbine performance beyond it [4].

VAWTs placed near highways with intensive traffic can produce significant amount of electrical energy. The generated electricity can be used to cover self-consumption of road infrastructure (traffic lights, electronic road signs, streetlights, etc.). This technology can reduce carbon emissions by reducing electricity consumption of infrastructure near roads.

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COMPARATIVE EXPERIMENTAL EVALUATION OF CONVENTIONAL AND MINIMAL TILLAGE TECHNOLOGY

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Every year climate changes affect crop production and farmer's work. It is necessary to work more efficiently and grow high-quality crops. A lot of attention needs to be paid to maintaining soil fertility and structure to reduce soil erosion, which results in the loss of the fertile layer of the soil. It is also important to prevent soil compaction when working with tillage equipment. These factors can be changed by using appropriate soil tillage technology.

The aim of the research is to compare and find out which of the two tillage technologies – conventional tillage technology or minimal tillage technology is the most technically and economically advantageous. The descriptive research method will be used to analyse available information from different sources and to assess differences between traditional and minimal tillage technologies.

Tillage technologies change many soil properties when implemented in a long term. Tillage systems affect soil properties such as temperature, moisture, bulk density, aggregation, organic matter content, and plant properties such as root density [1].

Modern agriculture, particularly on upland landscapes, increasingly uses minimal tillage to prepare the seedbed for planting to minimize negative consequences on soil erosion, greenhouse gas emissions, and water pollution. Inversion tillage systems help to control weeds, insects, and crop diseases, when cultural and chemical approaches are not feasible or not effective [2].

In the research, two tillage technologies are being used within one field on farm “Lejascini”. The field is divided into two equal parts so that the conditions would be the same for both tillage technologies. The production cycle is being monitored from the tillage works on the field to the harvest. In conventional tillage, the arable strip is inverted using a plough but in minimal tillage, the arable strip is only loosened and mixed using a tine cultivator.

In the first trial year, the study was performed for the winter wheat production cycle. The information is collected from the used tractor and harvester information system which gathers productivity, fuel consumption, working time, technical load, working speed, crop yield, and crop moisture data. The analytical research method will be used after obtaining field mapping information from the tractor and harvester to analyse the data precisely. The graphical research method will help to summarize and visualize the obtained research results. Another information resource will be the nitrogen sensors data. In the second trial year, the same tillage technology will be used in the field without changing any tillage circumstances to obtain the most accurate information and evaluate the changes in each tillage technology. It is planned to seed beans in the research field and collect the data exactly as in the first trial. Based on this information, a comparative economic assessment of each tillage technology will be performed.

The information obtained will be used to make decisions on future crop production technologies to be developed on the farm. In the parallel agronomic evaluation of plant, development will also be performed.

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DYNAMIC TESTING OF THE DEVELOPED MOBILE REMOTE CONTROLLED ROBOT CHASSIS ON A NON-DEFORMABLE SURFACE

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The use case variety for robots is expanding very rapidly, so more and more engineers and researchers are working in creating and explorer platforms for robotics. In Europe, 1% of workers is already a robot. Similar percentage is for global situation. Some of countries have as high as 3% (Germany) or even 7% (South Korea) quantity of robots in industry [1]. Industrial robots are already quite sophisticated systems (56% are being sourced from Japan) with good flexibility and reliability. Yet, industry is not the only area for robot use, where factories benefit from robot precision, velocity and absence of social problems caused by low-qualification work force. Other uses for robots also exist, e. g. in research, in work in harsh conditions, in military applications, in logistics, health-care, etc. Most of these cases require mobility, that leads to research of various types of movement according to required grip and traction specifications.

In military applications, the main purpose is to provide safe intel material without risk to human life, as well as to neutralise potential hazards, such as explosives or enemy troops [2, 3]. For these purposes, crawling, tracked, stepping, wheeled or other terrain-based movement types of robots are important, as they can have more carrying force with lower noise and battery consumption in comparison to frequently used drones. Ground-based robots also have better hiding opportunities because of low need for environmental clearance and better manipulation force because of friction with the ground. Their remote control operation can be paused for long term and resumed upon necessity [2]. Such use cases are already widely used in countries that are investing in military applications, such as USA [3].

On the other hand, in Lithuania, there are not many well-studied universal mobile robot platforms and their trials on non-deformable surfaces. Most of applications are using third party platforms, which might be a good choice for industrial or research applications, but not acceptable in case of use in the military, because of possible shortage during periods of high demand (i. e. during geopolitical events). Moreover, nationally based platform has the advantage of fast adaption to different needs on demand and has lower possibility of well-known enemy imperfections or bugs as in the case with mainstream products. This is why scientists, researchers and enthusiasts of Alytus College are studying 2017 year mobile robot chassis, that would be available for use on non-deformable surface. While creating such a platform, it is important not only to get dynamic characteristics, but also understand the underlying physics law. This allows to estimate possible load capacity, stability, velocity and other most important parameters when using the platform for particular application.

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LAND MANAGEMENT AND GEODESY

CHANGES IN DEFORMATION OBSERVATION PARAMETERS IN THE CONCRETE STRUCTURES OF THE HYDROPOWER PLANT (HPP)

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Large hydropower plants (HPPs) are very smart buildings influencing significant changes in the environmental balance. Most of the failures in man-made hydropower plants could be remedied if the structures had been continuously inspected, monitored and analyzed, and if appropriate corrective action had been taken in a timely manner [1].

In this study, the author focuses on the mechanical behavior of HPPs during the operation of HPPs for more than 55 years. Each hydraulic structure, from the idea to the project implementation, must be divided into conditional and development stages. The first is the stage of natural conditions in which, according to the most suitable topography of the surrounding river valley, the potential construction site of a HPP is studied, the natural conditions are preserved, nothing is dug, the flow of the river is not changed. Then the stage of construction conditions follows during which the component of natural conditions is significantly changed - the soil is dug and moved, often the groundwater level is changed, so the natural balance before construction is disrupted, which is completed by the construction followed by operating conditions, which can lead to the significant damage and the consequences can be catastrophic.

The techno-natural processes in the area of interaction of foundations and structures can be conditionally combined in geomechanical, geofiltration, geothermal. Technical-natural types of process development, nature, scale and dynamics, which are determined by the design features of the building, the specifics of its construction and operation in specific engineering geological conditions. And the consequences of the influence of these processes can be observed as the deformations of the hydroelectric power plant structures, which is also the object of this thesis. Thus, deformations do not occur arbitrarily, their causes are based on changes in the environmental processes of the groups described above.

Deformation observations, on the other hand, are the criteria for the stability of a structure, using geodetic measurement methods as the primary monitoring tool, which is interrelated with the interaction of technical-natural processes on structures. To assess the condition of hydroelectric power plant structures based on the results of deformation data analysis, a series of long-term structural observations should be made and the degree of consistency or discrepancy between parameter changes should be monitored and controlled against the design performance [2].

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DIFFERENCES IN SURVEYORS' LICENSE REQUIREMENTS

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Land surveying is a complex, ever-evolving profession that has stringent licensing requirements. Land surveyors serve as the bedrock of the real estate industry - without them, we wouldn't have fair, objective information about boundaries, easements, existing structures and other vital property-related information. It's critical that land surveyors adhere to professional licensing requirements to ensure they have the skills necessary to provide accurate and detailed land surveys. Every country requires land surveyors to be individually licensed before they can take on clients. Each country has its own requirements for what it takes to get a license, which share some similarities. Every land surveyor must have a degree from an accredited surveying program. We chose Lithuania and New York State for the comparison.

The main requirement to become a qualified surveyor is that person must have bachelor's degree of geodesy, real estate cadastre or land management. The second requirement is that you must have work experience in that field, before you get the license of land surveyor. In Lithuania you have to study three years to get bachelor's degree of geodesy. In NYS you must have four years of education and experience credit for a bachelor's degree and be at least 21 years old. Work experience is the same in Lithuania and NYS, you must have two years practice in this field. In Lithuania a person wishing to obtain a surveyor's qualification certificate shall submit the following to the National Land Service: an application for the issuance of a surveyor's qualification certificate, copy of the identity document, copies of educational confirmation documents, copies of documents confirming work experience. Then you need to pass an exam consisting of 50 theoretical questions and 2 practical tasks. In NYS before you want to be licensed, you must pass: Part 1: Fundamentals of Surveying exam, Part 2: Principles and Practice of Surveying exam and Part 3: New York State Specific Land Surveying exam. To pass an exam, you must pay the required fees. In Lithuania, when surveyor have a surveyor license, the person must improve his qualifications and take courses within the specified time limits.

Summarizing the qualification requirements for future surveyors in two different countries, it can be stated that two countries with different regulations have similar requirements for people who want to become professional surveyors. To become a good surveyor in the field of surveying, it is not enough to complete several years of studies in geodesy or civil engineering, you must have at least two years of work experience, as well as a 35-hour specially designed course for surveyors. And finally, submit all the necessary documents to the National Land Service to give it the right to take the qualification exam to obtain the surveyor's certificate.

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DEVELOPMENT OF QUASIGEOID MODELS IN LATVIA

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Everyone lives within the Earth's geographical cover. The Earth is the home of humanity. We walk on the physical surface of the Earth. Beneath our feet, at an average depth of 6371 km, lies the centre of the Earth. Many branches of science explore the Earth. They can be identified by the common prefix "geo", e.g. geodesy, geometry, geography, geology, geomorphology, geophysics, geodynamics, geotechnics [1].

Definitions of geoid are various in the last 200 years. The geoid is an equipotential surface of the Earth's gravity field that has the same potential value as the mean sea level at a specific epoch. Geoid determination utilizes gravity data collected on the Earth's surface and its vicinity to compute the geoid in the most rigorous way. To distinguish from global geoid determination, which requires global data coverage, local geoid determination focuses only on local areas or regions [4].

As an equipotential surface of the Earth's gravity field, the geoid has important implications in engineering for the definition of physical heights and for Earth system studies. The most precise technique for determining physical heights above sea level is the classical levelling, but this method is very time consuming and expensive. Today, GNSS-levelling provides a very efficient technology to obtain ellipsoidal heights, from which physical heights can be computed. However, an indispensable requirement for the application of this new methodology is the precise knowledge of the geoid. This underlines the importance of the geoid also for a broad spectrum of surveying and engineering tasks based on the availability of physical heights [2].

The Latvian geoid model quality rebound 98' year improvements from gravimetric values. The 98' geoid model did not give the high precision. Improvements were made to the integration of GNSS/levelling data and international models creating new 14' quasi-geoid model.

During the last years, the European, the Nordic quasi-geoid models and existing national q-geoid models covered the territory of Latvia. There are many ways for comparison and tests of the results achieved. Scientists and professionals can compare models directly at some special geodetic co-location stations or use GNSS/ levelling sites [2].

Recent advances in the field allow to make improvements to the geoid model with astrogeodetic measurements. The geoid model's accuracy is within 1 cm. The model was build using the method developed by the Danish State and verticality measurements [3].

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ACCURACY OF GPS RECEIVER MEASUREMENTS

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Global Positioning Systems allow receivers to determine the coordinates of an object anywhere in the world. GPS systems are constantly being used for various geodetic measurements, which are constantly evolving and facilitating geodetic measurements. The wide variety of GPS instruments necessitates the analysis of measurement data, accuracy, advantages and disadvantages of the instruments, measurement conditions in order to obtain the most reliable measurement results [1].

Accuracy studies of real-time GPS receivers (Trimble R4, Trimble R6 and Trimble 5800) under different measurement conditions have shown that the largest errors occur during the measurements at points with high building intensity, narrow horizon openness or the measurement point area richly surrounded/overgrown with trees, shrubs, greenery and other vegetation. Comparing different GPS receivers, the obtained data indicate which type is preferred [2].

An analysis by the authors comparing different GPS receivers (Skytraq V6, Syngio BU353-S4, Hama, Holux M-215+, Holux, GR-213) let to conclude that there is no mechanism or software to allow users to objectively compare GPS receivers in terms of the quality, stability and reliability of the information they provide. However, the yielded results confirm the assumption that the best quality parameters are offered by receivers using dual-frequency satellite signals.

The smaller the number of errors, the more accurate the measurements, the more accurate are the lower class [3]. The error can be estimated by comparing the measured coordinates with the actual geographical coordinates. The sum of the errors determines the accuracy of the GPS atmospheric phenomena, reflections, satellite positioning, measurement noise, ephemeris data, satellite clock shift, selective access. It can be concluded that different receivers and different constituent environmental conditions affect the accuracy of the measurements which the accuracy of the measurements depends on.

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DEVELOPEMENT OF THE EARTH'S CRUST MOTION MODEL FOR THE TERRITORY OF LATVIA

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Observation of the Earth crust movements and creation of future surface models are essential long-term planning tool for marine-mainland boundary territories. Several research data of precise levelling and the GNSS station in the Baltic Sea region show partly similar map models for post-glacial crust deformation called Fennoscandia uplift where vertical crust movements show that in Latvia's height differences mainly increase from north-west to south-east [1].

The precise data sources for the territory of Latvia are: the first class state levelling system, LatPos GNSS base station system observations and the sea gauges monitoring system. The levelling data of the first-class state geodetic network has been obtained in several campaigns for the territory of Latvia. Accessible data are for the periods: from 1929 till 1939, from 1967 till 1974 and latest leveling period - from 2000 till 2010. Relative elevation values can be examined for marks that has sustained untouched during all these periods. Many benchmarks from the levelling campaign from 1929 till 1939 have been destroyed, although many new benchmarks were created during period from 1967 till 1974.

The digital terrain model (with a step between points of 20 meters) is used as a reference for the model creation. The digital terrain model is a set of points with a step between points of 20 meters. Each point has known plane coordinates (X, Y) and altitude (Z). The points cover the area in the form of a regular network. The model is linked to the LKS-92 TM coordinate system, the normal altitude system LAS-2000.5. The data were obtained by aerial laser scanning (in the period from 2013 to 2019) [2].

To obtain reliable data and visualization, several data sets should be used with precautions as the research of vertical crust movement from various sources in Poland showed how the method of combining data sets (interpolation, network adjustment) affected the final cartographic model and co-kriging was found to be an unsuitable method for modelling the vertical movements of the Earth's crust based on the data from various sources, such as permanent GNSS stations and data acquired with the use of precision levelling techniques [3]. Usage of a digital terrain model (DTM) may give useful data for long-term planning. Taking into account the drainage system of rivers, continental water storage, the sea level change and Fennoscandia uplift, we may model future impacts, such as new wetland formation where the sink is observed or new land formation near the coastline where uplift is observed. 3D model may be visualized in the time scale as the past reconstruction, nowadays and the future prediction.

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THE USE OF UAV TECHNOLOGY IN GEODESY

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UAV – (Unmanned Aerial Vehicle) is commonly known as drone. Drones seem to have the potential to revolutionize numerous areas of our lives, but today their biggest disruption is in the field of mapping. These small flying machines have made mapping any area or an object a matter of few minutes or hours, instead of the typical days or weeks it used to take before.

Today drones are used for many purposes in geodesy, but the most commonly used areas for UAV technology are: land surveying, land management, urban planning, and for precise measurements. In land surveying, UAV technology generates high-resolution orthomosaics and detailed 3D models of areas where low-quality, outdated or even no data, are available. They thus enable high-accuracy cadastral maps to be produced quickly and easily, even in complex or difficult to access environments. Using drones for land management, work in this section becomes more simplified and faster. This holds true for site scouting, allotment planning and design, as well as final constructions. The development of increasingly dense and complex urban areas requires intensive planning and therefore time-consuming and expensive data collection. Thanks to drones, urban planners can collect large amounts of up-to-date data in a short period of time and with far less staff. The images produced in this way allow planners to examine the existing social and environmental conditions of the sites and consider the impact of different scenarios. High resolution orthophotos enable surveyors to perform highly accurate distance and surface measurements. With a drone, it is also safer to do precise measurements in dangerous areas like stockpile volumetric measurements in mining sites or slope monitoring measurements. Compared to traditional monitoring techniques, where sensors are placed on single points, drones enable more comprehensive data collection. Drones with PPK capability, which do not require laying out of multiple GCPs, are optimal for this application, since these areas are often hard to reach or even dangerous. As regards UAV technology, there are pros and cons of it as in any other technologies. Pros of using UAV technology are the following: reduce field time and survey costs, provides accurate data collecting, mapping of hardly reachable areas. Cons of UAV technology: the work is dependent on meteorological conditions and seasons, short battery life of UAV, hard to do accurate large object mapping at one take off.

All in all, UAV technology is a game-changer in geodesy and construction industry. Using of UAV technology, mapping is performed more precisely. Also, a drone in a geodesy is time-saving technology. Gradually UAV technology will become more advanced, and we will use it in everyday life.

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ENVIROMENT AND WATER MANAGEMENT

THE SPATIAL AND TEMPORAL DISTRIBUTION OF ZINC IN SNOW: CASE STUDY OF JELGAVA CITY

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The harmful effects of various air pollutants on human health and the life in polluted air environment have been proven: the number of diseases has been increasing, life expectancy has been decreasing. Suspended particulate matter found in the air are one of the generally recognized air pollutants. The most dangerous solid particles are released during primary combustion processes, they contain heavy metals (zinc, copper, iron, lead) [3]. Heavy metals are known to be persistent in the human body and remain for decades. Heavy metals can enter the human body by inhaling dust particles, being in contact with contaminated soil and water and eating food grown in a polluted environment.

According to the National Atmospheric Emissions Inventory, the main causes of zinc suspended particulate matter pollution are emissions from industrial areas, fuel and diesel combustion processes. Even suspended particles from car tires and worn brakes' disc can account for up to 20% of zinc air pollution. Also, households in the winter are often still heated with coal. As a result of all these activities, zinc enters the urban environment, where it accumulates as the snow melts [4].

Snow is a valuable resource for information on air pollution sources and air pollution levels during environmental monitoring. There are no heavy metals in the snow itself. Even small amounts of these metals indicate possible pollution [1].

In the study published in "Environmental Science: Process & Impacts", snowy conditions were simulated in an artificial environment. The snow was mixed with typical air pollutants found in engine exhaust gases. Researchers found that toxic particles were getting trapped in the snow particles or mixed with the melted snow, proving that snow serves as an effective accumulator for car exhaust gases [2].

The aim of the study is to look at the zinc pollution in the snow cover in the city of Jelgava by using descriptive statistics, and to draw conclusions about the changes in air quality over the years. The results of 240 measurements obtained from 60 measurement sites in Jelgava in the period from 2018 to 2021 were used in the data processing.

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INNOVATIVE PHYLLOSILICATE BASED BIOLOGICALLY ACTIVE POLYPHENOL COMPOSITES AND THEIR POTENTIAL FOR BIOECONOMY DEVELOPMENT

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Polyphenols, such as flavonoids, phenolic acids, lignans, anthocyanins, are biologically active compounds found in plant-based food - fruits, vegetables, grains and drinks like wine, coffee, and tea. Polyphenols are known as a preventive remedy for cardiovascular disease, degenerative diseases, osteoporosis, neurodegenerative disease, cancer, diabetes mellitus and premature skin ageing. However, despite the biological activity, polyphenols, have a significant limitation – they are unstable under several conditions. Clay minerals can be used to stabilize polyphenols and prevent them from degradation, thus expanding the range of their application in industries, such as biomedicine, biocosmetics, and food [1,2,3].

The aim of the study was to intercalate various polyphenol groups into smectite type minerals to enhance their stabilization and evaluate the physicochemical properties for application in innovative biocosmetic and nutraceutical products. For example, phyllosilicate based biologically active composites can be used as skin protective products that is a non-toxic alternative to chemical UV filters. In recent years, there is evidence for possible side effects, e.g., skin allergy, endocrine and nervous system disrupting effect of selected chemical UV-filters in cosmetics [4, 5].

In this research, smectite type clay minerals modified with anthocyanins and polyphenol extract, extracted from grape (*Vitis vinifera*), large cranberry (*Oxycoccus macrocarpus*) and black chokeberry (*Aronia melanocarpa* L.) press residues were chosen. The sorption was studied depending on the concentration of sorbate and sorbent, pH of the environment, contact time and temperature. Properties of the obtained composite materials were characterized by thermogravimetric analysis (TGA) methods, Fourier transformation infrared spectroscopy (FTIR), X-ray diffraction (XRD) and scanning electron microscope (SEM). The characterization methods confirmed the successful sorption of polyphenols in the clay mineral structure. The highest sorption capacity was achieved using black chokeberry anthocyanins at pH range from 1 to 4, sorbent mass 0.05 g and 2°C.

The study will expand the exploitation of Latvia's natural resources in the field of new technologies and will contribute to the development of a smart specialization strategy (RIS3), as evidenced by the development of innovative natural resource-based products in bioeconomy.

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THE EFFECT OF SOIL MOISTURE ON SOIL AMMONIA EMISSIONS AFTER APPLICATION OF FERTILIZERS

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Soil moisture is one of the factors that is affecting ammonia (NH_3) volatilization and can be the facilitator for higher NH_3 losses. The impact of NH_3 losses is not only environmental and health risks, but it can lead also to plants underfertilization if it is not considered and it is not cost-effective. There is a different effect of soil moisture prior to fertilization and addition of the water (irrigation and dilution of fertilizer) on pathways of NH_3 volatilization. The aim of this study is to analyze the initial soil moisture impact on NH_3 soil fluxes after the application of fertilizers.

Firstly, different types of fertilizers result in particular reactions after interaction with soil, but all those containing ammonium (NH_4^+) are susceptible to NH_3 loss. For example, hydrolysis chemical reaction with the urease enzyme and water forms an unstable compound ammonium carbonate that can lead to the release of NH_3 gas. Secondly, in dry soil conditions, the humidity of the air can drive the formation of NH_3 losses. Overall, soil moisture is crucial for the transfer of fertilizer compounds into soil and nutrient availability for plants [1].

Research results are not consistent about the effect of soil initial moisture on NH_3 emissions after fertilizer application. Akiyama researched NH_3 emissions after the application of organic fertilizers and urea to the soil under three moisture conditions. Results showed higher NH_3 emissions with lower soil water content than with a higher percentage of water-filled pore space [2]. That contradicts the results of Sigunga who observed the highest NH_3 losses at 80% water – absorption capacity [3]. In the meantime, irrigation with diluted fertilizers (organic and mineral) is considered an NH_3 abatement technique because of its rapid infiltration into the soil [4].

Soil moisture as one of the soil condition parameters affects NH_3 emissions. High initial soil moisture can increase the volatilization of NH_3 , especially after urea-based fertilizer application. The impact of other factors on NH_3 volatilization for certain inhibits investigations of soil moisture explicit effect that can be observed in contradictory conclusions [2;3].

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OPTIMISATION SOLUTIONS FOR INTEGRATED RIVER BASIN MANAGEMENT: CASE STUDY OF LĪGOTNE RIVER IN LATVIA

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The aim of the research is to explore Integrated River Basin Management [1] optimization solutions in the case of the Līgotne River. The wetlands of the river basin encounter moisture throughout the year. This area is managed by an agricultural company which acquires grass for cows from that territory. There are signs that the area is prone to floods due to the fact that the established drainage system does not work properly.

The author examined the documentation of the pilot project developed in 1984 to understand what problems were caused at that time and to draw conclusions what had changed and what could possibly be restored from this project to bring economic benefits from this area to the agricultural sector. The pilot project had been designed to provide analysis for the re-use of sewage water in agriculture. As part of the project, the main objective was to prevent sewage water from entering the Līgotne River and one of the functions of dams was the development of the drainage system that used water resources for the watering process. During the study signs of wetlands on the site was recorded. The evidence still showed that the area was unsuitable for farming.

As a result of the study, it can be concluded that the area adjacent to the river becomes waterlogged and the soil has been turning into a swamp's wet soil. The improvement of the area requires solutions to benefit from the renovation of the area so that it can be used by an agricultural company. One solution would be the restoration of the drainage systems and hydrostructures, but it will be not enough to solve the problem. It is necessary to change the type of land use, for example by growing resources for harvesting wood chips to provide the nearby heating system with the power or offer the area for sale. Another solution would be reshaping the area into natural wetlands which would ensure the deposition of nitrogen and phosphorus and thus prevent them from reaching the Līgotne River.

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THE CONCEPT OF SHARED SPACE STREET (SSS) AS PART OF RESTORATIVE AND SAFE ENVIRONMENT IN CITIES

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Nowadays one of the most popular types of transport vehicles are cars, which offer quite wide opportunities for traveling easier, faster and more comfortable, but together with gains comes losses. Although traffic accident fatalities in Europe have fallen by 2%, the European Commission in their report about 2019 road safety statistics claimed that Vulnerable road-users account for 70% of road deaths in urban areas (European Commission, 2020).

In the past decades, the urban landscape has been changing from a traditionally known street concept, which includes streets' division according to user groups, to the concept of Shared Space Street (SSS) that gives equal rights for movement to all user groups. Because of high traffic increase and street design that is made for motor vehicle access and parking, people have recognized that many traditionally designed streets turn out to be unattractive to live as well as unsafe for children (Collarte, 2012).

The SSS concept has proven to be successful in many European cities, by reclaiming the streets as public spaces for people's use (Collarte, 2012). This leads us to a research question - how Shared Space Street improves the safety of traffic?

The aim of this research was to collect information about the concept of Shared Space Street and analyse successful projects that have used this concept as well as bring up the discussion about shared spaces streets as part of a restorative and safe environment in cities and make a development proposal which is based on SSS principles. To find out the real situation about necessary improvement of traffic safety the following research methods were used: 1. monographic method; 2. graphic analysis; 3. comparative method by analysing of territories by design and functionality criteria.

Based on the research, a development proposal in which the Shared Space Street design guidelines have been introduced in Palejas Street, Jekabpils city, Latvia, was developed. Taking into account the proximity of several educational institutions and the street's location, a special attention was paid to the safety of children and pedestrians in this quarter by reducing the overall speed and intensity of traffic, creating conditions for drivers to pay more attention to other road users.

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HERBICIDAL AND FUNGICIDAL EFFECTS OF SOSNOVSKY HOGWEED ESSENTIAL OILS

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Invasive alien plant species are species that successfully spread outside their natural habitat. They are characterized by the ability to rapidly reproduce and compete with native species. These species are adapted to the new environment and can cause significant ecological and economic damage. The spread of invasive plant species is considered to be the second major threat to biodiversity after habitat loss. It is estimated that the costs of the damage and control measure of invasive alien species in Europe is about 20 billion euros per year [1]. Therefore, most actual are eradication solutions, as well as the application of plant-produced biomass.

Sosnovsky hogweed (*Heracleum Sosnowskyi*) is one of the most dangerous invasive plant species in Latvia, which was introduced from the Caucasus region as a promising forage crop, but due to its abundant sowing, hogweed has spread uncontrollably over a large part of Latvia. The species is dangerous due to its phototoxic effects which cause burns where the skin comes into contact with any part of the plant. Parts of hogweed also contain essential oils, which could be one of the compounds of allelopathic character [3].

In recent years, the development of organic plant products for biological control increases. Essential oils of plants demonstrate herbicidal, fungicidal and microbial activity [2], therefore studies of essential oils are of high importance. In this respect, invasive species with proven allelopathy can have high potential for such applications. Therefore, the aim of the study is to investigate the content of essential oils in Sosnovsky hogweed and their herbicidal and fungicidal properties.

The part of the plant richest with essential oils typically is seeds, and some studies shows the content of oils up to 5.3 %. In our study, hydrodistillation was used for extraction of essential oils, and the yield of essential oils in seeds reached 2.05%. Significantly less essential oil there is in leaves – 0.32%, roots – 0.41 %, and flowers – 0.37 %. Collected oils were used to test fungicidal and herbicidal activity and achieved results that demonstrate their potential.

Acknowledgements

This work was supported by the European Regional Development Fund under project number 1.1.1.2/VIAA/1/16/001, Post-doctoral research project number 1.1.1.2/VIAA/4/20/723

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CIVIL ENGINEERING

CERAMIC TILES, THEIR TYPES AND TECHNICAL DATA

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Ceramic tiles are the oldest, most well-known and most widespread roofing method. It originally appeared in the lands of present-day Germany, but was destroyed by the ancient Romans about 2,000 years ago. Later, the production of tiles was restored and spread throughout Europe and the world. Therefore, ceramic tiles are considered a traditional roof covering that has been tested for a long time and is used successfully to this day. Tiles are made from natural raw materials: clay and water. During the production process they are burned for a long time at a temperature of 1000 degrees. In this way, high resistance of the tile to the environment, harmful substances, and the durability of tile is achieved.

Tiles are divided into three types: natural, engobed (painted) and glazed. The main difference between natural color, glazed and engobed ceramic tiles is the color palette [1]. Natural tiles usually have shades of red provided by the iron oxide contained in the tiles. Engobed and glazed tiles have a slightly wider range of colors - they can vary from natural clay color, brown, gray, and graphite to copper red, anthracite, green, blue or even black.

The main advantages of ceramic tiles are: durability - tile roofs last more than a hundred years; variety of models and colors; naturalness and environmental friendliness of the substance, resistance to low temperatures, no noise during rain. Also roof repair is easy: it does not require dismantling the entire roof, it is enough to replace the damaged tiles with new ones. Such roofing is not subject to corrosion, is non-combustible, the original appearance of the roof is maintained throughout its service life and the colors of the roof do not fade at sunlight. It is a heavy roof covering, it withstands large lawns and hurricanes and is very popular in coastal regions.

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THE MOST FAMOUS FIRST BAROQUE BUILDINGS IN LITHUANIA AND ABROAD

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The Baroque style was formed in Italy (Rome). The Baroque style was characterized by fountains decorated with intricate designs and sculptures in richly decorated squares and castles. Monumental houses with picturesque facades and magnificent castles distinguished by their splendour were built for nobility. The facades of the buildings were divided into three vertical and three horizontal parts. Windows and doors were lavishly decorated, columns were in pairs and decorated niches and walls. The contrast between the light and shadow, curved, mottled elements, curving and twisting elements, profiled, bent, "broken" ledges and horizontal building details were used both in the interior and exterior [1]. The first early Baroque building was the Church of the Heart of Jesus (1584), designed by Giacomo da Vignola and Giacomo della Porta. It was not only an example of early Baroque, which influenced the development of architecture in all of Europe, but also became a prototype for all Baroque churches. One of the most striking examples of mature Baroque, designed by Francesco Borromini, was the Church of St. Charles at the Four Fountains Square in Rome, in another Italian Baroque centre, was built by St. Mary's Church and several palaces by the Grand Canal. Late Baroque forms - light and decorative, as in the Trinita dei Monti church, built by Francesco de Sanctis, had the monumental, winding staircase. The facade of the palace is designed by Nicola Salvi [1].

In Lithuania, the barrel and arched quilt of the structural system remained in the Baroque period. Pillars, vaults and domes were supporting structures. The system of construction of many Baroque sacral buildings was an arched bracket. The principles of planning, structural coherence and symmetrical composition were followed in the buildings. The plans for the buildings were complex, with varying intervals, with particular emphasis on the centre of the composition. Large, mostly symmetrical parks with many fountains were created. Terraces, stairs, cascades concentrated on one axis were very important in the complex [1]. The architect Jonas Frankevičius built Casimir's Church and Jesuit Monastery according to the plan and structure of the first Jesuit Church in Rome. The architecture of the temple corresponds to the image of early baroque churches. The temple is three-aisled, the interior is like a basilica. The Church of the St. Apostles Petras and Povilas is the most famous Baroque monument in Vilnius. The church is baroque in style, it has a Latin plan of the cross, two towers, a dome. During the mature Baroque period, St. George's Cathedral was built in Lithuania. During the late Baroque (Rococo) period the most famous architect J. K. Glaubicas designed Church of St. Johns and the Church of St. Catherine [1]. Thus, to summarize, it can be noted that the Lithuanian and foreign Baroque styles are quite similar, both use vaults, arches, decorated fountains, symmetrical, sculptural and curvilinear elements.

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PROCEDURE FOR DETERMINING THE ENERGY PERFORMANCE OF BUILDINGS IN LITHUANIA

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At present, it is important to reduce energy resources for heating, ventilation and cooling of buildings all over the world. The world is looking for the most efficient means of extracting and using various renewable energy sources. In the European Parliament directive 2010/31 / EU, Lithuania commits itself to reduce overall greenhouse gas emissions by at least 20%. It is estimated that buildings consume about 40 percent of all energy required [2].

In order to reduce the energy needs of buildings, a procedure for calculating the energy performance of a building has been developed and has been in force since 2016.11.11. According to the Technical Building Regulation "Design and Certification of the Energy Performance of Buildings", certification is required for all buildings for sale, new construction, modernization [1]. The regulation currently approves and calculates 9 energy classes for buildings. The lowest is the G class and the highest is the A++ energy class. In Lithuania, the heating season lasts about 6 months, depending on the energy class of the building, the energy demand in KWh / m² can vary as much as 700 times. According to the technical regulation from January 1, 2021, new buildings using heat sources must comply with class A++. Buildings that do not use heat sources are up to 50 m² in size; rest, garden, prayer houses, and cultural heritage buildings do not need to be certified [1].

According to the current regulation, the certification of buildings assesses the thermal conductivity of structural foundations, wall roofs, floors, as well as heat transfer coefficients for transparent product partitions, windows, skylights, external doors and gates [1]. The calculations also assess the usefulness and efficiency of heated, cooled and ventilated equipment. For newly built buildings of classes A, A+, A++, measurements of the tightness of the building must be performed. Leak measurements must also be carried out on Class C, B buildings being renovated with EU funding. The certificate is valid for 10 years [1]. According to the Construction Production Certification Center, as of March 30, 2022, 4866665 buildings are currently certified [3].

Number of certified buildings in Lithuania by energy efficiency classes

Energy Class	Date from when certification started	Date	Energy consumption of the building for heating, KWh / m ² per year	Number of certified houses, pcs.
G	05.01.2009	30.03.2022	701,51-1468,62	328990
F	28.04.2008	30.03.2022	218,19-906,49	33170
E	01.02.2007	30.03.2022	88,7-510	29800
D	31.01.2007	30.03.2022	88-669,33	14930
C	10.01.2007	30.03.2022	25,05-222,88	25890
B	29.01.2007	30.03.2022	21,26-317	39550
A	09.01.2009	30.03.2022	6,52-95,74	4860
A+	23.04.2013	30.03.2022	9,24-76,49	9185
A++	17.02.2020	30.03.2022	0-42,38	290
Altogether:				486665

Thus, it is possible to use the given data to find effective solutions for reducing greenhouse gas emissions.

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POSSIBILITIES OF USING WOOD ASH FOR MAKING CONSTRUCTION MORTAR

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Any classification and standardization for the use of ash is complicated and difficult as each country has its own regulations and conditions on the quality of the fuel, which changes the quality of the ash and its chemical content, which can also change the condition and quality of the final product [1].

The advantage of using ash in hardened cement is that the strength in concrete depends on many factors, the most important of which is the ratio of water in cement. Good quality fly ash usually improves workability or at least provides the same workability with less water. Water reduction improves durability. Because some flying ash contains more or less reactive particles than Portland cement, significant hydration can last for six months or longer, resulting in much higher final strength than ash-free concrete. There have been several cases where the early strength of concrete was low, especially when a significant portion, i.e., 30 percent or more of Portland cement was replaced with light ash. This does not have to be a serious problem nowadays, as the set time is also controlled by many other factors that can be changed if necessary to compensate for the amount of flying ash added [2].

Disadvantages of using ash in cement are following: poor quality ash can adversely affect concrete; when using ash, some of the concrete will harden slowly; freezing and thawing resistance may not be acceptable if ash is used in the concrete. The amount of air absorbed into the concrete controls the freezing-thawing resistance, and the high carbon content of certain fly ash products absorbs some of the airborne agents, reducing the amount of air produced in the concrete, making the concrete vulnerable to frost damage; slow hardening and low early strength must not be a consequence of ash use. Most of the time, high-fineness, low-carbon fly ash produces high early durability. Sometimes you will need extra lime, an accelerator or a superplasticizer. Of course, careful attention must always be paid to the design and water content of the mixture to obtain proper hardening and early strength development [2].

In the course of the research work, the composition of the dry mixture was prepared and the exact amount of the mixture was determined. From a commercial point of view, the mixture must be in a certain volume in the packaging in order to be able to produce on a large scale. At the time of manufacture, the dry mixture is accurately packaged and placed on the market for further consumption. In accordance with the provisions of the Eurocode, the analysis was performed according to the LVS NE 1015-1: 2002 regulations.

According to the laboratory work, it can be concluded that it is not possible to use ash from the company SIA "Gren Latvija", both sifted and unsifted, because they contain a large amount of slag, but when testing sifted ash under loads only positive but low results were observed, however, the company SIA "SAKRET" does not want to use them because it would increase the company's costs, both in terms of the amount of cement and in terms of time, as the company would have to sift itself. The ashes of SIA "Gren Latvija" have been assessed as having the low quality for the development of the final product. It was recommended that SIA "Gren Latvija" sifts their own ashes and then offers them to companies.

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RESEARCH OF TECHNOLOGICAL SOLUTIONS FOR VENTILATED FACADE STRENGTHENING IN MULTI-STOREY BUILDINGS

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The ventilated wall system is the most effective outdoor covering technology to solve the problem of protection against moisture and bad weather while offering heat and sound insulation. The system guarantees excellent performance in terms of temperature and humidity, without the need to interfere with the interior design of the building or change its interior decoration. The reasons for its growing popularity include the significant energy savings it offers, as well as the ability to improve the comfort of life [1].

With the ventilated façade system, you can choose from an infinite number of exterior finishing options - from classic hardwood cladding panels to luxurious broken stone, zinc, copper or exquisite glazed ceramic tiles. Whatever facade finishing material is chosen, the initial investment in a ventilated facade will be higher. But in a couple of years, the investment pays off and an owner has considerable benefits [2].

Before starting any facade work, it is very important to evaluate a number of criteria for the building to be designed in order to be able to predict future works. The surface of the project must be assessed and certain criteria must be met: 1) Assessment of surface adhesion and surface plane is necessary as more careful surface preparation is required in case of inadequate adhesion or uneven surface. 2) Presence of microorganisms on the facade. 3) Evaluation of the plane along the vertical and horizontal axis. (Wall level corrections are only made if the plane deviations are $> 15-20$ mm from the axes. This correction is made by applying the necessary layers of plaster. But these works are only performed if it is not planned to deviate from the axis deviations) [3].

During the renovation, the facade is usually insulated. Facade insulation is best done from the outside, and the ventilated facade also has its advantages in this case, as the thermal insulation easily fits between the frame profiles and is protected by a decorative "screen". ISOVER offers 2 types of insulation systems for ventilated facades – a single-layer system and a multi-layer system [4]. The second way to insulate a ventilated facade is with PAROC insulation solutions. The PAROC Cortex thermal insulation product group consists of two types of boards. PAROC Cortex is a thermal insulation wind protection board and PAROC Cortex One is a single layer thermal insulation for ventilated facades. These plates are special in that they are covered with a special non-combustible white coating which has low air permeability and good water vapour permeability. The PAROC Corte product is also suitable for the thermal insulation and wind protection of very intensively ventilated facades [5]. The best variant should be selected based on the regulatory requirements for buildings.

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WOOD PROPERTIES AND PRODUCTS

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From the ancient time people use wood in different areas. Houses, boats, bridges, stairs were built. Most of the life relied on wood because it was easy to work with, because of its excellent characteristics. Each type of wood has a unique natural structure and appearance that often occur over time.

Wood has many positive properties. One of them is its density. Denser wood is more valuable because it is strong and well processed [1]. Maple, beech and hornbeam belong to the species of dense wood. Another good property of wood is its flexibility. The flexibility of coniferous wood is low. Beech wood bends well enough. Wood, especially dry wood, is almost impervious to heat. It insulates heat well, it is used for indoor design and in the production of floor coverings due to this characteristics. Wood also has acoustic characteristics, the sound in it spreads faster than in the air. Due to the speed and resonance of the sound spread, wood is widely used in the manufacturing of musical instruments. Pine and spruce wood shrinks little when dried. However, wood has negative characteristics. One of them is non-resistance to rot. Larch and oak are the most resistant to rot, while birch and aspen are the most rotting wood. Another negative characteristics is that the wood is not fire resistant. The fire spreads quickly. Also when the wood dries, it distorts and cracks, especially birch wood.

Conifers, such as pine and spruce, are used in the same way in production, although their characteristics are slightly different. Pine and spruce wood is light and soft. However, spruce stem is more branched, making spruce more difficult to process than pine. These conifers are used for flooring, roof constructions, joinery, plywood, auxiliary constructions, siding. Larch is also coniferous, but it is heavier, harder and stronger than pine. Due to these properties, larch is used in the manufacturing of road and bridge structures, underground and underwater facilities [2]. Deciduous wood, unlike conifers, is hard and heavy. Windows, doors, parquet, trim panels, furniture, as well as heavy-duty products are made from oak and ash wood. Birch wood is not rot-resistant, so only furniture and plywood are made from it. Aspen is used for temporary wooden constructions, particle boards, matches, etc. [2].

Each wood is unique, which has specific characteristics, natural structure and appearance. It has been used since old times because it is easy to process and has characteristics that are required for certain products. On the other hand, it has negative characteristics, for example, it is not resistant to rot and fire. Due to the sustainability and longevity of wood, it is used in the construction of houses, bridges, interior decoration.

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FIRE CASES IN LITHUANIA FROM 2017 TO 2022 AND THEIR CAUSES

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Fires are caused by people resulting in the loss of lives and properties in addition to the damage done to the nature. People should be extremely cautious in the woods during warm seasons, because one small mistake next to trees can cause fires in vast areas, which are so hard to stop. In cold seasons mostly properties suffer from fires because people stop being alert, they smoke in their houses or are careless with cords in the electrical installations. Due to these reasons firemen have to extinguish fires in cold seasons.

9986 fires have been recorded in Lithuania from 2017 to March 18th, 2022. An average of 90 deaths of people occur in fires annually. Most fires occurred in 2018, but, unfortunately, 103 people died from fires per one year in 2017. This is the biggest number of deaths in this time period since 2017. On the other hand, in 2021 there was the smallest number of fires recorded in our country [1].

Almost two thirds of fires are caused by careless actions, about 10% of all fires are caused by untidy electrical installations. Other reasons for home fires are the following: untidy furnaces or ovens, children's playing with the fire, intentional fires and technical issues. A burning candle is an open fire, and it means that a candle can easily become a cause of fire which destroys everything in its way. It is necessary to be very careful when burning a candle to avoid any danger that may occur. 10% of all fires in Lithuania are caused by faulty electrical devices and inappropriate use of them. The most often encountered causes of fire are the following: water near the electrical cords, damage of the power supply wires, damaged, uninsulated wires and untidy electrical fuses. If the temperature is high and electrical fuses are tidy, they automatically turn off the power before the wires or devices catch fire. Untidy electrical fuses might become the cause of fire [2]. Other common causes of fire include careless smoking and violations of the requirements for the installation and operation of stoves, fireplaces and chimneys.

It is very important to use helpful advice in the event of the fire and follow rules that help to save lives in such cases, since improper decisions in such situations can cost so much. Fires in schools often claim many lives. It is common during panic in life-threatening situations caused by the fire to hide in enclosed spaces or rooms (especially for young children). Also, it happens that people who have fallen or stumbled while fleeing get trampled. It is not uncommon for fire safety equipment to fail or not even be installed because it is costly. Although various technologies and security measures have been evolving over time, fires still occur in schools with tragic consequences [3]. Therefore, in the event of the fire, the first thing to do is not to panic, but to think soberly and promptly about what is best to do in the situation, to protect yourself and other people from the fire so that they suffer as little as possible.

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INNOVATIVE IDEAS IN CONSTRUCTION: SELF-HEALING CONCRETE

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Concrete is a material used mainly in construction as a building material that is widely used in various construction projects with no competitive alternative. Another innovation is "self-healing" concrete. What principle does it work on? The special bacteria are locked in the concrete and when the crack appears after the wear and air enters it, these bacteria "wake up".

Self-healing concrete is currently one of the biggest hopes for the future in the construction industry, it can be made to serve for several decades. However, over time, cracks appear in the concrete structures into which water penetrates, resulting in corrosion of the structure and the need to restore its properties. Microbiologists, studying the application of limestone-producing bacteria, have figured out how to repair concrete cracks by healing micro-cracks: limestone-producing bacteria are mixed with concrete and evenly distributed in the structure. Limestone, produced by bacteria in contact with water and heat, joins the crevice by joining its edges and the crack heals [1]. The generated cracks result in a significant reduction in the concrete lifespan and an increase in maintenance and repair costs. In recent years, the implementation of bacteria-based healing agent in the concrete matrix has emerged as one of the most promising approaches to address the concrete cracking issue. However, the bacterial cells need to be protected from the high pH content of concrete as well as the exerted shear forces during preparation and hardening stages. To address these issues, we propose the magnetic immobilization of bacteria with iron oxide nanoparticles (IONs). In the present study, the effect of the designed bio-agent on mechanical properties of concrete (compressive strength and drying shrinkage) is investigated. The results indicate that the addition of immobilized *Bacillus* species with IONs in concrete matrix contributes to increasing the compressive strength [2]. Conditions for cracking suggests that cracks must be exposed to a humid environment (for example, water). What cracks can be fixed? Ordinary concrete - up to 0.05 mm crack width. Crystal accessories - up to 0.4 mm slit width. Bacterial accessories - up to 1mm slit width [3].

Concrete is arguably one of the most important and widely used materials in the world, responsible for the majority of the industrial revolution due to its unique properties. This method is known as the biomineralization technique. Although curing concrete is not yet on the market, and this method is being further investigated.

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ALTERNATIVE METHODS TO DETERMINE ROOM REVERBERATION TIME

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Reverberation time (T) is an essential characteristics of room acoustics, it is also necessary for the calculation of other acoustic parameters. The interrupted noise method and the integrated impulse response method can be used to determine T. However, several methods can be used to obtain a noise or an impulse. There may be limitations, including ethical ones, on the use of specific methods in certain rooms, for instance in churches. The aim of the research is to find convenient T measurement methods that can be applied in sacred buildings. Some studies compare well-known methods and offer new or less known alternatives. An omnidirectional source (OS) is used in many acoustic measurements set by the ISO etc., and the most common OS is a dodecahedron speaker (DS); parameters of fifteen acoustic sources alternatives found in the literature were compared to DS characteristics, and omnidirectionality, repeatability, sufficient sound pressure levels, precision in acoustic parameter measurement, as well as compliance with ISO 3382-1 sound source requirements were all prioritized [1].

Alternative sound sources might sometimes supply usable results when it comes to acoustic parameter measurements, but most of them do not comply with ISO 3382-1. The vast bulk of the researched sound sources is impulsive type. The balloon method which was considered for convenient measurements in sacred buildings, according to a study by Papadakis and Stavroulakis [1] cannot be regarded as OS and has a low sound level at low frequencies.

Szłapa et al. [2] studied T in various size rooms using three different sound sources: handgun shots, balloon bursts, and compressor hiss. They discovered that as room volume increases, the difference in T measured with gunshots and balloon bursting disappears. This study also shows that one-value T were shown to be both consistent and reliable when calculated as averages of the data for several frequency bands; even though the results obtained with compressor hiss do not differ considerably from those obtained with handgun shots and balloon bursts.

In practice, handgun shots are frequently used to perform measurements; therefore, balloon bursts in a sufficiently large room could be regarded as an acceptable substitute.

Pätynen et al. [3] evaluated the balloon bursts in reference to the ISO standard of electrodynamic acoustical sources for acoustic measurements. They also concluded, that while looking for sources that are as omnidirectional as possible, ISO 3382-1 only imposes particular directivity requirements on loudspeaker sources, allowing impulsive sources some leeway. Although this research also indicates that the directivity for lower frequency bands does not adhere to ISO 3382-1, the larger the balloon, the better the performance at low frequencies [3]. Studies show that with balloon burst there are uncertainties in T at low frequencies, which have also been experienced in practical measurements, for instance with a wooden clapper; Szłapa et al. [2] also indicate that these are offset by relatively low uncertainties at higher frequencies. The balloon that was considered for use in sacred building measurements can be used to assess T when access to the object is restricted or electricity is unavailable. However, a dodecahedron speaker is likely to be required for accurate and standardized data.

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CONCRETE (TYPES AND PROPERTIES)

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Concrete is an artificial material (artificial stone) obtained by mixing coarse and fine aggregates with binders, with or without the addition of admixtures and additives, by the formation of hydrated cement or by the hardening of the binder.

Concrete with both hydraulic and aerial binders is also often used in construction. In addition to mineral fillers, various organic fillers are used. Concrete is the most widely used building material. Various types of concrete are currently used in construction. The widespread use of concrete was determined by the relatively low cost of local aggregates. Their volume forms up to 80% of the total concrete volume. Also, products and constructions are provided with various shapes, a variety of properties, mechanized, automated production, laying, and compaction technology [1].

According to the type of aggregates, concretes come with dense aggregates (natural sand, gravel, crushed stone) with a natural density of dried particles $\rho > 2000 < 3000 \text{ kg / m}^3$; with porous aggregates (expanded clay, polystyrene foam, sawdust, etc.) with a natural density of dried particles $\rho \leq 2000 \text{ kg / m}^3$ or a bulk density of dry grains $\rho \leq 1200 \text{ kg / m}^3$; with special fillers (chamotte, ore-bearing rocks). Normal concrete is made of coarse and fine aggregates, cement and water. Each component in the mixture performs its functional purpose. Coarse aggregates form a "skeleton" of concrete, small aggregate voids between coarse aggregate particles, cement with water form hydration products that bind all aggregates into one system - a conglomerate. Concrete is a material consisting of a binder stone, aggregates of different types, sizes and shapes, admixtures in aggregates, numerous micro- and macro-pores and capillaries in the aggregate, aggregates and contact points [2].

All of these elements describe the structure of the concrete. Thus, the mesostructure, macrostructure, and megastructure of concrete can be examined. The following types of concrete are distinguished according to the structure: dense, fine-grained, coarse-grained (small-sand or non-sand), porous, impregnated. Dense concrete: lower price, more resistant to high temperature conditions, with higher concrete density. Fine-grained concrete: resistant to moisture and cold. It is characterized by plasticity, good adhesion to the surface, and is made of natural materials. Coarse-grained concrete: no or little fine aggregates. Aerated concrete: lightness, as well as strength, which makes it possible to combine both insulation and structural properties in one material. Prolonged exposure to high temperature weakens the material. Impregnated concrete: it provides high protection against the aggressive effects of water absorption, has good compressive strength. Each type of concrete has its advantages, and the appropriate type of concrete must be used for its intended purpose.

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TYPES AND COMPOSITION OF CEMENT

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With the construction industry expanding rapidly, due to the growing level of urbanization, there is a growing demand for building materials as well. One of the most widely used is cement.

It is a powdered mineral material, which when mixed with water, automatically binds and hardens, also can bind small and large aggregates into artificial stone [3].

Due to its great diversity, conventional cement is grouped into five types:

CEM I – Portland cement, CEM II – composite Portland cement, CEM III – slag cement, CEM IV – pozzolanic cement, CEM V – mixed cement. Portland cement is a material obtained by finely grinding Portland cement clinker with a gypsum additive. Composite Portland cement is obtained by grinding Portland cement clinker with one additive or mixture of additives. By grinding a mixture of blast furnace slag, Portland cement clinker and gypsum it is possible to obtain slag cement. This cement is slightly weaker than Portland cement. Pozzolanic cement is obtained by grinding Portland cement clinker with hydraulic additives. Mixed cement is obtained by grinding Portland cement clinker, blast furnace slag and adding hydraulic additives [1].

The main chemical elements that makes up cement is: calcium, aluminium, silicon, iron and oxygen (Ca, Al, Si, Fe, O₂). The reaction of these metals with oxygen produces oxides of the following metals: (CaO, Al₂O₃, Fe₂O₃, SiO₂) from which cement is produced. The oxides of cement are distributed in proportion to: CaO – 60-67%, SiO₂ – 17-25%, Al₂O₃ – 3-8%, Fe₂O₃ – 0,5-6% [1].

Of all the materials, most produced is cement, which is used to make concrete. It is second most consumed material after water in the whole world. Rapidly evolving cement technology will allow cement to be used even more widely. For example - light absorbing cement [2].

To sum up, new building materials are being developed and existing ones are being further improved, for example, cement, which, thanks to technology, can even shine.

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INNOVATION IN THE CONSTRUCTION BUSINESS

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Every day, new approaches, innovative technologies and advanced processes appear on the market [1]. Businesses, consumers, industry groups, and governments understand the importance of innovation for continued economic success and improvements in quality of life [1]. The growth of the construction sector opens the eyes of investors, engineers and construction companies and gives them the courage to look at new tools and tendencies. With the right technology, construction developers and contractors can control time and budget resources better avoiding supply disruption.

It is necessary to be aware of emerging new technologies and construction trends that allow businesses to invest in innovation. The first factor is sustainability which means caring for the environment is becoming more popular and companies that do not want to leave the market can no longer be left out. It is said that sustainable construction is based on six principles: conserving, reusing, recycling or renovating, protecting nature, creating non-toxic and high quality. Sustainable construction is a practice of creating a healthy environment based on ecological principles. The aim is to reduce environmental impact through sustainable development practices, energy efficiency and green technologies. The next factor refers to unmanned aerial vehicles: so-called drones, flying over construction sites since 2018. Their use in construction project provides an unparalleled advantage, reduces planning and research costs, increases the efficiency and accuracy of work, helps resolve disputes over the object. Drones are mainly used in the construction industry for inspection and testing purposes and can be used for more efficient measurements and analysis. The third factor is BIM: A tool that allows designers, engineers, manufacturers and other participants in the construction market to work together. It simplifies design, allows the cost-effectiveness of the solution to be calculated and avoids potential design errors, reduces time spent designing and building buildings. BIM acts as a system that ensures the integrity of all information created. The forth factor is renewable energy: systems that produce energy on the construction site during the project receive a lot of attention - the production of energy required for construction reduces the project costs. The use of renewable energy is focused not only on sustainability but also on the economy. A building that uses solar, wind, hydro or other renewable energy, producing a large part of its energy consumption, is attractive to the customer. The fifth factor is a three-dimensional (3D) printer: Whether you print beams in 3D or finished buildings, this is a way to facilitate the development of construction projects and use more sustainable materials. A 3D printer is a limited type of industrial robot that is able to perform certain functions when instructed by a computer. 3D printing is the process of making a three-dimensional solid object of virtually any shape from a digital model. Products produced in this way can be used in a variety of production cycles: both in the large-scale pre-production stage and in machining or post-production. To sum up, the above mentioned trends and new tools all contribute to the innovation approach in the construction industry.

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CONSTRUCTION CONTROL PROCESS, ITS EFFICIENCY

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Successful management of the company is not possible without economic control ensuring the competence of a manager [1]. A management audit is an assessment of how well an organization's management team is using its strategies and resources [2].

During construction process, control plays an important role from the idea to the result, so the contractor and employees must monitor the progress of the project and control all its processes to achieve the desired result. Successful business in any industry, including the construction industry, is not possible without economic control. Therefore, control is one of the most important means of improving financial performance, preventing deficiencies and losses, as well as complying with the law requirements, preserving fixed assets, the proper use of funds, and the achievement of key objectives and tasks [1].

An audit is an examination performed by the auditor to gather and evaluate information about a company's financial position and provide its opinion and recommendations. An audit is an examination of the correctness and legality of operations and transactions. The State Revenue Service controls the performance of such inspections or audits in Latvia. In the course of an audit, the accounting of the financial position, records of economic results, financial statements, accounts, and other items are examined. As a result, the audited annual report looks more reliable for potential investors, banks and business partners [3].

A management audit is an assessment of the capabilities of an organization's management team. The aim of the analysis is to assess how well this group can achieve the company's goals. An audit may cover strategic and tactical planning, decision making, financial and operational performance, and risk management. This type of audit is usually performed by an independent third party. Management audits are usually performed by an external consulting firm that specializes in this activity. This is not done by external auditors contracted to examine the company's financial statements [4]. Construction control management solutions improve forecasting, centralize information, increase efficiency and keep costs low [5].

To sum up, control is essentially the tracking and management of the key elements of project management - volume, quality, time, and cost. Construction control shall include the processes, experience, human skills, and tools used to plan, control, monitor, and mitigate any risk or event that may affect the cost and schedule of the project.

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SOCIAL SCIENCES

HIGH-PERFORMANCE WORK SYSTEMS IN THE HOSPITALITY INDUSTRY

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Hospitality is one of the most labour-intensive industries, and employees have a high personal interaction with each customer, which also means that organizations have to pay increasing attention to employee satisfaction to ensure high performance, as it directly affects the competitiveness of the business.

High-performance work systems (HPWS) view employees as a resource in the organization and claim that human resources of a particular organization can be a source of sustainable competitive advantage, which is achieved by creating a workforce that is perceived as “valuable”, “rare”, “inimitable” and “non-substitutable” [1]. Because the workforce plays a critical role in providing service in the hospitality industry, it is HPWS that ensures that there is a sustainable competitive advantage created. There is no census on what are the exact ways how HPWS should be used in hospitality, but they can fall into one of the eight categories: establishing an attractive compensation plan, job design, training and development, recruitment, and selection to ensure the right people are employed for the positions, turnover and retention management, to understand the reasons behind employee turnover, performance appraisal and regular feedback, employee relations, including grievance procedures and promotions in order to reward a good performance [2].

Creating a combination of factors that lead to HPWS can provide many benefits to the hospitality industry. In general, it has a positive effect on employee outcomes as well as organizational performance [1]. Studies report a positive impact of HPWS on employee productivity, work engagement, turnover intentions, and performance, which all lead to increased organizational performance [2]. Another study explored the positive impact of HPWS on organizational commitment, employee motivation, and job satisfaction [3]. However, another study argues that superior outcomes using HPWS can only be achieved with a help of leadership in the organization, which has to serve the people [4], therefore summarizing that the effects of HPWS are not always directly projected on the performance of people and organizations.

To conclude, the recent research provides increasing evidence that a superior organizational and employee outcome in hospitality organizations can be achieved by using high-performance work systems, which is a sustainable view of the workforce in any organization.

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AGRICULTURAL SUPPLY CHAIN MANAGEMENT IN RECENT TIMES: A METHODOLOGICAL ASSESSMENT

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Out of the many activities with an economic value around the world, agriculture is inevitably one of the most crucial with numerous benefits which cannot be overemphasized. Employment opportunities, source of national revenue, source of food supply to the teeming population are among the many uses of agriculture to any society. Hence, the need to evaluate the productiveness of this indispensable field, particularly its supply chain is more important now than ever, also by considering the ongoing economic condition of the world. Finding the most viable method of analysing the agricultural supply chain is of utmost importance as the improvement of the entire sector of agriculture largely depends on it.

Babatunde (2019), made use of some data (primary and secondary) as well as other sources including literature to seek reasons for the unprofitability and unmarketability of agricultural produce in Nigeria. The primary data was obtained by interviewing major actors of Nigeria's agricultural value chain such as agricultural value chain (AVC) practitioners, farmers, and stakeholders. Descriptive statistics such as chi-square was used to conclude on the fact that there is interdependence between supply chain and agricultural value chain as the latter is often influenced by the former. Recommendations such as government support to farmers and the improvement of information technology used by stakeholders, etc. were initiated.

Naseer et al. (2019), simultaneously used Kendell's coefficient of concordance, the mean ranking technique, and factor analysis to analyse the supply chain constraints of Pakistan's citrus industry. This approach is able to bring the identification, grouping, and alignment of supply chain constraints together with important marketing factors which in turn yields some findings which have policy implications.

Sharma et al. (2020), used Fuzzy Linguistic Quantifier Order Weighted Aggregation (FLQ-OWA) to assess the unparalleled risks and threats to the agricultural supply chain caused by one of the world's greatest disruptions of all time, COVID-19. This technique is capable of identifying the different types of risks that affect the agricultural supply chain. Corresponding theoretical and managerial implications are usually preferred after analyses.

The main goal of an agricultural supply chain manager is to reduce economic losses and improve supply chain performance by selecting and implementing the most effective set of methodologies capable of evaluating various agricultural supply chain situations.

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SOCIAL MEDIA MARKETING TOOLS IN TOURISM PROMOTION IN JAMMU AND KASHMIR, INDIA

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Due to widespread globalization and overseas competition, it has become increasingly challenging for tourism businesses to seek, maintain, and gain a competitive advantage in the market. Although tourism industry and several destinations experienced some instabilities, the lack of tourism activity created by the Covid-19 pandemic in tourist attractions caused inexperienced challenges. This study is aimed to examine the impact of social media marketing tools on promoting tourism in Jammu and Kashmir, India.

Consumer perceptions, attitudes, and behaviours toward brand appraisal have altered as a result of internet usage. Due to increased technological engagement, traditional marketing tactics have become outmoded and unsustainable [1]. As internet technology entered the arena, marketing dimensions changed dramatically. As a result, businesses are focusing more on adopting social media marketing tools and innovating marketing methods in order to improve their effectiveness. Digital marketing [2] is an online marketing strategy that targets clients using the internet, mobile devices, and social media marketing. The increased use of smartphones is necessary for the expansion of digital marketing. Digital marketing made use of a variety of electronic platforms to promote a company's products and services. It also gives a better understanding of clients and analyses their behaviour [3].

The current research is quantitative, and it was conducted using a cross-sectional method. The data were collected during a three-month timeframe. A simple random sampling strategy was utilized to implement the probability sampling method. Two hundred respondents were involved in the research through different social media platforms - Instagram, Facebook, LinkedIn.

As a result, social media marketing is a more effective instrument for communication and allows tourism firms to retain long-term relationships with customers. Social media is crucial in maintaining relationships with loyal clients. It is not just a means of communication, but it also facilitates direct transactions.

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QUALITY OF LIFE AMONG INTERNATIONAL STUDENTS OF LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES DURING THE COVID-19 PANDEMIC

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In 2020, Latvia as other countries faced the Covid-19 pandemic with quarantine and lockdown measures implemented by international and government health organizations to prevent the rapid spreading of the Coronavirus (Covid-19) [1]. This affected all spheres of life, also QOL - a broad multidimensional concept that usually includes subjective evaluation of both positive and negative aspects of life [2]. The aim of this research is to analyse the perception of quality of life by international students of Latvia University of Life Sciences and Technologies during the Covid-19 pandemic. To collect empirical data, a qualitative semi-structured interview with nine full-time international students was conducted (March-April, 2021). The questions were about the core eight domains of QOL: material well-being, physical well-being, interpersonal relations, emotional well-being, personal development, self-determination, social inclusion and rights [3].

The analysis of empirical data showed that the students faced challenges and unexpected changes in their life due to the Covid-19 pandemic. The pandemic caused negative changes to such core domains of QOL as physical well-being, emotional well-being, personal development and social inclusion. The data show that limited physical activities due to restrictions caused a negative physical well-being. Similarly, lack of on-site education caused depression, low motivation and productivity; and difficulty to find a quality internship opportunities during the pandemic caused negative emotional well-being and personal development. Social inclusion was assessed negatively due to the reasons such as being treated differently in the society due to skin color, being unable to make local friends, and few situations of racial discrimination. On the other hand, domains such as material well-being, interpersonal relations, self-determination and rights were not affected by pandemic negatively. The students remained financially stable and happy with the living condition at the dormitory, being able to communicate well with their families and friends, make their own choices and decisions, and they received support whenever needed from the university and government organizations in Latvia.

The main conclusion of the research is that the overall QOL of international students was influenced by the pandemic as it caused negative effects to some domains of QOL.

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SUSTAINABLE SUPPLY CHAIN MANAGEMENT TO INCREASE THE PRODUCTION EFFICIENCY IN SRI LANKA'S TEA INDUSTRY

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Nowadays sustainable supply chain management is critical to any company's supply chain. The amount of social, environmental, and economic effect and validity that consumers and producers have may be determined using a sustainable supply chain. In many developing nations, an agriculture-based supply network improves societal well-being and decreases shortages [1]. Tea is a significant agricultural commodity. Sri Lanka is one of the world's earliest tea-producing countries. Sri Lanka's tea industry has played a significant role since 1867, it has contributed to the national employment production and the forging of exchange. Sri Lanka's tea business generates around 15% of direct job opportunities and contributes around 4% of the country's GDP as the second-largest exporting product. The economy of Sri Lanka depends on the long-term viability of the tea supply [2]. The aim of the research is to research sustainable supply chain management in Sri Lanka's tea industry to increase production efficiency.

All operations connected with the movement and transformation of commodities from the raw material stage to the end-user fall under the term of supply chain management. Supply chain management includes logistics [3]. A sustainable logistics system combines sustainable development and a logistics system to improve long-term achievement. Using a sustainable supply chain can help to reduce environmental impact. It can also minimize the amount of time that consumers are ignored because customers are seeking more sustainable goods and services from businesses.

Data were collected from the managerial and executive-level employees working in tea factories using a structured questionnaire where items were measured using a five-point Likert scale. For the analysis, SPSS used to measure the production efficiency and other independent variables. The significant influence of sustainable supply chain management on production efficiency in Sri Lanka's tea business was investigated and proved in this study. To conclude, Sri Lanka's tea supply chain efficiency largely depends on implementing sustainability measures.

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THE IMPORTANCE OF TECHNOLOGY AND KNOWLEDGE TRANSFER IN SUSTAINABLE DEVELOPMENT OF UNIVERSITIES

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Technology and knowledge transfer processes are different in all sectors and areas of economics, and transfer takes place in each of them slightly differently but with the common goal of effectively managing and introducing new knowledge or technology.

Knowledge and technology transfer between university and industry is seen as an important driver of innovation and economic growth as it facilitates the commercialization of new scientific competencies in companies [1]. Higher education is a source and provider of knowledge that addresses and promotes various sustainability processes.

Sustainable Development Strategy of Latvia until 2030 states that knowledge, universities and research play an increasingly important role in today's economics [2]. Many research universities around the world have begun to build their own technology transfer institutions that act as a “facilitator” between innovators (university researchers, students and academics) and stakeholders [3]. In order for higher education to be able to transfer technology and knowledge to society as successfully as possible, support from the public and business sectors is needed to foster innovation growth and opportunities.

National research programmes were launched in 2018, with a total funding of 19.1 million EUR, promoting the creation and transfer of knowledge and technologies [4]. In 2020, Latvia granted a total of 7.9 million to 30 research teams to commercialize scientific developments to promote the creation of high value added products and services [5]. While the Latvian government and financial institutions are increasingly starting to grant funding and support opportunities for both small and medium-sized enterprises and young scientists and innovators, Latvia still has a small level of investment in research and development, a weak commercialization performance of research results and a low level of patent creation.

Knowledge and technology development constitutes world cycles of variability. Thanks to the role of education and sustainability solutions, educated and knowledgeable people are entering society, creating future developments, creating innovation and digital change, and transferring new knowledge to the general public.

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URBAN AGRICULTURE – 21ST CENTURY LINKAGE BETWEEN HUMANS AND NATURE

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Urban agriculture is gaining an increasing topicality in different aspects – more and more urban dwellers see it not only as an option for growing fresh food, but also as a specific linkage between city-type lifestyle and nature. The renaissance of urban agriculture is characterized by science and research activities, technological development and wider adaption approaches to territory, changing values of the society and the inclusion of this practise in the principles of sustainable development [1]. The aim of the research is to identify urban agriculture's role in renewing a connection between urban dwellers and nature.

The world population grows rapidly, the demand for life quality and resources is rising, urbanization and globalization are developing even faster – all those factors emphasize the importance of sustainable development. Sustainability is one of the main principles determined by the United Nations, the European Union and national strategies and action plans. Although urban agriculture has a rather low relation to the development strategies for national and global sustainability, in 21st century there are similar trends for both – not only strategies and plans are adopted in legislation aspects, but also focus and interest in urban agriculture in science and research are increasing [1]. The UN has developed sustainable development goals [2], the EU has specified the Green Deal, principles of the circular economy, strategy Farm to Fork and other documents that are changing paradigms in perception of resources, and human and nature interaction [3].

Urban agriculture has functionality in different aspects than the sustainable development, especially in the comparison with peri-urban and rural agriculture. In social dimension the biggest impact of urban agriculture is in the context of the social cohesion, promotion of food education, public involvement and social participation, permanent emancipation of the urban environment, diverse motivational aspects. In economic dimension: provision of short food chains and realization of principles of circular economy. In environment dimension: improvement of environmental quality, diversification of the landscape, implementation of innovative solutions in environmental management [4].

Urbanization is a developing trend in the society of 21st century, and although it gives a lot of opportunities, it creates also risks, and most of them are related to dismantled balance between consumption and supply of resources, especially between urban and rural areas. Urban agriculture is a practice that can renew a linkage between human and nature in social, environmental and economic aspects all together.

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EMPLOYEE CREATIVITY IN TOURISM AND HOSPITALITY INDUSTRY IN THE 21ST CENTURY

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The tourism and hospitality industry has become very diverse in recent decades, and tourists demand unique service and unforgettable experiences, rather than standardized tourism and hospitality offerings. This requires tourism employees to become creative and “think outside of the box”, rather than perform routine tasks [1]. Creative employees ensure customer engagement and contribute towards the competitiveness and performance of the business.

Despite the fact that creativity is considered a critical success factor for the tourism and hospitality business, there is no census on what drives creativity and makes creative employees. Currently, there are two main perspectives on employee creativity- a componential model of individual creativity and an interactional model of organizational creativity [2], showing that creativity can be seen from an individual or organizational perspective. According to [1], employee creativity is driven by three groups of factors: first, ability-oriented antecedents, which refers to employee behaviors, self-efficacy, and social support in organizations; second, motivation-oriented antecedents, which describes factors in work that can promote employee willingness to be creative, namely leadership, satisfaction, empowerment, engagement, motivation amongst others; thirdly, opportunity-oriented antecedents, which can contribute towards positive organizational climate that promotes creativity, for example, high-performance human resource practices, tenure, transformational leadership, and leader-member exchange. Results of the study show that specifically in the tourism and hospitality industry, creativity is driven mainly by skill promotion, resource supply, opportunities and autonomy given to employees, and a positive organizational climate that fosters creativity [1]. Another study confirms the findings and concludes that employee creativity in hospitality is driven mainly by leadership, with organizational climate and culture also having a strong positive contribution towards creative employees [3]. Finally, another study confirmed that high-performance work practices and leader-member exchange and empowerment have a statistically strong effect on employee creativity in hospitality [4].

In conclusion, employee creativity in tourism and hospitality is considered a critical success factor that contributes towards better performance and competitiveness. Nevertheless, there is no single factor that will ensure that organization has creative employees, instead, it is complexity and variety of personal, organizational, environmental, and leadership factors.

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GUEST HOUSE INNOVATIONS

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A number of theoreticians claim that starting an entrepreneurial activity in the countryside is recommended for everyone due to the fact that it enables the development of the rural community by employing the population and socially integrating people [1]. In order to start a meaningful entrepreneurship, a dynamic and sustainable business plan must be developed. The business plan depends on the type of entrepreneurship and also differ by time periods. Developing a business plan secures a more stable flow of financing while reducing the possibility of risks. The business plan evaluates the entrepreneurial idea presented by the businessman, taking into account all the nuances. However, when starting a business, entrepreneurs may face some risks, therefore it is important to find innovative solutions in order not to lose the consumers of their product or service [2]. A business plan consists of an analysis of: a business idea's summary, the company and its management, financial forecast, market competition, products or services and personnel. Theoreticians claim that diverse methodology must be implemented when designing a business plan [3]. The problem of the research: The foundation and development of a guest house in the Dobeles district during the pandemic of Covid-19. The subject of the research is connected to the analysis of viability and realization possibilities of the designed guest house "Melitas Miera Osta". The company will offer 2 camping houses and a guest house with an innovative-digitalized solution: QR codes through which the guests can receive the services of the guest house without the need of actual guest house personnel. The guests operate through an electronic application which allows them to book a necessary date of visit and choose desired services. After making a reservation, a guest arrives at the location and receives SMS with a code. They enter the code at the gate and scan the other QR code upon the time of leaving the premises. After scanning the QR code, monetary funds are withheld for the service provided. These kind of innovative guest houses is an unprecedented idea in Latvian tourism industry. During the last 2 years Latvia has been affected by the Covid-19 pandemic, therefore, in order to implement the desired business idea, innovative solutions must be considered. These solutions may help to secure a safe position in the market of the particular industry.

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SOCIOECONOMIC INDICATORS AND INVESTMENTS IN THE EASTERN BORDER MUNICIPALITIES OF LATVIA

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The sustainability of the country is not possible without balanced development of its regions within it. One of the major elements of the sustainable development is economic growth which is boosted by the volume of investments in the given territory. The aim of this research is to identify the major socioeconomic factors defining the economic growth potential of the Latvia's East border municipalities (EBM) – Balvu, Ludzas un Kārslava districts and compare them with the neighboring North-East border municipalities (NEBM) – Alūksne, Smiltene, Valka districts and four Valmiera district administrative units. The research is based on the sources with secondary statistical data mainly from 2014 to 2021.

Theoretical basis of the research is built on the view of economists like Gunnar Myrdal, John Maynard Keynes, Nicholas Kaldor and Albert Otto Hirschman who emphasized the importance of investments and population in economic development of territories. For years the main economic development indicators of EBM have significantly lagged behind the other regions of the country. Since 2014 population of EBM region has decreased by 15%, NEBM by 11% but in Latvia by 5%. Another lingering factor for economic development is low population density in EBM – 8 people per km², NEBM – 9 people per km², Latvia – 31 people per km² [1].

In 2021 June the unemployment rate in EBM was 15%, NEBM areas 6% and Latvia 6% [2]. The private sector in EBM is dominated by enterprises with small number of employees, 97% of all companies have less than 10 employees [3]. The private sector can't provide large number of jobs for local community. The share of the public sector in the field of employment in the period from 2014 to 2020 have increased by 3,3% in EBM but only by 1,6% in Latvia [4]. One of the most important indicators of socioeconomic development is Territory Development Index (TDI) of Latvia's municipalities. According correlation analyses eight of the ten EBM have a positive correlation between the amount of state funding allocated for local government and changes in TDI. Other major sources of investments in EBM are EU financial instruments. In the EU budget planning period 2014-2020 from EU Structural funds (except agricultural funds) EBM received 992 euros per capita, NEBM received 852 euros, Latvia – 1302 euros per capita. Thus, during this period EBM received 14% more funding per capita than NEBM, but 24% less than average in Latvia. Also, since 2002 under EU agricultural policy financial instruments EBM received 13075 euros per capita, while NEBM border received 12275 euros [5].

The low density of population makes complicate to provide public services and facilitate development of businesses in the EBM. The proportion of the state sector in employment is steadily increasing and government subsidies play crucial role for the socioeconomic stability. Today EU financial instruments are the main tool for promoting economic growth in the region.

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INTERNATIONAL CREDIT UNIONS

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More and more people are choosing to become members of credit unions and use their offers. According to the World Council of Credit Unions, the number of members in credit unions increased from 235 million in 2016 to 375 million in 2020. People choose credit unions because they offer better financial deals, provide variety of financial training and education, and they have great customer service.

Credit union is a cooperative with variable number of members and capital which provides financial services to its members, for example, attracts deposits from its members, credits its members or issues guarantees [1]. Credit unions use the 7 Rochdale Principles of Cooperation, which were established in 1844 in the Rochdale Weavers Cooperative. The principles are voluntary and open membership, democratic member control, member economic participation, autonomy and independence, cooperation among cooperatives, concern for community and education, training and information [2]. World Council of Credit Unions is the global trade association and development platform for credit unions. It acts as the leading voice of the international credit union community. World Council continues to promote economic freedom and the sustainable growth of financial cooperatives across the globe through education, collaboration and community-based development projects. The Worldwide Foundation for Credit Unions strives to improve lives and communities through contributions from the members of the Council of the World Credit Unions as well as donations received through various charitable events [3].

World Council of Credit Unions publishes annual Statistical Report which provides financial data of credit unions and financial cooperatives around the world [4]. In 2016, there were almost 69 thousand credit unions with over 235 million members. The number of members tends to increase every year, by 2020 it increased by almost 60% and reached 375 million members. Although in 2018 number of credit unions decreased by 3.18%, the total amount of deposits received by credit unions increased from USD 1.41 trillion in 2016 to USD 2.69 trillion in 2020 but the total amount of issued loans increased from USD 1.22 trillion to USD 2.06 trillion. The lowest increase of both indicators was in 2018, when total deposits increased by 3.8% and total issued loans by 7%, due to the merge of smaller credit unions. The highest increase in total deposits by 24% was in 2020 related to the increase in the number of members, mainly due to the development of digital financial tools in credit unions. The recommended loan to deposit ratio limit showing the credit union's ability to cover losses and loans taken out by members is from 85% to 100%. The ratio is within recommended range from 2016 to 2018, which means that credit unions are able to cover unforeseen expenses. In 2019-2020, the ratio decreased to 85-76%, which means that the credit unions are not fully using their lending capacity to issue loans and making profit.

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REDUCING FOOD WASTE IN THE AGRI-FOOD SUPPLY CHAIN, THE IMPORTANCE OF FOOD WASTE MANAGEMENT

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Food waste is one of the primary reasons for food insecurity around the globe. Therefore, through this research the author has studied the best possible ways to shrink the waste in the agri-food supply chain. Food waste reduction in the supply chain has a significant economic effect, thus food waste management has become a topic of academic interest. There is a concept of “farm share of consumer” as an approximate measure of the extent of this phenomenon. This new concept helps reduce the total waste in the food supply chain [2].

Reducing food waste is the combination of policies and institutions and a favourable environment that enables coordination and collaboration among different factors and stakeholders. Policy reforms, innovative technology, and managerial skills are required to strengthen waste management in food production companies. Also, the ability to formulate efficient supply chain networks, to build and manage their capabilities. The smother networking system is generally controlled and dependent on regulatory bodies, food policy, and market infrastructure [1].

Technological innovations at the production and trade level, supplier selection, vertical integration, packaging innovation are equally important for the waste reduction process in the supply chain. Food waste prevention is also affected by new trends. The increased popularity of online ordering and home delivery may help to reduce the deterioration of the products at the retailers. Along with changing consuming habits, there is also an increased awareness of the impact of food on human health and the impact of food production on the environment [3].

In the end, as observed, the various aspects of food waste management have a critical effect on the economy and market and every step in the food supply chain. Food waste can also be reduced by carefully applying various steps and policies among the members of food supply chains.

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FOREIGN TRADE RELATIONSHIP BETWEEN LATVIA AND THE UNITED STATES OVER A PERIOD OF ONE HUNDRED YEARS AND ITS PROSPECTS

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The research goal is to trace the evolution of trade relations between Latvia and the United States of America (USA). Since the beginning the countries had very little contact, but everything changed on July 28, 1922, when the USA recognized *de iure* the Republic of Latvia. Soon afterwards, imports increased starting in 1928 and peaked in 1929 at roughly twenty million lats. As Latvia was then an independent country with established diplomatic relations, it had a trade balance in which it imported more than it exported [1]. Cereals, raw cotton, automobiles and parts, industrial and agricultural machinery, petroleum products were Latvia's biggest imports from the USA. In 1939, the Latvian-American Chamber of Commerce was founded, increasing the rate of Latvia's principal exports such as canned fish, chocolates, cellulose, skins, plywood, lumber and timber products, peat and its products and hides and furs were the most important products [1].

The previous dynamic shifted, it should be noted, following the restoration of Latvia's independence in 1991, Latvia worked closely with the USA, and exports to the USA rose, taking over imports for the first time since the country's foundation. In this new era Latvian exports to the USA totaled 283.4 million Euros in 2017, accounting for 2.5%. The largest product with an approximate value of 10.5 million Euros is wood and articles derived from it. The next commodity is idiosyncratically telephone and smartphone parts, apparatus and sets. Then the third with a value of 2.5 million Euros are optical instruments, music instruments and watches. In fourth is glassware for 1.5 million Euros, and a fifth is foodstuff, tobacco products and alcoholic beverages such as the balsams that are traditionally crafted. In 2021, Latvian exports jumped by 131.3 million Euros on year-to-year basis [2].

While imports from the USA accounted for 167.4 million Euros, or 1.2% of total Latvian imports, it consists mostly of machinery, vehicles, aircraft, optical equipment, and chemical products [3]. One sector of imports that currently is lower than the mean is mineral oils and fuels. Economic relations between the USA and Latvia are active, and have gone beyond trade in recent years, the USA has helped Latvia strengthen its security. The countries have signed accords on investment, trade, intellectual property protection, and double taxation avoidance [3].

In conclusion, Latvia has managed to increase its exports and achieve a positive trade balance. The current trend is of gradual, steady growth and it's forecasted that the bilateral commerce between the USA and Latvia will reach a higher ceiling over the coming years. Ultimately, the relationship in mutual interest, has endured many barriers and the bond will continue to be as close and strong as it has been previously.

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IMPACTS OF COVID-19 ON THE SUPPLY CHAIN OF MEAT PRODUCTS

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The World Health Organization defined the COVID-19 outbreak as a pandemic in March 2020. Pandemics have affected humanity throughout history, and a typical feature of pandemics is their negative impact on the agri-food supply chain, as well as the chaos they bring in the global economy as a whole. This paper focuses on the impact of COVID-19 on the supply chain of meat products.

Many livestock farmers in East African countries rely on the export of live animals and frozen meat to Middle Eastern countries; however, because of restrictions on transportation during Covid-19, producers were unable to sell their animals and frozen meat. [1]. Food-away-from-home purchases decreased as a result of the temporary closure of restaurants and other food service outlets under lockdown laws, and these food expenditures shifted to food retail outlets. Consumer panic buying and stockpiling behaviors amplified the effect of the shift in food demand to retail outlets, resulting in stockout [2]. Stockout causes lost sales and long-term consumer relationships may suffer as a result of this. The pandemic had a significant influence on the European sheep and goat meat industry, owing to decreasing demand. The global production capacity of the beef, pork, and poultry industries was reduced by up to 25, 43, and 15%, respectively, as a result of the pandemic [3].

COVID-19 significantly impacted the meat and meat products market. Animal export restrictions, as well as the closure of slaughterhouses, other processing units, restaurants, and food services, had a negative impact on all stages of the meat supply chain, which resulted in price increase and instabilities in the supply chain.

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TRANSFORMATIVE SUPPLY CHAIN MANAGEMENT

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Climate change [1], rapid urbanization, demographic trends, resource overconsumption [2], and corresponding alterations in demand patterns are all anticipated to have a significant impact on supply chains. The need for a better understanding of future changes within global economic systems from the sustainability perspective is highlighted by current global socio-economic and political trends.

Through a service concept, transformational service research (TSR) emphasizes the well-being of individuals, communities, and ecosystems [3]. Integrating transformative service research into supply chain research is advantageous in terms of accomplishing the purpose of sustainable supply chain management, which is to improve human life quality. Transformative service research is a new field of study that encourages researchers to explore and broaden the concept of business operations in terms of the economy, society, and environment [6]. The supply chain system, according to transformative service research, needs to be refocused from the tangible to the intangible, and from operand resources to operant resources [4], with service as the essential premise of trade [7].

The interaction and resource integration among the entities (economy, society, and environment) within an ecosystem are the focus of the transformative supply chain. The operant resources are an important component of resource integration. Customers must have the expertise to interact with and perceive value from the providers, and supply chains utilize operant resources to develop an environmentally friendly product. Therefore, in order to generate transformative supply chain development, organizations must respond to client requests as well as the value of the process behind products and services [5].

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JOB SATISFACTION WITH WORKING CONDITIONS IN “PUTUP” LTD

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One of the most important building blocks of any company alongside its purpose and strategy is its people. People's ability and motivation to do their job is the most important factor in a company's success. The first researchers to study job satisfaction were Hamermesch [1] and Freeman [2]. According to the researchers, satisfaction is subjective and it is not exactly the same as utility, satisfaction can help to explain individual's work behaviour. One of the most widely used or "gold standard" job satisfaction analyses is the JDI scale developed by a group of researchers [3] from the USA, which divides satisfaction conditions into five groups: pay, career, psychological climate, relationship with management, and the job itself. The job satisfaction methodology developed by a Russian researcher [4] includes eight factors: interest in the job; satisfaction with job achievements; satisfaction with employee relations; satisfaction with supervisor; level of career ambition; preference for high pay for work done; job satisfaction; professional responsibility. The problem to be addressed: job satisfaction will determine staff productivity and the level of performance quality, which will shape not only the well-being of the company, but also its image and brand reputation. The subject of the study is job satisfaction with working conditions at PUTUP Ltd, founded in 2007 in Latvia and specialising in the production of plastic components. The company closed 2020 with a turnover of EUR 9.4 million, 1.43 times less than in 2019, and employed 83 employees, 5 times less than in 2019. A job satisfaction survey was carried out with 45 employees from different departments - 12 office workers, 26 workshop workers, 4 truck drivers and 3 warehouse workers. 24 were male and 21 were female, 13 had a higher education, 14 had a secondary education, 16 had a vocational secondary education and 2 had a primary education. The results of the research showed that PUTUP Ltd. has a high level of job satisfaction - 68.99%, including 72.92% for office workers, 56.59% for workshop workers, 78.57% for warehouse workers and 67.86% for truck drivers. Office workers have the lowest score for interest in work - 68.05%, which can be explained by routine work. The lowest score for workshop workers is also interest in work - 39.74%, which can be explained by routine and hard work in the factory. Warehouse workers have the lowest score for professional responsibility - 50%, which can be explained by the inability to deal with the tasks. For truck drivers, the lowest score is preference for work in relation to earnings - 50%, which means if another job offers the best pay, the employee will leave. The HR manager should conduct annual employee surveys to identify gaps and weaknesses that prevent employees from being fully satisfied with their working conditions and develop a plan to improve them.

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DEVELOPMENT OPPORTUNITIES OF FARMERS' MARKET CONCEPTS IN LATVIA

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Farmers' markets have historically played an important role in shaping urban life and promoting economic development, concentrating traders and buyers in one place, promoting the exchange of goods and creating a relationship between the buyer and the seller, while also building a part of the overall infrastructure and image of the city or populated area. Nowadays the market concept, including only physical places for sellers, is outdated because the customer's demands have changed. And the role of it has also changed, becoming less significant in economical dimension, but more important in social, environmental, entertainment and tourism dimension. Also, this historical trading system is important today because it provides a suitable environment for short-chain food chains. The biggest advantage of which is a direct buyer-seller communication and relatively faster feedback on the product, which in most cases creates a positive buying experience for the buyer and a desire to buy again; and small-scale product manufacturers that, due to the relatively small volume of production, cannot be distributed through other sales channels, can have an opportunity to attract the attention of buyers to various alternative products in this trading model.

It is clear that with the growing awareness of the human impact on the environment and climate change, and the role of food in improving health, as well as the growing sense of social responsibility, consumers are interested in locally sourced food, and opportunity to buy it in farmers markets is increasing [1]. But when examining statistical data, the opposite trend is observed in Latvia – since 2000, the turnover index in retail trade in market stalls and farmers markets has significantly decreased [2]. That shows that consumers, although willing to support the local producer and understand the impact of their choices on the prosperity of the region [3], do not choose market as their main place to shop.

Which suggests that farmers' market managers do not organise market activities in line with the customers' demands for shopping experience, or that marketing and communication activities are unable to promote consumption at these trading sites. In order to improve the performance of the market, the author has defined three different market performance concepts. Research suggest that farmers' market can be designed as a multifunctional concept, a locally important function concept or as a prosocial value concept, based on functions the farmers' market provides or has as a value orientation.

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ROLE OF PARENTS IN THE PREVENTION OF EARLY START OF ALCOHOL USE IN ADOLESCENTS

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Early start of alcohol use among adolescents is a widely spread problem both in Latvia, and other European Union Member States. In 2019, 89% of Latvian pupils have used alcohol at least once, which is one of the Europe's highest indicators of pupils who have used alcohol [4]. 48% of pupils in Latvia have tried alcohol for the first time early, i.e., before reaching the age of 13 [4]. The objective of the study was to explore the habits of alcohol use of Latvian pupils and development of these habits during the period from grade 7 to 9. The task of the study is to find out the role of parents in early starting of alcohol use among pupils.

Assessments carried out within the framework of pupils' alcohol use prevention programmes outside Latvia show that the involvement of parents has a huge role on prevention of early alcohol use. The impact of parents is particularly significant for adolescents of the youngest group (primary school period) [2]. The early start of alcohol use is affected not only by information provided by parents about the negative consequences of alcohol use, but also the example shown by parents themselves, using alcohol in the presence of young people. Studies show that the perception of alcohol drinking habits of parents affect mutual relations between young people and their parents. On the one hand, close relations between young people and their parents can work preventively in terms of starting of alcohol use – young people, who have good relations with their parents will be less tended to counteract the rules set by parents [1]. On the other hand, good relations between children and alcohol-using parents may encourage pupils to follow the example set by their parents and start alcohol use [3].

The study was carried out as a longitudinal quantitative survey of pupils in Latvia over the period from 2015 – 2018. The results of the study show that among those pupils who are living with their parents and consider their mutual relations as good, a higher proportion of those who have used alcohol is among young people whose parents are using alcohol in their presence. In the group of pupils of grade 7 whose parents are not using alcohol in the presence of children, 53% of pupils also have not used alcohol, whereas among those pupils whose parents use alcohol in their presence at least once a month, the proportion of young people who have not used alcohol is 19%. This trend can be observed in all stages of the study.

Early start of alcohol use is affected by several aspects, and the information provided by parents and the example shown by them are only a couple of such aspects. Support for prevention of early alcohol use is ensured to pupils not only by the information on the consequences of alcohol use provided by parents, but also by the example shown by parents themselves concerning alcohol usage. Contradictions between these two aspects may reduce the role of parents in the prevention of early alcohol use in young people.

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CHALLENGES OF IMPLEMENTING THE EUROPEAN GREEN DEAL IN AGRICULTURE

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The European Union has set itself an ambitious goal of becoming the first climate-neutral part of the world by 2050, thereby significantly reducing greenhouse gas emissions and resource consumption. The aim is to decouple resource consumption from economic growth, while limiting global warming and maintaining economic growth [1].

Set of policy initiatives to achieve this goal is called the "European Green Deal". Europe is facing major changes that will affect every business and citizen. Businesses will face the challenges of implementing the Green Deal, as resources may become more expensive and production costs internalised, thereby eco-innovation will play a major role.

Agriculture has become dependent of mineral fertilizers. Since 1965, the annual amount of fertilisers used in agriculture worldwide has increased fourfold by 2019. Nitrogen (N) consumption has increased by five times, while phosphorus oxide (P₂O₅) and potassium oxide (K₂O) consumption have increased by three times [2].

At the same time, one of initiatives "Farm to fork" is intended to achieve 50% reduction of pesticides, 50% reduction of antimicrobials for livestock and aquaculture, 50% reduction of nutrient loss in soil and at least 20% reduction of fertilizers, 10% reduction of agricultural land [3], which could result in a lower productivity and a need for additional funds to support payments for farmers so they could reach an average income level.

Implementation of the EU Green Deal's "Farm to fork" and biodiversity strategies only in the EU could lead to reductions in: production by 12%, exports by 20%, gross farm income by 16%, GDP by 71%. While there is projected increase in: prices by 17%, imports by 2% and annual food cost per capita 153 USD [4]. In the end, the implementation of new strategy will require new solutions and new innovations to balance rising costs and lowered productivity, while maintaining environment and economic growth.

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INTEGRATION OF NEWCOMERS IN THE RURAL AREAS OF LATVIA

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The integration of newcomers is important in the context of demographic processes in rural areas. Although the integration process and its positive and negative consequences have been analysed in foreign studies, the issue has not been widely studied in Latvia so far. The aim of this study is to find out how newcomers integrate and what structure of the integration process in Latvian rural areas is.

Newcomers to rural areas are considered to positively affect the demographic situation by creating new jobs and providing social and cultural services for local society. At the same time, in underpopulated areas where the support from public authorities is smaller and the society is more conservative, the integration of newcomers is more complicated [1].

As newcomers have previously moved, they may be more inclined to move again in the future. Newcomers are more likely to re-evaluate the aspects of staying in a certain area than local rural residents. Physical and social aspects of rural life are the primary factors for staying, especially if they are suitable for the newcomers' children [2]. The impact of newcomers on the permanent population depends on their ability to integrate into society and various local systems. Integration is influenced by various factors, including newcomers' gender, length of residency, ethnic origin, religion, and social networks. However, social networks are critical for providing support to newcomers to rural areas during the process of integration [3].

For more than two decades, Latvia has struggled with demographic challenges due to a significant level of emigration, negative natural increase, and population ageing. Attracting, but more importantly, retaining of new inhabitants is essential for each territorial unit, especially in territories where demographic changes have been decreasing each year, therefore each newcomer is crucial. However, the impact of newcomers on the permanent population depends on their ability to integrate into society and local systems.

The research is part of National Research Program project VPP-LETONIKA-2021/4-0002 "Cutting-edge knowledge and solutions to study demographic and migration processes for the development of Latvian and European society (DemoMigPro).

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COMMUNICATION IN ÅLAND GOLFKLUBB

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Communication in the companies is crucial since employees exchange with an important information necessary for tasks performance in high-quality and appropriate time. Research problem: there are barriers to communication that hinder the flow of information and prevent a company from achieving its goals. According to researchers (1): despite technological advances, leaders mostly use verbal communication because it provides instant feedback and is easy to use. The form of written communication tends to be accurate and carefully compiled and is intended to use permanent records (2). The purpose of internal communication in a company is to promote its development and provide management functions (3). Information is extremely important in the company; it is important that the necessary information is available to employees at the right time and in the right place (4).

The subject is communication between the staff of the kitchen department of Ålands Golfklubb restaurant. Ålands Golfklubb golf club was founded in 1975 in Castelholm, Åland, Finland. The company's turnover was the highest in 2017 which was 1.2 million. EUR. In 2018, compared to 2017, the turnover has decreased by 0.6%. In 2019, the company's turnover decreased by 41.6% compared to 2018. In 2020, compared to 2019, the turnover increased by 9.1%. A survey with 31 question for 15 kitchen employees was conducted. The rating used Likert's 5-point system, where 1 is very bad and 5 is very good. The survey was about communication between supervisor and other colleagues. The study found employees are unaware of the company's economic situation, the manager does not share this information with his subordinates, it affects the motivation of employees. Employees talk little to each other about the day's tasks, employees do what they have to do, and do not rush to help others until they are assigned to help. The tasks expressed by the manager to the subordinates are not fully understood, sometimes even late, as a result the execution of tasks is delayed, information about changes in the work schedule does not occur so quality of work in the kitchen department deteriorates. In order to improve the quality and faster performance of the tasks of the kitchen department staff in the restaurant, the author's recommendation to the golf club owner is to send the existing head of the kitchen department to training courses about communication management to understand the the importance of communication in the company. Without the exchange of information in the restaurant department, work is impossible, there are several problems in task achievement, delayed orders and, as a result, dissatisfied customers and poor overall quality. Improved communication skills would help kitchen manager make the right decisions to perform his duties and improve communication with subordinates and within other departments heads of the company.

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