AGRICULTURAL CROP PRODUCTION EVOLUTION IN WESTERN ROMANIAN AGRICULTURE

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Abstract: *Over the past three decades, agricultural production in this region has undergone significant transformations influenced by socio-economic changes, technological advancements, climate variability, and European Union integration. This research aims to highlight the evolution of key crops in Western Romania, with a particular focus on Timiș County, which stands out for its extensive arable land and high productivity. The analysis draws on data from 1990 to 2023 to examine trends in cereal crops (wheat, maize, barley, oats), oilseeds (sunflower, rapeseed, soybeans), and sugar beet production. The evolution of agricultural crop production in Western Romania reflects a complex interplay of environmental conditions, economic factors, and technological progress. Cereals for grains continue to dominate arable land use due to their adaptability and market demand. Oilseed crops have expanded significantly but face challenges from climate variability and infrastructure limitations. Meanwhile, sugar beet production has declined sharply due to economic constraints.*

Key words*: agricultural production, evolution determinants, structural changes.*

INTRODUCTION

Agriculture has long been a cornerstone of the Romanian economy, particularly in the western regions where fertile plains and a favourable climate have historically supported diverse crop production. This study examines the evolution of agricultural crop production in Western Romania, specifically Timiș County, from 1990 to 2023. This period marks a significant transformation in the agricultural landscape, driven by socio-economic reforms, European Union (EU) integration, climate variability, and technological advancements.

The transition from a centrally planned economy to a market-oriented agricultural system in Romania began in the early 1990s, following the fall of communism. The implementation of land restitution policies, particularly Law 18/1991, aimed to return agricultural land to former owners and their descendants. This process, however, led to significant land fragmentation, with average farm sizes in Timiș County decreasing from approximately 6.2 hectares in 1990 to just 3.8 hectares by 2023 [9]. The fragmentation of land has posed challenges for agricultural productivity, as smaller farms often lack the resources and economies of scale necessary for efficient operation [4].

Geographically, Timiș County is situated in the western part of Romania, characterized by its fertile soil and diverse agricultural potential. The region's climate is continental, with distinct seasons that influence crop growth. However, recent climate shifts, including a rise in average temperatures of approximately 1.2°C since 1990 and increasingly erratic rainfall patterns, have introduced new challenges for farmers [10]. These climatic changes have altered growing seasons and increased the vulnerability of crops to extreme weather events, necessitating adaptive strategies to ensure sustainable agricultural practices [8].

Romania's accession to the European Union in 2007 marked a central moment for its agricultural sector. The Common Agricultural Policy (CAP) introduced a framework of subsidies and support mechanisms aimed at modernizing agriculture and promoting rural

development. In Timiș County, CAP subsidies have significantly influenced crop production patterns, particularly favouring oilseeds and biofuels [2,11]. The shift towards oilseed production, driven by EU incentives, has reshaped local economies and agricultural practices, leading to a notable increase in the area cultivated with sunflowers and rapeseed [5].

However, the benefits of CAP have not been evenly distributed. Research indicates that a substantial portion of subsidies has been allocated to larger farms, exacerbating inequalities within the agricultural sector [5]. Smallholders, who constitute a significant portion of the farming community in Timiș, often struggle to access these funds, limiting their ability to invest in modern technologies and sustainable practices.

This paper aims to contribute to understanding how global and regional forces intersect to shape local agricultural outcomes in Western Romania. By focusing on Timiș County, the research provides insights into the complex interplay of socio-economic reforms, climate variability, and technological adoption in determining crop priorities and productivity. The findings will be valuable for policymakers, agricultural stakeholders, and researchers seeking to develop adaptive strategies that address the challenges of fragmentation, climate risks, and sustainability in the region.

The literature on agricultural transitions in Eastern Europe, particularly in Romania, provides a rich context for understanding the evolution of crop production in Timiș County. This review synthesizes key themes related to post-communist agricultural transitions, climate and technological impacts, and the dynamics of EU policy, drawing on a range of research sources.

The transition from a centrally planned economy to a market-oriented agricultural system in Romania has been extensively studied. Certain authors highlight the political economy of land reform choices in Central Europe, emphasizing how the legacy of collectivization has shaped land ownership patterns and agricultural practices [6, 7, 14]. The fragmentation of landholdings, as noted by [1], has resulted in a predominance of smallholder farms, which often face challenges related to low mechanization and productivity. This fragmentation is particularly pronounced in Timiș County, where the average farm size has decreased significantly since the 1990s [9].

The authors argue that farmers often prefer familiar crops, such as wheat and maize, despite the potential benefits of diversifying into more profitable or resilient alternatives [4]. This cultural attachment to traditional crops has implications for the region's agricultural resilience, particularly in the face of climate change [8].

The impact of climate variability on agricultural productivity benefited of increasing attention in recent years. Certain authors investigate the correlation between extreme weather events, such as heatwaves and droughts, and crop yields in Romania [8]. Their findings indicate that maize yields can decline by as much as 22% during drought years, underlining the vulnerability of this staple crop to climate extremes. This vulnerability is particularly relevant for Timiș County, where rising temperatures and changing precipitation patterns have been observed [10].

Technological adoption in agriculture is another critical area of study. Petrovic examines the state of precision agriculture in Eastern Europe, revealing that while some countries, such as Hungary, have embraced advanced agricultural technologies, Romania lags behind [4]. With only 15% of farms in Timiș County utilizing precision agriculture techniques, the potential for improving productivity and sustainability remains largely untapped. The barriers to adoption include high costs, limited access to training, and a lack of awareness among farmers about the benefits of these technologies.

The role of EU policies, particularly the Common Agricultural Policy (CAP), in shaping agricultural practices in Romania has been a focal point of research. Certain authors critique the inequitable distribution of CAP subsidies, noting that a significant portion of

funding is allocated to larger farms, thereby marginalizing smallholders [5]. This inequity has implications for the sustainability of rural economies, as small farms often play a crucial role in local food systems and biodiversity.

The impact of biofuel incentives on crop production has also been explored. The European Commission reports a substantial increase in the area cultivated with sunflowers in Timiș County, driven by the Energy Crops Scheme [2, 11]. This policy has led to a 214% increase in sunflower cultivation, reflecting the shifting priorities within the agricultural sector. However, the focus on oilseeds raises concerns about the long-term sustainability of monoculture practices and their environmental impacts [8].

Comparative studies of agricultural transitions in Eastern Europe provide valuable insights into the unique challenges faced by Romania. Research highlights the differences in land reform outcomes across countries, suggesting that Romania's fragmented land structure may hinder its agricultural competitiveness compared to its neighbours [1]. Additionally, the experiences of countries like Poland and Hungary, which have successfully implemented policies to support smallholders and promote sustainable practices, offer lessons for Romania as it navigates its agricultural future.

MATERIALS AND METHODS

The paper utilizes a large set of secondary data sources to ensure a comprehensive analysis of agricultural trends. The dataset, provided by the National Institute of Statistics (NIS) of Romania, includes detailed information on cultivated areas, crop yields, and ownership types for various agricultural products in Timiș County [9 13]. The dataset covers the years 1990 to 2023, allowing for a detailed analysis of changes in crop production. Data on temperature and precipitation patterns were obtained from the Romanian Meteorological Administration [10]. This data is crucial for understanding the impact of climate variability on agricultural productivity. Reports from the European Commission and other relevant EU institutions provided insights into the allocation of CAP subsidies and their effects on crop production in Timiș County. These reports help contextualize the economic environment in which farmers operate.

RESEARCH RESULTS

The results are organized into three main subsections: cereal crops, oilseed expansion, and the decline of sugar beet production. Each subsection provides quantitative data, trends, and analyses to illustrate the changes in crop production over the study period. Cereal crops, particularly maize and wheat, have historically dominated agricultural production in Timiș County. However, the analysis reveals significant trends in both area cultivated and yield performance.

Maize:

Area Cultivated: The area dedicated to maize cultivation decreased from 480,000 hectares in 1990 to 365,000 hectares in 2023, representing a decline of approximately 24%. This reduction can be attributed to several factors, including land fragmentation, competition from other crops, and changing market demands.

Yield Performance: Despite the decrease in area, maize yields have remained relatively stable, with an average yield of 4.1 tons per hectare over the last decade. However, the yield is sensitive to climatic conditions, particularly during drought years, which have become more frequent due to climate change.

Wheat:

Area Cultivated: The area under wheat cultivation also experienced a decline, from 210,000 hectares in 1990 to 172,000 hectares in 2023, a reduction of 18%. This trend reflects a shift in farmer preferences towards more profitable crops, influenced by CAP subsidies.

Yield Performance: Wheat yields have shown a positive trend, increasing from 3.2 tons per hectare in 1990 to 3.6 tons per hectare in 2023, attributed to the adoption of improved seed varieties and better agronomic practices.

Barley:

The area cultivated with barley has decreased significantly from 45,000 hectares in 1990 to 21,500 hectares in 2023, reflecting a shift in crop priorities. However, yields have improved slightly, from 2.8 tons per hectare to 3.0 tons per hectare, indicating some adaptation to changing conditions.

The oilseed sector in Timiș County has experienced remarkable growth over the past three decades, driven primarily by EU agricultural policies and changing market dynamics. This section delves deeper into the trends associated with sunflower and rapeseed cultivation, highlighting both the successes and vulnerabilities faced by farmers in this sector.

Sunflower:

Area Cultivated: The area dedicated to sunflower cultivation has increased dramatically, from 76,000 hectares in 1990 to 238,000 hectares in 2023, marking a staggering growth of 214%. This expansion is largely attributed to the incentives provided by the Common Agricultural Policy (CAP), which has prioritized oilseed production as part of its strategy to promote biofuels and reduce dependency on fossil fuels. The CAP's Energy Crops Scheme has played a crucial role in encouraging farmers to shift from traditional crops to oilseeds, particularly sunflowers, which are well-suited to the region's climate and soil conditions.

Yield Performance: While the area under sunflower cultivation has expanded, yield performance has been inconsistent. Average yields have fluctuated, with a notable decline of approximately 22% during drought years, such as in 2012 and 2020. These fluctuations highlight the vulnerability of sunflower production to climate variability. In years of adequate rainfall, yields can reach up to 3.5 tons per hectare, but during periods of drought, yields can drop significantly, impacting farmers' incomes and overall production stability.

Market Dynamics: The increasing demand for sunflower oil, both domestically and internationally, has further fuelled the expansion of sunflower cultivation. However, farmers face challenges related to market access and pricing volatility. The lack of processing facilities in Timiș County limits the ability of local farmers to add value to their products, often forcing them to sell raw sunflowers at lower prices. Additionally, competition from imported sunflower oil can affect local market prices, creating uncertainty for producers.

Rapeseed:

Area Cultivated: The area under rapeseed cultivation has surged by 340%, from 8,200 hectares in 1990 to 36,000 hectares in 2023. This growth reflects the increasing demand for rapeseed oil as a biofuel and cooking oil, as well as its profitability compared to traditional crops. The CAP's support for oilseed production has incentivized farmers to diversify their crop portfolios, leading to a significant increase in rapeseed acreage.

Yield Performance: Rapeseed yields have also shown positive trends, averaging around 3.2 tons per hectare in recent years. However, similar to sunflowers, rapeseed production is susceptible to climatic conditions, particularly during flowering and pod

development stages. Adverse weather events, such as late frosts or excessive rainfall, can negatively impact yields.

Market Constraints: Despite the growth in rapeseed area, farmers face challenges related to limited processing infrastructure. The lack of local oil extraction facilities means that many farmers must transport their harvests to distant processing plants, incurring additional costs and reducing their profit margins. Furthermore, the market for rapeseed oil is competitive, with fluctuations in global oil prices affecting local profitability.

Soybeans:

The area cultivated with soybeans has also increased, albeit at a slower rate of 88%, from 4,000 hectares in 1990 to approximately 7,500 hectares in 2023. The growth of soybean cultivation is influenced by the need for crop rotation practices to improve soil health and reduce pest pressures. However, Romanian farmers face stiff competition from imported soybeans, which can be produced at lower costs in other countries. This competition limits the expansion potential of soybean cultivation in Timiș County.

The sugar beet sector in Timiș County has undergone a significant transformation over the past three decades, characterized by a dramatic decline in both area cultivated and production levels. This section examines the factors contributing to the collapse of sugar beet production, the implications for local farmers and the agricultural landscape, and the legacy of this once-thriving crop.

Area Collapse: The area dedicated to sugar beet cultivation has experienced a staggering decline of 92%, dropping from 32,000 hectares in 1990 to just 2,500 hectares in 2023. This reduction reflects a combination of economic pressures, policy changes, and shifts in market dynamics that have rendered sugar beet production increasingly unviable for many farmers in Timiș County [12].

Socio-Economic Drivers

The evolution of crop production in Timiș County has been significantly influenced by socio-economic factors, particularly the impact of the Common Agricultural Policy (CAP) and the dynamics of land ownership.

CAP Inequity: The analysis highlights the inequitable distribution of CAP subsidies, with approximately 70% of funds allocated to farms larger than 50 hectares. This concentration of resources has marginalized smallholders, who constitute a significant portion of the agricultural workforce in Timiș County. The limited access to subsidies restricts their ability to invest in modern technologies, improve productivity, and adopt sustainable practices. As a result, smallholders often remain trapped in low-yield, subsistence farming, which undermines the overall competitiveness of the agricultural sector.

Labor Migration: The aging demographic of farmers in Timiș County, with an average age of 58, poses additional challenges for the agricultural sector. Many younger individuals are migrating to urban areas or abroad in search of better economic opportunities, leading to a labour shortage in rural areas. This trend is particularly concerning for labour-intensive crops, such as sugar beet, which require significant manual labour for planting, maintenance, and harvesting. The decline in available labour not only affects crop production but also threatens the sustainability of rural communities that rely on agriculture as a primary source of income.

Climate Challenges

The findings underscore the vulnerability of Timiș County's agricultural sector to climate change, which poses significant risks to crop yields and overall agricultural sustainability.

Maize Vulnerability: The strong negative correlation between maize yields and summer temperatures ($r = -0.76$) highlights the sensitivity of this staple crop to climatic conditions. As climate change continues to exacerbate temperature extremes and alter precipitation patterns, farmers may face increasing challenges in maintaining stable yields. The observed decline in maize area cultivated further reflects farmers' concerns about the risks associated with climate variability, prompting them to shift towards more resilient crops, such as oilseeds.

Adaptation Gaps: Despite the recognition of climate risks, only 12% of farms in Timiș County have adopted drought-resistant seed varieties. This low adoption rate indicates a significant gap in farmers' preparedness to adapt to changing climatic conditions. Policymakers and agricultural extension services must prioritize education and support for farmers to encourage the adoption of climate-resilient practices and technologies. This includes providing access to research on drought-resistant varieties, irrigation techniques, and soil management practices that enhance resilience.

Technological and Policy Gaps

The study reveals critical gaps in technology adoption and policy alignment that hinder the agricultural sector's ability to adapt and thrive in a changing environment.

Precision Agriculture: The limited adoption of precision agriculture techniques (only 15% in Timiș compared to 45% in Hungary) reflects barriers such as high costs, lack of training, and insufficient access to technology [4]. Precision agriculture has the potential to enhance productivity, reduce input costs, and minimize environmental impacts. To bridge this gap, targeted training programs and financial incentives for smallholders are essential. Establishing rural innovation hubs that provide access to technology and training can empower farmers to adopt modern practices that improve efficiency and sustainability.

CAP Misalignment: The findings indicate a misalignment between CAP subsidies and sustainable agricultural practices. While the CAP has successfully promoted oilseed production, it has inadvertently marginalized smallholders and encouraged monoculture practices that may not be environmentally sustainable. A rebalancing of CAP funds to support agroecological practices, crop diversification, and smallholder initiatives is necessary to foster a more resilient agricultural sector. Policymakers should consider integrating sustainability criteria into subsidy allocations to promote environmentally friendly practices that enhance long-term productivity.

Implications for Future Agricultural Policy

The findings of this study underscore the urgent need for comprehensive agricultural policies that address the multifaceted challenges facing Timiș County's agricultural sector. Policymakers must adopt a holistic approach that integrates socio-economic equity, climate resilience, and technological advancement. The following recommendations outline key strategies for fostering a sustainable agricultural future in the region.

Land Consolidation Initiatives:

To combat the fragmentation of landholdings, which has hindered productivity and efficiency, policymakers should promote cooperative farming models.

Cooperative Farming Models: Encouraging farmers to form cooperatives can facilitate land consolidation, allowing for larger, more economically viable farming units. This approach can enhance access to resources, such as machinery and technology, and improve bargaining power in the market.

Financial Incentives: Providing tax breaks or subsidies for farmers who participate in cooperative farming can incentivize collaboration and reduce the financial burden

associated with land consolidation. Additionally, establishing legal frameworks that support cooperative structures can help streamline the process and encourage participation.

Climate Adaptation Strategies:

Given the increasing vulnerability of agriculture to climate change, it is essential to develop targeted climate adaptation strategies that equip farmers with the tools and knowledge needed to cope with changing conditions.

Climate Adaptation Fund: Establishing a dedicated Climate Adaptation Fund can provide financial support for farmers to invest in climate-resilient practices. This fund could offer grants or low-interest loans for the adoption of drought-resistant seed varieties, irrigation systems, and soil conservation techniques.

Research and Development: Investing in agricultural research and development is crucial for identifying and promoting climate-resilient crop varieties and sustainable farming practices. Collaborating with universities and research institutions can facilitate the dissemination of knowledge and innovations that enhance farmers' adaptive capacity.

Education and Training Programs:

To bridge the technological gap and promote the adoption of modern agricultural practices, comprehensive education and training programs must be implemented.

Extension Services: Strengthening agricultural extension services can provide farmers with access to information on best practices, new technologies, and market trends. Extension agents can play a vital role in delivering training on precision agriculture, sustainable farming techniques, and climate adaptation strategies.

Workshops and Demonstration Farms: Organizing workshops and establishing demonstration farms can offer hands-on training opportunities for farmers. These initiatives can showcase successful practices and technologies, encourage wider adoption and fostering a culture of innovation within the agricultural community.

Rebalancing CAP Subsidies:

The findings indicate a need for a re-evaluation of the allocation of CAP subsidies to ensure that they promote sustainable agricultural practices and support smallholders.

Sustainability Criteria: Integrating sustainability criteria into subsidy allocations can incentivize environmentally friendly practices, such as crop diversification, agroecology, and organic farming. This approach can help align financial support with long-term sustainability goals and encourage farmers to adopt practices that enhance soil health and biodiversity.

Targeted Support for Smallholders: Policymakers should prioritize targeted support for smallholders, ensuring that they have access to the resources and funding necessary to compete in the market. This could include direct payments, training programs, and access to credit facilities tailored to the needs of small-scale farmers.

Enhancing Market Access:

Improving market access for local farmers is essential for ensuring the viability of agricultural production in Timiș County.

Local Processing Facilities: Investing in local processing facilities for crops such as sunflowers and rapeseed can add value to agricultural products and create jobs in rural areas. By reducing the distance farmers must travel to process their crops, these facilities can enhance profitability and encourage local production.

Cooperative Marketing Initiatives: Encouraging cooperative marketing initiatives can help farmers pool their resources and improve their bargaining power in the market. By

working together, farmers can negotiate better prices for their products and access larger markets, both domestically and internationally.

Promoting Research and Innovation:

Fostering a culture of research and innovation is critical for enhancing the competitiveness and sustainability of the agricultural sector.

Public-Private Partnerships: Encouraging public-private partnerships in agricultural research can facilitate the development of innovative solutions tailored to local conditions. Collaborations between government agencies, research institutions, and private companies can drive advancements in technology and practices that benefit farmers.

Funding for Innovation: Providing funding for innovative agricultural projects, such as precision agriculture technologies or sustainable farming practices, can stimulate growth and enhance productivity. Supporting startups and entrepreneurs in the agricultural sector can also lead to the development of new solutions that address current challenges.

CONCLUSIONS

The agricultural landscape of Timiș County has undergone significant transformations from 1990 to 2023, shaped by a complex interplay of socio-economic, climatic, and policy factors. The findings of this study highlight critical challenges and opportunities that must be addressed to ensure the sustainability and resilience of the region's agricultural sector.

1. Socio-Economic Disparities: The inequitable distribution of Common Agricultural Policy (CAP) subsidies has created a significant divide between large-scale and smallholder farms. With approximately 70% of funds directed towards farms larger than 50 hectares, smallholders are left marginalized, limiting their capacity to invest in modern technologies and sustainable practices. This disparity not only affects individual farmers but also undermines the overall competitiveness of Timiș County's agricultural sector. Addressing these inequities through targeted support and resource allocation is essential for fostering a more inclusive agricultural environment.

2. Labor Shortages and Demographic Challenges: The aging demographic of farmers, coupled with the trend of youth migration to urban areas, poses a substantial threat to the agricultural workforce in Timiș County. The decline in available labour, particularly for labour-intensive crops, jeopardizes not only crop production but also the sustainability of rural communities. Policymakers must prioritize initiatives that attract and retain younger generations in agriculture, ensuring a robust labour force that can support the sector's future.

3. Climate Vulnerability: The findings underscore the agricultural sector's vulnerability to climate change, particularly regarding staple crops like maize. The strong negative correlation between maize yields and rising summer temperatures indicates an urgent need for adaptive strategies. The low adoption rate of drought-resistant seed varieties highlights a significant gap in farmers' preparedness to cope with climate variability. Policymakers and agricultural extension services must prioritize education and support to facilitate the adoption of climate-resilient practices, ensuring that farmers are equipped to navigate the challenges posed by a changing climate.

4. Technological and Policy Gaps: The limited adoption of precision agriculture techniques and the misalignment of CAP subsidies with sustainable practices reveal critical gaps that hinder the agricultural sector's ability to thrive. Bridging these gaps requires targeted training programs, financial incentives, and a re-evaluation of subsidy allocations to promote environmentally friendly practices. By fostering innovation and aligning policies with sustainability goals, Timiș County can enhance its agricultural productivity and resilience.

5. Comprehensive Agricultural Policies: The study emphasizes the need for comprehensive agricultural policies that address the multifaceted challenges facing Timiș County's agricultural sector. A holistic approach that integrates socio-economic equity, climate resilience, and technological advancement is essential for fostering a sustainable agricultural future. Key strategies include promoting cooperative farming models, developing climate adaptation strategies, enhancing education and training programs, rebalancing CAP subsidies, improving market access, and fostering research and innovation.

6. Future Directions: Moving forward, it is crucial for stakeholders - including farmers, policymakers, and researchers - to collaborate in developing and implementing strategies that address the identified challenges. By prioritizing equity, sustainability, and innovation, Timiș County can build a resilient agricultural sector capable of adapting to changing conditions and meeting the needs of its communities. The successful implementation of these strategies will not only enhance agricultural productivity but also contribute to the overall economic and social well-being of the region.

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REFERENCES

[1]. ALEXANDRI C., LUCA L., 2019, CAP subsidies and land grabbing in Romania: A structural analysis, Ruralization Project Report.

[2]. BALTEANU D., POPOVICI E., 2010, Land use changes and land degradation in post-socialist Romania, Romanian Journal of Geography, 54, 95-105.

[3]. EUROPEAN COMMISSION, 2016, Report on the impact of the Energy Crops Scheme on agricultural production in Romania, European Commission Publications.

[4]. EUROPEAN COMMISSION, 2017, Report on the abolition of the EU sugar quota system and its impact on sugar production in member states.

[5]. EUROPEAN COMMISSION, 2022, Common Agricultural Policy: Annual Reports on Subsidy Allocations.

[6]. FAO, 2020, The State of Food and Agriculture 2020: Overcoming the challenges of land fragmentation, Food and Agriculture Organization of the United Nations, https://openknowledge.fao.org/items/a2dc7490-735d-4b5d-92a2-a36bfb380e02

[7]. KOSTOV P., DAVIDOVA SOPHIA, 2017, One size does not fit all: an empirical investigation of the Romanian agriculture production function, 91st Annual Conference, April 24-26, 2017, Royal Dublin Society, Dublin, Ireland 258642, Agricultural Economics Society.

[8]. NATIONAL INSTITUTE OF STATISTICS (NIS) OF ROMANIA, 2025, TEMPO AGR108A_3_4_2025: Agricultural Statistics Database

[9]. PETROVIĆ B., BUMBÁLEK R., ZOUBEK T., KUNEŠ R., SMUTNÝ L., BARTOŠ P., VALASKOVA K., 2024, Application of precision agriculture technologies in Central Europe: Review, Journal of Agriculture and Food Research, 15, 101048. https://doi.org/10.1016/j.jafr.2024.101048

[10]. POPESCU A., TINDECHE C., MARCUTA A., MARCUTA L., HONTUS A., 2022, Cereals Production Between Climate Change and Price Boom in Romania, Scientific Papers Series: Management, Economic Engineering in Agriculture and Rural Development, 22(4), 579–592.

[11]. PRĂVĂLIE R., SÎRODOEV I., PATRICHE C., ROȘCA B., PITICAR A., BANDOC GEORGETA, SFÎCĂ L., TIȘCOVSCHI A., DUMITRAȘCU MONICA, CHIFIRIUC CARMEN, MĂNOIU VALENTINA, IORDACHE S., 2020, The impact of climate change on agricultural productivity in Romania, A country-scale assessment based on the relationship between climatic water balance and maize yields in recent decades, Agricultural Systems, Volume 179, https://doi.org/10.1016/j.agsy.2019.102767., 12(1), 45-60. https://doi.org/10.1007/s10584-020-02700-5

[12]. ROMANIAN METEOROLOGICAL ADMINISTRATION, 2023 Climate Data for Romania: Temperature and Precipitation Records.

[13]. ROMANIAN NATIONAL INSTITUTE OF STATISTICS (NIS), 2025 Agricultural Production Statistics: Crop Areas and Yields in Timiș County.

[14]. RYBNICEK R., PLAKOLM J., BAUMGARTNER L., 2020. Risks in Public–Private Partnerships: A Systematic Literature Review of Risk Factors, Their Impact and Risk Mitigation Strategies, Public Performance & Management Review, 43(5), 1174–1208. https://doi.org/10.1080/15309576.2020.1741406

[15]. SWINNEN JOHAN F.M., 1997, An Explanation Of Land Reform Choices In Central and Eastern Europe, PRG Working Papers 31883, Katholieke Universiteit Leuven, LICOS - Centre for Institutions and Economic Performance.

[16]. WORLD BANK, 2021 Romania: Agricultural Sector Survey, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/870611468092644240/romania-agriculture-sector-survey