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AGRICULTURE

THE USE OF SOILLESS SYSTEMS FOR CROP CULTIVATION

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The increasing global population and the reduction of arable land drive the need for alternative food production methods. The hydroponic method offers a sustainable solution that ensures efficient crop cultivation without soil. Other soilless cultivation systems, such as aeroponics and aquaponics, are also known worldwide; however, this article focuses on the advantages and disadvantages of hydroponic cultivation. In hydroponic systems, plants absorb necessary nutrients from a solution, ensuring optimal water and fertilizer use while reducing environmental impact. The aim of this study was to describe the research conducted by institutions in various countries on hydroponic cultivation systems. The results confirm that hydroponic systems are viable, necessary, and economically beneficial in different regions of the world. The findings demonstrate how plant growth changes when adjusting parameters such as electrical conductivity (EC), temperature, substrate, and others. The study [1] presents the comparison of hydroponic system variants, and analysis of the impact of various growth factors on tomato yield. Nitrogen (N) and potassium (K) concentrations of 137.5 and 275 mg L^{-1}, respectively, with an N:K ratio of 1:2 were found to be optimal for tomatoes during the vegetative phase. The study results showed that a wick system provided a higher fruit yield and better quality sugars for tomatoes grown in winter, using a solution with an N and K ratio of 1.4:3 during the vegetative stage, and a solution with an N and K ratio of 1.7:3.5 during the reproductive stage [2]. As concerns lettuce, the highest number of leaves was achieved using a floating raft system compared to other methods such as Nutrient Film Technique (NFT), Deep Film Technique (DFT), Ebb and Flow Systems (EFS), and Aeroponic Systems (AS) [3]. Hydroponics can also be used for sprouting fodder crops, such as cereals or legumes. Studies on *the use of soilless systems for crop cultivation* confirm the potential of soilless systems for the cultivation of medicinal plants, achieving higher and better-quality yields. When growing *Valeriana officinalis* and *Inula helenium* roots, a fourfold increase in yield was obtained after 120 days compared to field-grown plants [4].The results confirm that soilless systems can be successfully integrated into urban areas and locations where traditional agriculture is impossible, such as large warehouses or structures with consistent light and heat. The future research should include socio-economic factors, electricity prices, consumer preferences, and perceptions regarding what constitutes clean and healthy food. Reviewing research results from other parts of the world raises questions about the feasibility and necessity of hydroponic systems in Latvia. Some practical examples confirm that such systems are effective under specific conditions, but further research is needed for particular circumstances.

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NUTRIENT ACCUMULATION IN SEA BUCKTHORN (*HIPPOPHAE RHAMNOIDES* L.) PLANTATIONS

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Sea buckthorn is a relatively recent crop in Latvia but interest in its cultivation is steadily increasing. Sea buckthorn's cultivation can be done both conventionally and organically. Practical use of plant is very diverse. For example, fruits can be used for food, for beauty as well as in medicine. Leaves and shoots can be used for production of biologically active ingredients. Plants themselves are useful for soil erosion control as well as for decorative purposes. But at the same time cultivation of sea buckthorn is not a simple undertaking. Environmental preconditions, pest and diseases control, agronomic techniques, harvesting and processing of the yield, etc. requires specific knowledge and practical experience [1].

In order to intensify sea buckthorn cultivation, various agrotechnical studies are being carried out, including those related to fertilization. But to properly understand the needs of nutrients for this specific plant, there should also be information regarding the nutrient cycle in a sea buckthorn plantation. This could help to understand the needs of the plants, to produce certain products such as berries or leaves. All organisms need a certain amount of energy and nutrients to increase biomass to a certain level. Therefore the objective of my research was to study plant nutrient accumulation in the different proportions of sea buckthorn plant biomass.

Experiments were carried out in the farm "Dzelmes", Ogres municipality. Buckthorn rows in the plantation were oriented at north-east to south-east direction, the width between the rows was 3 m, and the distance between the trees was 2 m. The plantation was established in 2018 using the sea buckthorn variety 'Marija'; the total area of plantings was 3.5 ha. Three different fertilization methods were used. (1) No fertilizers were used in the control method. (2) Organic fertilizers (compost) was incorporating into the soil, kg ha-1: N – 38, P_2O_5 – 22.5 and K_2O – 53.5. (3) Mineral fertilizers were incorporated into the soil, kg ha-1: P_2O_5 – 39 and K_2O – 45. In 2023 twelve (12) trees were harvested for experimental purposes, e.g., four trees from each fertilizer treatment. The obtained plant material was divided into five parts: berries, leaves, branches, stump, and roots. Analysis was performed to determine dry biomass, as well as chemical composition (nitrogen, phosphorus and potassium content in the each part of the tries). The soil profile description and sampling were made for soil characterization. In addition, soil samples were also taken around each of the harvested tree at two depths: 0 – 20 and 20 – 40 cm, respectively, to characterize the first two horizons of the soil. Soil acidity, organic matter, total nitrogen, plant available phosphorus and potassium were determined in soil samples. All together 24 soil samples and 75 biomass samples all in three replicates were analyzed. Obtained results showed significant variations of plant nutrient concentrations. For example, the nitrogen concentration in berries varied from 1.99 to 3.01%, in leaves from 2.46 to 3.68%, in roots from 0.79 to 1.02%, and in branches from 1.33 to 1.85% N in the dry mass. Obtained results showed that most nitrogen in sea buckthorn is accumulated in the berries and leaves. This would be important because these are the most commonly used parts of the plant. But this does not necessarily mean that nitrogen fertilization would be needed, because the highest nitrogen concentration was found in the control variant. This could be explained by sea buckthorn symbiosis with Frankia spp. Actinobacteria. This demonstrates how other nutrient accumulation data can be used to determine the specific needs of sea buckthorn fertilization.

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WINTER WHEAT DISEASES DEVELOPMENT AFFECTING FACTORS IN LATVIA

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Wheat (*Triticum aestivum*) is one of the most economically important crops in Latvia. Wheat leaf diseases affect yield and grain quality [1]. The aim of this research was to clarify the charasteristics of wheat leaf blotch development and to assess the impact of wheat's pre-crop on disease severity. Observations were conducted in wheat fields where wheat was sown after various pre-crops, i.e., wheat and oilseed rape, under reduced soil tillage during the 2024 season. Severity (%) of diseases was assessed every two weeks. The area under disease progress curve (AUDPC) was calculated to evaluate the influence of diseases during the vegetation period [2].

Tan spot (caused by *Pyrenophora tritici-repentis*) was the dominant disease, septoria tritici blotch (caused by *Zymoseptoria tritici*) and brown rust (caused by *Puccinia recondita*) were also observed. Powdery mildew (caused by *Blumeria graminis*) was observed only during the wheat stem elongation stage (GS 33.-37.) with low severity (0.06%).

The first symptoms of tan spot were observed at the start of the wheat stem elongation (GS 32.-33.). Further development of tan spot was slow and gradual. Rapid development started only after flowering and milk ripeness stages, which is associated with ascospore production when meteorological conditions were optimal. Tan spot severity in the final observation was 23.98%. Development of septoria tritici blotch at the beggining of the season during the stem elongation stages (GS 32.-37.) was higher than that of tan spot, 2.6% and 5.84%, respectively, compared to 0.86% and 1.1.% for tan spot. This can be associated with the pathogen's life cycle and conidia splash dispersal with rain as the end of April and the beginning of May were very wet (HTC>2) and rainy. Rapid development of *Z. tritici* started only after flowering and milk ripeness stages at GS 71.-73., and disease severity was 4.40% in the last observation.

The first symptoms of brown rust were observed after flowering at growth stages 71.-73. Development of *P. recondita* was rapid until the end of the season. The highest severity of brown rust was observed (2.82%) at milk ripeness stage (GS 75.-77.).

Pre-crop significantly ($p<0.001$) influenced development of tan spot. AUDPC values of this disease increased almost three times from 102.06 after rapeseed to 304.38 in repeated wheat sowings. Moreover, the impact of pre-crop on septoria leaf blotch was not statistically important. Since *P. tritici-repentis* survives on wheat residue, using wheat as previous crop increases pressure of infection.

Wheat diseases development was influenced by meteorological and other agroecological conditions. To collect more precise data and reach valid conclusions, research on winter wheat disease development should be conducted over several years in a row.

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ANALYSIS OF THE PRODUCTIVITY OF SOWS DEPENDING ON THE TYPE AND SIZE OF A FARROWING PEN

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In 2024, there were 46 herds with 20,335 sows under supervision and performance testing [1]. In recent years, the number of piglets per litter has increased significantly in commercial pig breeding, which is accompanied by an increase in piglet mortality before weaning [2]. In Latvia, purebred and crossbred Landrace and Yorkshire sows are used for piglet production, Pietren and Djurok breeds are used less often. This study is relevant for pig breeding farms that aim for high piglet retention and high piglet weaning rates. The goal of the study was to analyze the productivity indicators of M_1 (Landrace × Yorkshire) crossbred sows depending on the type and size of farrowing pens.

The study database was created using information provided by four farms in the Latvian pig farming sector. In total, data on 6,148 litters of M_1 crossbred sows were analyzed, which occurred in the period from January 1st, 2022, to December 31st, 2023. The size of the farrowing pens in farms A (5.04 m^2), B (4.16 m^2) and D (4.42 m^2) were different, but the pen system were the same. In turn, a free farrowing system is used in farm C (8.56 m^2). Microsoft Excel software was used for data processing.

The number of litters was 3,123 for 2nd parity sows and 3025 for 3rd parity sows, and it can be stated that the sows in the studied farms were young. The gestation period of sows ranged from 115.0 days in Farm C to 117.7 days in Farm D. The longest lactation period was 32.5 days in Farm D, the shortest, 24.6 days, was in Farm C.

Comparing the productivity of sows by parity, the 3rd parity sows were more fertile than the 2nd parity sows, 16.5 ad 15.3 piglets per litter, respectively. Thus, there were also more live-born and stillborn piglets of the 3rd parity sows (14.4 and 2.0 piglets) than of the 2nd parity sows (13.6 and 1.5 piglets). It was observed that Farm A, which uses farrowing crates, had the lowest piglet mortality before weaning, an average of 4.5% of piglets. Farms B and D had higher pre-weaning piglet mortality than Farm A, 14.6% of piglets in the same farrowing crates. Since Farms B and D had a higher number of piglets per litter than Farm A (17.1, 20.6 and 14.3, respectively), higher piglet mortality can be explained by the smaller available space per animal, 0.24, 0.21, 0.35 m^2 for one piglet, respectively. Farm C, with a free farrowing pen system, had a pre-weaning piglet mortality of 22.2% on average. In this farm number of piglets per litter were 11.6 and space per animal in pen was 0.74 m^2.

In conclusion, the retention of piglets in farrowing pens is influenced by many factors, the most important of which are the area of the pen and the equipment used in the pen.

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INFORMATION TECHNOLOGIES

CUSTOMER RELATIONSHIP MANAGEMENT SYSTEM PROTOTYPING FOR CLEANING BUSINESS PROCESS AUTOMATION

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In this paper, the author explores approaches to the development of CRM systems from scratch, with a focus on the needs of small and medium-sized businesses in the field of cleaning services. An analysis of existing market solutions reveals that universal CRM platforms are often redundant, difficult to use, or financially unviable for highly specialized companies. This has necessitated the creation of an in-house prototype system customized for specific business processes.

During the course of the research, a minimum viable product (MVP) is developed to demonstrate how a supported and extensible system can be built while considering industry-specific requirements. At the first stage, a monolithic architecture with the simplest possible technology stack is used: MongoDB as the database, a REST API for data exchange between client and server, and a client-server interaction model. This approach allows for a focus on the application logic and data structure, avoiding unnecessary complexity in the initial stage.

In parallel, the possibility of a gradual transition to a microservice architecture is investigated, where the first experimental element is a separate monitoring service implemented using RabbitMQ, developed independently from the main application. This represents a step toward a more scalable and modular architecture.

The project is not limited only to the implementation of functionality, but also covers issues of system stability and quality: integration testing of key components is carried out. Overall, this research aims to identify effective CRM system design strategies applicable to specific, niche business challenges.

This research contributes to domain-specific CRM design by offering ideas for adapting general CRM principles to niche industries with unique operational challenges. The framework presented lays the foundation for further academic and practical study of CRM applications in small and medium-sized service businesses.

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CHATGPT: THE PROGRESS OF ARTIFICIAL INTELLIGENCE IN THE FIELD OF MATHEMATICS

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These days, students often use artificial intelligence to educate themselves and test their knowledge. Artificial Intelligence handles many tasks in many areas, but it is not always able to perform the task correctly.

In the context of mathematics, comparing the performance of artificial intelligence (ChatGPT [1]) in 2023 and 2025 reveals noticeable improvements in functionality. This is evidenced by the simple prompt "I want to solve the equation $3x + 4(1 - 5x) = -9$" [2]. In 2023, the answer of artificial intelligence was wrong: $13/20$, however, in 2025, the answer was $\frac{13}{17}$, which is the correct answer. In addition to the correctness of the answer, it is also worth paying attention to the fact that artificial intelligence began to do fewer illogical and unnecessary actions, and presented its solutions in a more structured format (for example: $1/2 \rightarrow \frac{1}{2}$).

Even today, artificial intelligence makes mistakes, such as incorrect calculations, and performs mathematical operations incorrectly. When given a prompt "$9.11 > 9.9$", the Artificial Intelligence initially responded "Yes, 9.11 is greater than 9.9." However, after the error was pointed out, it corrected itself. Also, artificial intelligence occasionally allows some illogical actions. For example, converting several fractions in powers to the smallest divisor, and then without using the new powers in any way, returns to the original form. For example: $\int \frac{x^{\frac{1}{6}}}{\left(x^{\frac{1}{3}}+x^{\frac{1}{4}}\right)\sqrt{x}}dx = \int \frac{x^{\frac{1}{6}}}{\left(x^{\frac{2}{6}}+x^{\frac{1}{4}}\right)x^{\frac{1}{2}}}dx = \int \frac{x^{-\frac{1}{3}}}{x^{\frac{1}{3}}+x^{\frac{1}{4}}}dx$

Also artificial intelligence makes errors such as two variables under an integral, for example: $\int \frac{4t^2}{u^2} \cdot \frac{du}{2t}$. From a mathematical point of view, this is the wrong approach to solving integrals.

In addition to minor errors like illogicality in the solution, artificial intelligence also makes errors, such as replacing variables with incorrect data. For example, if the variable $t^2 = u - 1$, and the integral follows $\int \frac{2t}{u^2} du$, then artificial intelligence puts $u - 1$ in place of t: $\int \frac{2(u-1)}{u^2} du$, without extracting the root from this expression. Correct option: $t^2 = u - 1 \rightarrow t = \sqrt{u-1} \rightarrow \int \frac{2\sqrt{u-1}}{u^2} du$

Although artificial intelligence has made tremendous progress over the past two years, students must still critically evaluate AI-generated solutions when using it for educational purposes or to verify their own knowledge.

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ASSESSING MOTOR IMAGERY TASK PERFORMANCE OF THE NEUROSITY CROWN IN THE PRESENCE OF INTERFERENCE

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The landscape of EEG technology is shifting, with a growing emphasis on commercial applications. While historically confined to clinical and research settings, advancements in technology and portability are expanding its reach to diverse audiences. A common strategy for consumer-oriented brain-computer interfaces is to enable users to explore their brain signals for wellness, though productivity gains in this area may be limited [1], and, in some cases, as a tool for controlling and interacting with other devices and technologies [2]. The current research paper focuses on testing the Neurosity Crown device's built-in motor imagery predictions with interference and aims to identify the limitations of the device's motor imagery predictions under such conditions.

The performance evaluation involved a testing procedure that introduced interference during the execution of motor imagery tasks. We employed four distinct interferences: eye movements, horizontal head movements, body movements, and index finger opposition. Testing focused on the motor imagery of the right index finger. We tested them five times each, each test had four training sessions and 30 epochs per test, consisting of 15 rest and 15 motor imagery epochs. Evaluation was based on a prediction value threshold of 0.9 for motor imagery. If this threshold was sustained for a few seconds, even with brief instability, artificial interference was introduced to observe the motor imagery task's response.

We found that interference resulted in inconsistent prediction values of the motor (index finger movement imagination) imagery task, indicating prediction failure. Eye movement Interference resulted in a prediction value drop to 0.1. Head movements caused a sharp decline in prediction value to 0. Body movements led to extreme fluctuations, rapidly reaching either the maximum or minimum value. Conversely, opposite finger movement affected predictions but closely mimicked the actual motor imagery movement of the right index finger. Furthermore, we found that the presence of hair negatively impacted device function, and extended training periods resulted in a rapid increase in device temperature that made it more unstable.

This study revealed that artificial interference significantly hinders the Neurosity Crown device's motor imagery prediction accuracy, leading to prediction failure in certain motor imagery tasks. Practical limitations, such as hair interference and device overheating, were also identified.

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AI-POWERED OBJECT DETECTION FOR IDENTIFYING WASP THREATS IN BEEHIVE: TOWARDS A REAL-TIME SURVEILLANCE SYSTEM

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For centuries, beekeeping has been part of human culture as a source of food and medicine. In Latvia, beekeeping has become a profitable agricultural industry in recent years. According to [2], beekeeping has generated 1.65 million euros in exports, surpassing 0.95 million in imports by 2023. However, being the second largest honey producer after China, the European Union is also the second largest honey importer, satisfying only 63% of its domestic demands through local production, which presents a significant opportunity for the nation's economic growth through beekeeping [1]. However, sustainable growth depends on prioritizing the well-being of bee colonies along with the growth in the number of colonies. [3] identifies eight highly relevant types of threats to bees, including predators such as the Asian hornet (a predatory wasp), highlighting the need for effective threat mitigation. Therefore, this research aims to "Enhance the security of the bee colonies against the wasp attacks" by evaluating and identifying the most effective object detection model for distinguishing wasps from bees in the given environment in an effort to support the economy.

The author of this research intended to develop an AI-powered system for real-time wasp detection in beehives using deep learning and IoT devices. The experiment will begin with a Raspberry Pi camera v2 (8MB) mounted on a Raspberry Pi 3, chosen for its cost-effectiveness and efficiency. The collected data from the beehives in "Jelgavas Tehnoloģiju Vidusskola, Jelgava," will then undergo preprocessing before being used to evaluate different deep learning models, which are selected considering their unique advantages, such as YOLOv5s for its advantages in detecting small objects, R-CNN with ResNet-101 for its unique abilities in segmentation, GoogLeNet for identifying abnormalities within colonies, and BEiTv2 for its unique mechanism in detecting subtle image variations. Later, these models will be assessed based on precision, F-score, recall, and accuracy to determine the most effective model. Finally, the best-performing model will be deployed on Nvidia Jetson Nano and Raspberry Pi camera v2 (8MB) to identify wasps in the colony and notify the beekeeper in real-time.

In conclusion, the research is tasked to minimize the threat of predatory wasps by leveraging low-cost techniques and minimal manpower. The findings of this study could contribute to the advancement of smart beekeeping practices, ultimately improving hive management and colony sustainability. The authors of this research believe that integrating technology into existing industries, even on a small scale, would greatly benefit the nation's economy when effectively implemented.

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QUANTUM NEURAL NETWORKS (QNNS) AND VARIATIONAL CIRCUITS

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Quantum neural networks (QNNs) are a new research frontier that crosses the boundaries of quantum computing and machine learning. QNNs aim to tackle tough problems faster compared to the traditional means of computing. QNNs are of particular interest as they may surpass regular neural networks by taking advantage of unique quantum characteristics like entanglement and superposition. This article will focus on variational circuits, a key part of quantum machine learning.

Both variational circuits and classical neural networks perform similar functions from a higher standpoint. They apply tunable quantum gates to minimize the value of a certain function, like any classical neural network, during training. Gradients are optimized in the works of Schuld et al. (2020), leading to an adoption where variational circuits fit best-fit supervised-learning tasks [1]. Mixing quantum with classical computation is shown in their work, yielding a considerable level of efficiency for such circuits.

As stated by Benedetti et al. (2019), variational algorithms gain from their application on today's quantum technologies under substantial error and noise. Such systems are referred to as noisy intermediate-scale quantum (NISQ) devices [2]. Benedetti and colleagues therefore discuss both merits and degrades of these algorithms, as well as attempting to develop reliable variational circuits for practical implementations.

In McClean et al. (2016), some challenges in training variational circuits were found. One such issue is called barren plateaus, wherein the gradients used for optimizing the circuits become very small. At the same time, researchers cannot manipulate the circuit parameters effectively; hence, the training process becomes very slow, drastically reducing the practical applicability of these variational circuits [3]. They provided suggestions on modifying the circuit design to circumvent these training problems.

One of the main opportunities offered by quantum neural networks and variational circuits is their ability to solve some of the toughest problems far beyond what any traditional computer would be able to do. This is, however, not without its challenges, from dealing with errors to improving our methods for training. It is quite realistic that some breakthroughs would occur as more work is done in these areas. Once some of these problems are sorted out, quantum computing might just become a very practical tool, changing everything from scientific and technical practices to day-to-day applications.

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DEVELOPMENT OF A SYSTEM PROTOTYPE FOR PRODUCT TRACEABILITY

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Product delivery from producer to consumer through the supply chain can be voluminous and complicated, and for the product to be successfully delivered, its journey has to be traced. Product traceability is an important factor so that the output can be effectively traced in the production and distribution stages. In almost every manufacturing sector, product traceability is implemented because it boosts cost, resource, and productivity metrics. The aim of this research is to secure beekeeping product traceability.

The globalization of the world market has strengthened product logistics and data flow. This has caused more product accessibility for consumers, which has simultaneously raised the number of involved supply chain members. To ensure quality throughout the supply chain, full traceability is required for the individual components of the final product. However, for this condition to be met, information exchange between all parties is necessary. If this requirement is executed, then the consumer demand for safety and sustainability is secured [1].

This topicality is addressed by creating a beekeeping product traceability system prototype where every member of the supply chain can oversee the product flow. The product traceability system includes three main functions, which are code (for example, QR code) generation and printing on products, data input from supply chain members, and data reading from the supply chain members so that the information could be accessible [2].

In conclusion, beekeeping product system creation enhances product transparency with the help of QR codes for all members of the supply chain, and it provides insight for consumers about the purchased product. Data about beekeeping products is securely stored in a system, which means that an authorized user can access and manage their input data at any time.

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FORESTRY

TECHNOLOGICAL ASPECTS OF WOOD

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Wood has played a vital role as a material for centuries by being widely used in construction and manufacturing. Understanding its technological properties helps optimize its processing, durability and sustainability. This research aims to explore key positive and negative characteristics of wood and how to improve its strength.

Wood has several unique technological properties. Its density is one of the most significant, with higher-density wood being more resistant to bending, abrasion, and splitting. The colour of wood, which varies from white to yellow, red, or even black, is determined by tannins, resins, and other colouring substances. The texture of wood and natural shine are due to grain in the heartwood, especially in hardwoods like oak and maple. Wood is also known for its specific scent caused by essential oils, resins, and tannins, which is stronger in fresh wood and diminishes as it dries. The moisture content of wood, crucial for its functionality, is measured by its moisture content ratio, which influences its drying process [1].

However, using wood in construction has some drawbacks. It is scalable, resistant to shock and vibration, and resistant to abrasion. It is flexible and easy to process but lacks fire resistance. Additionally, wood changes dimensions and shape due to moisture and temperature fluctuations. It can be damaged by insects and microorganisms. Any such damage or deviation that affects its properties is considered a defect. When treated with flame retardants, wood becomes more fire-resistant. It can also be treated with antiseptics to prevent rotting, insecticides to protect from insects, and hydrothermal treatments to improve its technological and operational properties [2].

Wood-based composites outperform natural wood and most plastics but still face challenges due to their relatively short development history. While adhesives lower production costs, they can introduce new issues. These composites have higher density and fire resistance than natural wood but still fall short of fire safety standards. Adding flame retardants, especially halogen-free options like zinc chloride and ammonium sulfate, enhances fire resistance. However, water-soluble refractory salts limit their use to indoor applications. Despite these challenges, techniques like lamination and flame retardant treatments can significantly improve fire safety [3].

In conclusion, wood remains vital as a material with unique properties. While it offers durability, flexibility and aesthetic appeal, it also has limitations, such as susceptibility to fire, moisture fluctuations, and pest damage. Advances in treatments, including flame retardants, antiseptics, and hydrothermal processes, enhance its performance and firmness. Wood-based composites provide improved strength and fire resistance, though they still require further development to meet fire safety standards. Overall, optimizing wood's properties through innovative treatments ensures its continued relevance and sustainability.

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AMANITA MUSCARIA: ECOLOGY, CHEMISTRY AND MODERN USE

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Amanita muscaria, commonly known as fly agaric, is one of the most widely recognized mushrooms due to its distinctive red cap with white spots. This research explores its ecological, chemical and toxicological properties, as well as the cultural significance and common trends in its consumption. The study aims to provide a comprehensive understanding of *A. muscaria* by analysing scientific literature and understanding the tendencies surrounding its use as mentioned in Carboué and Lopez [1].

The research problem centres on the limited public understanding of *Amanita muscaria* and the essential role it plays in ecology and medical research. While it is a widely recognized mushroom, many people are aware only of its toxic nature. This division in society's perception presents challenges for environmental scientists, healthcare professionals and policymakers.

As stated by Policelli et al. [3], *A.muscaria* forms ectomycorrhizal association with a variety of tree species, contributing to forest ecosystem stability. Additionally, the mushroom accumulates heavy metals, making it a potential bioindicator for soil contamination. This finding is significant for environmental monitoring and conservation efforts.

Studies have also focused on the toxicology and pharmacological effects of *A. muscaria* consumption. Ordak et al. [2] conducted an extensive analysis of online discussions revealing an increase in the mushroom's use for home remedies and recreational purposes. Their research highlights gender differences in consumption, with men primarily using it for stress relief and women for pain management. However, adverse effects such as nausea, vomiting, and drowsiness were commonly reported, raising concerns about its safety.

In addition to modern research, *A.muscaria* has long been associated with spiritual practices and symbolic representations in various cultures as explained by Šultess et.al. [4]. Its prominent character has also influenced art, literature and modern media, often symbolizing mystery or danger. These cultural portrayals play an essential role in the continued fascination and modern-day appeal.

A comparative analysis of these sources demonstrates the dual nature of *A. muscaria* as both an ecologically valuable species and a controversial psychoactive substance. While its traditional use in shamanistic rituals is well established, modern usage patterns suggest a need for greater public awareness regarding its potential risks. Future research should explore regulatory measures and further pharmacological studies to assess its long-term effects.

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CHARACTERISTICS AND DISTRIBUTION OF *IMPATIENS GLANDULIFERA* ROYLE IN LATVIA

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Among various non-native and potentially invasive herbaceous plants found in Latvia, Himalayan balsam (*Impatiens glandulifera* Royle) has been widely discussed among researchers and the public due to its rapid spread across high-moisture habitats. This descriptive research aims to raise awareness of the effects of the Himalayan balsam species in forests and riparian habitats and the characteristics and distribution of its invasion in Latvia.

As this species name suggests, its native range is traced back to a harsher climate in the western Himalayan mountains region. During the 19th century, Himalayan balsam was brought to Europe for its decorative characteristics. It is widely accepted that this species displays significantly different growth patterns between its native range and warmer European climate. Himalayan balsam in Latvia can be found in habitats with increased soil moisture, such as riparian habitats, as well as nutrient-rich habitats like black alder forests. This species is an annual plant, however, its flowering period has a considerable length from late June till late October [1].

The key characteristic that defines this plant as potentially invasive in Latvia is the species' ability to reproduce at an intense rate. Himalayan balsam possesses a lot of nectar, which attracts pollinators, therefore, there is an increased chance that other native plants will not be able to effectively reproduce, further weakening populations. On average, one individual can produce around 500-2500 seeds, which can reach a distance of 3-5 metres. Though Himalayan balsam has many strengths to maximize its invasiveness, its weaknesses, such as its sensitivity to moisture levels in soil, cannot be ignored. During periods of prolonged drought or intense moisture level fluctuations, Himalayan balsam populations will begin to wither. The most effective method of limiting this species is mowing before the fruit can ripen [2].

The distribution of this species was actively studied only a few years ago, and the results of this research can still be used as a guide to evaluate the current situation. Areas heavily invaded by Himalayan balsam are typically weakened habitats around urban locations, such as the Lielupe River, Abava River, various smaller streams surrounding Liepāja, and coastal streams that flow into the Gulf of Riga. However, unlike in other European countries, Latvia's habitats aren't always favourable for Himalayan balsam. This observation is supported by a clear increase in distribution in regions of Latvia with slightly milder weather conditions. The distribution path of this species typically follows rivers that provide the right conditions for further migration [3].

There is a basis for believing that Himalayan balsam can have a lasting effect not only on the richness of flora and fauna species in the habitats it invades but also on soil quality. If the species invades forests, such as those with black alder, the vitality of saplings drastically declines. As new methods for combating these potentially invasive species have become better known, it remains important to continue researching the environmental impact of their presence.

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INNOVATIVE APPLICATIONS OF WOOD-DERIVED FIBRES

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Wood, as a lignocellulosic material with a hierarchically organized structure, has undergone significant modifications in the last decade to expand its application beyond the traditional construction and transportation sectors. Modern modification strategies focus not only on improving mechanical properties, but also on adding functional properties. The main point of this review is to analyse approaches to altered wool from different trees like spruce and birch because it has potential in eco-friendly construction materials and lightweight composites for automotive and packaging industries with a particular focus on using it as a fibre reinforcement in composite materials [1].

The mechanical properties of wood depend on the selected tree species, processing methods and preservation of fibre integrity. Wood which was experimentally obtained by planning very thin wood fibre from birch and spruce, which reached tensile strength very close to solid wood. When compared to traditional wood-polymer composites (WPC), wood wool offers greater elasticity while retaining high mechanical strength. Not only are the physical and mechanical properties of wood wool being studied, but also its chemical modification and functional adaptation possibilities. Structurally preserving delignification methods with the use of ionic liquids and deep eutentic solvents allow the formation of porous, hydrophilic materials that can be used in bioengineering composites. Vacuum densification and controlled drying methods also provide a combination of these properties [2].

It is very important because it indicates the potential of wood fibre as a high-value biocomposite material that can serve as an intermediate between traditional wood fillers and veneers. Its future applications may include flexible structural materials, biocomposites, and energy storage systems, expanding the possibilities of wood as a sustainable material in various fields of engineering [3]. Wood fibres are a byproduct of an industry that will directly and indirectly drive the economic transition to a sustainainable bioeconomy.

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POTENTIAL OF *QUERCUS SPP.* FOR TIMBER PRODUCTION IN LATVIA

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Due to the climate change, research on various tree species with potential economic value in Latvia is becoming increasingly common. As of now, the only financially viable oak species in Latvia are *Quercus robur* L. and *Quercus rubra* L. The aim of the research was to determine how well different species of oak can adapt and grow in the climate of Latvia. The following species and one cultivar was included in the research: *Q. macranthera* Fisch. et Mey., *Q. petraea* Liebl., *Q. libani* G.Olivier, *Q. coccinea* Muenchh. and *Q. robur* 'Timuki'. Some of these species are known for their fast growth and vegetative reproduction, e.g., stumps of *Q. coccinea* Muenchh. produce sprouts at an older age and larger size compared to most other oak species. They also produce a larger number of sprouts per stump, and these sprouts grow faster than those of most associated oaks, hickories and red maples [1]. *Q. coccinea* Muenchh. is also known for its brilliant red autumn colour [1] making it useful not only for timber but also for landscaping. Furthermore, the introduction of other oak species may provide the opportunity to utilize forest stands where the soil may not be preferred by other species, e.g., *Q. petraea* Liebl. shares a wide common range of occurrence with *Q. robur* L., but it is more frequent in mesotrophic and poor mesic forests [2]. The increasing demand for oak wood products and the reduction of natural forests have influenced the development of modern silviculture [3]. Oak species possess the capacity to produce large volume of valuable timber. In Latvia, forest stands where the dominating species is *Q. robur* L. are considered as protected habitats and therefore cannot be commercially exploited [4], but other oak species do not have this restriction, therefore introducing more oak species to Latvia would prove invaluable to the timber industry. To conclude, this research aims to find out which of the aforementioned oak species are best suited for the climate in Latvia with the goal of later introducing these species to the nature and thus benefitting the timber industry.

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EVALUATION OF THE STEM QUALITY OF *FAGUS SYLVATICA* L. AND ITS EFFECT ON ECONOMIC GAIN

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The natural range of European beech (Fagus sylvatica L.) may expand northward into regions such as Latvia due to the climate change, which is expected to create more favourable growth conditions (Jansone et al., 2021). This shift could provide significant ecological and economic benefits, as beech wood is highly valued in industries such as furniture, flooring, veneer production, and more (Puriņa et al., 2017). Key factors influencing the economic value of beech timber include stem quality, with traits such as branches, wood colour, and structural integrity playing important roles in determining market price (Jansone et al., 2021). Forest management practices and site conditions further influence timber quality and productivity, which are critical for maximizing the financial return from beech stands (Rais et al., 2022).

The aim of this research is to collect and analyse information about the stem quality characteristics of Fagus sylvatica in Latvian conditions and to evaluate how they influence the economic value of individual trees and stands. Given that stem quality directly affects the assortment structure and price of timber, understanding its variability is crucial for effective forest management and economic optimization. The research problem lies in the need to predict and improve the quality characteristics of beech stands under changing climatic and market conditions, ensuring their profitability and sustainable use. As beech is a relatively new species for Latvian forestry at a broader scale, knowledge about its growth, quality formation, and economic potential is still limited and requires systematic investigation.

Globally, the demand for high-quality hardwood is growing, particularly due to increased consumption in Asia and changing market dynamics within Europe. While European countries have traditionally been the major suppliers of beech timber, the importance of sustainable forestry practices is rising in response to environmental concerns and regulatory pressures. At the same time, competition from other wood species and shifts in international trade policies may influence the future of beech wood exports. Understanding how variations in stem quality impact the economic value of beech timber is crucial for optimizing forest management strategies and ensuring the long-term profitability of beech stands (Puriņa et al., 2017). Knowledge of timber properties also aids in the standardization of the timber industry, enhancing the reliability and consistency of mechanical properties such as strength and durability (Rais et al., 2022). As the climate change continues to affect forest ecosystems and timber markets evolve, adaptive forest management practices will be essential to maintaining the sustainability and economic value of beech forestry in Europe and beyond.

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GROWTH OF YOUNG LOW DENSITY EUROPEAN ASPEN (*POPULUS TREMULA* L.) STANDS

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European aspen is a fast-growing, light-demanding broad-leaved softwood species native to boreal regions and cooler areas, such as the temperate zones of Europe and Asia. As a pioneer species, it is often among the first to colonize areas following disturbances like windbreaks, windfalls, wildfires, or clear cuts [1].
The European aspen (*Populus tremula* L.) is often considered an important component of the forest ecosystem due to its essential role for the benefit of other plant and animal species. It is one of the most attractive tree species for large herbivores as a food source. Aspen wood is also very valuable and is used in the production of furniture, paper, construction materials, and even firewood. Due to all these good qualities, the aim of the study is to determine how different density of young aspen stands affect the growth process and animal attraction [1].
For successful growth, choosing the right growing site is crucial, as aspen requires light, and its vegetation period is long. The young tree shoots, buds and bark provide nutrients and vitamins for forest animals during the winter season, which is why the successful development of these trees from a forestry perspective is at risk [2]. In this case, measures are needed to protect the trees from hoofed animals browsing, using both repellents and plastic protective tubes, plastic spirals, as well as fencing the areas [2].
Aspen grows rapidly, especially its first 15-20 years, when crown competition starts to increase. Crown competition is affected by the distance at which the trees are planted from each other [1]. Initial density determines the shape of the tree trunk, trunk volume, diameter and height growth, wood quality and the potential risk of ungulate damage. If the objective of the stand is to achieve maximum wood yield, as is the case with energy wood plantations, then high-density plantings should be established. However, if the goal is to obtain larger dimension roundwood the initial density should be lower [3]. The decrease in tree height growth indicates that if thinning is not carried out in a timely manner, over-dense young forest stands are expected to experience a reduction in growth rate [4].
Low initial density of aspen stands can promote faster growth and a more uniform trunk shape, but it also increases the risk of ungulate animals caused damage and potential wind damage. The correct choice of initial stand density depends on forest management objectives whether aimed at fast wood production, improving biodiversity, forest science or other factors.

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WOOD FLAWS: TYPES, CAUSES AND IMPACT ON WOOD QUALITY

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Wood quality can be affected by various factors throughout its lifecycle, including environmental conditions, fungal and insect attacks, improper seasoning and faulty conversion. These defects can significantly impact the strength and suitability of timber for construction and other uses. This research aims and highlights the main causes of wood defects and their effects on timber quality.

First of all, trees are vulnerable to defects from soil, climate, accidents, as well as attacks by fungi, insects, or animals, which can affect the quality of wood. After reaching maturity, trees often experience internal deterioration, leading to decay. Once felled, shrinkage and fungal attacks can cause serious defects in the timber. While insect and fungal attacks on leaves may harm seedlings, they typically only affect tree nutrition in mature trees, reducing wood production but not significantly impacting timber quality for most users [1].

Moving on, defective seasoning of timber can cause serious issues, as improper drying leads to stress from differences in shrinkage between the surface and interior. This results in defects like bows (curvatures along the length), cups (curvatures across the width), checks (small cracks between fibers), splits (cracks extending end-to-end) and honeycombing (cracks in the heartwood). Additionally, defective conversion can lead to problems like boxed heart (pith in the centre throughout the length), machine burnt (overheating), machine notches (improper handling), miscut (erroneous sawing) and imperfect grain (misaligned grain) [2].

Lastly, it is important to mention impacts on wood quality. Horizontal cracks along the length of sawn timber significantly impact its strength. The size, depth and length of these cracks are critical in assessing their effect on load-bearing capacity, with deeper and longer cracks leading to greater strength deterioration. Additionally, the slope of the grain, which indicates deviation from the wood's longitudinal axis, weakens the material's mechanical strength, reducing its ability to carry the intended loads in structural applications [3].

In conclusion, wood defects arise from various factors during the growth, processing and seasoning stages, each of which can compromise the quality and strength of timber. Environmental conditions, fungal and insect attacks, improper seasoning, conversion errors all contribute to weaknesses in the wood. These defects, such as cracks, curvatures, grain misalignment can significantly reduce the load-bearing capacity and suitability of timber for construction. Understanding the causes and effects of these defects is crucial for improving timber quality and ensuring its reliable performance in structural applications.

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SOIL PROPERTIES IN GREY ALDER (ALNUS *INCANA* (L.) MOENCH) STANDS ON ABANDONED AGRICULTURAL LAND

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Grey alder (*Alnus incana* (L.) Moench) is one of the most common so-called pioneer tree species in Latvian conditions, which is rapidly taking over abandoned agricultural land, especially drainage ditches and banks of natural watercourses. The species is able to grow in soils of a wide variety of granulometric composition from sand to clay soils. Of course, the productivity of a tree stand differs in different soils. It is generally accepted that grey alder grows well in moderately moist, loose and humus-rich sandy loam soil [3]; it is often growing in the clearcut areas, especially in fertile soils corresponding to meadows, heaths and other types of forest growth conditions. The previous information gives evidence that both mesotrophic and eutrophic growth conditions are suitable for grey alder growth [2].
Studies have been conducted in Latvia on changes in soil physicochemical properties in plantations of land not used for agriculture, including the long-term impact of afforestation [1]. In the study on the growth of grey alder stands in agricultural lands overgrown with woody plants, which was initiated in 2024, nine pure grey alder stands with an age of 37-52 years were selected, 3 of which were located in drained agricultural land, 3 were located in drained forest land and 3 were found on the forest land along rivers. All stands were located in Kuldīga Region, Kabile Parish approximately 3 km apart each from another.
The obtained results indicated a high content of organic matter in the soil Horizon A (10-20%). It exceeded 20% in the soil humus layer, and it even reached 30% in individual stands. The granulometric composition in the upper mineral horizons was mainly silt loam, clay loam or clay in the deeper horizons. The soil exchange reaction pH in the soil humus layer and mineral horizons was from neutral to slightly acidic (on average pH 6). The soil in the upper mineral horizons was from low to medium carbonatic ($CaCO_3$ content in the soil on average is 1.8%). In all stands, gleyic properties were detected in the mineral horizons of the soil, which was determined by the soil saturation with water caused by the high groundwater level. The soil, according to the Latvian Soil List, in the studied grey alder stands was classified as a humi-gleyic soil or a humi-gley soil. According to the current version of the World Reference Base, the soil was classified as corresponding to the reference soil groups Phaeozem, Gleysol and Umbrisol.

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HETEROBASIDION SPP. CAUSED ROOT ROT IN CONIFEROUS FORESTS OF NORTHERN EUROPE

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Forest pathogens are capable of destruction of forest ecosystems, resulting in reduced forest health and productivity, increasing widespread tree mortality and diminishing overall biodiversity. In coniferous forests of Northern Europe, pathogens from the *Heterobasidion* genus, most commonly *Heterobasidion annosum* and *Heterobasidion parviporum* are some of the most devastating causing stem, butt and root rot. The aim of this descriptive research is to summarize and evaluate the knowledge on the topic.

Modern forestry has contributed to a high frequency of *Heterobasidion spp*. pathogen infections due to year-round logging operations that expose fresh stump surfaces. Another anthropogenic factor is the afforestation process on previously used agricultural land. Due to the chemical composition differences and fungi background – significant lack of antagonistic organisms, the planting can happen on infested sites, thus endangering the new generation of trees and risking a further spread to adjacent areas [2]. After the infection, further disease development largely depends on forest management practices.

H.annosum and *H.parviporum* generally display different host preferences: *H.annosum* is commonly associated with pines (especially Scots pine *Pinus sylvestris* L.) although it can also infect Norway spruce (*Picea abies* (L.) H.Karst.), but *H.parviporum* prefers and mainly infects Norway spruce (*Picea abies* (L.) H.Karst.) [1]. Biological control agents are advised over chemical treatments and stump removals that entail negative consequences for the surrounding environment and biodiversity. The most effective and widely used treatments contain the fungus *Phlebiopsis gigantea* (Fr.) Jülich. It is a saprotrophic basidiomycete fungus, naturally occurring and widely distributed in the conifer forests of Northern Europe, and is a very effective competitor of *Heterobasidion spp*. on a fresh stump surface [3]. Commercial formulations contain asexual spores (oidia) and fragments of mycelium of *Phlebiopsis gigantea*.

In conclusion, the issue of *Heterobasidion spp*. caused root rot, even with control measures from forest management, will have to be dealt with for an indefinite time. Even though it is not possible to eliminate it from forest stands, advising felling timing restrictions (avoiding sporulating periods), planning forest management operations in sync with pathogens' life cycle and activity periods, as well as using and developing control agent methods, especially furthering the research on different biological control agents, local strains of *P.Gigantea* and other alternatives are important to fully unlock the potential of protection and prevention against *Heterobasidion spp.* caused root rot.

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FOOD SCIENCE

THE STUDY ON IMMUNOGLOBULIN SEPARATION TECHNIQUE FROM BOVINE COLOSTRUM

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Immunoglobulins (Ig) play an important role in the immune system by protecting the body from pathogens and other harmful substances. There are five main classes of Ig, namely IgG, IgA, IgM, IgE and IgD. Each of them plays a different role in the immune response. Bovine IgG from colostrum may be one of the ways to boost passive immunity against diseases in animals and humans [1]. The aim of this study was to evaluate the technique of IgG separation from bovine colostrum using a multicascade approach.

The colostrum samples were separated using a disc bowl centrifuge (Armfield, UK). One part of the skimmed colostrum was diluted 1:1 with deionized water and the caseins were precipitated with 0.5 M HCl at a pH of 4.6. The acidified samples were centrifuged at 2300 g for 30 minutes using the CM-6MT Skyline centrifuge and the supernatant was micro filtrated using the FT17 Cross Flow Membrane System (Armfield, UK). The second part of the skimmed colostrum was diluted 1:1 with deionized water and the casein was precipitated with a 1% solution of LL (CHY MAX Ultra 1000, Chr. Hansen, Denmark), then the coagulum was centrifuged under the same conditions, and the supernatant was further microfiltered. Ammonium sulphate and sodium sulphate were added to both micro filtrated permeates to precipitate whey protein. The samples were centrifuged at 2300 g for 30 minutes. The supernatant was discarded, the pellets were washed with equal amounts of ammonium sulphate and sodium sulphate and the samples were ultrafiltered using the FT17 Cross Flow Membrane System (Armfield, UK) to concentrate IgG. The isolation technique was taken from [2] and modified to obtain more accurate results.

The total solids concentration ranged from 3.0 °Brix in the colostrum sample precipitated with HCl to 3.1 °Brix in the colostrum sample precipitated with the rennet solution. The IgG concentration in the colostrum sample precipitated with two antibody reagents and 47.5 g/L in the samples found by absorbance analysis.

The results of the study confirmed the IgG separation technique and similar IgG results were also observed by other authors.

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QUALITY CHARACTERISTICS OF PASTA SUBSTITUTED WITH CHICKPEA AND ALMOND FLOUR

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In the modern world, where eating habits are changing, consumers are increasingly opting for healthier foods. Pasta is a popular everyday food, especially among children and teenagers. Pasta is traditionally made only from wheat flour, but it can be made by adding other functional ingredients to increase its nutritional and functional value compared to regular pasta. Functional foods offer a great opportunity to improve product quality by replacing part of the wheat flour in pasta products with functional, valuable flour sources, tomatoes and spinach [1], spinach [2]. The aim of this study was to compare the quality characteristics of pasta when part of the wheat flour was replaced by chickpea and almond flour. Three pasta samples were prepared and tested: S0 – the control sample of wheat flour (Kauno grūdai, Lithuania), S1 – wheat flour (75%) and part was replaced with chickpea flour (15%) (BauckHof, Germany) and almond flour (10%) (USA), S2 – wheat flour (75%) with chickpea flour (10%) and almond flour (15%). The chemical composition of all pasta samples was calculated based on the chemical composition of the raw materials. All samples were cooked at boiling temperature for 5 minutes and the product quality was analyzed. Standard procedures were used to evaluate moisture content and rehydration rate. Cooking losses were estimated by measuring the dry matter content in the cooking water using an ATAGO refractometer (Japan). The salt content (sodium chloride) was determined by titrating the boiling water with silver nitrate. The color of all samples were determined before and after cooking using a "Lovibond LC100/SV100" colorimeter. The starch fermentation of wheat, chickpea and almond flour was also investigated.

The study showed that the cooking loss and salt content were similar in all samples tested. The highest moisture content was found in the control sample and the lowest in the sample with 10 % chickpeas and 15 % almonds, which is due to the higher fat content in the almond flour. The rehydration rate was lower in both samples with chickpeas and almond flour, which means that the product remains firmer after cooking than in the control sample. The salt content in the pasta is a very important indicator for extending the expiration date of the product. The research result shows that the salt content changes slightly after cooking in all three samples. The fermentation of chickpea and almond flour was faster than that of wheat flour at the same enzyme concentration. The colorimetric studies showed that before cooking, the highest L* value (0-100: black to white) occurred in the control sample and the lowest L* value occurred in sample S2, the a* values (-a to +a: color from green to red) were similar in all samples, the b* values (-b to +b: color from blue to yellow) were lowest in the control sample and highest in sample S1. Color is important for the visual appeal of the product, and it was found that sample S1 had the best color retention after cooking.

In summary, replacing part of the wheat flour in pasta with chickpea and almond flour enriches the product with more protein, fat, fiber and essential fatty acids than pasta made with wheat flour.

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BIOCONVERSION OF ACID WHEY FOR YEAST-BASED SINGLE-CELL PROTEIN PRODUCTION

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The increasing demand for sustainable protein sources has highlighted the potential of dairy by-products such as acid whey. Despite its high lactose content and nutritional value, acidified whey is underutilized in the food industry and often contributes to environmental pollution if not properly utilized. Recent studies emphasize the feasibility of microbial protein production from whey and position it as a promising solution in sustainable biotechnology [1]. Study investigates the bioconversion of clarified acid whey permeate into unicellular protein using two lactose assimilating yeast strains, *Cyberlindnera jadinii* MSCL 87 and *Kluyveromyces marxianus* MSCL 79, under different substrate processing conditions.

The study was conducted from February to April 2025 at the Food Institute of Latvia University of Life Sciences and Technologies. The acidified whey used for the experiments was obtained from Tukuma Piens (Latvia). The composition of the whey was determined using the MilkoScan™ Mars (Foss, Denmark). The clarified acid whey permeate was obtained by ultrafiltration FT17-50 (Armfield, UK) and concentrated under vacuum to a total solids content of 13% and 20% (Laborota 4000, Heidolph, Germany). Each substrate batch was further processed into hydrolyzed and unhydrolyzed samples. Lactose hydrolysis was carried out with β-galactosidase NOLA™ Fit 5500 (Chr. Hansen, Denmark) at 37 °C and pH 5.0. Fermentation was carried out in the Multifors 2 bioreactor (INFORS-HT, Switzerland) at 30 °C, pH 5.0, 70 rpm, for 72 hours. The yeast strains were inoculated in a volume of 1 µL to 400 mL. The biomass was separated by centrifugation, then dried at 60 °C and used for further analysis. The moisture content was determined gravimetrically, while the protein content was analyzed using the Kjeldahl method.

Cyberlindnera jadinii MSCL 87 showed higher yields of wet biomass on hydrolyzed substrates, reaching up to 31.20 g/L at 20% solids. The highest protein content (28.64%) was obtained at 13% solids with hydrolysis. In all cases, lactose hydrolysis resulted in improved protein content compared to the corresponding unhydrolyzed samples, although the effect was more pronounced at lower solids levels.

Kluyveromyces marxianus MSCL 79 showed a condition-dependent response to substrate composition. At a solids content of 13%, hydrolysis increased the yield of wet biomass from 9.72 g/L unhydrolyzed to 16.09 g/L hydrolyzed, with a corresponding increase in protein content from 46.23% to 48.69%. At 20% solids, the hydrolyzed substrate resulted in a higher protein content (25.43%) compared to the unhydrolyzed state (8.27%), although biomass formation was lower between 24.55 g/L and 39.49 g/L. *K.marxianus* showed a measurable shift between biomass yield and protein content depending on the substrate conditions.

The study showed that both substrate solids and lactose hydrolysis affect unicellular protein production. While *C.jadinii* benefited more from hydrolysis in terms of biomass formation, K. marxianus responded to substrate conditions with opposite trends in biomass yield and protein content. This illustrates the sensitivity of the strain to substrate processing and nutrient allocation. The results contribute to further optimization of acid whey bioconversion strategies for unicellular protein production.

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DEVELOPMENT OF GARLIC CONFIT

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Confit is a preservation technique in which salt is used and the ingredients are cooked slowly in fat. This method is traditionally used to preserve meat in its own fat. The most well-known example is duck confit, but the term “confit” can also describe any other ingredient that is slow-cooked in fat or oil [1]. Garlic confit is most commonly used in French cuisine and is prepared in small quantities, but its popularity is slowly increasing. Therefore, a study was developed to improve production efficiency in the production of garlic confit, with the aim of reducing the heat treatment process, production time and raw material consumption.

A total of 9 samples were prepared for this study. The samples differed according to the type of oil used – rapeseed, sunflower and olive oil. All samples were thermally processed at 100°C, with holding times of 30, 40 and 50 minutes. The samples were analysed 24 hours after preparation and after 30 days of storage at room temperature. The quality of the prepared samples was analysed based on microbiological safety, colour, water activity, peroxide value and structure.

The data obtained showed that all garlic samples had elevated yeast and mould counts after 30 days, which could indicate that the selected sterilisation temperature, time or technological process as a whole was not sufficient to produce a microbiologically stable product. Water activity showed no significant changes between samples and ranged from 0.847 to 0.865. The highest peroxide value 24 hours after preparation was found in the samples prepared with olive oil and a 30-minute sterilisation - 5.30 meq O2 kg-1 and the same trends were found after a 30-day storage, where the peroxide value had increased to 6.97 meq O2 kg-1. Other samples also showed at least a twofold increase in peroxide value after 30 days of storage. No significant colour changes were observed in the samples during storage. The data obtained on the structure of the samples showed that the firmness of the garlic cloves decreased with prolonged thermal processing and after 30 days of storage. The highest firmness 24 hours after preparation was observed in samples prepared with olive oil and sterilised for 30 minutes. A force of 2.3 N is required to cut the garlic cloves in half. The greatest reduction in firmness was observed in the samples processed with olive oil, while relatively higher structural stability was maintained with rapeseed oil.

In summary, it can be said that the technological steps chosen to improve production efficiency were unsuccessful, as the modification of the technological process led to a deterioration in product quality. Overall, the type of oil, temperature, processing time and storage time have a significant impact on microbiological safety, garlic texture and peroxide value. The reduction of heat treatment has a significant impact on product quality and safety. Further research should be carried out to produce a more acceptable product.

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EFFECTS OF DIFFERENT HEAT TREATMENTS ON QUALITY OF SALMON WITH LEMON PEEL EXTRACT

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The quality of fish and fish products is very important to consumers, so preserving the texture, moisture and delicate flavours of these products is of great importance. In the article [1,2], the authors argue that using sous-vide (SV) cooking methods, it is possible to prepare products with more biologically active compounds, with higher nutritional value, brighter colours, textural and sensory properties than conventional cooking methods.
The aim of the study was to assess the differences in the quality characteristics of salmon with lemon peel extract using sous vide technology and conventional cooking methods.
The chilled salmon filet used in the study was purchased from Rimi supermarket (Lithuania) and the lemon peel extract was produced from lemon peel using the Naviglio extractor. Three salmon samples (100 ± 5 g) were prepared with salt, Senegalese pepper, persillade, coriander and lemon extract and cooked with different heat treatments: oven cooked (CSO, 180 °C 20 min), processed sous vide at different temperatures (SVS1, 55 °C 60 min, SVS2, 60 °C 50 min). The quality parameters were analysed to compare the effects of cooking on salmon quality: Determination of moisture with a hydrometer, yield of the process, colour parameters with a colorimeter "Lovibond LC100/SV100" before and after cooking and sensory evaluation.
The tests showed that the moisture content decreased in the sample CSO but was not significantly altered in the SVS1 and SVS2 sous-vide cooked samples compared to fresh fish. The yield of the process was lowest when cooking in the oven (CSO - 90.8%) and highest when cooking in the SV (SVS1 – 94.5%). Sample SVS2 had a higher L* value than SVS1 and CSO and was determined to be 69.4 ± 0.52, 67.8 ± 0.73and 64.6± 0.68, respectively. A higher L* value means brighter colour. The change in a* values (-a to +a: colour from green to red) was similar for the two SV samples (SVS1 – 4.1± 0.76, SVS1 – 3.95 ± 0.82) and CSO had a higher value (CSO – 4.6± 0.83). The change in b* values (-b to +b: colour from blue to yellow) was similar to a* for all samples. The cooking process causes denaturation and aggregation of sarcoplasmic and myoglobin proteins, which reduces brightness and causes colour changes compared to fresh fish. Consumers (n=12) participated in a sensory evaluation to assess consumer response to the texture, taste and appearance of the product using an emotional test on a 5-point scale. The CSO sample was rated with a total of 7 points, SVS1 - 12.5 points, SVS2 - 11.5 points. Based on the research data and sensory evaluation by consumers, it can be concluded that the salmon sample prepared in SV at a temperature of 55 °C for 60 minutes is the softest, retains moisture, fish and spice flavour.

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VETERINARY MEDICINE

ANTIBIOTIC RESISTENCE OF INDICATOR ORGANISMS IN PRIMATES AT RIGA NATIONAL ZOO AND MALTA WILDLIFE PARK

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Nowadays, mainly due to the excessive and inappropriate use of antibiotics in human medicine, veterinary medicine, and food production, antimicrobial resistance (AMR) has developed, posing a major threat to both public and animal health. Zoos and wildlife parks house a high density of animals from various species in relatively small areas, creating a favourable environment for the development and spread of AMR.

The aim of this study is to assess the antibacterial resistance of primates from two institutions: Riga National Zoo and Malta Wildlife Park. This study evaluated AMR in microorganisms obtained from faeces, water, and soil samples from four primate enclosures at Riga National Zoo, and faeces from five primate enclosures at Malta Wildlife Park. The isolated bacterial species were identified using MALDI-TOF and subjected to a disk diffusion test.

High resistance has also been documented in the literature in captive primates. For example, 93.7% of *Salmonella* spp. isolated from Iranian zoo animals (32) showed resistance to at least one of the antibiotics tested [2]. Resistance genes for the third-generation cephalosporin cefotaxime were detected in several primates kept in Chinese zoos—including five squirrel monkeys (*Saimiri*), two brown capuchins (*Sapajus apella*), and one gibbon (*Hylobatidae*) [1].

In this study, 95% of bacteria isolated from Riga National Zoo were resistant to at least one of the antibiotics tested. Gram-positive isolates from Riga showed high resistance to ampicillin (70%), cephalexin (100%), and amikacin (60%). The AMR observed at Malta Wildlife Park is particularly concerning, as resistance was detected against antibiotics that are critical in human medicine. A 100% resistance rate was observed against Category A antibiotics (as classified by the European Medicines Agency), including vancomycin and linezolid, along with high resistance to antibiotic combinations—78% against trimethoprim-sulfamethoxazole. None of the isolates from either country showed resistance to meropenem. Multi-drug resistance (MDR) was also observed in both locations—35% at Riga National Zoo and 89% at Malta Wildlife Park.

Antimicrobial resistance is a major and growing global problem. To slow its spread, coordinated plans and continuous monitoring are required at local, national, and global levels. Due to the large number of animals, the high number of visitors, challenges in determining the correct dosage of medications, and other factors, zoos may significantly influence the development and spread of AMR and MDR. The high prevalence of resistance in environments housing captive wildlife suggests that locations such as zoos, national parks, animal collections, and similar facilities with large animal populations should be included in the development of AMR control measures.

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MILK UREA RELEVANCE TO MILK QUALITY AND AMMONIA EMISSIONS IN DAIRY COWS

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Ammonia (NH_3) gas production has been increasingly studied in recent years due to growing concerns about greenhouse gas (GHG) emissions. On dairy cattle farms, NH_3 is primarily produced as a by-product of protein metabolism, especially when there is excessive protein intake in the feed. Milk urea (MU) is not only an indicator of milk quality but also reflects the amount of NH_3 gas potentially produced [3].

This study aimed to investigate the potential NH_3 emissions in relation to milk urea levels and their relevance to milk quality. Milk parameters—including yield, milk fat (MF), milk protein (MP), the MF/MP ratio, somatic cell count (SCC), and milk urea (MU)—were collected from a 1,900-cow Holstein dairy farm (HM) with an average milk yield of 14,000 kg/cow/year in January 2025. The potential production of NH_3 was calculated using formulas recommended by other authors [1].

MU reference values were set between 15–30 mg/dL [2]. Data statistics (mean, standard deviation, correlations, and two independent sample t-tests with a significance level of $p < 0.05$) were calculated using Excel 2019 to compare milk parameters between low (L) and high (H) MU-level cow groups. The milk parameters between the L and H groups were as follows: MF 4.3±1.04 vs 4.4±0.87%, MP 3.8±0.85 vs 3.8±0.44 %, MF/MP 1.1±0.29 vs 1.2±0.23 respectively. Differences in these parameters were not statistically significant $p>0.05$. Other parameter differences were statistically significant: milk yield 43.7±2.00 vs 38.6±9.97 kg/day, SCC 428.0±344.73 vs 53.1±55.18 thousand/ml, MU 13.3±2.52 vs 37.3±2.01 mg/dL, calculated NH_3 56.0±6.08 vs 112.7±4.62 g/day per cow, and NH_3 g/kg of milk produced 1.3±0.17 vs 3.2±0.96 g respectively, $p<0.05$. Statistically significant ($p<0.05$) correlations were found between milk yield and NH_3 g/kg of milk ($r=-0.86$) and between MP and NH_3 g/kg of milk ($r=0.44$).

This study confirms that highly productive cows excrete lower levels of NH_3 due to more efficient protein utilisation. Furthermore, MU is not only a parameter for managing effective protein use to optimise productivity but also serves as an indicator for monitoring GHG emissions in relation to milk production on dairy farms.

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COMPARISON OF INTRAOCULAR PRESSURE VARIATIONS DURING MINOR OPHTHALMIC PROCEDURES UNDER THREE DIFFERENT PREMEDICATION PROTOCOLS

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In ophthalmic surgery, the impact of anaesthetic drugs on intraocular pressure (IOP) is a significant concern. Anaesthetic agents have diverse effects on IOP, making the selection of appropriate drugs crucial for maintaining optimal IOP levels [1, 2]. The aim of this study was to investigate IOP dynamics during minor ophthalmic procedures involving mild pain (e.g., third eyelid or minor eyelid surgeries), using three different standard protocols for intraoperative analgesia.

Research methods: the study was conducted from March, 2023 to December, 2023 at Veterinary Clinic of the Latvia University of Life Sciences and Technologies in Jelgava, Latvia. The study population consisted of 30 dogs of various breeds and sexes (19 male, 11 female), both castrated and intact, aged between 4 months to 11 years, with body weights ranging from 7,8 to 77 kilograms (25.9 ± 19.1 kg). Dogs were randomly assigned in one of three premedication protocols, with ten animals in each group. B group: butorphanol 0.2 mg/kg. BM group: butorphanol 0.2 mg/kg and medetomidine 0.005 mg/kg. BA group: butorphanol 0.2 mg/kg and acepromazine (ACP) 0.02 mg/kg

IOP was measured using rebound tonometry at the following time points: before surgery (T_0), five (T_5) and ten (T_{10}) minutes after premedication, after intubation (T_{int}), before performing the surgical incision (T_{bsur}), after surgery (T_{asur}), after extubating (T_{ext}) and before leaving clinic (T_{lea}). Statistical analyses, including t-tests and Pearson correlation, were performed to assess differences within and between groups.

Results: Changes in IOP were observed at different time points across groups. B group: IOP significantly increased from T0 (15.55 ± 3.50 mmHg) to Tint (19.3 ± 4.19 mmHg) ($p < 0.05$). BM group: IOP increased from T0 (15.9 ± 2.77 mmHg) to Tint (19.15 ± 4.52 mmHg), but significantly decreased postoperatively at Tasur (13.5 ± 3.50 mmHg). BA group: IOP significantly decreased from T0 (20.35 ± 2.78 mmHg) to Tbsur (16.45 ± 3.97 mmHg) and Tlea (17.15 ± 4.22 mmHg).

No significant differences were observed in IOP between the left and right eyes and no correlation was found between IOP and sex, breed, or age.

Conclusion: Throughout the perioperative period, IOP remained within normal physiological ranges in all groups. The combination of ACP and butorphanol provided effective perioperative IOP control. ACP was particularly effective in mitigating the IOP elevation associated with tracheal intubation, suggesting its potential benefit for patients at risk of corneal perforation. To optimize surgical outcomes, premedication protocols should prioritize medications that cause minimal fluctuations in IOP.

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INVESTIGATION OF WILD BIRD ADMISSIONS TO THE WILDLIFE CARE CENTER IN LATVIA IN 2024

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This retrospective study aims to identify the reasons wild birds were brought into a wild bird rescue center in Latvia in 2024.

In recent years, bird populations across Europe have tended to decline, including common species such as the House Sparrow (*Passer domesticus*) and the Common Starling (*Sturnus vulgaris*). However, in some areas, certain species like the Eurasian Spoonbill (*Platalea leucorodia*) and the White Stork (*Ciconia ciconia*) have been recovering and thriving [1, 2]. Recent studies indicate that over 40% of wildfowl and wader species, over 30% of seabirds, and approximately 25% of raptors are experiencing population declines in Europe. The primary causes of these declines include large-scale land use changes, widespread agricultural expansion, infrastructure development, overfishing, inland water pollution, and unregulated forest management [3].

A total of 2.442 bird admissions were recorded in 2024. Of these, 1.139 birds (46.6%) were admitted from Riga and nearby areas such as Ķengarags, Jūrmala, Salaspils, Mārupe, Babīte, Olaine, Baloži, Ķekava, Carnikava, and Ādaži.

The most commonly admitted species were Rock Doves (*Columba livia*) (22.7%), European Herring Gulls (*Larus argentatus*) (22.4%), and Common Swifts (*Apus apus*) (7.4%). Notably, 7.6% of all birds admitted belonged to species classified as vulnerable: 180 Common Swifts, 2 Velvet Scoters, 2 Long-Tailed Ducks, and 1 Red-Footed Falcon.

The admission cases were categorized into six main groups – injury, attack, helpless state, chick or juvenile, human-induced hazards and infection/disease. The results indicate that 29.95% of admissions were due to injury, 9.08% from attacks, 11.58% for helplessness, and 27.18% involved chicks or juveniles. Human-induced hazards accounted for 1.76% of admissions, while infections or disease were responsible for 2.64%. The remaining 17.82% of birds were admitted without clear information or diagnosis at the time of entry.

These percentages underscore the clear dominance of urban-adapted bird species in rescue center admissions, reflecting critical human-wildlife interactions and highlighting the urgent need for conservation actions aimed at mitigating human-induced threats.

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ASSESSING INBREEDING LEVELS IN GENETICALLY TESTED HOLSTEIN COWS IN LATVIA: IMPLICATIONS FOR DAIRY FARMING AND GENETIC DIVERSITY

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Over the past decade, global genetic tendencies have shown a significant shift towards the use of related sires to maximise desirable traits. This practice has also been adopted in Latvia, raising concerns among farmers about potential increases in inbreeding levels within the local Holstein cow population. The objective of this study was to analyse and compare the genomic inbreeding levels of genetically tested heifers born in 2023 and 2024. Pedigree inbreeding refers to the probability that an individual inherits two randomly sampled alleles from a given ancestor [1]. Populations managed under breeding programs that rely on pedigree data rather than genomic data tend to show higher inbreeding levels, due to unreliable pedigree records and the selection of sires that appear unrelated by pedigree but may actually share homozygous genes. Crossbreeding between different breeds or non-elite sires should be implemented to reduce genetic inbreeding requests. Moreover, their sons are frequently used for artificial insemination, further narrowing the gene pool [2]. Although the increase in inbreeding resulting from the use of elite sires may be outweighed by their economic benefits, the long-term effects on genetic diversity remain a concern. While using non-elite sires can help reduce inbreeding, farmers may be hesitant due to the perception of lower economic returns. Materials and methods: genome testing was performed at the Genetic Visions-ST™ laboratory in Wisconsin, USA, on 136 animals born in 2023 and 2024. The genomic inbreeding level (gINB) and genomic expected future inbreeding (gEFI) were analysed in relation to animal age (months) and productivity, measured by over-base cow values in the USA (kg). IBM SPSS 21 software was used to calculate the mean, standard deviation, two-tailed correlation, and perform a Mann-Whitney U-test to compare two independent groups. Statistical significance was set at $p < 0.05$. Results: the mean gINB values for animals born in 2023 and 2024 were 10.7 ± 2.78 and 11.8 ± 3.29, respectively. The gEFI values were 11.4 ± 0.76 and 11.74 ± 0.62, respectively ($p < 0.05$). Productivity, as measured by over-base cow values, increased from 1582.0 ± 477.05 kg in 2023 to 1829.6 ± 432.73 kg in 2024 ($p < 0.01$). Statistically significant correlations were observed between gINB and gEFI ($r = 0.57$), and between gINB and over-base productivity values ($r = 0.23$, $p < 0.01$).
Conclusions: this study reveals that inbreeding is a growing concern in the local Holstein cow population in Latvia. Greater attention should be paid to monitoring inbreeding levels and implementing strategies to reduce inbreeding in the future, in order to prevent the associated negative consequences.

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INFRARED THERMOGRAPHY AS A DIAGNOSTIC TOOL FOR THE ASSESSMENT OF SUBCLINICAL MASTITIS IN GOATS

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Mastitis is considered a major problem that threatens goats` health and can cause significant economic losses on the farms. There are no clinical signs in the case of subclinical mastitis, except noting the milk reduction and increased somatic cell count (SCC) [1]. Infrared thermography (IRT) is a non-invasive method that can be used as a diagnostic tool for mastitis, and is easy to use on site, having the results immediately. With thermography, it is possible to determine the temperature of a particular area, quickly identify abnormal deviations in body surface temperature distribution, locating sites of the pathological or physiological processes, visualize perceived infrared reflection at various levels and obtain useful information on inflammatory sites or thermoregulatory processes [1, 2]. The aim of the study was to assess the use of infrared thermography (IRT) in the diagnosis of subclinical mastitis in goats and to determine its effectiveness by analyzing changes and anomalies in the surface temperature of the udder, in association with the SCC, and the results of the California mastitis test (CMT). Data were collected from 17 goats, ranging from their 1st to 7th lactation, during the last month of lactation. The goats were milked manually once a day. Each goat`s udder was tested using the CMT. SCC data were obtained from monthly milk recordings. A FLIR T425 thermal camera (FLIR Systems Inc., Wilsonville, Oregon, USA) was used with a resolution of 320x240 pixels, an automated focus, <0.05 °C thermal sensitivity, and a temperature range from -20 °C to +1200 °C. The udder was evaluated by IRT before and after milking. The temperature measurements were taken from the warmest point of the udder before and after milking. The normal udder surface temperature, as a reference, was assumed to be 32 °C ± 1.5 °C before milking and 30 °C ± 1.5 °C after milking. The association between udder surface temperature, SCC, and the lactation number was statistically evaluated using multiple linear regression.

The association between the SCC and the temperature before and after milking was statistically significant. Before milking, the surface temperature of the udder increases by 0.15 °C with an increase of SCC by 1000 somatic cells (p=0.026). However, after milking, the surface temperature of the udder increases by 0.29 °C with an increase of SCC by 1000 somatic cells (p=0.009). In contrast, the association between temperature and CMT was not detected. It was concluded, the IRT method is applicable to detect goats with increased SCC in milk more efficiently than CMT.

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EXTRACTION AND CHARACTERIZATION OF BIOACTIVE COMPOUNDS AND AMINO ACIDS FROM SWEET AND SOUTHERN WORMWOOD (*ARTEMISIA* SPP.) AND THEIR ANTIMICROBIAL PROPERTIES AGAINST PATHOGENIC MICROORGANISMS

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Antibiotics are the "magic bullets" for combating bacteria and are considered as the most remarkable medical discovery of the 20th century. The introduction of antibiotics has changed the therapeutic paradigm and continues to save millions of lives from bacterial infections [1]. However, with the increasing use of these drugs and, in particular, their misuse, microorganisms have developed antimicrobial resistance to many antibiotics [2]. The incidence and prevalence of antimicrobial-resistant-bacterial infections has attained incongruous levels during the 21st century and threatens global public health as a silent pandemic, necessitating urgent interventions [3]. To ensure universal health care, the World Health Organization recognized the significance of complementary and alternative medicines and recommended the use of natural herbs and plants bearing therapeutic potential and fewer adverse effects [4]. *Artemisia* spp. plants belong to this category.

This research investigated the optimization of extraction methods for bioactive compounds, including artemisinin, phenolics, tannins, and amino acids from the aerial parts of Sweet Wormwood (*Artemisia annua* L.) and Southern Wormwood (*Artemisia abrotanum* L.) using ultrasonic-assisted extraction. Freshly harvested plant material was freeze-dried, ground, and subjected to various ethanol concentrations (40%–96%) coupled with ultrasonic treatment under controlled conditions [5].

The extraction efficiency was evaluated through spectrophotometric analysis, measuring total phenolic content, total tannin content, amino acid profiles, and antioxidant activity using DPPH$^{\bullet}$ and FRAP assays. Special emphasis was placed on the extraction of artemisinin, with results demonstrating optimal recovery at 60% ethanol during 60 min of ultrasonication. Additionally, liquid chromatography-mass spectrometry (LC-ESI-TQ-MS) was employed to confirm the presence and quantify artemisinin and amino acids in the extracts. These findings underscored the effectiveness of ultrasonic extraction in maximizing the yield of valuable phytochemicals and amino acids, promoting the sustainable use of Sweet Wormwood and Southern Wormwood as sources of natural antioxidants, antimicrobial agents, and nutritional supplements, with significant implications for pharmacological and dietary applications.

Artemisia spp. plants have shown antibacterial activity against *Escherichia coli*, *Enterococcus faecalis*, *Streptococcus pyogenes*, and *Staphylococcus aureus* both in this study, using microdilution plates to determine minimal inhibitory and minimal bactericidal concentrations, and in the publications of various authors around the world.

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PERCEPTION OF VETERINARIANS AND ANIMAL OWNERS ON THE USE OF ARTIFICIAL INTELLIGENCE IN VETERINARY MEDICINE IN LATVIA

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In recent years, the development and application of artificial intelligence (AI) have rapidly expanded across various fields, including veterinary medicine, where digital technologies are being used to assist in diagnostics, treatment planning, and communication with clients. The topicality of this research lies in the growing importance of AI tools in veterinary care and the limited awareness and readiness among professionals and clients to adopt such technologies. Therefore, the aim of this research is to explore the current level of AI awareness and acceptance among veterinarians and animal owners, as well as to identify the factors influencing trust in AI-supported veterinary care, based on surveys conducted among veterinary professionals and pet owners in Latvia.

The Akinsulie et al., 2024 provides a comprehensive overview of how artificial intelligence (AI) is transforming veterinary clinical practice and biomedical research, with applications in diagnostics, surveillance, reproductive management, surgery, and disease modelling [1]. It highlights the potential of AI to enhance precision, efficiency, and personalization in animal healthcare, while also acknowledging current limitations such as data quality, lack of regulation, and the need for interdisciplinary collaboration.

According to the Digital report on AI in veterinary practice (2023), the most common areas where AI is currently being applied include radiographic image analysis, decision support systems, and client communication enhancement [2]. Despite these developments, the report also highlights that the majority of veterinary professionals have limited or no hands-on experience with AI tools, and many express concern over the ethical implications and the potential for AI to replace human judgment. These concerns resonate with the findings of the current study, with majority of veterinarians that rate themselves as "Neutral" to "Somewhat Familiar" with AI (total 48.9%), 46.8% have never used AI. and ethical scepticism was noted among both veterinarians and pet owners.

This observation is further supported by the AI in Dog Care Report (Daisy Pet, Inc., 2023), which reveals that while a majority of dog owners (54.5%) are open to using AI to improve their dogs' health and wellness, many still express significant reservations [3]. Concerns about the accuracy, reliability, and unfamiliarity with AI are among the most frequently cited issues. It resonates with the current study where 43.4% of owner respondents reported being "not familiar at all" with AI in veterinary medicine, but 49.2% believe AI can improve treatment.

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EFFECT OF PROTEIN AND ENERGY SUPPLY IN THE PERIPARTUM PERIOD ON COLOSTRUM QUALITY IN SHEEP

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Sheep farming holds major significance in Latvia and worldwide, providing meat, milk, and wool. One of the most critical stages in sheep production is ensuring high-quality colostrum during lactation, as colostrums immunoglobulins and other bioactive components directly affect neonatal lamb immunity [2]. The success of lamb growth and protection against pathogens largely depends on colostrum intake within the first hours of life. In order to prepare ewes for breeding and the subsequent peripartum period, it is crucial to supply balanced protein and energy; otherwise, risks such as pregnancy toxemia may increase, alongside a reduction in both colostrum yield and quality - especially in ewes carrying multiple fetuses [1].

A total of 60 ewes (Gotland–Texel crosses) were divided into three groups based on ultrasound-confirmed litter size: 14 ewes carrying singles, 16 carrying twins, and 30 carrying triplets. Each group received tailored rations differing in protein and energy density. Body Condition Score (BCS) was measured (scale 1–5), and blood samples were collected from v. jugularis tree weeks befor lambing, to assess beta-hydroxybutyrate (BHB), glucose, urea, total protein, albumin, and cholesterol levels. Colostrum samples were obtained within 30 minutes postpartum and analyzed via optical and electronic (Brix) refractometers. Lamb daily weight gains were recorded up to 40 days of age. Most ewes (58/60) maintained an optimal BCS of 2.5–3.5. Single- and twin-bearing ewes showed higher BHB values (0.6±0.31 and 0.7±0.27 mmol/L, respectively) than triplet ewes (0.4±0.14 mmol/L). Urea levels exceeded the reference (>7.2 mmol/L) in all groups, whereas 78% of ewes had total plasma protein below 60 g/L. 64% of all ewes had albumin levels higher than 30mmol/l,where the highest values were in triplet ewes – 31.5± 2.04 mmol/l. Colostrum quality (electronic Brix) varied by litter size: single ewes averaged 24.9% Brix, twins 27.1%, and triplets 28.8% (max. 38.2%). Lambs from single-bearing ewes gained an average of 0.41 kg/day, compared to 0.37 kg/day (twins) and 0.35 kg/day (triplets). Kruskal–Wallis tests confirmed significant differences ($p<0.05$) in both colostrum Brix and lamb weight gains among the groups.

Balanced protein and energy provision in late gestation and early lactation significantly affects ewe metabolic status, colostrum quality, and lamb performance. Despite high urea levels suggesting excess dietary protein, the majority of ewes produced colostrum above 26% Brix. Contrary to expectations, single ewes had an average lower Brix colostrum than twin and triplet ewes. Nonetheless, single-lamb ewes demonstrated superior lamb growth. Proper ration formulation and regular health monitoring are critical to optimize outcomes in sheep production systems.

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POSSIBLE CHRONIC INFLAMMATORY CONDITION IN OVERWEIGHT DOGS

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Obesity and overweight in dogs have become a significant concern in veterinary medicine. Beyond the well-known consequences of excess weight, the chronic inflammatory state in these dogs is less frequently described.

Canine obesity is a metabolic condition characterized by excessive fat accumulation and currently affects up to half of the domestic dog population [1]. Factors contributing to obesity include high-energy diets, lack of exercise, and owner lifestyle choices.

Many consequences of obesity—such as decreased life expectancy, cardiovascular disease, and orthopedic disorders—are well documented in both human and veterinary medicine. However, the state of chronic inflammation has been more extensively studied in human medicine. In dogs, the involvement of leptin, adiponectin, and insulin-like growth factor-1 has been described [2], but no clear association has been found between obesity and hematological or biochemical blood markers.

The aim of the present study was to compare chronic inflammation markers and blood pressure between normal-weight and overweight dogs.

Hematological parameters - including total white blood cell count, neutrophil, monocyte, and lymphocyte counts - as well as biochemical parameters such as C-reactive protein, total protein, albumin, and globulin, and blood pressure measurements were evaluated in 12 normal-weight and 14 overweight dogs at a private veterinary clinic. All dogs were clinically healthy and voluntarily recruited for the study.

The results revealed a lower monocyte count in the overweight group (0.37 ± 0.03 vs. 0.61 ± 0.10, $p < 0.05$) and a higher average systolic blood pressure (146 ± 4 vs. 129 ± 2 mmHg, $p < 0.05$) compared to the control group. No significant differences were observed in the biochemical blood parameters between the groups.

Conclusion: while monocyte count and systolic blood pressure were altered in overweight dogs, the hypothesis of a chronic inflammatory state associated with canine obesity was not supported by this study. Further research with larger sample sizes and additional markers is recommended to clarify the potential link between obesity and chronic inflammation in dogs.

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TEAR PRODUCTION AND FERNING IN MESOCEPHALIC AND BRACHYCEPHALIC DOG BREEDS

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Dry eye disease (DED) is a complex condition that develops when the eye loses its normal homeostasis [1]. It has been shown that brachycephalic dog breeds have a 3,63 times increased risk of developing DED compared to mesocephalic breeds [2]. The aim of this study was to analyse the Schirmer tear test (STT), punctate staining (FI) grade, and tear ferning (TF) test results in brachycephalic and mesocephalic breeds.

A total of 59 dogs participated in the study, including 19 French Bulldogs (14 female and 5 males, aged 2 to 9 years, weight ranging from 9,8 till 17,5 kg), 22 Cavalier King Charles Spaniels (CKCS) (14 females and 8 males, aged 2 to 11 years, weith weight ranging from 5,6 kg and 14,8 kg), and 18 Australian Shepherds (11 females and 7 males, aged 1 to 7 years, with weight from 15,4 kg and 26,9 kg). The study was conducted between November 2024 and February 2025 at the Veterinary Clinic of the Latvia University of Life Sciences and Technologies in Jelgava, Latvia. All animals underwent compleate ophthalmic examination, including FI grading test and STT in both eyes. For TF, one of the STT strips was randomly selected from either the right or left eye, placed in a Eppendorf tube and centrifuged until a tear drop was formed. This drop was placed on a microscope slide for examinated under light microscope 10x magnification. Tear ferning was evaluated according to the Masmali scale.

In the French Bulldog group, the STT results for all dogs were within normal range (15 – 25 mm/min), with an average 21.53 mm/min for the right eye and 21.68 mm/min for the left eye. However, the FI results were positive for all dogs, with scores distributed as follows: 1 (n=8), 2 (n=5), 3 (n=4), and 4 (n=2). TF scores were elevated in 9 animals, while the SST remained normal.

In the CKCS group, 10 dogs had STT values below the normal range. Notably, only 1 female had STT readings below normal in both eyes, accompanied by an FI score of 4 and a TF score of 3, indicating the presence of DED. The average STT for CKCS was 15.91 mm/min for the right eye and 17.23 mm/min for the left eye, representing the lowest values among all groups. Additionally, FI scores were distributed as follows: 2 (n= 3), 3 (n=4) and 4 (n=15). The TF was normal for 9 individuals, while 13 dogs had TF scores ranging from 2 to 4. In the Australian Shepherd group, only one dog had an SST below the limit, with a measurment 11 mm/min in the right eye. The remaining dogs exhibited normal STT values, with an average an of 22.67 mm/min for the right eye and 23.22 mm/min for the left eye, the highest values observed among the groups. FI was graded as 2 (n=1) and as 1 (n=3), with TF scores of 4 in one dog, 3 (n=2), and scoring 2 (n=3).

All French Bulldogs exhibited normal STT results, while (FI) staining indicated the presence of corneal damage. The Cavalier King Charles Spaniel group demonstrated a concerning prevalence of dogs with SST values below the normal range, suggesting an elevated risk for the development of dry eye disease (DED). In contrast, the majority of Australian Shepherds showed STT results within the normal range, indicative of healthier ocular function. These findings collectively suggest that brachycephalic breeds exhibit poorer STT, FI, and TF values compared to mesocephalic dog breeds, implying an increased susceptibility to ocular pathologies.

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ENDOPARASITOSIS IN WILD RUMINANTS IN THE SALDUS REGION

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Wild ruminants, particularly Red deer (*Cervus elaphus*) and Roe deer (*Capreolus capreolus*), are among the most commonly hunted wild mammals for human consumption in Latvia. While wild ruminant meat offers several beneficial nutritional qualities [1], it also poses zoonotic risks that may impact food safety [2]. Furthermore, wild ruminants serve as reservoirs for various endoparasites, which can be transmitted to domestic ruminants, contributing to the broader circulation of parasitic infections in the environment [3]. This study investigated endoparasitosis in Red deer and Roe deer in the Saldus region, Latvia. The aim was to determine the prevalence and intensity of endoparasitic infections in both species.

The research was conducted between June 2023 and November 2024 at the Parasitology Laboratory, Faculty of Veterinary Medicine. A total of 10 Red deer and 10 Roe deer gastrointestinal tracts were examined macroscopically, with adult parasite specimens collected from the rumen, abomasum, small and large intestines. Fecal samples were analyzed using flotation and Baermann methods to detect parasite eggs and larvae. Additionally, muscle samples from the diaphragm were examined microscopically using the compression method with staining. After collection and fixation, adult parasite specimens were identified. Infection intensity and prevalence (extensity) were calculated.

A total of 11 endoparasite species were identified in Red deer, resulting in a total prevalence of 100%. In 90% of examined samples *Ashworthius sidemi* and *Protostrongylidae spp*. were identified with intensity of infection 42.8 ± 24.52 and 82.9 ± 27.75 respectively. 40% of examined Red deer muscle tissue were positive for *Sarcocystis spp*. with intensity of infection 10.5 ± 1.84. *Paramphistomum cervi, Nematodirus spp., Moniezia spp., Trichuris spp., Oesophagostomum spp., Capillaria spp., Dictyocaulus spp*. and *Eimeria spp*. were also found but the prevalence did not exceed 20%. A total of 10 endoparasite species were identified in Roe deer samples, resulting in a total prevalence of 100%. In 80% of examined samples *Chabertia spp*. was identified with intensity of infection 66.9 ± 21.08, in 70% of samples *Trichuris spp*. and *Sarcosystis spp*. were identified with intensity of infection 7.4 ± 2.13 and 96.7 ± 31.19, respectively. 60% of samples contained *Eimeria spp*. and *A.sidemi* with intensities 383.3 ± 101.16 and 170 ± 52.27, respectively. In 50% of samples *Haemonchus contortus* was found with intensity 272 ± 124.8. Other parasites, including *P.cervi, Bunostomum spp., Protostrongylidae spp*. and *Moniezia spp*., were also identified in Roe deer but the prevalence of these invasions did not exceed 20%.

This study demonstrated a high prevalence of endoparasites in both Red deer and Roe deer in the Saldus region, even though the animals exhibited good clinical health. Importantly, the zoonotic parasite *Sarcocystis* spp. was detected in both species, with higher prevalence and infection intensity in Roe deer. These findings underscore the significance of ongoing parasitological monitoring in wild ruminants, not only for wildlife and livestock health, but also for public health and food safety considerations.

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ENGINEERING

DESIGN MODIFICATION AND PERFORMANCE ANALYSIS OF DRONE PROPELLER

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Progressing upon the previous research on innovative wing design, this master's thesis aims to investigate further the application of aeronautics. The thesis focuses on the design modification and performance analysis of drone propellers to improve their aerodynamic efficiency and overall flight performance. Modern drones face several challenges, such as limited flight time, increased power consumption, noise generation, and reduced stability due to inefficient propeller designs. Most commercial drone propellers are designed for general purposes, which often leads to performance compromises in different flight conditions [1].
This study aims to explore optimized propeller designs by modifying key parameters, such as blade shape, twist angle, chord length, and material selection. The previous bachelor's thesis concluded that using CAD modeling and Computational Fluid Dynamics (CFD) simulations theoretical calculations can be obtained and for the master's level a 3D printed prototype will be analysed. Additionally, different propeller designs will be analyzed to understand airflow behavior, lift generation, thrust, drag, and noise characteristics [2].
The study and experimental testing of lightweight materials such as carbon fiber-reinforced plastic will be carried out on a drone in a controlled environment to compare performance metrics like thrust efficiency, power consumption, noise level, and flight stability with standard propellers.
The results of this study are expected to provide design guidelines for more efficient and quieter drone propellers, contributing to longer flight times and reduced energy consumption. Future research can focus on smart propeller materials, bio-inspired blade designs, and AI-based optimization techniques for real-time propeller adjustments [3].
To sum up, this study improves drone propeller design by testing new shapes and materials to make drones fly longer, use less power, and make less noise. The results will help create better propellers and guide future research.

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FILTER COATING TOOL DESIGN

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Different types of filters and catalytic converters play a crucial role in reducing air pollution by converting harmful emissions such as nitrogen oxides, carbon monoxide, and hydrocarbons into less harmful substances like nitrogen, carbon dioxide, and water vapor. These systems transform approximately 98% of harmful exhaust gases into less harmful ones to make the surrounding environment cleaner [1]. For these filters and catalytic converters to function optimally, their manufacturing process must be very precise and uniform. One of the critical tools used in this manufacturing process is the coating tool.

The coating tool typically consists of two parts – the shower head section and the vacuum cone section. The shower head section is responsible for delivering and evenly distributing the washcoat onto the filter surface, while the vacuum cone is used for pulling the washcoat into the filter structure.

This research mainly focuses on the shower head section. The main problems and challenges in this section lie in the design of its components. The complex design of these components, combined with the need for high precision in washcoat distribution, makes them difficult and time consuming to manufacture, resulting in high manufacturing costs. To address these issues, the goal was set to redesign the shower head to make it more convenient, faster, and cost-effective to produce, without compromising the quality of the coating or the productivity of filter production.

To achieve this goal, a model of the existing design was created using Solidworks and the potential areas for improvement were identified. Then using Solidworks Flow Simulations, a mathematical model was created to predict the outflow parameters of the shower head [2]. Based on the results, prototypes were developed to test the new design and compare the results to the simulations. Additionally, Mastercam software was used to estimate how much time would be saved by manufacturing the redesigned parts of the shower head and the total economic benefit was calculated.

As a result of this research, an improved tool design was developed. This new design is more convenient and faster to manufacture, as well as cheaper and can be used to coat filters and catalysts of various sizes and shapes.

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DEVELOPMENT AND RESEARCH OF A MOBILE HYDRAULIC STATION

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Currently, self-propelled machines used for various applications, such as excavators, compact loaders, mobile chassis, and platforms, are becoming increasingly popular [1]. However, the versatility of these machines is constrained by limitations in their hydraulic systems. Specifically, they often fail to deliver the required oil flow and pressure necessary for the efficient operation of the attached work implements, leading to reduced overall performance and effectiveness.

This issue primarily stems from inaccuracies in the technical specifications published by self-propelled machine manufacturers regarding the hydraulic system parameters of the carrier machine. While manufacturers typically provide data on the overall hydraulic flow and maximum operating pressure, they often omit critical details concerning the distribution of flow and pressure in auxiliary hydraulic lines. This lack of precise information hinders the optimal selection and integration of work implements, further diminishing the machines' operational efficiency [2].

Typically, the parameters specified in the technical specifications are determined by manufacturers through mathematical calculations without subjecting the equipment to actual load testing. However, the performance of a hydraulic system is influenced by various variable working conditions, such as ambient temperature, workload, the condition of the hydraulic oil, and the simultaneous execution of multiple functions [3].

This master's thesis proposes the hypothesis that equipping self-propelled machines with an autonomous, universal mobile hydraulic station will enhance operational efficiency and ensure continuous power to working implements, regardless of the machine's operating mode.

The aim of this master's thesis is to develop a universal mobile hydraulic station for mobile technical units and to evaluate its productivity and efficiency. The study examines and analyses existing hydraulic station solutions available on the market, their applications, design, and technical capabilities. Based on this analysis, technical requirements for the new hydraulic station are developed, ensuring that the station is universal and suitable for a wide range of tasks related to providing the necessary hydraulic flow and pressure.

Experimental tests under real working conditions will determine the actual parameters of the newly developed hydraulic station. Following the completion of experimental testing, data collection, and analysis, the calculated work efficiency and economic benefits will provide a clear assessment of the system practicality and effectiveness.

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APPLICATION POSSIBILITIES OF AIR-TO-AIR HEAT PUMP

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Heat supply in residential buildings is one of the most important processes. The heat supply process directly contributes to the comfort of the living environment. It is also worth mentioning that the increasing energy demands and the strengthening climate change force us to think and choose a more efficient heat supply system. Moreover, it is also important to apply the latest and most modern technologies that would reduce energy losses. A properly selected heating system will reduce energy needs and contribute to a sustainable environment.

Air-to-air heat pumps are advanced devices that use the heat transfer principle. In this way, heating and cooling are provided in the building. Their operating principle is based on a refrigeration cycle, which allows heat to be taken from the outside air and transferred into the room. It is also possible to extract heat from the room and take in cool air. In this way, the building would be cooled during the summer [1].

One of the most important aspects is to identify the advantages and disadvantages of air-to-air heat pumps. Firstly, they can work both as heating and cooling devices. Therefore, they are an excellent solution for rooms where both functions are needed. In addition, these types of heat pumps are often cheaper and quicker to install than air-to-water systems. Also, air-to-air heat pumps directly heat the air, so the heat is distributed quickly and the desired temperature is reached more efficiently. However, these devices have disadvantages as well. They cannot heat water, so they are not suitable if there is a need to use the heat pump for hot water preparation. Furthermore, although air-to-air heat pumps work efficiently in most conditions, their performance may decrease at very low outdoor temperatures. Therefore, these devices are best suited for regions with a milder climate [2].

Air-to-air heat pumps are usually selected based on the size of the room and the heating requirements. The smaller the room, the more efficiently these pumps can operate, ensuring optimal heating or cooling results. Air-to-air heat pumps are especially suitable for offices, small rooms, or other small spaces where it is important to maintain a stable and comfortable temperature [3].

In summary, it can be said that air-to-air heat pumps are efficient and versatile devices that provide both heating and cooling. These pumps are most suitable for small spaces, such as offices or administrative rooms, where a comfortable temperature needs to be maintained.

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METAL CORROSION

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Metal corrosion is the spontaneous degradation of metals and their alloys due to chemical or electrochemical interactions with the environment. This process leads to the formation of compounds lacking metallic properties, such as oxides or salts. Corrosion is fundamentally an oxidation-reduction reaction, where metals lose electrons to surrounding substances. Understanding corrosion mechanisms and control strategies is essential for ensuring the longevity and safety of metal structures. The aim of this paper is to explain the processes of metal corrosion, its types, the factors affecting corrosion rate, and to present preventive measures such as material selection, protective coatings, and cathodic protection to ensure the longevity and safety of metals.

Corrosion can be classified based on the nature of the chemical processes involved: 1) Chemical corrosion occurs in non-electrolytic environments, such as dry gases or non-conductive liquids, where electrons transfer directly between metal atoms and corrosive agents; 2) Electrochemical corrosion predominantly takes place in conductive environments like moist air, water, or electrolytic solutions. It results from the formation of micro-galvanic cells on the metal surface, where anodic regions (more active metal areas) undergo oxidation, and cathodic regions (fewer active areas or impurities) facilitate reduction reactions [2].

Several factors influence corrosion rates and mechanisms, including metal properties, environmental conditions, and microbial activity. For instance, in marine environments, metals are subjected to aggressive conditions due to saltwater, leading to specific corrosion behaviors and aging processes [3].

Studies have shown that metals like aluminum, zinc, copper, and steel exhibit varying corrosion rates and mechanisms when exposed to marine conditions, with factors such as surface morphology and the presence of biofilms playing significant roles. Surface morphology and biofilms also impact corrosion behavior. Microbial-induced corrosion (MIC) is another critical aspect, where microorganisms such as bacteria and fungi accelerate metal degradation. Some microorganisms produce corrosive metabolites or form biofilms that alter electrochemical conditions. Research indicates that the vitality of these microorganisms on metal surfaces is influenced by the metal's nature and morphology, affecting the corrosion process. Studies indicate that microbial activity is influenced by the metal’s nature and morphology, affecting corrosion processes [1].

In conclusion, preventive measures against corrosion include material selection, protective coatings, cathodic protection, and environmental control. Alloying metals with elements like chromium enhances corrosion resistance by forming protective oxide layers. Protective coatings such as paints or galvanization act as physical barriers, while cathodic protection methods help mitigate galvanic corrosion. Understanding environmental conditions and corrosion mechanisms is crucial for developing effective control strategies.

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A REVIEW OF SUPERCRITICAL CO2 ENERGY STORAGE SYSTEMS FOR GRID APPLICATIONS IN THE BALTIC REGION

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Renewable energy deployment is rapidly expanding in the Baltic region as a part of broader efforts to enhance sustainability, reduce carbon emissions and strengthen energy independence. The unpredictable output of wind and solar energy, combined with fluctuations in electricity demand throughout the day and across seasons, creates major challenges for maintaining a stable and balanced power grid. This paper is devoted to investigating the potential of a supercritical carbon dioxide energy storage system as a viable solution for ensuring grid stability in the Baltic power sector.

The Baltic states aim for climate neutrality by 2050, requiring a fully renewable electricity system supported by reliable and flexible infrastructure. Technologies like hydropower, electrochemical batteries, thermal storage, and power-to-gas enable cost-effective and stable energy supply [1].

Hydropower and electrochemical battery systems represent the most established storage technologies in the Baltic region. Hydropower, particularly pumped storage, provides reliable long-duration energy balancing but is limited by geographical constraints. Electrochemical batteries provide fast response and high efficiency, but high costs and short discharge durations limit their use for large-scale seasonal storage [1, 2].

Supercritical carbon dioxide [sCO_2] energy storage systems offer a competitive solution for large-scale grid storage due to their favourable thermophysical properties and operational flexibility. Unlike compressed air energy storage systems that need large underground spaces and have low efficiency, or cryogenic storage that relies on complex insulation and fragile components, sCO_2 systems operate efficiently at near-ambient temperatures and pressures accessible with the existing industrial infrastructure. The high critical temperature and pressure of CO_2 (31 $^{\circ}$C and 7.38 MPa) allow for efficient liquefaction and storage without extreme cooling, enabling compact reservoir designs and cost-effective deployment. Closed-loop configurations minimize environmental dependency, while integration with transcritical or Brayton cycle architectures facilitates energy recovery with round-trip efficiencies exceeding 67%. sCO_2 energy storage systems lower reliance on imports and offer a sustainable, regionally adaptable solution with reduced environmental impact [3].

The thermodynamic efficiency, compact design, and site flexibility of supercritical carbon dioxide energy storage systems make them well-suited for the Baltic region`s transition to renewables. Their compatibility with the existing infrastructure, minimal geographic constraints, reduced reliance on scarce materials, lower environmental impact, and ability to support both short and long duration storage address key challenges posed by variable wind and solar generation. It is concluded that sCO_2 energy storage systems offer a reliable and efficient solution for enhancing grid stability and supporting energy independence in the Baltic region.

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AWA NINGYO JORURI – THE TRADITIONAL PUPPET THEATER OF TOKUSHIMA

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Awa Ningyo Joruri, originating in Japan's in Edo period (1603–1868), represents a captivating blend of intricate puppetry, compelling storytelling, and traditional Shamisen music. Unique to Tokushima, this refined art form distinguishes itself through puppets operated harmoniously by three skilled puppeteers. Their synchronized manipulation creates vivid, lifelike expressions, enabling the puppets to portray subtle and complex human emotions. Crafted meticulously from wood, each puppet stands approximately one meter tall, adorned with historically accurate costumes and hairstyles that reflect precise craftsmanship and attention to detail. These puppets become vivid, relatable characters, deeply engaging audiences.

Central to each performance are the narrator (Tayu) and the Shamisen musician. The Tayu narrates the story and voices all characters, displaying remarkable vocal versatility, while the Shamisen provides melodic support, intensifying the emotional depth and drama. Famous plays like "Keisei Awa no Naruto" and "Ehon Taikoki" are central to the repertoire, exploring universal themes such as love, duty, and honor. These narratives resonate deeply within Japanese culture, embodying moral lessons and emotional storytelling.

Recognized as an Important Intangible Folk Cultural Asset by Japan, significant efforts are underway to preserve Awa Ningyo Joruri through educational initiatives, workshops, and annual cultural festivals. Visitors to Tokushima have the unique opportunity to experience authentic performances and participate in interactive puppet-making workshops, gaining firsthand appreciation of this remarkable cultural tradition.

Awa Ningyo Joruri is thus more than entertainment; it encapsulates Japan's profound cultural heritage and artistic tradition, providing an enriching, memorable experience for all who encounter it.

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DEVELOPMENT OF A METHODOLOGY FOR DETERMINING THE MARKET VALUE OF USED TRACTORS

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The accurate determination of the market value of used tractors is a critical factor influencing decision-making processes for farmers, dealerships, and financial institutions involved in the agricultural sector. Current valuation methods often rely on traditional approaches, which may lack precision due to the complexity of factors affecting used tractor prices, such as operational hours, production year, engine power, and additional equipment. This study proposes a novel methodology that integrates traditional valuation techniques with advanced artificial intelligence (AI), machine learning (ML), and computer vision (CV) methods to enhance the accuracy and reliability of used tractor pricing.

The theoretical framework of this research is grounded in existing literature on vehicle valuation, particularly within the agricultural machinery sector [1]. Previous studies have identified key factors influencing depreciation and market value, including operational history, technical specifications, and market demand. Recent advancements in AI-driven predictive modelling, such as regression analysis and deep learning, have demonstrated significant potential for price forecasting in various industries [2]. Additionally, computer vision techniques, particularly object recognition algorithms like YOLO (You Only Look Once), have been successfully applied in automated feature detection for machinery valuation [3].

This research aims to develop a predictive model by employing machine learning algorithms, including Random Forest, Linear Regression, and Neural Networks, trained on comprehensive real-world market data. Furthermore, computer vision techniques will be utilized to automate the identification of tractor configurations and additional equipment, thereby improving the precision of the valuation process. The proposed methodology will be rigorously evaluated using standard performance metrics, including mean absolute error (MAE), root mean square error (RMSE), and mean absolute percentage error (MAPE). A comparative analysis will be conducted to assess the effectiveness of the AI-enhanced valuation approach against traditional methods.

The expected contribution of this research is the development of a standardized, automated, and data-driven methodology for the valuation of used tractors. This approach has the potential to significantly improve pricing accuracy, benefiting stakeholders in the agricultural industry by facilitating more informed decision-making in the purchase, sale, and financing of agricultural machinery. Future research directions may include the extension of this methodology to other types of agricultural equipment and the enhancement of AI models through the incorporation of larger and more diverse datasets.

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APPLICATION OF INNOVATIVE TECHNOLOGIES IN UNDERFLOOR HEATING SYSTEMS

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A heating solution that is one of the most popular today is underfloor heating, which is characterized by modernity and efficiency, and is therefore increasingly used in both residential and commercial spaces.

When choosing an underfloor heating system, there are two main options: water-based and electric. A water-based system, although requiring higher initial investment and more complex installation, is more economical for large areas due to heat transfer through circulating water. An electric system, conversely, features simpler installation and rapid heating, making it ideal for smaller spaces, but its operating costs are higher. The final decision should be based on room size, energy consumption analysis, investment amount, flooring requirements, and building thermal insulation to ensure optimal comfort [1].

For systems to operate efficiently and economically, intelligent control is necessary. One technology used in conjunction with underfloor heating is the smart thermostat. Modern smart thermostats allow you to remotely control the temperature in each room from anywhere in the world via a smartphone or tablet. They adapt to your daily routine, automatically adjusting the heating, and provide data on energy consumption. Manufacturers such as Google Nest, Hive, Tado, and Honeywell have developed user-friendly smart thermostats that seamlessly integrate into home smart device systems [2].

Today, technology has advanced to the point where floor sensor detectors can be used to both protect and control air quality. Smart floor sensors perform multiple functions, ensuring comfort and safety in homes. They constantly measure temperature and humidity, helping to maintain an optimal microclimate and preventing mold and floor deformation. By detecting water leaks, these sensors protect against potential damage, and by monitoring movement, they optimize energy consumption. Additionally, some advanced models respond to unusual movements, thus increasing home security [3].

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VENTILATION SYSTEM FOR ROOT VEGETABLE STORAGE

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The method of fresh vegetable storage becomes increasingly important as the global demand for fresh and high-quality vegetables grows. One of the key factors for that is the proper ventilation system, which ensures longer storage time and preserves quality.

The goal of the study is to improve the ventilation system to achieve a more even airflow throughout the storage area. This will help to prevent local spoilage and maintain an optimal microclimate. Additionally, the improvements will reduce energy consumption. A significant problem is uneven airflow: if the flow is too strong, vegetables wilt; if the flow is too weak, vegetables overheat, moisture accumulates and they start to spoil.

In the ventilation system, proper air circulation and humidity are critical factors that influence the storage duration, appearance and nutritional value of vegetables. To extend storage time and maintain quality fruits and vegetables need a consistent temperature in the range from 0° to 10°C and relative humidity of 80-95% throughout the storage space [1]. Effective ventilation helps to disperse heat, carbon dioxide and other buildup gases, which can negatively affect the product [2].

To ensure a uniform airflow throughout the space, the study conducts simulations using air openings of varying sizes in the ventilation system and evaluates several parameters such as humidity, temperature, and airflow strength. A system that uses vertical airflow to prevent temperature stratification helps to avoid areas where hot air accumulates. For example, a good solution in practice is a ventilation system that draws warm air to the ceiling and supplies cool air to the floor [3]. An adjusted airflow strength is achieved to maintain the appropriate temperature and humidity when surrounding conditions change with automatically regulated sensors. Additionally, by integrating heat recovery technology, energy consumption is reduced by reclaiming warm exhaust air to heat incoming air. Besides, the system includes air filters and disinfection. General control of ventilation regulation is provided by smart monitoring, which offers real-time information on air quality and room conditions.

The obtained data from the study of optimal airflow strength, speed and ventilation opening sizes will be beneficial to farmers, logistics specialists and food processing companies. These data will help them select the most suitable ventilation system, ensuring optimal conditions for quality preservation and reducing food waste. The study provides a foundation for further ventilation research to create more energy-efficient and sustainable vegetable storage systems as well as to develop new technologies.

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AI POWERED DRONE IN AGRICULTURE: REVIEW

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In the past, farmers had to manually scout fields for deficiencies and pests, either on foot or using all-terrain vehicles (ATVs). Subsequent decisions regarding pesticide application were then executed using ground vehicles. This research aims to examine possible solutions for an AI-powered drone system for optimized agricultural monitoring and pesticide application.

There is a need to reduce response time, and artificial intelligence (AI) allows rapid identification of problem areas, enabling quicker decision-making. AI can detect early signs of pest infection, such as changes in color or wilting, which helps to prevent the spread of infestations and minimizes damage to yield and crop quality and is cost-effective but requires significant initial investment [1].

Nowadays, AI systems can be run on compact hardware like the Raspberry Pi 5, allowing for the creation of small, portable AI modules. Machine learning, in conjunction with computer vision, enables the rapid recognition of patterns and anomalies. However, the training process requires the analysis of a substantial amount of visual data. This challenge can be mitigated by utilizing cloud computing. For training purposes, a dataset with annotated images will be used for AI model evaluation.

Drones offer the capability to rapidly survey fields and capture high-resolution photographs and videos, thereby enhancing field monitoring efficiency. Technological advancements have significantly extended drone flight durations and ranges, with many models now capable of carrying substantial payloads. Equipped with sprayers, drones can apply pesticides locally with high precision and speed, even in challenging soil conditions. Compared to the Knapsack method, which achieves an effective pesticide utilization rate of 30%, the drone spraying system demonstrates a significantly higher efficiency, reaching up to 85% [2].

The shelf products tend to be more expensive and less customizable. Alternatively, it is feasible to assemble a modular drone using components tailored to specific tasks. The modular design of drone simplifies repairs and modifications. Integrating an AI module transforms the drone into an autonomous unmanned aerial vehicle (UAV). The prototype will be a quadcopter with a payload capacity of under 300 grams.

AI is set to play a crucial role in plant protection and pesticide usage optimization, and when combined with drones, it can notably enhance yield and product quality. A potential solution to enhance field coverage rates involves deploying a scout drone to rapidly survey the fields, with the collected data processed centrally to optimize the flight paths of sprayer drones.

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LAND MANAGEMENT AND GEODESY / GEOINFORMATICS AND REMOTE SENSING

IMPLEMENTATION OF GIS TECHNIQUES IN LATE BLIGHT CONTROL IN POTATO

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Late blight, caused by Phytophthora infestans, is a devastating disease affecting potato crops worldwide, leading to significant yield losses and economic damage. With the increasing demand for efficient and sustainable disease management, Geographic Information System (GIS) technologies have emerged as powerful tools for monitoring, predicting, and controlling plant diseases.

This research explores the application of GIS techniques in the management of late blight, emphasizing their role in spatial disease surveillance, environmental modeling, and precision agriculture. Recent studies, such as those by Hijmans et al. and the GEOPOTATO project, have demonstrated how integrating GIS with weather-based forecast models significantly enhances the accuracy of late blight prediction. The GEOSIMCAST model developed by the International Potato Center (CIP) further illustrates the potential of GIS in generating regional risk maps and optimizing fungicide applications. Moreover, modern applications of UAVs and machine learning, using high-resolution remote sensing data, enable early disease detection and site-specific intervention as well as identification of critical periods in late blight disease management. This study confirms that GIS-based systems, when coupled with real-time data and decision support tools, can drastically improve late blight control, reduce chemical inputs, and support sustainable potato farming practices.

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GEOMORPHIC ASPECTS OF FLOODING IN VALGUNDE, LATVIA (2023): A REMOTE SENSING AND GIS-BASED STUDY

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Floods are among the deadliest natural disasters causing extensive destruction to infrastructure, ecosystems and human livelihoods. Flooding presents significant challenges in both Latvia and India varying in magnitude, causes, and management strategies. In 2023, the area of Valgunde, Latvia, experienced severe flooding primarily due to rapid snowmelt and heavy rainfall in its temperate climate region. In contrast, India faces large-scale monsoon floods, particularly in states like Assam, Bihar, and West Bengal where excessive rainfall and river overflow from systems like the Ganges lead to widespread inundation [1].While Latvia employs remote sensing and GIS for flood monitoring and prevention, India has also adopted these technologies, primarily through ISRO and NRSC. The 2023 flood in Valgunde underscores the necessity for comprehensive flood risk assessments as climate change continues to increase the frequency and severity of extreme weather events, including droughts and floods [2]. Analyzing the geomorphic and hydrological factors contributing to flooding is critical for developing effective mitigation and adaptation strategies. Valgunde was chosen for this study due to its vulnerability to rapid snowmelt-induced flooding, its distinct temperate climatic conditions, and its relatively small watershed, making it an ideal case for assessing geomorphic flood influences. Additionally, the availability of high-resolution geospatial data and past flood records provides a strong foundation for effective analysis and model validation.

This study integrates Remote Sensing (RS), Geographic Information Systems(GIS),and Weighted Index Overlay Analysis (WIOA) to assess the geomorphic aspects of flooding in Valgunde. High-resolution Sentinel-2 satellite imagery and Digital Elevation Models (DEMs) were utilized to analyze terrain characteristics, land use/land cover (LULC) changes, and watershed morphometry [3]. By integrating GIS-based spatial analysis with multi-criteria decision-making methodologies, this study highlights the impact of geomorphology, land-use alterations, and hydrological processes on flood susceptibility.

This research contributes to advancing geospatial flood modelling techniques and underscores the need for proactive flood mitigation measures, such as improved drainage systems, sustainable land-use planning, and early warning systems. Future studies should incorporate climate change projections, real-time flood monitoring, and hydrodynamic simulations to enhance flood risk assessments and disaster preparedness.

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GEOSPATIAL MODELLING OF RISK SITUATIONS IN WASTEWATER TREATMENT PLANTS

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In the context of modern climate change and increasing urbanization, wastewater management systems face growing challenges. One of the most pressing issues is the occurrence of heavy rainfall-induced flooding, which significantly impacts the operation of wastewater treatment plants, threatening both infrastructure safety and environmental as well as public health [1]. This issue is increasingly relevant on a global scale, including Latvia, where climate change has led to more frequent and intense precipitation events.

According to the Latvian Environment, Geology and Meteorology Centre (LVĢMC), the frequency of intense rain events has significantly increased over the past two decades [2]. In the summer of 2024 wastewater treatment plants, for example in Jelgava city, operated at full capacity during periods of heavy precipitation, indicating increased pressure on the infrastructure. These floods not only caused extensive infrastructural damage but also overwhelmed wastewater treatment facilities, leading to the release of untreated sewage into streams and rivers. Such incidents underscore the vulnerability of existing wastewater infrastructure and highlight the need for precise risk modelling tools [3].

Geographic information systems (GIS) provide a powerful framework to analyse terrain data, water flow paths, infrastructure location, and other parameters crucial for flood prediction [4]. By integrating meteorological data, digital elevation models, and the physical characteristics of wastewater treatment plants, scenario-based flood risk simulations can be constructed. The modelling approach allows municipalities and emergency services to plan and implement timely mitigation of strategies [5].

Given the growing pressures from climate change and the need for sustainable wastewater infrastructure, the objective of this thesis is to develop a geospatial model for predicting heavy rainfall-induced floods at the wastewater treatment plant in Riga, Latvia. The study will utilize spatial analysis techniques and scenario simulations to support evidence-based and practical risk management approaches.

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DETECTION OF DISEASES IN GRAPEVINES USING UAV HYPERSPECTRAL IMAGING

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Grape cultivation is a significant source of income for farmers globally, but the diseases make considerable impacts on the quality and the quantity of the harvest they produce. In France, Grapevine Fanleaf Virus (GFLV) causes an estimated annual loss of $1.5 billion. In the United States, Grapevine Leafroll Disease causes financial losses ranging from $25,000 to over $226,000 per hectare over a 25-year vineyard lifespan, with annual losses in California alone reaching $90 million [1]. These details highlight that early detection of these diseases helps prevent crop losses, maintain grape quality, reduce chemical use, prevent disease outbreaks, minimize costs, promote sustainability, and ensure long-term vineyard health which are the benefits that traditional field scouting methods cannot effectively provide.

Hyperspectral imaging is an advanced technology in remote sensing industry that has the ability to captures detailed spectral data throughout hundreds of narrow, adjacent bands across a wide range of wavelengths, allowing precise identification of slight bio-chemical and structural changes in plants. This makes it highly effective for plant disease detection by identifying spectral variations before they become detectable to the human eye. Hyperspectral sensors mounted on Unmanned Arial Vehicles (UAV) help to cover more ground area in less time and help in identification of these variations in plant physiology that indicate the presence of diseases [2].

A study investigated downy mildew infection in grapevine leaves at an early stage, before visible symptoms appeared. Leaves of the grapevine cultivar '*Cabernet Sauvignon*' were inoculated with three different strains of *Plasmopara viticola* under controlled conditions in a glasshouse environment. A Support Vector Machine (SVM) model was optimized using grid search cross-validation, achieving a validation accuracy of 96% and a test accuracy of 99% on independent leaves excluded from training. The classifier successfully detected downy mildew two days before visible symptoms emerged [3]. Another study focused on detecting and classifying powdery mildew infections on grapevine leaves at different stages. An SVM classifier was trained to distinguish between healthy and infected leaf patches based on their spectral profiles. The classifier's performance was evaluated using cross-validation, achieving an accuracy of over 90% [4]. This method enabled early, non-destructive detection of plant diseases before severe symptoms appeared and needs further research to maximize its potential.

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APPLICATION OF THERMAL IMAGING DRONES IN THE CONSTRUCTION SECTOR

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The application of thermal imaging drones in the construction industry has gained significant relevance due to the increasing need for efficient, accurate, and safe monitoring of construction processes. Thermal imaging drones are becoming increasingly valuable in the construction sector due to their ability to detect heat differences and provide insights that are invisible to the naked eye.

The use of thermal imaging technology allows identify areas where insulation is lacking or failing (e.g., roofs, walls, windows). According to evaluation of aerial thermography for measuring the thermal transmittance (U-value) of a building façade, in outdoor inspections, the main limitations of ground-based thermography are due to the inaccessibility of capturing images of the façade of tall buildings and the expense of operator time in capturing images of large sets of buildings. For this reason, aerial thermography, performed with infrared thermal cameras mounted on UAVs (unmanned aerial vehicles), is proposed as a methodology with significant advantages over ground-based thermography, although its use is currently infrequent [4]. Also Infrared thermography is a practical diagnostic tool used to detect defects in the building envelope such as heat loss, missing or damaged insulation, and air leakage. Thermal drones can cover large areas quickly without the need for physical access, reducing risk and labor.

Thermal drones are increasingly being used for scan electrical panels, machinery, or materials for overheating components, to identify hotspots that could pose fire hazards. Moreover, drones equipped with thermal cameras, high-resolution imaging systems and even artificial intelligence enable efficient and accurate inspections of infrastructure, buildings, and equipment [5].

UAVs with thermal cameras also are frequently used for progress tracking and quality control. Proper installation of insulation or waterproofing layers can be ensured. Also thermal data over time to track degradation or validate repairs can be compared. In another study [6] it is presented that drones provide an efficient and accurate method for monitoring construction progress throughout the project's lifecycle. By regularly capturing aerial imagery or conducting photogrammetry surveys, drones enable project managers to assess the status of different construction activities [6].

The use of thermal imaging technology allows the identification of anomalies that are not visible to the naked eye. According to Smith, thermal drones provide precise data that facilitate early detection of structural inefficiencies by ensuring timely corrective measures [1]. Furthermore, Johnson and Lee [2] emphasize that the deployment of thermal drones in construction sites enhances safety by allowing remote inspections thus reducing risks associated with manual inspections in hazardous environments.

Comparative studies by Brown [3] demonstrate that thermal imaging drones significantly reduce inspection time and costs while increasing the accuracy of results. The integration of this technology contributes to sustainable construction practices by ensuring energy efficiency and reducing material wastage.

In conclusion, the research highlights the potential of thermal imaging drones to transform the construction sector by enhancing inspection processes, improving safety, and supporting sustainable building practices. The adoption of this innovative technology is pivotal for advancing modern construction methodologies

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IMPACT OF THE PLACEMENT AND NUMBER OF GROUND ATTACHMENT MARKERS ON THE POINT CLOUD OBTAINED FROM REMOTE SENSING

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The surface obtained from the point cloud can be used to determine changes in the volume of the mining site. There is no more accurate method than obtaining a digital surface model as a point cloud from the current situation at the site. Aerial photography is a solution, and an unmanned aerial vehicle (UAV) is the most relevant method because of its price, ease of use, as well as the obtained visualisation for further data processing are appropriate for obtaining a high-quality point cloud [1,2,3,4,5]. To obtain the result, field survey data are captured with an unmanned aerial vehicle using the photogrammetry method, tying it to the ground coordinated marks, which are installed with a total station by cross-stitching it from the support points in the object. By processing the data, a point cloud is obtained from which a surface model is created. They are compared with each other to analyze the obtained result [1,2,3].

The purpose of work was to determine the impact of the number and location of ground coordinate marks on the accuracy of the point cloud obtained as a result of photogrammetry.

As regards the research methods and materials, the point cloud of the tachymeter/laser scanner was used as reference data. It was compared with the UAV, which was equipped with an RTK module. The tachymeter was used as a tool for determining the coordinates of the ground reference marks, and the interpolation method was used for positioning. Taking into account the fact that the tachymeter/laser scanner was used only as a control data acquisition tool, its data did not cover the entire calculation area. Therefore it was decided to create test polygons with sufficient data density to obtain a high-quality surface model and determine mutual discrepancies. Field survey data were used in the work, performing repeated data processing by changing the number of reference marks, gradually excluding them from the calculations and performing the placement with the aim of determining the influence of variable parameters on the obtained result. Seven reference marks were placed on the object, covering the entire perimeter of the object (6 pieces) and in the center of the object (1 piece). Calculations were made using all reference marks, four marks in the outer corners of the object, only one central and one of the corner marks. The object size was ~155x200m (~3.1ha) [4,5].

The obtained result shows that the reduction of the number of marks as well as their unsuccessful placement negatively affected the quality of the point cloud along the Z axis. Placing marks along the perimeter of the object in 4-6 rows, depending on the size of the object, is an optimal balance of the time and quality to be used as reference data for further calculations of volume changes.

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USING SURVEYING EQUIPMENT TO OBTAIN A POINT CLOUD

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Nowadays, remote sensing technologies are increasingly used in surveying. This study was conducted with the aim of assessing the impact of different technologies of unmanned aerial vehicles (UAVs) and their settings on the quality and repeatability of point clouds, as well as determining their most effective parameters. The comparative work was carried out within one day with two photogrammetric UAVs equipped with RTK modules, one UAV with LIDAR equipment and the photogrammetric method performing flights at different altitudes, as well as changing the location of ground reference marks for each flight and determining repeated coordinates by repeatedly crossing the tachymeter and changing its position. Geodetic control points in the LKS-92 TM coordinate system and the LAS-2000.5 height system were used for the survey. The data obtained in March 2023 were used as reference data.

The flights were conducted using two Autel EVO II Enterprise and DJI Matrice 300 with LiAIR X3 lidar drones, Trimble SX12 robotic boards (for determining the coordinates of the marks), Emlid Reach RS2 GPS receivers in RTK and post-processing mode, which were used as a base station for the LIDAR device. The flights were conducted at altitudes of 50, 60 and 80 meters [1,2,3,4,6].

The difference in repeated and different height volume measurements for the Autel device was up to 15mm. The difference in repeated and different height volume measurements for both Autel devices was up to 20mm. The volume measurements obtained by Autel and LiAIR X3 with photogrammetry at an altitude of 80 meters were up to 60mm. The volume measurements obtained by LiAIR X3 with photogrammetry and scanning at an altitude of 80 meters were more equivalent to each other than the photogrammetry data of Autel and LiAIR X3. The standard deviation of the volume measurement by sectors was equally close, and on average it was 15mm, but over the entire area it was 14mm [5,7,8,9].

All the obtained results meet the required surveying accuracy standards and are suitable for use in the fieldwork. The accuracy of LiAIRx3 photogrammetry shows slight variation but still complies with the established standards. The LiAIRx3 photogrammetric data serve as supplementary field information and can be used for generating orthophoto images.

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THE PROBLEM OF BUILDINGS WITHOUT OWNERSHIP ON MUNICIPAL LAND

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Currently, there are nearly 200,000 buildings in Latvia with unresolved property rights, which restricts landowners in managing their land. According to Latvian regulations, a municipality can sell its land only to the owner of a building situated on it. This means that the presence of such buildings on municipal land poses a burden for the municipality, as the land cannot be sold through a simplified procedure, this leads to the emergence of abandoned and unmanaged derelict buildings. To achieve the research objective, a questionnaire was designed, and a survey was conducted among Latvian municipalities to evaluate the problems and obstacles identified by municipal representatives regarding buildings without ownership status and to examine how this issue is addressed in other municipal territories [1].

Out of 43 Latvian municipalities, 38 have provided their opinions. By summarizing the opinions of municipal representatives, it was concluded that 26 municipalities had not conducted the research on this issue. The problem was addressed in various ways, including legal proceedings, notarial processes, demolition of structures, and removal from the State Immovable Property Cadastre Information System. Municipalities face challenges to sell lands on which ownerless buildings are located, as the process is time-consuming, requires numerous administrative procedures, and demands significant financial resources. The highest number of buildings without ownership status is in rural areas. According to their primary usage, the majority are classified as other, previously unclassified buildings. Most municipalities (60.5%) frequently encounter issues related to the presence of buildings without ownership status on municipal land in their daily operations. They indicate that it is not possible to freely undertake actions concerning such buildings and that their existence complicates the further planning of land use.

An interesting case was highlighted by two Latvian Municipalities. The Madona Municipality, which attempted to sell a land containing a building without ownership status. However, the judge rejected the change of land ownership due to the presence of a building without an identifiable owner. In contrast, the Ventspils State City Municipality has successfully resolved similar issues using the same approach. This discrepancy suggests that judges hold differing interpretations of the issue, and that the Latvian regulatory framework does not clearly define the appropriate course of action in such cases [2].

The issue of buildings without ownership status affects most municipalities. Most municipalities have not conducted research on such buildings located on municipal land; however, they encounter this issue in their daily operations and seek ways to address it. As the main challenges related to buildings without ownership status on municipal land, municipalities highlight the lack of ownership documentation, restrictions to sell lands, the emergence of abandoned buildings, and obstacles in calculating real estate taxes. Representatives of municipalities and state institutions interpret the regulatory framework of the Republic of Latvia regarding buildings without ownership status in different ways. Therefore, it is necessary to introduce clarifications in the Latvian regulatory framework to clearly define the procedures concerning buildings without ownership status.

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APPLICATION OF REMOTE SENSING METHODS FOR CADASTRAL OBJECT REGISTRATION IN THE BALTIC STATES

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With the rapid development of construction and urban planning, the number of cadastral objects and unregistered changes are constantly increasing. Cadastral data that are kept up-to-date reveal true value of the real estate and changes that have been done with them, which are necessary for providing actual information for urban planning needs and land taxing [1]. As changes to cadastral objects increase, it is necessary to find a solution for faster data acquisition and processing, which is why different remote sensing methods come in handy.
While different approaches of remotes sensing can be used, the most promising results are acquired by aerial photography and Light detection and ranging (LiDAR) methods.
For registration and visualization purposes, buildings that have not been surveyed and do not have coordinates, are vectorized and visualized using building plan and orthophoto maps. Nowadays, the quality and resolution of the airborne photos has drastically increased and so is their precision.
Using LiDAR method, performed by aerial vehicles, a 3D point cloud is created, which then can be used to visualize the vectorized building data layer. This data layer outlines natural or human created differences between registered cadastral objects [2], [3].
For the purpose of obtaining more accurate data for the research, it is necessary to compare remote sensing methods with measurements, configuration and location information acquired by cadastral surveying performed by a certified person in land cadastral surveying. With the development of the Cadastre of the State Land Service and surveying methods, the principles of registration of cadastral objects have changed multiple times, as have the regulations of the Cabinet of Ministers and the methodological instructions for surveying process and registration. Additionally, the cadastral object registration and visualization methods will be compared in the Baltic States, to better understand possibilities for Cadastral object data acquisition and registration.

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EVALUATING FOREST REGENERATION SUCCESS AFTER SELECTIVE LOGGING USING UNMANNED AERIAL VEHICLES AND REMOTE SENSING

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Selective logging provides a balanced forest management approach, combining economic benefits with ecosystem continuity by gradually removing trees and supporting natural, even-aged stand replacement where natural regeneration plays a key role. This study aims to assess regeneration success after selective logging using unmanned aerial vehicles (UAVs) and remote sensing methods. UAV technologies are essential in modern forestry, enhancing efficiency by rapidly providing accurate stand data, assessing regeneration uniformity, identifying gaps, and supporting targeted decisions. For successful research implementation, high-resolution RGB images would be required, which can be obtained using commercial drones such as DJI Phantom 4 and Mavic Pro. In previous studies, these data have been processed using semantic and instance segmentation to count and identify individual trees, determine crown size and spatial distribution, and accurately map forest stand structure [3]. The timing of data acquisition is critical: during the leaf-on period, crowns are easier to assess, while the leaf-off period facilitates distinguishing conifers from deciduous trees [4]. Such an approach can also be applied in selectively logged areas to determine young tree composition, count, and density based on orthophoto materials.

Machine learning algorithms play a vital role for UAV data processing, enabling automated analysis, improved efficiency, and detailed outputs [1]. For example, random forest classification allows precise identification of stand structural elements and distinguishing large, retained trees from young ones [2]. This approach is valuable for monitoring selectively logged areas and assessing regeneration to determine species composition and differentiate mature from young trees.

Additionally, UAV-acquired orthophotos enable analysis of gaps in canopy structure, including in selectively logged areas, allowing evaluation of gap proportion, size, and distribution [4]. This helps to identify gap uniformity and its impact on young stands, as well as identify areas that need further management.

Overall, UAV technologies, combined with artificial intelligence algorithms, hold significant potential for further development, providing efficient and practical solutions for forestry, including selective logging management. However, challenges remain, such as seasonal conditions, the need for high-quality training data, and algorithm adaptability to various forest types.

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THE IMPORTANCE OF VISUAL DESIGN IN GEOINFORMATICS PRODUCTS

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Nowadays, considering the large amount of available information and data, the visualization of information is becoming increasingly important. It facilitates data perception, as most people have a highly developed visual sense. This means that if data are successfully represented visually, it becomes easier for the majority of people to understand it. The visual design of geoinformatics products is a topical issue both in Latvia and globally, as geoinformatics is rapidly developing [1]. Often, geoinformatics products lose their sense of scale because the information they contain can be zoomed in and out - it is not static, but dynamic, and carries a large volume of content [2]. However, the more geoinformatics products emerge, the clearer it becomes that they can ease the problem-solving process in crisis situations provided that people know how to use, apply, and interpret these products as accurately as possible. This can be achieved through effective visual design and the use of clear, understandable, and internationally accepted principles applied during development by taking into account colour relationships, visual contrast, font and number sizes, proportional relationships between elements to emphasize what is most important, as well as a harmonious and visually balanced layout to ensure the design is effective, aesthetically pleasing, and easy to interpret [3].
Geoinformatics products, meaning any data tied to a specific location and displayed visually, can convey information to recipients in a convenient and comprehensible way [4]. The more successfully these products are designed, the greater the chance that users will understand and be able to apply the information.
In this study, various international principles related to the visual design of geoinformatics products will be examined - including how they are defined in internationally recognized ISO standards, by the ICA (International Cartographic Association), OGC (Open Geospatial Consortium), the INSPIRE directive, and in various cartographic handbooks (Robinson, Dent, Slocum, Brewer). It is also important to assess whether these are merely recommendations and guidelines, or whether non-compliance may result in penalties or other consequences.

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ANALYSIS OF CRITERIA, CLASSIFICATION AND ASSESSMENT OF DEGRADED TERRITORIES IN LATVIA

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The assessment of degraded areas has become an essential part of spatial planning and development worldwide. Due to the limited land resource, significant attention is given to its efficient and sustainable use [3], including Latvia. The first step in managing and planning the development of degraded areas is their identification, which involves defining degraded territories, establishing assessment criteria and creating a comprehensive database [1].
In Latvia, a procedure for assessing degraded areas and soil degradation has been developed, which includes degradation criteria and the classification of degraded areas. In Latvia, the responsibility for identifying and assessing degraded areas within each administrative territory lies with the local municipalities [2].
The regulatory framework for identifying degraded areas provides only general criteria, which outline the key characteristics of such areas. This creates conditions for varied interpretations and application practices among local municipalities. The aim of this study was to develop a methodology for applying criteria to assess territorial degradation.
As part of the research, a survey was conducted among local municipalities to gather insights into their experience in identifying degraded areas, applying assessment criteria, and conducting inventories. Additionally, the criteria for degraded areas were analyzed, and specific indicators were defined based on these criteria to justify the designation of an area as degraded.
As a result, a refined methodology for applying criteria to identify degraded areas has been developed. This methodology improves clarity in understanding the indicators of territorial degradation and provides a more justified framework for determining an area's degraded status.

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URBAN MICROCLIMATE MODELLING GIS FOR CLIMATE ADAPTION STRATEGIES

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Urban green infrastructure is increasingly recognized as crucial for cities confronting the effects of climate change. This research investigates the role of Geographic Information Systems (GIS) in modeling urban microclimates, underscoring its significance in climate adaptation strategies and sustainable urban planning.

GIS-based spatial analysis and remote sensing techniques are crucial for monitoring temperature variations in urban environments. Weng (2009) illustrates the capability of thermal infrared remote sensing to identify differences in surface temperatures and their relationship to land use and vegetation coverage [1]. Such methodologies facilitate the precise identification of high-risk zones, informing effective mitigation strategies.

In addition, including green infrastructure in city planning helps regulate microclimates. Bowler (2010) reviews urban greening projects and shows how they can reduce heat stress and improve city comfort [2]. GIS tools help to plan the best locations for green infrastructure to provide maximum cooling effects.

The influence of airflow and urban morphology is another vital element in urban microclimate analysis. Ching (2018) discusses how GIS, combined with computational fluid dynamics (CFD), can be used to model wind flow patterns and enhance natural ventilation [3]. This integration provides urban planners with essential insights for optimizing building layouts and street networks to mitigate heat accumulation.

GIS-based urban microclimate modelling offers a data-driven framework for addressing climate adaptation challenges. The review emphasizes the role of remote sensing in temperature analysis, the effectiveness of green infrastructure in mitigating urban heat island effects, and the benefits of combining CFD with GIS for enhancing urban airflow. These findings underscore the importance of incorporating GIS tools into urban planning to strengthen resilience against climate change.

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ENVIRONMENT AND WATER MANAGEMENT

DEFINING SOLUTIONS FOR THE SUSTAINABLE USE OF ORGANIC SOILS IN AGRICULTURE IN THE VENTA RIVER BASIN AREA

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The environmental quality of the Baltic Sea is generally determined by the limited water exchange and low water salinity concentrations, which results in an increased sensitivity to the impact of anthropogenic loads on river basins, as well as climate change. Anthropogenic activities, such as agriculture, are considered to be one of the most significant causes of the deterioration of water and soil quality. Excessive nutrient runoff from agricultural lands, mainly nitrogen and phosphorus, contributes to eutrophication. Therefore, sustainable management of agricultural lands, including organic soils, plays a major role in the context of natural ecosystem wellbeing, as well as climate mitigation.

Data shows that although only 3% of Latvia's agricultural production is obtained from organic soils, their inadequate management results in approximately half of the total GHG emissions of the agricultural sector [1,2]. Converting organic soils into agricultural land by the drainage not only contributes to the dispersion of GHG emissions, but also affects the hydrological cycles of river basin areas, degrades soil and water quality, including the reduction of biodiversity and the supply of a range of ecosystem services [3,4,5]. Long-term studies characterising the environmental quality of river basins have been sufficiently conducted at the scale of the Baltic Sea Region [4,5], however, studies of transboundary water basins that purposefully select organic soil territories as potential locations for strategic solutions are limited.

The study area of the Venta River Basin was selected based on data available indicating the impact of agricultural activities in the form of diffuse pollution, in correlation with locations of the organic soil drainage practices [1,6]. By analysing and modelling spatial data with a geographic information system, a data-based characterisation of the defined problem scope was determined, which can be used for further implementation of the spatial strategy development of the associated river basin district. Preliminary results show that by applying integrated land management solutions, the sustainable use of organic soils in the Venta River Basin can be ensured, while improving the ecological status, reducing carbon emissions and promoting the provision of ecosystem services and socio-economic benefits.

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SPATIAL DISTRIBUTION OF LEAD IN SNOWMELT IN JELGAVA CITY

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Heavy metal pollution is a worldwide environmental concern with long-lasting impacts on ecosystems and human health. Humans, animals, and plants are particularly vulnerable to heavy metals due to their ability to circulate at low altitudes and easily enter the body through the respiratory system [1]. Lead, as one of the most hazardous heavy metals, accumulates in urban environments, posing significant environmental and public health risks. This study aims to determine the spatial distribution of lead pollution in Jelgava city and identify potential sources of contamination. Urbanization and population growth have intensified pollution levels, particularly in urban and industrial areas, emphasizing the importance of monitoring these environments [2].

This research is distinguished by its use of inductively coupled plasma mass spectrometry (ICP–MS) and a high-resolution snow sampling methodology. Snow samples were systematically collected from 2020 to 2024 across various locations in Jelgava, including highways, urban centres, and industrial zones, to analyze spatial variations in lead contamination. By examining pollution patterns in relation to different land use types, this study provides insights into the primary drivers of lead accumulation.

The results indicate that the highest lead concentrations were detected near highways (16.33 μg/L and 13.36 μg/L), followed by railway-adjacent areas (6.71 μg/L), industrial zones (3.77 μg/L), and residential areas (0.89 μg/L). These elevated concentrations suggest that major pollution sources include vehicular emissions, industrial activities and combustion of heating fuels in private households. As snow melts due to rising temperatures, pollutants are transported into the environment through surface runoff, increasing contamination in stormwater systems and potentially impacting aquatic ecosystems. Future research should expand upon these findings by investigating lead contamination in rainwater and assessing seasonal variations in pollutant distribution. A comprehensive understanding of precipitation-related pollution dynamics will aid in the development of effective mitigation strategies to reduce heavy metal contamination in urban environments.

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ARSENIC CONCENTRATION IN SNOWMELT AND ITS DISTRIBUTION IN JELGAVA CITY

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Environmental pollution is a significant issue that affects both ecosystems and human health. The presence of heavy metals, including arsenic, in natural waters raises particular concerns, as high concentrations of this element can cause severe toxic effects [1]. However, in Latvia, including Jelgava, there is a lack of in-depth studies on arsenic concentration and its distribution characteristics in snowmelt. A detailed investigation is necessary to better understand pollution levels and potential sources.

This study analyzed arsenic concentrations in snowmelt collected from various districts of Jelgava over a five-year period (2020–2024). Snow samples were collected and analyzed using spectrophotometry [2, 3, 4, 5, 6]. The results revealed significant fluctuations in arsenic concentration: minimum values ranged from 0.0064 µg/L (2023) to 0.1552 µg/L (2021), while maximum concentrations varied between 0.1287 µg/L (2022) and 4.7242 µg/L (2023). The lowest average concentration was recorded in 2022 (0.0304 µg/L), whereas the highest was observed in 2023 (0.7252 µg/L). Higher arsenic concentrations were detected in industrial zones and areas with heavy traffic, indicating a possible link between pollution and industrial activities as well as transportation emissions. In some cases, detected concentrations exceeded legally established thresholds highlighting localized pollution risks.

The findings emphasize the need for continuous environmental monitoring and more effective pollution source control to mitigate arsenic's impact on water quality and public health. Future studies could help more precisely identify sources of contamination and develop sustainable strategies for its reduction. By focusing on a more detailed analysis of pollution sources and implementing regular monitoring systems, it would be possible to more effectively control arsenic concentrations in natural waters and reduce the associated risks to ecosystems and residents.

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IMPACT OF CROP TYPE AND SOIL CHARACTERISTICS ON GREENHOUSE GAS EMISSIONS IN LATVIAN AGRICULTURAL SYSTEMS

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Reducing greenhouse gas (GHG) emissions is a critical component of global efforts to mitigate climate change and support sustainable development [1]. Agricultural landscape, particularly those related to soil management and crop selection, play significant role in influencing GHG emissions [2]. This study investigates the impact of crop type and soil characteristics on GHG emissions in Latvian agricultural land.

Measurements were conducted from 2020 to 2023 across four monitoring sites in Latvia, each featuring different crop types. Research aimed to quantify and compare CO_2, N_2O, CH_4 emissions from soils under different crop and soil types. The monitoring sites covered areas with both organic and mineral soils. GHG emissions were measured every two weeks during vegetation period using Picarro G2508 gas analyser, which uses a ring down spectroscopy technology for precise measurements on the field with each measurement lasting 240 seconds [3, 4]. Measured GHG emissions were calculated using Soil Flux Processor and analysed using RStudio to ensure data's accuracy and reliability.

The main findings revealed significant variations in GHG emissions depending on crop type and soil characteristics. CO_2 emissions were highest in organic soils under maize cultivation, averaging 184.91 kg CO_2 ha^{-1} day^{-1} in Mārupe, while mineral soils under spring barley in Bērze emitted significantly less, 60.98 kg CO_2 ha^{-1} day^{-1}. N_2O emissions were notably higher in organic soils, with maize reaching 33.15g N_2O ha^{-1} day^{-1}, due to high nitrogen demand of the crop. CH_4 absorption was highest in well-aerated mineral soils, with spring barley fields in Auce showing absorption of 6.11g ha^{-1} day^{-1}.

In conclusion, crop type and soil characteristics are critical factors influencing GHG emissions in agricultural land. Organic soils with crops like maize contributed the most CO_2 and N_2O emissions, while well aerated mineral soils were effective reducing methane. By implementing nature friendly agriculture practices, such as optimized crop rotation and precise nitrogen management, it is possible to reduce the environmental impacts of farming. Study provides valuable insights how crop type and soil characteristics are distributing GHG emissions in agricultural lands.

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ZINC CONCETRATION IN SNOW WATER AND POTENTIAL HAZARDS IN THE CITY OF JELGAVA

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As urban populations grow, infrastructure expansion and increasing traffic intensity contribute to environmental pollution. Heavy metal contamination in urban environments poses a significant risk to public health, as prolonged exposure can lead to various diseases [1, 2, 3]. However, many previous studies on air quality have been limited in duration or have not been repeated making it difficult to analyze long-term trends in heavy metal pollution and identify key sources of contamination.

To address this gap, a continuous study was conducted in Jelgava from 2020 to 2024. The aim of this study was to assess changes in zinc concentrations within Jelgava city and evaluate potential risks to the environment and public health. Snow samples were collected annually from 59 sites within Jelgava and one site in Mežciems. The samples were analyzed using inductively coupled plasma mass spectrometry (ICP-MS) to determine spatial and temporal variations in zinc concentration. The results revealed significant fluctuations in zinc concentrations over the study period. The highest concentrations were recorded near the Lietuvas highway, with 47.98 µg/L in 2020 and 13.46 µg/L in 2022. In 2024, an exceptionally high concentration of 312.81 µg/L was detected in a private housing area, suggesting the presence of localized pollution sources, possibly linked to domestic heating, industrial emissions, or other anthropogenic activities. These findings indicate that zinc contamination is influenced by both traffic-related and residential pollution sources. This study provides valuable insights into the long-term trends of heavy metal pollution in Jelgava and highlights the need for continuous environmental monitoring.

The findings may be useful for urban planning and infrastructure improvement, particularly in managing pollution sources and mitigating risks to public health. Future research should focus on identifying specific contributors to zinc contamination and developing effective pollution control strategies.

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NICKEL POLLUTION LEVELS AND SPATIAL DYNAMICS IN SNOWWATER IN JELGAVA

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Nickel is heavy metal that can enter the environment as a result of both natural and anthropogenic processes posing potential risks to the ecosystem and human health. Industrial action and transport are major sources of nickel pollution as metal can spread through atmospheric emissions, wastewater discharges and other processes [1]. The purpose of this study is to determine the level of nickel pollution and its spatial dynamics in the snow water in Jelgava, its distribution and potential environmental impact, as well as to examine possible solutions for reducing pollution.

As part of the study, data on 59 plots in Jelgava territory and one control plot outside the city were analyzed to assess spatial dynamics of nickel contamination. The choice of such a location was based on the intensity of industrial and transport infrastructure in different parts of the city, which could affect pollution levels. A control plot outside Jelgava served as a reference point for comparing levels of pollution in urbanized and less affected environments. An inductively coupled plasma mass spectrometer (ICP-MS) was used to determine nickel concentration providing high sensitivity and precision in the determination of heavy metals. This method makes it possible to obtain reliable data on the presence of nickel in different plots and to assess possible sources of contamination [2]. Nickel concentration in snowwater in Jelgava fluctuated between 2020 and 2024 with the highest maximum value of 14.21003 μg/L in 2021 in the private houses and the district of small household gardens; the lowest minimum value of 0.026 μg/L was in 2023, while the average concentration overall decreased from 0.4363 μg/L in 2020 to 0.1243 μg/L in 2024.

Limiting pollution sources, effective pollution monitoring and appropriate urban planning solutions should be considered to reduce environmental pollution. The common strategy includes strengthening environmental protection measures and developing sustainable development plans for Jelgava and other urban areas.

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ASSESSMENT OF MANGANESE POLLUTION IN URBAN SNOWMELT: A FIVE-YEAR STUDY IN JELGAVA

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Manganese (Mn) is classified as a heavy metal and can enter the environment through both natural processes and anthropogenic activities. Due to its persistence in the environment and inability to degrade, Mn pollution poses significant risks to public health and ecosystems. The primary sources of Mn contamination include industrial activities and transportation emissions, making urban areas particularly susceptible to elevated concentrations.

This study aimed to determine the concentration of Mn pollution in snow samples collected from various urban areas in Jelgava and to analyze its spatial and temporal distribution trends. A total of 59 sampling sites were selected within Jelgava, alongside one control site located outside the city. The sampling locations were chosen based on the intensity of industrial activity and transportation infrastructure in different parts of the city, which might influence pollution levels. The control site served as a reference point for assessing differences in Mn contamination between urban and less impacted environments. Inductively Coupled Plasma Mass Spectrometry (ICP-MS), specifically the Agilent 8900 ICP-QQQ, was used to determine Mn concentrations with high sensitivity and precision. This analytical approach enabled the reliable detection of Mn across various locations and provided insights into potential pollution sources.

The results revealed fluctuating Mn concentrations in Jelgava's snowmelt over the studied period (2020–2024). The highest recorded concentration of 161.371 µg/L was observed in 2022 near the A8 highway, indicating significant contamination from traffic emissions. In contrast, the lowest concentration of 0.222 µg/L was recorded in 2024 near Bemberu pond, an area with a lower human activity. The average Mn concentration in urban snowmelt showed a declining trend decreasing from 13.01 µg/L in 2020 to 2.211 µg/L in 2024.

To mitigate the environmental impact of Mn pollution, measures such as promoting eco-friendly transportation, implementing stricter industrial regulations, enhancing environmental pollution monitoring, and incorporating sustainable urban planning strategies should be prioritized. These findings emphasize the need for continuous monitoring and targeted interventions to reduce heavy metal contamination in urban environments.

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CHROMIUM CONCENTRATION IN SNOWMELT AND ITS POTENTIAL ENVIRONMENTAL IMPACT IN JELGAVA

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Chromium is a hazardous heavy metal that originates from industrial activities, traffic emissions and other anthropogenic sources. Its presence in urban environments raises concerns due to its toxic effects on humans, animals, and plants. Despite its environmental significance, there is a lack of long-term studies on chromium contamination in snowmelt, which serves as a temporary reservoir for pollutants before they enter surface and groundwater systems. Understanding chromium distribution in snowmelt is essential for assessing its environmental impact and identifying key pollution sources.

This study aimed to determine the concentration of chromium in snowmelt across Jelgava and evaluate its potential environmental effects. Snow samples were collected from 60 locations, with 59 sites within Jelgava and one in Mežciems, outside the city. At each location, three samples were taken annually from 2020 to 2024. The samples were analyzed using inductively coupled plasma mass spectrometry (ICP-MS) in the laboratory conditions to quantify chromium concentrations and identify spatial and temporal variations in contamination levels.

The results showed significant fluctuations in chromium concentration over the five-year period. The average chromium levels were 0.251 μg/L in 2020, 0.090 μg/L in 2021, 0.735 μg/L in 2022, 1.343 μg/L in 2023, and 0.127 μg/L in 2024. Higher chromium concentrations were consistently observed near high-traffic areas, while lower values were found in residential zones. These findings suggest that vehicular emissions and industrial activities are the primary contributors to chromium pollution in snowmelt, reinforcing the role of urbanization in heavy metal contamination.

The study highlights the need for continuous environmental monitoring to track chromium pollution trends and assess its long-term impact on urban ecosystems. Implementing stricter pollution control measures, particularly in high-traffic and industrial areas, could help mitigate chromium contamination. Future research should focus on identifying specific pollution sources and evaluating mitigation strategies to reduce chromium levels in urban environments, ultimately contributing to improved environmental and public health outcomes.

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SPATIAL AND TEMPORAL DISTRIBUTION OF CADMIUM IN SNOW: ASSESSING URBAN POLLUTION IN JELGAVA

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Urban and suburban environments are highly susceptible to various pollutants resulting from anthropogenic activities. One of the most concerning pollutants is the presence of heavy metals, which pose risks not only to the environment but also to human health. This study investigates the accumulation of cadmium in snow and its distribution within the urban environment of Jelgava [1]. Previous studies have highlighted challenges in this field, particularly the short duration of many investigations and the lack of long-term data on changes in heavy metal accumulation over extended periods. Additionally, some studies are limited by small sampling areas, which may not provide a comprehensive overview of contamination patterns [2].

This research focuses on assessing cadmium presence in snow across Jelgava. A total of 59 sampling locations were selected within the city, along with one additional site outside the urban area. Snow samples were collected approximately 5 meters from the roadways and analyzed using inductively coupled plasma mass spectrometry (ICP–MS). Sampling was conducted annually over a five-year period from 2020 to 2024. The highest cadmium concentrations were consistently observed near major highways throughout the study period. However, in 2020, the highest cadmium value was recorded in a residential area, which may indicate pollution linked to waste burning.

These findings highlight the necessity for continuous environmental monitoring and stricter pollution control measures, particularly in areas with significant human activity and potential sources of heavy metal emissions.

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CIVIL ENGINEERING

THERMAL INSULATION MATERIALS OF ORGANIC ORIGIN: WOOD FIBRE BOARDS, ECOWOOL, FOAMED POLYESTER FOAMS, POLYURETHANE FOAM

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The growing demand for energy-efficient and environmentally friendly building solutions highlights the importance of selecting sustainable thermal insulation materials. The aim of this research is to analyze and evaluate the thermal insulation properties of wood fiber boards, cellulose wool (ecowool), foamed polyester foams and polyurethane foam. These materials are increasingly considered as viable alternatives to conventional insulators due to their lower environmental impact and good thermal resistance.

Klemczak, Kucharczyk-Brus, Sulimowska and Radziewicz-Winnicki (2024) provided a comprehensive overview of natural insulation materials such as cellulose, hemp, and wool in the context of climate-neutral construction [1]. They noted that these materials not only have low thermal conductivity but are also environmentally friendly, non-toxic, and easier to recycle compared to synthetic insulation. As energy regulations become stricter, these materials are becoming increasingly important in both new and renovated buildings.

Kosiński and Patyna (2024) analyzed the performance of organic loose-fill insulation in wooden frame constructions using hygrothermal simulations [2]. Their study showed that materials like cellulose and wood fiber can absorb and release moisture helping to stabilize the indoor environment. This moisture-buffering capacity is an advantage over mineral wool, which tends to transport moisture outward and may cause condensation. Furthermore, wood-based materials maintained stable thermal performance over time, even in varied humidity conditions.

Kowalczyk, Korol, Chmielnicki, Laska, Chuchala and Hejna (2023) explored the use of recycled polyurethane (PU) foam in the development of composite insulation materials, contributing to circular economy goals [3]. The study revealed that such composites, especially when modified with foaming agents, could significantly reduce thermal conductivity by as much as 64%. These innovations supported the broader adoption of recycled foams as lightweight and efficient insulators.

In conclusion, the scientific literature confirms that organic-origin insulation materials offer a balance between energy efficiency, sustainability and moisture management. Wood fiber boards and ecowool perform well in regulating indoor climate and retaining thermal properties, while foamed polyester and polyurethane foams show great potential when reused through circular production methods. These findings suggest that combining natural and recycled materials may offer optimal solutions for future sustainable construction.

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THE EFFECTIVENESS INCREASE OF TIMBER-CONCRETE COMPOSITE SLAB

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As an environmentally friendly building material, timber aligns with government strategies for sustainable development and climate change mitigation. Enhancing the efficiency and load-bearing capacity of timber structures is a current and pressing concern. European and North American markets have seen a rapidly growing popularity and demand for CLT (cross-laminated timber) panels [1]. Combining timber with materials that have superior mechanical properties, such as concrete, can improve the load-carrying capacity of timber structures creating TCC (timber concrete composite) [2].

Investigations in this study are oriented in two main directions. The first direction involves evaluating the potential to increase the load-carrying capacity, the second direction of this investigation focuses on reducing the brittleness of adhesive timber-to-concrete connections. There were several, CLT (t_{CLT}=100 mm, 5-layer) with added concrete layer ($t_{concrete}$=50 mm), laboratory specimens prepared for testing with span of 1400mm. A simplified design method based on the transformed section method and the γ-method outlined in Annex B of EN 1995-1-1 for mechanically jointed beams was considered for behaviour analysis of the structure [3]. The finite element models were developed to verify the results obtained by the simplified design method. The software ANSYS was used for the development of the FEM models for laboratory specimens. The SHELL element type was used for modelling the TCC specimens. Timber members and concrete layers were in the strength classes C24 and C20/25, respectively. Connections between all the layers of the FEM models were modelled as rigid ones.

The results show that the addition of a concrete layer with a thickness of 50 mm and mechanical properties close to C25/30 strength class concrete results in a notable increase in the load-carrying capacity of the CLT panels with dimensions 1400 mm × 400 mm × 100 mm by up to 40%. The possibility of decreasing the brittleness of the structure failure by adding the polypropylene microfibres was determined. It was shown that the addition of microfibres MAPEI PP-FIBER M6 to the concrete surface layer changes its behaviour under the failure load; the beam-type panels did not collapse brittle, and in some specimens, the concrete layer did not disintegrate at all but rather delaminate from the CLT section. It can be concluded that the addition of the polypropylene microfibres increases the maximum vertical displacements of the specimens, causing a decrease in the modulus of elasticity of the concrete layer.

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CONSTRUCTION WASTE REDUCTION AND RECYCLING

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The construction sector, as one of the largest waste-generating industries globally, faces significant environmental challenges, making waste reduction and recycling essential not only for minimizing environmental impact but also for contributing to the development of sustainable construction practices. The aim of sustainable construction practices is to improve efficiency and reduce environmental impact by minimizing, recycling and reusing construction waste.

One of the examples of best practice is ”Skanska’s Deep Green” projects in Sweden, where over 95% of waste is recycled or reused, renewable energy was used during construction, and sustainable material suppliers were prioritized showing how companies can combine waste reduction with economic efficiency [1].

The article by Alwisy [2] focuses on strategies for waste minimization throughout the construction process. It discusses approaches such as efficient project planning, material selection and waste sorting at construction sites to reduce waste. A good example is the Cross rail project in the UK, where early-stage planning and material optimization using BIM technology helped significantly reduce waste. The author emphasizes that waste minimization should begin in the early stages of construction, when appropriate material choices can significantly lower waste generation [2].

Another article provides an overview of various recycling technologies for construction and demolition waste focusing on methods for processing and reusing materials. The Tokyo 2020 Olympic construction is mentioned as an example, where 99% of construction waste was recycled, including concrete and steel, to conserve resources and reduce landfill use. The authors highlight how these techniques help reduce environmental impact by conserving natural resources and lowering landfill use [3].

A number of research articles emphasize the need for sustainable construction waste management through waste minimization and recycling. Thus, Alwisy [2] stresses the importance of starting waste reduction in the design phase, while Soni [3] highlights the challenges of recycling technologies, including high costs and inefficient sorting. Ghaffar and Wali [1] point out the technologies and policy barriers to effective waste management.

In conclusion, adopting these practices can reduce the environmental impact of construction. For Lithuania, improving waste sorting, recycling technologies and policies will be key factors for a more sustainable construction sector.

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TIMELESS FOUNDATIONS: VITRUVIAN PRINCIPLES IN ARCHITECTURE

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Architectural design balances functionality, aesthetics and stability to create practical, visually appealing spaces. This research explores Vitruvius' principles of proportion, symmetry, and harmony, which shape both classical and contemporary architecture by highlighting their impact on architectural aesthetics and structural integrity.

De Architectura [3] by Vitruvius is one of the earliest and most influential sources in architectural theory by introducing three key principles: firmitas (structural integrity), utilitas (functionality), and venustas (aesthetic appeal). Vitruvius argues that a well-designed building must be structurally sound, functional and beautiful through proportion and symmetry. His emphasis on mathematical precision remains a major influence on architectural thought. He stated: "Symmetry is a proper agreement between the members of the work itself, and relation between the different parts and the whole general scheme, in accordance with a certain part selected as standard." Later theorists built on Vitruvius' ideas by emphasizing the importance of proportion in defining architectural beauty. Kruft (1994) explored how mathematical ratios have been applied across architectural styles highlighting their role in achieving balance and order [1]. Summerson discussed the relationship between symmetry and aesthetic appeal in classical architecture and how these principles created visually pleasing structures [2]. He also examined how material selection, site adaptation and economic factors complement Vitruvian principles in modern practice.

Vitruvius' theories on proportion and symmetry serve as a foundation for architectural aesthetics. However, contemporary architecture often adopts these principles rather than strictly adhering to them. While symmetry remains a key design element, modern architects experiment with asymmetry to create dynamic and innovative structures. Additionally, material advancements and digital design technologies have introduced new possibilities in balancing form and function. Vitruvius' principles remain in neoclassical architecture but are challenged in modernist and postmodernist styles, which favour function and minimalism over ornamentation. This evolution reflects architecture's adaptation to societal and technological change while retaining classical influences.

In conclusion, architectural design balances structure, function, and aesthetics. Vitruvius' emphasis on proportion and symmetry remains influential, even being adapted in modern architecture. Understanding these principles offers insight into architecture's evolution and enduring classical roots.

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IMPLEMENTATION OF PRINCIPLES OF CIRCULAR CONSTRUCTION IN DAUGAVPILS

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Nowadays, increasing attention is being paid to improving residents' quality of life and health. Waste is one of the factors affecting public health, as construction and building materials production increase every year. Approximately one-third of the emissions generated by the construction industry come directly from material extraction during production, the construction process itself, and during renovation and demolition.

The topic of circular construction is highly relevant in Europe and worldwide in the context of sustainable development. Circular construction is a strategy based on specific principles [1]. The first step in this strategy is extending the life cycle of buildings aiming to preserve and maintain them as long as possible, adapting to new needs. Once all possible options have been considered and none are suitable, the building can be demolished, but the materials from demolished elements can be reused. If reuse is not possible, the materials should be recycled. This principle also applies to new buildings – provisions should be made for their adaptation to other needs, demolition, and the possibility of recycling the demolished elements. The main goal of this principle is to ensure that no waste is generated at any stage of the construction process.

Currently, there is active implementation of circular construction principles in legislation and discussions among industry specialists. However, the public lacks sufficient knowledge, which is why no specific requirements are set for new buildings. The introduction of circular construction principles into everyday life is a way to live in a more environmentally and health-friendly manner, change habits, care for the future of humanity, create the possibility of living in a cleaner environment, as well as to develop the adaptation of buildings to sustainable construction principles [2,3].

The aim of the research work was to identify the barriers to implementing circular construction principles in the city of Daugavpils. The implementation of this scientific work involved both qualitative and quantitative research methods to obtain a comprehensive understanding of the implementation of circular construction principles in Daugavpils. First, the literature review presented the experiences of other countries in implementing circular construction principles, as well as examined construction projects in Daugavpils that are based on these principles. In this phase, relevant regulations, laws, and standards from both Latvia and other countries, as well as certification systems, were also analyzed. This provided an overview of the laws and guidelines influencing this type of construction. In the second part of the study, a survey was designed and conducted. The survey involved representatives from the construction industry, construction engineers, architects, as well as Daugavpils residents, to gather opinions on the opportunities and challenges of implementing circular construction principles in Daugavpils..

The study identified the main obstacles to the implementation of circular construction principles in Daugavpils. Based on the data obtained from the survey, it can be concluded that the main challenges to implementing circular construction principles are related to the lack of knowledge, public awareness and financial support. To promote implementation and further development of these principles, it is necessary to educate both the public and industry professionals through events and media campaigns. Additionally, financial support from the state and local governments would make sustainable construction solutions more accessible. Practical positive examples play a significant role in this process.

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THE IMPACT OF THERMAL INERTIA OF WOODEN BUILDINGS ON THE ENERGY PERFORMANCE OF THE BUILDING

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Currently, there are a lot of wooden houses in Latvia that have sufficient energy efficiency indicators to comply with building regulations. However, they do not create suitable conditions for thermal comfort, a factor that contributes to the quality of the indoor environment of buildings. This scientific paper aims to explore optimal solutions to address issues of discomfort and unnecessary expenses focusing on the low thermal inertia and mass of the building's envelope as the underlying cause.
On the basis of the literature review, relevant regulations and standards were examined, methods for calculating thermal inertia and other thermal engineering parameters were selected to analyze the energy performance of wooden building envelope structures. The research was designed to determine the thermal inertia, temperature time shift and other thermal parameters for 11 exterior wall details of wooden buildings used in Latvia.
Shortcomings and the lack of a clear definition regarding the concept of thermal inertia were identified in the Latvian Construction Standard LBN 002-19 "Thermotechnics of Building Envelopes". The collected and compared data suggested possible solutions to improve structures' thermal resistance.
To conclude, it is necessary to consider the mass of wooden buildings and the adequate thermal inertia, when constructing buildings in Latvia's climatic conditions, to ensure that the space does not heat up too quickly in summer and cool down in winter, as well as to ensure that the external structure transfers the daytime heat to the nighttime hours. This should be clearly defined in the LBN, thus improving the indoor climate of newly built buildings and saving energy needed for heating and cooling. The required thermal inertia values can also be achieved in wooden buildings by incorporating a solid wood layer, fiberboard, or phase change materials. In such cases, there is no need to use very thick insulation layers, which, in addition to economic considerations, also reduce the space.

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ECO-FRIENDLY BUILDING MATERIALS

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The construction industry significantly influences global environmental sustainability, primarily due to the extensive use of traditional materials like concrete and steel, which are associated with high carbon emissions and resource depletion [4]. As the demand for infrastructure continues to grow, finding sustainable alternatives has become essential in reducing the environmental burden of construction. This paper compares environmentally friendly building materials based on their properties, advantages and potential to replace conventional materials.

Bamboo, a rapidly regenerating renewable resource, has certain species capable of growing up to three feet in 24 hours, making it one of the fastest-growing plants suitable for construction [3]. It also exhibits a high strength-to-weight ratio, surpassing that of many traditional materials, making it suitable for flooring, cabinetry and even structural components in some architectural applications [1]. Additionally, bamboo's natural flexibility and durability contribute to its resistance to earthquakes and other environmental stresses, making it an ideal material for sustainable construction.

Hempcrete, a bio-composite material made from the inner woody core of the hemp plant mixed with a lime-based binder, is another promising alternative. It is lightweight, offers excellent thermal insulation, and is both fire-resistant and pest-resistant, making it a durable and energy-efficient option for modern buildings [2]. Compared to traditional materials, these sustainable alternatives contribute to carbon footprint reduction, as materials such as bamboo, hempcrete, and sustainable cements are either carbon-neutral or carbon-negative, significantly lowering greenhouse gas emissions in construction [2]. Additionally, natural materials like cork and hempcrete provide superior thermal insulation, reducing the energy demand for heating and cooling in buildings. The use of reclaimed wood and metal further minimizes the need for new resource extraction while maintaining structural integrity and aesthetic appeal. Integrating environmentally friendly materials into construction practices presents a viable pathway to mitigating the environmental impact of the building sector. By adopting materials such as bamboo, cork, reclaimed wood and metal, hempcrete, cross-laminated timber (CLT) and sustainable cement alternatives, the industry can move toward more sustainable development, balancing structural integrity with ecological responsibility [1,4].

Through continued innovation and adoption of green building materials, the construction sector can significantly contribute to global sustainability efforts, paving the way for a more environmentally conscious future.

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ORGANIZATIONAL STRUCTURE AND CHALLENGES IN CONSTRUCTION

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This study aims to describe the organizational structure, challenges faced by construction organizations, daily on-site organization and give an introduction about construction project management.

VeilSun, a development company, helps construction companies tackle some challenges. Whether it is implementing user-friendly digital run scheduling or creating customizable applications for comprehensive project management. They do all of this through five core principles: start with a solid plan, manage resources effectively, schedule for success, manage risk, and create budget accountability [1].

Construction companies are at the heart of modern cities. That's why every construction project must run without any problems. For this reason, construction projects need an organizational chart. Someka provides a complete guide to the construction organization chart focusing on the construction project manager but also discussing all chart positions [2]. But although the construction industry plays a crucial role in the global economy, it currently faces multiple challenges that hinder potential for sustained growth. These include regulatory compliance, project delays, safety issues and rising cost. In this article, we examine the main obstacles faced by the construction sector and offer practical ideas on how companies can overcome them, while laying the groundwork for speeding up project timelines and improving project safety rates [3].

As a conclusion, despite strategic planning and organization efforts, challenges like labour shortages and project delays persist. So, with adequate tools and qualified people, efficiency can be improved by complying with regulations and safety concerns and avoiding risks such as cost increases or the complicated availability of material.

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CONSTRUCTION DURING AND AFTER THE PANDEMIC COVID-19

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The COVID-19 pandemic significantly impacted the construction industry, disrupting supply chains, workforce availability and regulations. This research aims to explore the effects of the pandemic on construction practices by examining how companies adapted and how the prices changed after the pandemic.

One of the articles on the pandemic problems [1] describes the unpreparedness of certain market segments to the adaption needed to cope with the pandemic situation. The author analyses the influence the information infrastructure of the housing market has on decisions to build or purchase housing, as well as on the process of financing business entities. We can say that the housing market and construction during pandemic reduced their capacity significantly.

Another article [2] explains how, after the pandemic, everyone understood the gaps in construction. Covid-19 showed that there is a need to increase the efficiency of all processes. The construction sector had been going through many changes recently, so the best results could only be achieved through close cooperation between scientific institutions developing the latest materials and technologies.

It is impossible to forget the crisis after the Covid-19, when inflation did not spared the construction sector either. The official statistics [3] explains in an article that Lithuanian department of statistics estimated that the prices of construction elements increased by almost 20 percent over the year after the pandemic hit. Compared to the article above, more detailed clarification of reasons for the price increase in construction sector is presented.

The pandemic brought rapid and significant changes to the construction industry exposing existing gaps and weaknesses in the sector. During the COVID-19 crisis, many construction projects were either halted or delayed due to supply chain disruptions, labor shortages, and strict safety regulations. This highlighted the industry's heavy reliance on global supply chains and revealed the lack of flexibility in adapting to sudden economic shifts. Additionally, after the pandemic, there was a noticeable increase in the prices of construction materials due to the limited supply and rising demand. This further complicated the execution of new projects and led to higher costs for housing and infrastructure development. At the same time, the shortage of skilled construction engineers became an even bigger issue, making it harder for companies to meet growing market demands.

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SAFETY AND HEALTH IN CONSTRUCTION INDUSTRIES

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Construction safety practices fifty years ago were underdeveloped, based more on experience than regulations, leading to frequent accidents. Over time, awareness of workplace hazards led to stricter safety measures. Today, construction sites follow strict standards, reducing accidents through continuous advancements in safety procedures. This research examines the evolution of construction safety, comparing past practices with modern standards.

Safety in construction depends on proper equipment use, including scaffolding, ladders and machinery guards to prevent falls and mechanical injuries. Fire extinguishers, alarms and first-aid kits help manage emergencies, while regular inspections and maintenance keep tools safe. Training and clear signage further reduces hazards, improving site security and efficiency [1].

Five decades ago protection of falls was almost nonexistent, moreover helmets were not the standard a century ago. From 1980 to 1989, falls caused 49.6% of U.S. construction-related fatalities, accounting for 2,798 deaths, mainly in Texas, California, and Florida. Most resulted from unstable surfaces and missing guardrails. The improved enforcement, training and safety equipment could have prevented many of these deaths [2].

In today's standards, construction workers must wear Personal Protective Equipment (PPE) to ensure safety on-site. This includes a hard hat for head protection, safety glasses or goggles to shield eyes from debris, earplugs or earmuffs to reduce noise exposure. Gloves protect hands from cuts and burns, while a high-visibility vest enhances visibility to prevent accidents. A safety harness is essential for fall protection, and chaps pants offer leg protection from sharp objects. Finally, steel-toed boots safeguard feet from heavy objects and punctures. Wearing proper PPE significantly reduces workplace hazards and ensures a safer construction environment [3].

In conclusion, safety in construction is essential for preventing accidents and ensuring efficient project completion. Key measures include proper training, risk assessments, adherence to regulations, and regular inspections. Clear communication and a strong safety culture further enhance workplace security, leading to safer and more productive construction sites.

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COMPARISON OF CERAMIC BUILDING MATERIALS: PAST AND PRESENT

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Ceramic building materials (CBM) have been used in construction as early as 4th century BCE, with first ceramic materials being discovered in 26,000 BCE. With such a long history, it would be interesting to know how modern ceramic materials have changed from then, and that would be the aim of this research.

The function of tiles has not changed, but the way that they are produced has changed [1]. Early pieces of ceramics were shaped manually, fired at lower temperatures, the materials did not get quality control. Currently, developments in technology have improved production processes; tile shaping is performed by specialized machinery, and materials undergo quality control procedures. Everything is done quicker and better. “Rapid urban growth created a huge demand for CBM which could not be met by hand-made production alone. Machinery for the manufacture of CBM continued to develop” [1].

In the late 19th century, cities all around the world were expanding, which meant the need for more materials. This was the moment where more people were trying to make CBM quicker, stronger and more reliable. For example, the Hoffman kiln was introduced, which ”was of particular importance, allowing larger numbers of bricks to be fired quickly, cheaply and evenly” [2]. The method of creating CBM also changed, where one of the priorities was to make strong, durable meterials that could withstand pressure, for example Accrington bricks, where almost dry clay was crushed to make bricks of exceptional strength. In modern world, even more advances have been made to production of CBM. Innovating more types of them, enhancing the capabilities. ”One of the key innovations is the development of lightweight ceramics, where new manufacturing techniques have improved strength while reducing overall structural load” [3].

Such innovations help builders, constructors and designers minimize stress on buildings, which will let them move more freely and have more place to change the way they want to build. Another material has been introduced: self-cleaning ceramics [3]. Such material breaks down dirt when exposed to sunlight, which lowers maintenance costs.

Ceramic building materials have evolved significantly over millennia, transitioning from manually shaped, low-temperature-fired materials to highly engineered products with improved strength, efficiency and versatility.

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SOCIAL SCIENCES

HOUSING AFFORDABILITY IN THE CONTEXT OF CLIMATE NEUTRALITY

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Housing availability and affordability is a key aspect of every person's life. Understanding that housing as a building consumes energy for heating and cooling, the question of energy efficiency of the building stock is being raised when climate goals are discussed. The research aims to outline the following question: Can housing be energy efficient and affordable?

A quality home at an affordable price is one of the basic needs of the population. The availability of quality housing is a crucial condition for economic development, affecting not only the level of household welfare and population growth, but also labour mobility, the creation of new jobs, access to economic growth opportunities, enabling or denying residents the opportunity to actively participate in the labour market, as well as reducing poverty and social exclusion [1].

Building stock in the European Union consumes 40% of total energy consumption and emits 36% of all European greenhouse gas emissions. The European Commission indicates that around 75% of the total building stock is energy inefficient [2]. The climate and energy ambition has set a new energy efficiency of buildings: the zero-emission building, with very low energy demand, zero on-site carbon emissions from fossil fuels and zero or a very low amount of operational greenhouse gas emissions. All new buildings should be zero-emission buildings by 2030, and existing buildings should be transformed into zero-emission buildings by 2050 [3].

The question remains open: how to ensure that newly built dwellings are energy efficient and also financially affordable to the general public. Understanding that most people cannot afford housing in Latvia, many experts indicate that Latvia needs a new housing segment: affordable housing, which is being financed through a revolving fund [4]. Although there are two support programmes for the construction of affordable housing in Latvia, which can lead to decarbonization of housing stock, in the authors' opinion, there is a third and less costly option to promote affordable rental housing by renovating an existing unoccupied housing stock.

Countries like Poland are using municipality-controlled rental agencies to rent out unoccupied housing. One of the benefits of renting out an empty dwelling through the agency is being able to get your building renovated for free, and the finding of renters, as well as property security, is being done by the rental agency [5]. Similar programmes exist in England, the Netherlands, and Denmark.

In conclusion, for policymakers, it is necessary to look into all available aspects of housing affordability promotion and look into ways to "hunt two rabbits with one stone".

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CHANGES IN APPROACHES TO INFORMAL WORKPLACE RELATIONSHIPS

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This research of secondary sources was done as part of writing the author's bachelor's thesis. It examines the evolution of informal working relationships in organizations, highlighting the shift from classical theories that strongly criticized such relationships to a modern understanding that recognizes their value. The aim is to provide insight into how these theories shape perceptions of informal working relationships.

The theoretical argument starts with Frederick Taylor's scientific theory of management, which criticized informal workplace relationships, arguing that such interactions reduce productivity by focusing on personal rather than organizational goals [3]. Taylor's position set the stage for a trend to which subsequent theories reacted, providing a basis for understanding the question of the benefits of informal relationships in the work environment.

Further development in the understanding of workplace relationships is largely attributed to Elton Mayo's experiments at Western Electric, which contradicted Taylor, demonstrating that social interactions and informal relationships significantly increase employee productivity and satisfaction [2]. Mayo's work brought about a paradigm shift, emphasizing the human factors in workplace management and the positive aspects of informal relationships that foster a therapeutic and supportive environment for employees.

Finally, the research discusses the Theory Z of the 1980s by W. Ouchi, which emphasizes a strong corporate culture and the involvement of employees in the decision-making process to increase their sense of belonging and motivation [1]. Ouchi's model represents a shift towards recognizing the importance of a supportive and inclusive workplace, illustrating how a well-integrated corporate culture can foster informal relationships that positively impact organizational performance.

In conclusion, this research takes these theories into account, stating that informal working relationships, while once considered unhelpful, are now recognized for their crucial role in improving organizational performance and employee well-being. The evolution from Taylor's skepticism to modern endorsements of informal interactions illustrates a significant transformation in management theory and practice, recognizing the complex, social nature of the workplace.

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LATVIA'S OPPORTUNITIES TO BECOME A HOME COUNTRY FOR EXPORTING BUSINESS CONSULTING SERVICES

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Business consulting services is a specific industry where "the product" is the services companies offer and there is no difference where the company is registered. Taking into account that when choosing a place of the business there is no need to consider the availability of raw materials, proximity of the market or location of clients, business consulting services companies may choose the most favourable jurisdiction for the company's operations depending on the business environment, ease of doing business, available state support for business, restrictive or business-promoting nature of regulations and how large is tax burden. Physical location is not important for this kind of company, and if Latvia does not have a competitive offer, that might become a problem. Even more, this might become a double problem, because, if the business environment is not favourable, business consulting companies dealing with placing investments or transferring assets to countries with better investment climates on behalf of the client will not only register their activities in another country, they will also not recommend Latvia as a place of investment to their clients.

Study hypothesis: Latvia does not have an absolute competitive advantage to attract business consultancy companies and their clients; nevertheless, there is an opportunity to develop the export of services. The study aims to evaluate opportunities to improve Latvia's competitive advantage to increase the export of business consulting services.

The functioning of a company is ensured by its assets. In a production company, these are, first of all, equipment and raw materials, and only then employees. In business consulting companies, however, the primary asset is high-level professionals. The main asset of this kind of company is highly qualified employees with deep, specific knowledge who offer complex services [1].

Two types of classic private consulting can be contrasted - management consulting and technology consulting, both of which operate in the current era of digital transformation. Comparing the factors that underpin the successful development of both types of consultancy companies, it could be concluded that technology consultants must stay at the forefront of innovation to serve their clients effectively, while management consultants primarily need to focus on client orientation [2]. Artificial Intelligence (AI) offers unprecedented opportunities to automate data analysis, improve decision making and support innovations within consulting practices, at the same time its integration raises considerable ethical doubts regarding transparency, bias and privacy, therefore balance is needed between the use of AI to ensure operational efficiency and preserving the human-centred aspects of counselling [3].

The study results confirm that companies need to evolve internally to keep up with market trends such as digital transformation, innovations, and skill development. However, for managerial consulting providers, a client-focused approach and deep knowledge of strategic company development are even more critical.

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THE COMPETITIVENESS-SUSTAINABILITY PARADOX: A THEORETICAL REVIEW

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The society and economics of the 21st century face several development challenges: rapid population growth, insufficient resources, territorial imbalance, regeneration issues, as well as growing demands for a culture of well-being and high quality of life. Due to the influence of diversified challenges, in social sciences, a paradox can be identified - the necessity to solve short-term competitiveness issues while simultaneously balancing sustainable development dimensions. One of the main problems of the multidirectional paradox is related to the tension between short-term goals of competitiveness and long-term targets of sustainable development. To specify the characteristics and interactions between competitiveness and sustainability, the aim of this study is to identify and define the competitiveness-sustainability paradox. The first theoretical material about this topic is Michael Porter's work on competitiveness. The theoretical source discusses the aspects of competitiveness that are influenced by a country's or a company's ability to innovate and adapt in a globalized market and tendencies [1]. As Porter's theory emphasizes, competitiveness is not just about short-term economic gains. Still, it is deeply intertwined with long-term sustainable practices, especially when viewed in the context of a country's economic development. This theoretical base highlights that competitiveness in the modern economy requires a long-term vision that addresses the challenges of resource management, social well-being, and environmental sustainability.

Another theory discusses the coaction between competitiveness and sustainability, and how the theory of paradoxes applies to particularly focusing on the conflict between short-term competitive strategies and long-term sustainability goals [2]. This highlights the challenges faced by companies in balancing both objectives and how sustainability-related decisions often conflict with short-term profitability and benefits. To overcome this paradox, organizations must adopt strategies that incorporate both immediate competitiveness and long-term sustainable development.

The third source expands on the need for organizations to align their competitive strategies with sustainable practices. The theoretical material emphasizes how a shift toward more sustainable business models can reduce the tension between competitiveness and sustainability. [3] As a result of the research, it was identified that there is a paradox between the goals of competitiveness and sustainability, mostly because the definition of competitiveness has changed historically, especially in the context of sustainable socioeconomic responsibility; therefore, the intensity of the paradox also varies.

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WORK EXPERIENCE OF ILLEGALLY EMPLOYED WORKERS IN CONSTRUCTION

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In its 2023 declaration, the Latvian government listed tackling illegal employment as one of its main aims. This shows that illegal employment is still a problem, and it is worth researching, especially in the sector where it is most widespread - construction. The aim of the research is to examine the work experience of illegally employed workers in construction and to understand why they choose to work illegally. The main theoretical approaches were general strain theory [1], the concept of precariat [4], as well as research on the shadow economy [2,3]. The research was conducted using four semi-structured interviews with illegally employed workers in construction during January 2025 in Jelgava, Latvia. Most of the interviews took place at the interviewees' place of residence. The research questions were: 1. What is the work experience of illegally employed workers? 2. Why do illegally employed workers in construction continue to work illegally?

The results show that the work experience of illegally employed construction workers does not indicate that their social income is lower than that of legally employed workers or that their job security is significantly reduced. Therefore, illegally employed construction workers do not belong to the precariat. Their work experience also does not appear to support a macro-level correlation between changes in company workforce size and the prevalence of illegal employment within the company.

According to illegally employed construction workers, the shadow economy in the construction sector is driven by tax burdens, clients' inability to afford legal labour, intensive accounting requirements for construction firms, ineffective state regulations, and weak enforcement mechanisms for occupational safety norms. Further research is needed to be done on: How does illegally employed construction workers' control over their working hours, responsibilities, and job location affect their willingness to continue working illegally? How does clients' inability to pay for legal labour contribute to the expansion of the shadow economy in construction? How do employment relationships between the employee and the employer differ from those in the legal sector?

The main conclusions are that illegally employed workers in construction perceive the risks of being penalized as low. The likelihood that job precariousness will cause strain for illegally employed workers in construction is low. However, if precariousness leads to conditions that generate strain, it is almost always both subjective and objective. Often, as a result, the individual engages in criminal behaviour as a means of coping with the situation. The research also shows that illegally employed construction workers choose to continue working illegally because they believe the nature of the industry makes legal employment unfeasible.

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SOCIAL NETWORK AS A RESOURCE IN FAMILIES OF CHILDREN WITH DISABILITIES

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Families raising children with disabilities face significant daily challenges, requiring access to various forms of support to ensure the well-being and development of their children. In Latvia, approximately 2.6% of children have been diagnosed with a disability [1]. Furthermore, between 2020 and 2023, the number of children with disabilities increased from 8,746 to 9,372 [2], reflecting a growing demand for support systems. Social networks have emerged as essential resources that provide emotional, informational, financial, and practical assistance, helping families navigate caregiving complexities and mitigate risks of social exclusion. This study employs a qualitative research approach, utilizing ego-centric network analysis to examine the personal social networks of parents raising children with disabilities. Semi-structured interviews were conducted to identify key actors within these networks, the types of support they provide, and the challenges associated with network accessibility and sustainability. Ethical considerations were prioritized throughout the research, ensuring confidentiality and sensitivity in data collection.
The findings reveal that social networks serve as crucial mechanisms for families seeking both emotional and practical support. Digital platforms such as Facebook and WhatsApp groups play a particularly vital role in enabling parents to share experiences, seek advice, and provide mutual assistance. Practical support, including childcare help and access to medical services, was identified as one of the most valuable aspects of social network engagement. However, the study also highlights several challenges, including insufficient emotional support, the weakening of close friendships due to caregiving responsibilities, and barriers to accessing necessary resources and information. Many parents reported that despite digital networking opportunities, the burden of seeking help often remained solely on them.
The study concludes that while social networks provide indispensable support, their effectiveness could be enhanced through targeted interventions. One key recommendation is the development of a centralized information platform specifically designed for families raising children with disabilities. This platform would serve as a comprehensive resource hub, consolidating relevant information, support services, and networking opportunities in a single, easily accessible space. Additionally, establishing structured emotional support groups within these networks would help address the lack of emotional support experienced by many caregivers. These groups could provide a safe space for parents to share their struggles, offer mutual encouragement, and build stronger social connections.

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FLEXIBILITY OF CALL CENTER EMPLOYEES IN SOLVING NON-STANDARD SITUATIONS

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The aim of the research project was to investigate a call centre workers' flexibility when solving non-standard situations. It was crucial due to the changes in customer service practice standards due to COVID-19, as well as the growing popularity of remote work [1].
The theoretical works used in the research were articles, books and other similar sources related to work sociology, call center specifics, customer service and flexibility.
Customer experience is more important than ever, yet it has never been more challenging as companies face a perfect storm of increasing call volumes, talent shortages, and rising customer expectations. Berg et al. [2] highlights the relevance of this research, as identifying which methods and tools best assist call center employees in remaining flexible can help combat the lack of staff and an increasing demand.
One of the solutions for improving worker flexibility and compensating for a lack of staff is the automation of processes. As O'Leary [4] points out, automating different tasks and allowing customers to make changes on their own, along with utilizing various AI tools, can reduce the amount of manual work.
Another important part of managing the workload more effectively and offering workers more flexibility is optimising current processes and educating the employees on new technological advances and changes to ensure that the company remains relevant in the industry [3]. The research concluded that there is a lack of communication and problems in the learning process of new advances within the company, as some workers did not agree that the company provided sufficient resources.
The following solutions were offered: 1) a company should invest and assist employees in dealing with the emotional stress, as this can impact worker flexibility negatively, 2) reduce the workload by introducing modern, AI-powered solutions for daily tasks that can be automated and continually work to improve upon them, 3) even with the problems in the learning process, most surveyed workers still agreed that they would like more learning possibilities as well as more in-house trainers to assist daily.

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STEP BY STEP: BUILDING POSITIVE ATTITUDES TOWARD CHEMISTRY WITH INQUIRY-BASED LEARNING

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Chemistry, like other STEM subjects, is often perceived by students as challenging and less engaging. Our research aimed to identify teaching strategies that can positively influence learners' attitudes towards this subject. Inquiry-based learning (IBL) has been recognized as an effective approach for skill development and attitude improvement [1, 2]. IBL is characterized by active learning, thought-provoking situations and questions, increased student responsibility, and a teacher taking up the role of facilitator. It is centered around seeking knowledge and developing new understanding [3].

The empirical phase of our research focused on examining the frequency of IBL-related factors in Hungarian high school chemistry lessons and their impact on students' attitudes. Quantitative data were collected via an online survey among teacher trainees (N=273) at the University of Debrecen during the 2022-2023 academic year. Participants responded retrospectively to questions regarding their experiences. The prevalence of IBL elements was assessed using frequency scales, with means and standard deviations calculated using SPSS. Multiple regression analysis was employed to explore factors influencing attitudes (assessed using 4-point Likert scales and semantic differential scales) toward chemistry.

The study revealed a limited presence of IBL in Hungarian chemistry classrooms, though certain components, such as open-ended questions, opportunities for students to explain their ideas, and real-life-based tasks, were generally at least sometimes present. In terms of shaping attitudes, IBL can have both positive and negative effects. Significant positive contributors to favorable attitudes included the teacher's role as a facilitator (B=0.273, p<0.001), the incorporation of problem-solving tasks related to everyday life (B=0.260, p=0.007), and emphasizing the societal relevance of chemistry (B=0.205, p<0.001). Conversely, the frequency of experiments and the use of open-ended questions did not significantly influence attitudes. Furthermore, we found that increased responsibility and the increased frequency of student decision-making, which are typical features of IBL, were not considered desirable by students.

To conclude, IBL holds the potential to enhance students' attitudes toward chemistry but requires step-by-step and consistent implementation. Rapid or unstructured introduction of IBL elements can overwhelm students, increase cognitive load and stress, and ultimately counteract the benefits. Our findings highlight the importance of strategic, student-centered teaching methods to foster engagement and reshape perceptions in chemistry education, providing valuable insights into both the challenges and opportunities of IBL.

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EU SCIENCE DIPLOMACY REINVENTS AN ACCLAIMED TRADITION

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The forthcoming launch of the European Science Diplomacy Agenda of the European Union (EU) captures a policy-making momentum that is of substantial importance to EU - Serbia relations, especially the ongoing 'member state building' [1, 3, 5, 7, 8]. In the domains of academic enquiry, advanced research, technological advancement, and innovation, Serbia is a significant contributor to the overall European science performance and output. In fact, Serbia outperforms several EU member states with its innovation potential and achievements [2].

Brain circulation across many generations of scientists and academics of Serbian origin has contributed to the joint European efforts to develop internationally acknowledged accomplishments [4]. These experiences continuously reconfirm that Europe is an internationally attractive place and an enduringly desired destination to conduct science and respond to societal challenges with targeted evidence-informed and technologically advanced solutions, purposeful interventions, tailor-made programmes and other support measures. Many intellectuals and innovation experts of Serbian origin have proven that their motivation and expertise, combined with the conducive intellectual environment, merit-based incentives, and technological affordances offered across Europe (with substantial EU support), form a powerful combination. This fusion delivers a meaningful and sustainable contribution to science internationally, economic performance, and societal challenges faced across the world.

2025 is an excellent year to reinvent an acclaimed tradition and engage in science diplomacy routines in a less ad hoc and more supranationally oriented manner [6]. This is a year to revisit some internationally well-known names that adorn the titles of institutes across Serbia. This permanent gesture of intellectual recognition, pride, and gratitude underlines that talent mobility and close research cooperation between Serbia and many European countries is a long tradition with high contemporary value to the post-Westphalian aspirations of the EU.

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THE CHALLENGES OF ENVIRONMENTALLY RESPONSIBLE AND SUSTAINABLE BUSINESS

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Sustainability is about meeting the world's needs today and tomorrow by building systems that allow us to live responsibly within the limits of our planet. Creating a sustainable world and Europe is no easy task, especially in the face of shocks and crises such as global pandemics, war, inflation, as well as climate change. This will not be possible without a rapid and fundamental transformation of production and consumption systems. The aim of the study is to identify the challenges of sustainable business practices. The tasks are: 1) characterize the situation in Latvia in terms of progress towards Sustainable Development Goals (SDG), 2) identify the main directions for environmentally responsible and sustainable business.

Latvia ranks 13th out of 167 countries in the 2024 SDG Index, with a score of 81.0, reflecting its significant progress in sustainable development. However, economic performance remains a concern, as Latvia recorded an adjusted GDP contraction of -3.1% in 2022, coupled with low research and development (R&D) expenditure of 0.7% of GDP, which may limit long-term innovation and competitiveness [1]. Sustainable and environmentally responsible businesses can develop in multiple directions, addressing a range of environmental and societal challenges. One of the directions is based on *responsible production and consumption*, focused on more efficient use of resources, waste reduction and the promotion of sustainable lifestyles, which are important for ensuring the livelihoods of current and future generations. In recent years, the environmental impact of business has become a major concern for both consumers and businesses. One of the main ways businesses reduce their environmental impact is by reducing their carbon footprint [2]. Achieving sustainable goals requires *investment, innovation and the creation of new business models*. Several authors and practitioners suggest thinking about product eco-design, reducing resource consumption, using environmentally friendly materials, optimizing the production, distribution, use and end-of-life management of the product [3]. Environmental sustainability and ethical business operations today depend on a balance between consumer and shareholder goals. Incorporating environmental sustainability into corporate governance has become imperative for organizations that want to survive in today’s rapidly changing commercial world [4].

Conclusions: 1) sustainable economic growth requires further investment in human capital, technology and inclusive economic policies; 2) sustainable corporate governance principles and business models are the key directions for sustainable business.

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ROLE OF CROWDFUNDING IN FINANCING STARTUPS

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Startups often encounter significant challenges in securing capital through traditional channels like bank loans, venture capital or angel investors. Factors such as stringent eligibility criteria, lack of collateral and limited financial history present common barriers to financing. This limited access to funding compels many entrepreneurs to explore alternative mechanisms [1].
Crowdfunding, defined as the practice of raising capital from a large number of individuals via online platforms, has emerged as a robust and innovative financing model. It includes various forms, including reward-based, equity-based, lending-based and donation-based crowdfunding, each catering to a wide spectrum of projects, from entrepreneurial ventures and creative initiatives to social causes and charitable enterprises [2].
The global crowdfunding market is expanding rapidly, valued at USD 2.14 billion in 2024, with projections indicating a compound annual growth rate (CAGR) of 17.6% from 2025 to 2030. This growth is fuelled by increasing internet penetration, the proliferation of social media and advancements in financial technology. Prominent platforms like Fundable, Kickstarter and Indiegogo have become central to this expanding ecosystem, offering tailored solutions for startups to secure essential capital [3]. Fundable, in particular, stands out for its focus on startup fundraising, having committed over USD 700 million and connected startups with more than 20,000 accredited investors [4].
Beyond financial support, crowdfunding offers unique benefits for startups. It serves as an effective market validation tool, enabling entrepreneurs to assess demand for their ideas before launching. Additionally, crowdfunding acts as a cost-effective marketing strategy, leveraging the vast reach of online platforms and social media to build awareness and attract backers. Equity-based crowdfunding, in particular, allows startups to secure investment while retaining significant ownership, preserving entrepreneurial control [5].
Its growing influence is poised to further contribute to economic development, enhancing opportunities for both startups and investors alike.

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