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HORTICULTURE DEVELOPMENT AS A STRATEGIC DIRECTION OF THE REGIONAL ECONOMY OF TRANSCARPATHIA

ABSTRACT

Horticulture, a beacon of resilience, is essential for bolstering the economic stability and competitiveness of regions. This article sets out to gauge the current state of horticulture in Transcarpathia and explore avenues for its fortification, drawing from the experiences of European countries.

The study's methodology is rooted in scenario modelling, trend assessment, and forecasting of horticulture development, leveraging the comparative experiences of European countries.

The research results underscore the efficacy of automated systems and storage infrastructure in horticulture, as observed in Transcarpathia, Finland, Belgium, Denmark, Sweden, and Germany. The findings reveal that agricultural technologies can boost the yield of fruit and berry crops by 20% through enhanced fertility of sown areas. Despite the significant setbacks inflicted by the ongoing war in Ukraine, the horticultural sector has shown remarkable resilience, a testament to its strength and adaptability. One of the critical consequences of the war was a 27% reduction in capital investment in Ukrainian agriculture - from UAH 68 billion in 2021 to UAH 49.6 billion in 2022. The war has led to the loss of controlled territories and the destruction of the infrastructure that supports the agricultural sector. The article proposes strategies to enhance horticultural practices, advocating for corporate sector involvement and government support for lending.

The practical significance of the work lies in formulating recommendations for implementing effective horticultural methods adapted to local conditions. Further research on horticultural practices should focus on improving sown land with the latest tillage tools.

Keywords: horticulture development, regional economy, agrotechnology, storage infrastructure, innovative technologies, state support

JEL Classification: Q13, Q14

INTRODUCTION

Horticulture development in times of worsening food crises is crucial in providing the population with fresh fruits and vegetables, essential sources of vitamins and minerals. As Dže et al. (2023) point out, horticulture not only contributes to developing regional economies but also holds the potential to create new jobs and stimulate infrastructure development, a beacon of hope in challenging times. In the face of the growing global population and limited natural resources, the efficient use of land for growing high-quality products is becoming increasingly vital. As many countries grapple with the challenges of climate change and soil degradation due to environmental issues, the modernisation of the agricultural sector is gaining more significance. The introduction of modern horticultural practices is not just a necessity to ensure stable harvests and reduce dependence on imported food but also a beacon of optimism, as it increases food self-sufficiency and creates additional export opportunities.

The peculiarities of horticulture development in Transcarpathia are due to the region's unique climatic and geographical conditions, favourable for growing various fruit and berry crops. However, the full-scale war that began in 2022 has had a significant impact

on Ukraine's agricultural sector, resulting in substantial infrastructure destruction, crop losses, and reduced access to financial resources (Litvak, 2014). According to Hong et al. (2023), many farmers faced logistical problems and shortages of fertilisers and plant protection products, significantly complicating the production process. Despite these challenges, horticulturalists in Transcarpathia continue to work actively to preserve and restore their farms. They are looking for new markets, implementing sustainable farming practices and adapting to new conditions. An important aspect is the support of the government and international organisations that provide the necessary resources for the recovery of the agricultural sector.

To attract investment and strengthen the regional economy of Transcarpathia, it is vital to introduce innovative technologies such as automated irrigation systems, the use of drones for crop monitoring, and biotechnology to improve plant quality in horticulture. The author Rondon (2023) believes that using modern methods of storage and processing of products allows the preservation of the freshness and quality of fruits and vegetables for a more extended period. This approach is essential for expanding markets both domestically and abroad. They also ensure stable demand for Transcarpathian gardeners' products. The introduction of innovative approaches to farming helps to preserve natural resources and improve the environment. The state must create additional opportunities to attract environmentally conscious investors and develop a sustainable agricultural sector in Transcarpathia.

LITERATURE REVIEW

Modern literature offers different approaches and interpretations of agriculture and horticulture. The authors Veettil et al. (2023) emphasise the importance of horticulture investment to increase the region's economic stability by supporting the agro-industrial complex. The researchers Kallio and LaFleur (2023) argue that introducing modern agricultural technologies can significantly increase yields and product quality, but the efficiency of sown areas remains unexplored. The researchers Huan-Niemi et al. (2023) add that using automated systems will dramatically increase the productivity of the agricultural sector.

Järvenpää et al. (2023) emphasise the importance of environmental sustainability and organic production in horticulture development and claim that the waste management issue needs further analysis. The authors Postolache et al. (2023) argue that integrating horticulture with tourism can be an additional source of income for regions. Turunen and Huttunen (2023) discuss the impact of climate change on horticulture and the need for adaptation strategies that have to be tested in practice by agribusinesses. According to He et al. (2023), economic instability can stimulate and hinder agricultural production development.

Other scholars Singh and Rao (2023) claim that the successful development of horticulture depends heavily on the ability of regions to manage human resources, which creates further research issues effectively. Kaur et al. (2023) emphasise the importance of integrating the latest technologies to ensure the environmental development of farms. A study by Akhtar and Sarkar (2023) confirms that applying a systematic approach to horticulture management has allowed several regions to implement large-scale projects successfully. Kumar et al. (2023) dwell on the importance of corporate social responsibility in forming farms. Still, he ignores the question of corporate social responsibility's impact on the enterprise's efficiency. The authors Gerasko et al. (2023) argue that the development of horticulture contributes to strengthening food security and improving living standards in the region.

According to Li et al. (2023), the involvement of local employees in horticulture contributes to the adaptation of enterprises to the local conditions of the region's financial and economic policy. The article of Chathuranika et al. (2023) draws attention to the need to consider cultural specificities and challenges when introducing agricultural technologies in different regions. The authors Irga et al. (2023) emphasise that the effectiveness of horticultural projects depends on their relevance to local conditions and needs, which are in line with climatic conditions. Burdun et al. (2023) consider horticulture part of a broader modernisation process of the agricultural sector. The authors Vysochanska and Zubchenko (2023) add that an important aspect is the ongoing training and skills development of workers involved in agro-industrial projects.

The researchers Basinger et al. (2023) note that using innovative technologies for crop management and monitoring is essential to implement horticultural projects successfully. Another critical topic is the region's agro-climatic conditions and their impact on horticulture. The microclimatic conditions in different parts of Transcarpathia must be further assessed to reveal potential opportunities for horticulture. The study with correlation analysis should cover the dynamics of climate change, sown area and yields. In summary, there is a consensus among scientists that horticulture development plays a vital role in strengthening the regional economy. It contributes to the efficient use of land resources and increases the competitiveness of regions at the national and international levels.

AIMS AND OBJECTIVES

The article aims to explore the potential for development and assess the impact of horticulture on the economic growth of Transcarpathia, positioning it as a strategic direction for the region's economy.

Objectives of the study:

- to determine the economic indicators of horticulture development in Transcarpathia;
- identify the impact of different approaches to horticulture management on economic growth and outline the main trends in the agricultural sector;
- to study the impact of the war on the damage to Ukraine's agricultural sector and horticulture;
- develop recommendations for improving the management and support of horticulture based on Finland's experience.

METHODS

The research procedure included several stages, each revealing the problems of the analysed issue (Figure 1).

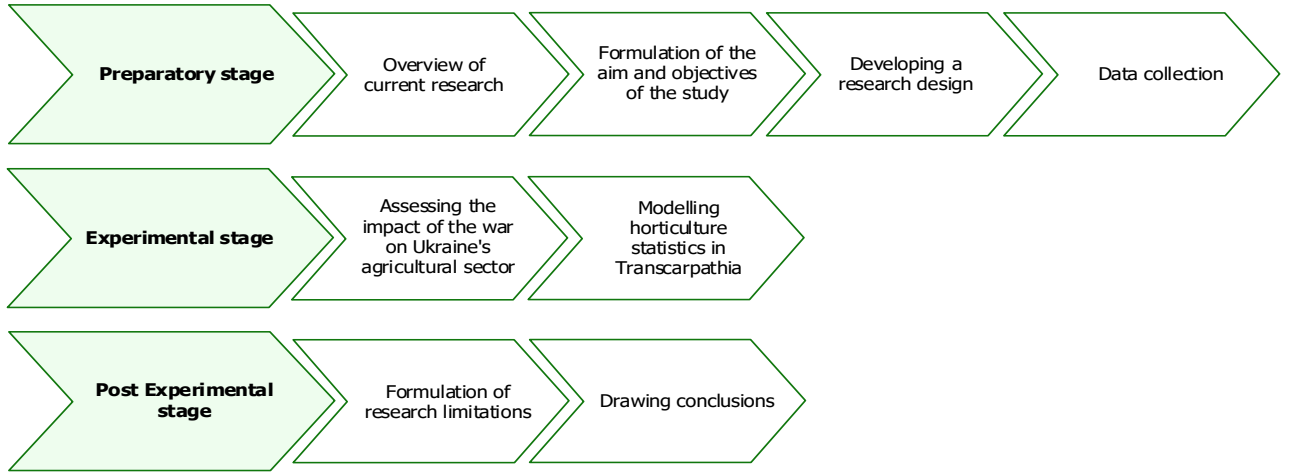

Figure 1. Stages, which are revealing the problems of the analysed issue.

The research methods included financial and statistical analysis, analytical modelling and scenario forecasting based on agricultural data. The prospects of horticulture in Transcarpathia for 2024 are characterised by scenario forecasting. Financial analysis was used to estimate the indirect and direct losses of agriculture and land resources, as well as the dynamics of capital investments in agriculture and industry in Ukraine from 2017 to 2022. The peculiarities of using sown areas in European countries and the introduction of innovative technologies for horticulture are studied through analytical modelling. The deductive analysis allowed us to objectively assess the state and prospects of horticulture development in Transcarpathia. The statistical analysis allowed us to identify the main trends in horticulture regarding sown areas and yields in Transcarpathia, Finland, Denmark, Germany, Belgium and Sweden. We compared the practices and results of horticulture development in Transcarpathia, Finland and the USA through the comparison method. Based on the results obtained, successful strategies that can be implemented in Ukraine to improve horticulture efficiency are outlined with the help of the deduction method.

The study sample included the regions of Transcarpathia, Belgium, Denmark, Finland, Germany, Sweden, and the Netherlands. Transcarpathia was chosen as one of the leading regions of Ukraine with a strong potential for horticulture development. In 2023, the area under fruit and berry crops in Transcarpathia was 12.6 thousand hectares, with a projected increase to 13.86 thousand hectares in 2024. The European countries were selected due to the similarity of the problems of limited areas suitable for sowing and the need to introduce innovative technologies to increase productivity.

The research tools included data collection and analysis methods using Excel. Statistical data were collected from official sources of the State Statistics Service of Ukraine, the Ministry of Agrarian Policy and Food of Ukraine, the Ministry of Agriculture and Forestry of Finland, Eurostat, the Food and Agriculture Organisation of the United Nations, the Ministry of Food, Agriculture and Fisheries of Denmark, and the Federal Ministry of Food and Agriculture of Germany. Reports of international agricultural research organisations were also studied.

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RESULTS

Government support through subsidies and financial assistance programmes plays a vital role in stimulating the development of the agricultural sector. Introducing modern farming technologies, such as drip irrigation systems, automated harvesting systems and the latest storage methods, can increase productivity. Some of them are also used in Transcarpathia, and the results of horticulture with the calculated scenario modelling indicators for 2024 are shown in Table 1.

Table 1. Horticulture development in Transcarpathia. Note: *- Projected value in the current socio-economic situation. *(Source: compiled from Gov.ua (2023))*

Category	2023	2024*
Total sown area of crops (thousand hectares)	167.9	184.69
Sown area of grain crops (thousand hectares)	71.6	78.76
Projected gross harvest of grain crops (thousand tonnes)	310	341
Production of fruit and berry crops (thousand tonnes)	110	121
Area of fruit and berry crops (thousand hectares)	12.6	13.86
Sown winter crops for next year's harvest (thousand hectares)	25.3	27.83
Approved grant applications for the production of traditional products	79	86.9
Total amount of approved grant applications (UAH million)	29.7	32.67

The positive forecasts for 2024 are supported by the Social and Economic Development Program for the Transcarpathian Region, recently approved by the regional council. According to the Program, the region received USD 544.3 million in investments from the European Union countries, representing 96.1% of the total investment volume. The largest inflows of foreign direct investments came from countries such as Cyprus, Austria, the Netherlands, Germany, Hungary, Luxembourg, the Czech Republic, Slovakia, the United States, Italy, and Poland. This substantial foreign investment, along with key regional development programs and projects outlined by the Transcarpathian Regional State Administration, serves as a foundation for the projected growth in agriculture and other sectors in 2024. Based on forecasts, the agricultural sector in Transcarpathia is expected to develop significantly in 2024. The total sown area of crops will increase from 167.9 thousand hectares in 2023 to 184.69 thousand hectares.

The full-scale war that began in 2022 significantly negatively impacted Ukraine's agricultural sector. The hostilities destroyed 40% of the infrastructure, causing more than 50% loss of crops and a significant reduction in access to finance. Many farmers faced logistical problems, such as a shortage of fertilisers and crop protection products, which made it difficult to conduct business. The number of approved grant applications for the production of traditional products will increase from 79 to 86.9, and the total amount of approved grant applications will rise from UAH 29.7 million to UAH 32.67 million. This indicates an increase in confidence in the region on the part of investors and government support programmes, which will stimulate further development of the agricultural sector in Transcarpathia in 2024.

The decline in yields and product quality has become a severe challenge to local gardeners. More than 15% of agricultural land was destroyed or contaminated due to the hostilities. Government support and assistance from international organisations, which provide the necessary resources and financial support for the farm sector, play an essential role in the recovery process. The total direct and indirect losses are shown in Figure 2.

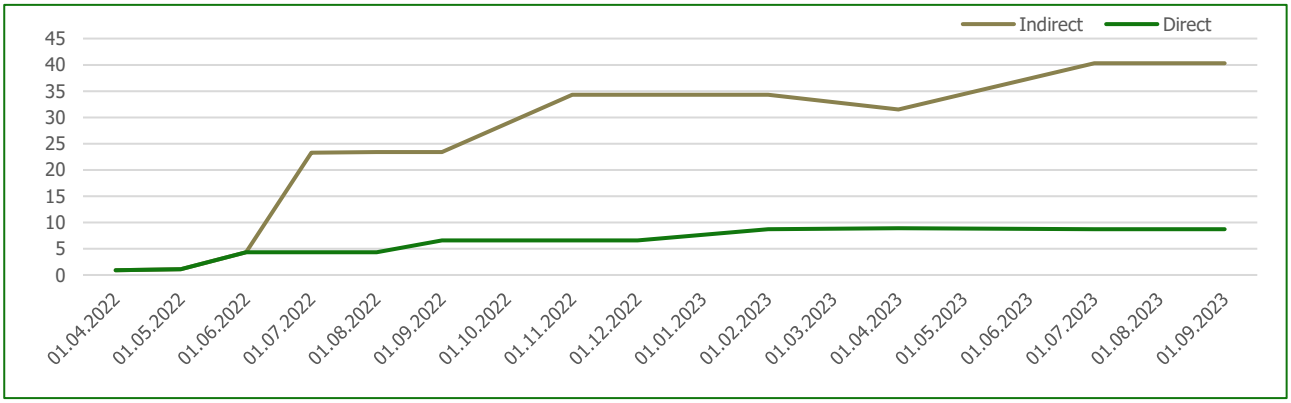

Figure 2. Estimating indirect and direct losses of agriculture and land resources, USD billion. *(Source: compiled on Latundist (2023))*

According to the assessment, indirect losses of the agricultural sector and land resources from 01.04.2022 to 01.09.2023 increased from USD 0.9 billion to USD 40.3 billion. Direct losses over the same period increased from USD 0.9 billion to USD 8.7 billion. These losses reflect the extent of the destruction and economic damage caused by the hostilities. Reduced yields, destroyed infrastructure, and higher production and logistics costs create severe obstacles to the development of horticulture and other sectors of agriculture. Given the existing factors, the recovery and development of the agricultural industry require significant financial support and the introduction of the latest technologies and management methods. This will minimise the impact of the war on agriculture and ensure its sustainable growth in the future. The overall dynamics of capital investment in industry and agriculture are shown in Figure 3.

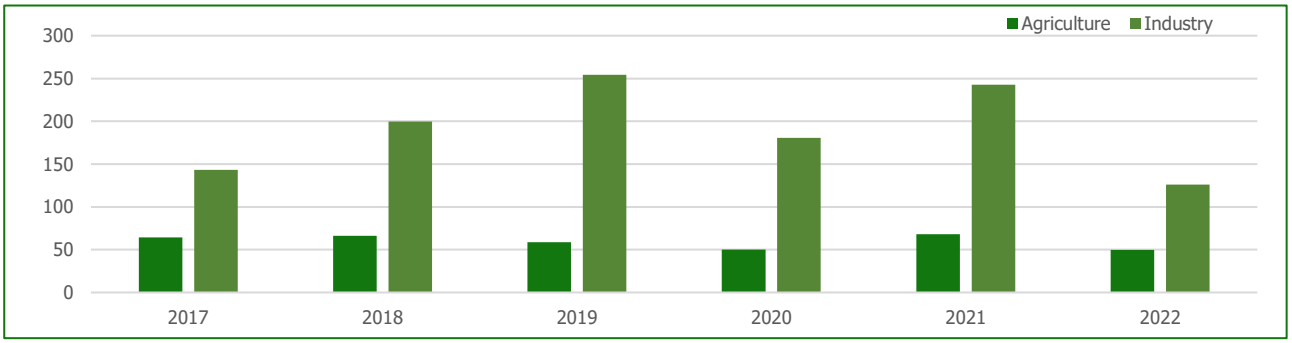

Figure 3. The dynamics of capital investments in agriculture and industry in Ukraine in 2017-2022, UAH billion. *(Source: compiled according to the State Statistics Service of Ukraine (2024))*

Capital investment in industry fell from UAH 242.9 billion in 2021 to UAH 126.1 billion in 2022, a 48% decrease. Bombed roads, damaged warehouses, and destroyed fields have negatively impacted agriculture's production potential. Capital investment in agriculture totalled UAH 50.2 billion in 2020 and UAH 58.6 billion in 2019, indicating a downward investment trend exacerbated by the war. Uncertainty in the economic situation and high risks led to a reduction in investment by both domestic and foreign investors.

According to the State Statistics Service of Ukraine (2024), capital investments in agriculture amounted to UAH 66.1 billion in 2018 and UAH 64.2 billion in 2017. If the current trend continues without significant stabilization or changes, capital investment in agriculture could decrease further. Based on war dynamics, it is forecasted that investments in agriculture may fall to around UAH 45 billion in 2023, UAH 42 billion in 2024, UAH 40 billion in 2025, and as low as UAH 38 billion by 2026. These projections could fluctuate depending on different scenarios, reflecting the significant challenges ahead for the recovery of the agricultural sector and the urgent need to attract more investment.

An analysis of horticulture development in Europe and Transcarpathia shows significant differences in this sector's scale and development trends. The data on agricultural areas in European countries such as Belgium, Denmark, Germany, Sweden, and Finland indicate significant resources are allocated to agriculture. For example, in Germany, the total area of agricultural land is 276120 hectares, of which 206490 hectares are arable lands, which provides excellent potential for growing various crops. The allocation of land resources highlights the strategic importance of efficient land use in these regions. A similar situation is observed in Belgium, Denmark, and Finland, where a significant share of agricultural land is used for arable land and permanent grassland, indicating high intensification and efficiency in land use. The total area for sowing in Europe is shown in Figure 4.

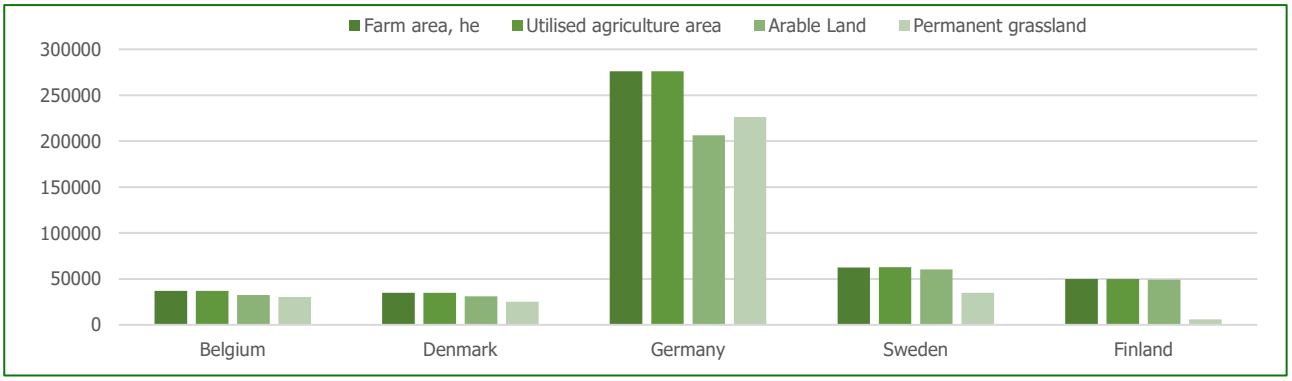

Figure 4. Main farm land use by Europe Regions, hectares, 2023. *(Source: compiled based on Eurostat (2023))*

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Finland has considerable experience in dealing with crises in agriculture, especially in horticulture. Although the country has not faced war, economic crises and climate change have required significant adaptation measures. One of the main challenges for Finnish farmers was abrupt climate change, which led to crop failures and losses. The Finnish government has developed several programmes to support horticulture in response to these challenges. The Rural Development Programme for Mainland (Maaseudun kehittämisohjelma) includes funding for equipment modernisation, new technologies and infrastructure development. Funding is provided through the European Agricultural Fund for Rural Development (EAFRD), which allows farmers to upgrade their farms and introduce innovative approaches to horticulture. The country had a city-village programme (Kaupunki-maaseutu), which stimulated rural development by creating new jobs and supporting small businesses in rural areas (Figure 5).

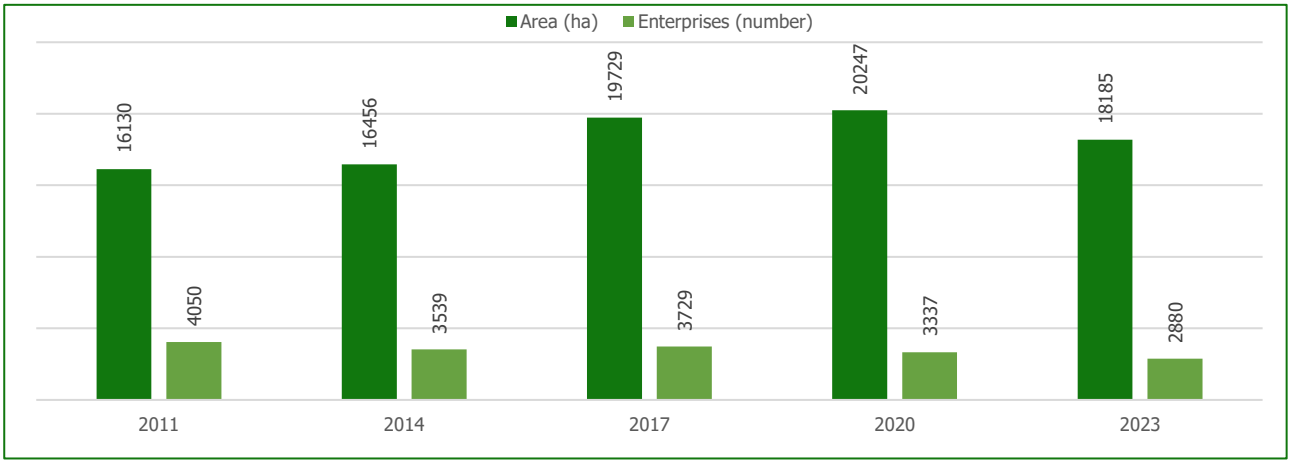

Figure 5. Number and area of horticultural enterprises in Finland. *(Source: OSF: Natural Resources Institute Finland, Horticultural Statistics (2024))*

To ensure production stability in the face of climate change, a crop insurance programme (Kasvinsuojeluvakuutus) was created to cover losses from adverse weather conditions. It allows farmers to reduce financial risks and ensure the sustainability of their farms. The ecological production programme (Ympäristökorvaus) is a vital support element encouraging farmers to adopt environmentally friendly technologies and practices. Table 2 outlines a comparison of horticulture development opportunities between Transcarpathia and European countries. It highlights specific practices from Europe that could be adopted in Transcarpathia to enhance natural resource conservation and increase yields.

Table 2. Comparison of horticulture development opportunities: Transcarpathia and European countries.

Parameter	Transcarpathia	Europe	Opportunities for Transcarpathia based on European experience
Climatic conditions	Temperate continental climate	Cold continental climate	Use of greenhouse and plant shelter technologies
Main crops	Apples, pears, plums, grapes, berries	Apples, berries (blueberries, raspberries, strawberries), vegetables	Expanding the range of berries and vegetables
Processing Technologies	Traditional methods	Modern processing and storage technologies, mechanisation	Implementation of contemporary harvesting and storage technologies
Storage infrastructure	A limited number of modern warehouses	Developed storage infrastructure (refrigerators, warehouses)	Construction of contemporary storage and refrigerators
Fruit and berry processing	A small number of companies	Developed processing industry (juices, jams, frozen berries)	Investments in the processing industry, creation of new enterprises
Government support	Support through grants and concessional financing	Extensive government support, grants, subsidies	Expanding government support programmes and attracting investment
Scientific research	Limited resources for research	Active research and innovation in horticulture	Development of research institutions, cooperation with international organisations
Exports	The primary market is domestic	Active export of products (EU, Asia)	Development of export potential, search for new markets
Resilience to climate change	Moderate resistance	High resilience thanks to adaptive technology	Implementation of adaptive technologies to reduce the impact of climate change
Labour force	Decreased labour force, low wages	High labour costs, mechanisation	Implementation of mechanised and automated systems

Considering European countries' experience, Ukraine should implement similar programmes to support agriculture. One of the top priorities is to develop a rural development programme that will include funding for modernising equipment and introducing new technologies. The experience of developed countries should be used to stabilise the existing problems. The integration of such approaches can contribute to developing the Ukrainian agricultural sector even under challenging conditions.

It should be based on co-financing with international organisations. Crop insurance mechanisms like the Finnish Kasvinsuojeluvakuutus programme, which covers losses from adverse weather conditions and other risks associated with war and economic instability, should be created. This will help reduce financial risks for farmers and ensure production stability.

According to EWG (2022) data, the American model of agricultural support includes powerful financial mechanisms such as subsidies, soft loans and crop insurance to help farmers cope with economic and natural risks. For example, the federal government allocates billions of dollars annually to support farmers through a crop insurance programme that covers losses from adverse weather conditions and market price fluctuations. In 2022, the total amount of subsidies to US agriculture was over USD 50 billion.

Investments should be made in educational programmes and training for farmers to increase their competence in farm management and the use of modern technologies. Järvenpää (2023) describes a programme similar to Finland's Ympäristökorvaus (Ecological Production Programme), which encourages the adoption of environmentally friendly technologies and practices, would be appropriate. As a result, natural resources will be preserved, yields will increase, and the agricultural sector will be sustainable. Support for cooperative initiatives and cooperation between farmers can help improve the farm sector's competitiveness and resilience. Thus, a comprehensive approach that includes financial support, insurance, education and collaboration will help Ukraine overcome the crisis in the agricultural sector in the context of the war.

DISCUSSION

The issue of horticulture development as a strategic direction of the regional economy shows the need for a deeper analysis of different approaches to introducing modern technologies. The study results align with the findings of Jaiswal et al. (2023), who focus on investment and the importance of integrating the latest technologies and infrastructure projects.

According to Lehtonen and Rämö (2023), the development of storage and processing infrastructure is critical, as evidenced by the experience of Finland. The findings of Zhang et al. (2023) on the role of government support show that subsidies and grants stimulate horticulture development.

A study by Wirrdiana Yuniasih et al. (2023) highlights the role of cooperatives, consistent with our results showing that cooperative associations effectively increase productivity and sales. Balawejder et al. (2023) argue that using innovative technologies can significantly improve productivity.

The results of Räsänen et al. (2023) on environmental sustainability and organic production are supported by our study, which shows that organic horticulture will contribute to the long-term economic stability of the region. The article of Räty et al. (2023) on the integration of horticulture with international food security is supported by findings that point to the potential of the agricultural sector as an additional source of income.

The authors Laasasenaho et al. (2023) emphasise the impact of climate change, which aligns with his findings on the need for adaptive strategies. The study by Vac et al. (2023) confirms the results of previous researchers and points to the need for an integrated approach to the development of horticulture.

Thus, an essential factor is the introduction of modern technologies, infrastructure development, government support, and integration with other sectors of the economy. These measures can significantly increase the region's competitiveness and contribute to its economic stability.

CONCLUSIONS

Thus, research on the development of horticulture as a strategic direction of the regional economy of Transcarpathia shows the need to introduce modern agricultural technologies and financial projects. They are critical factors for increasing yields and product quality. The analysis of capital investments and the state of horticulture indicates that standardisation of farming methods will stabilise the situation. Additional measures include systematic training of farmers and workers and significant investment in storage and processing infrastructure to increase the industry's productivity. The study confirms

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the importance of government support and a flexible legal framework to facilitate regional horticulture development. Integration of the latest technologies, cooperatives development, and innovative management approaches are critical to ensure long-term economic stability. Increasing the competitiveness of Transcarpathia at the national and international levels is only possible if the consequences of the war are overcome.

Horticulture development in Transcarpathia faces several challenges due to the ongoing hostilities in Ukraine. The main challenges include a lack of financial resources for sustainable business operations, rising production costs and limited storage and processing infrastructure. Global challenges include climate change, which affects the yield and quality of horticultural crops. There is economic instability, which is compounded by uncertainty in planning and implementing long-term investment projects. The problem of labour outflow from rural areas and competition in international markets require Ukraine to adapt and implement new strategies to maintain its competitiveness. Further research is needed to identify the impact of innovative technologies in horticulture on increasing the productivity and sustainability of Transcarpathia's agricultural sector and to determine the most effective methods of integrating these technologies into the regional economy. Expanding international cooperation and using Finland's experience in horticulture development will help increase Transcarpathia's competitiveness in the global market.

Recommendations

The following measures are proposed based on the study of horticulture development in the region.

1. Introduce standardised horticultural practices adapted to local climate and soil conditions.
2. Organise regular training for farmers and workers to improve their skills in modern agricultural technologies.
3. Ensure significant investments in infrastructure development for storing and processing fruits and berries, which will reduce crop losses and improve product quality.
4. Develop a flexible legal framework to support and regulate horticulture development, providing favourable conditions for expansion.
5. Establish effective monitoring and evaluation systems for horticulture to improve processes and increase productivity continuously.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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The Authors received no funding for this research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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РОЗВИТОК САДІВНИЦТВА ЯК СТРАТЕГІЧНИЙ НАПРЯМ РЕГІОНАЛЬНОЇ ЕКОНОМІКИ ЗАКАРПАТТЯ

Проблематика садівництва є актуальним питанням для підвищення економічної стабільності та конкурентоспроможності регіонів. Метою дослідження є визначення поточного стану ведення садівництва Закарпаття та можливості його зміцнення на основі досвіду країн Європи. Методологія дослідження базується на використанні сценарного моделювання, оцінці трендів і прогнозування розвитку садівництва із застосуванням порівняльного досвіду європейських країн. Результати дослідження висвітлюють практику застосування автоматизованих систем, інфраструктури зберігання для садівництва в Закарпатті, Фінляндії, Бельгії, Данії, Швеції та Німеччині. Отримані результати свідчать про те, що агротехнології дозволяють підвищити врожайність плодово-ягідних культур на 20% шляхом підвищення родючості посівних площ. Через війну, яка триває на території України, агропромисловий комплекс зазнав значних збитків. Одним із критичних наслідків конфлікту стало зменшення капітальних інвестицій у сільське господарство майже вдвічі. Згідно з результатами, капітальні інвестиції в сільське господарство в Україні знизилися з 68 млрд грн 2021 року до 49,6 млрд грн 2022 року, що становить падіння на 27%. Війна призвела до втрати контрольованих територій, зруйнувала інфраструктуру, що забезпечує аграрний сектор. У статті запропоновані шляхи вдосконалення садівницьких практик на основі державної підтримки кредитування та залучення корпоративного сектора. Практичне значення роботи полягає у формулюванні рекомендацій щодо впровадження ефективних методів садівництва, адаптованих до місцевих умов. Подальше дослідження методів ведення садівництва має бути зосереджене на вдосконаленні посівних земель шляхом новітніх засобів обробки.

Ключові слова: розвиток садівництва, регіональна економіка, агротехнології, інфраструктура зберігання, інноваційні технології, державна підтримка

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