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Economic efficiency pulse growth in Ukraine

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Abstract. The study aimed to investigate the economic efficiency of buckwheat and oats cultivation in Ukraine for the period 2020-2024, incorporating production costs, yields, price changes, climate risks and the impact of state support. The regional coverage of the study included the northern, western, southern and eastern regions of Ukraine, including Chernihiv, Zhytomyr, Lviv, Mykolaiv, Odesa, Kirovohrad, Kherson and Zaporizhzhia, which provided a comprehensive analysis within different agro-climatic conditions. The research methodology was based on the analysis of official statistics from the State Statistics Service of Ukraine, the Ministry of Agrarian Policy and Food of

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Ukraine, case studies of farms, regulatory cost calculations, assessment of yields, price dynamics and profitability using economic and statistical analysis methods. The cost of key production inputs, including the cost of seeds, fertilisers, crop protection products, land lease, fuel and machinery, was addressed. The study determined that the average cost of growing buckwheat (16.9 thousand UAH/ha) was higher than that of oats (15.9 thousand UAH/ha), but due to the higher average selling price, buckwheat provided higher profitability (46.2% vs. 34.8%). The study found a significant impact of agricultural technologies and regional conditions on yields: buckwheat showed the best results in Chernihiv, Zhytomyr and Lviv regions, and oats in Mykolaiv, Odesa and Kirovohrad regions. Seasonal and average annual price fluctuations were summarised: in years of drought, buckwheat prices increased by 20-25% and oats by up to 12%, which compensated for crop losses. The role of government subsidy programmes, preferential lending and agri-insurance in increasing profitability by 10-15% in the medium term was analysed. Additionally, the efficiency of conventional and organic production models was investigated, considering premium pricing in the European Union markets. The results of the study can be used by farm managers, agro-consulting companies, and state and local authorities to make decisions on the choice of technological approaches, planning production strategies, cost optimisation and development of the export potential of niche crops

Keywords: buckwheat; oats; agriculture; yield; profitability; export potential

INTRODUCTION

Niche grain crops, such as buckwheat and oats, formed a separate segment in the structure of Ukrainian agricultural production. Demand for these crops was strong both in the domestic market and among international consumers, which necessitated an assessment of their economic efficiency. The production characteristics of buckwheat and oats were largely determined by agro-climatic conditions, the level of technological support and access to markets. Growing interest in organic production, changes in the structure of food demand and the need to optimise costs have made it important to study the profitability of these crops.

Assessing the efficiency of buckwheat and oat production required an analysis of the cost, yield, technological aspects of cultivation and market trends. Various approaches to determining the economic feasibility of producing these crops were considered in scientific sources, including an assessment of traditional, intensive and ecological farming methods. M. Vysochanska and V. Zubchenko (2024) studied the environmental and economic aspects of growing niche crops, in particular their dependence on technological changes and market factors. The study determined that the use of ecological farming methods contributed to the production of added value, although it was accompanied by a decrease in yield and an increase in cost. N. Tkach (2023) highlighted the peculiarities of growing niche crops in small agricultural enterprises in Ukraine. The analysis showed that the production of buckwheat and oats could be economically justified if resources were used efficiently and organic farming was introduced but remained dependent on market conditions. The economic efficiency of niche vegetable oil production under martial law in Ukraine was analysed in the study by O. Starikov and A. Reva (2024). Even though the subject of the study was other crops, the paper contained generalised conclusions about the dependence of the profitability of niche production on access to state support and the level of technological support. The economic efficiency of growing niche crops was assessed in the study by Y. Synyak (2023), which identified the main factors that influenced the formation of production costs. The use of intensive methods contributed to productivity growth, but increased production costs, which could reduce the economic attractiveness of these crops.

Foreign studies covered a wide range of issues related to the application of technological innovations in the production of niche crops. X. Cui *et al.* (2025) analysed the development of remote monitoring and machine learning systems in specialised agriculture, which had the potential to reduce production costs. The readiness of farmers to adopt biotechnological innovations was investigated by M. Abbey *et al.* (2024). The results showed that the prospects for the development of niche crops largely depended on the acceptability of genetic modifications and the effectiveness of the use of biological products in agriculture.

The issue of economic efficiency of agricultural diversification was considered in the study by A. Kurdyś-Kujawska *et al.* (2021). The study determined that expanding the range of crops grown contributed to the financial stability of small farms and reduced their dependence on market price fluctuations. The economic factors that determined the development of specialised agricultural production in the United States were the subject of a study by C.L. Neill and K.L. Morgan (2021). The study determined that the competitiveness of niche crops largely depended on marketing strategies, access to premium markets, and the level of production mechanisation. An analysis of measures to protect specialised crops was conducted in the study by M. Fuchs *et al.* (2021). The study determined that the policy of supporting the niche sector had a positive impact on its profitability, contributing to the financial sustainability of producers. I. Vijulie *et al.* (2022) examined the possibility of expanding lavender production in

smallholder farms in Romania. It was found that growing niche crops created added value, especially when targeting specialised markets.

The analysis of literature sources showed that the economic efficiency of buckwheat and oats cultivation depended on several factors, including production costs, yields, technologies and market conditions. Analysis of these factors was used to assess the possibilities of increasing the profitability of these crops and the prospects for their development in the domestic and foreign markets. The study aimed to assess the economic efficiency of buckwheat and oats cultivation in Ukraine, considering the level of production costs, yields, the impact of agricultural technologies and market factors. To achieve this goal, the following objectives were formulated: to study the structure of production costs in buckwheat and oats cultivation and assess their impact on the cost price. Analyse the impact of agricultural technologies on yields and economic performance. To determine the dynamics of market prices for niche crops and assess their profitability.

MATERIALS AND METHODS

The study was based on the analysis of the economic efficiency of growing niche crops of buckwheat and oats in different regions of Ukraine in 2020-2024. The analysis covered the northern, western, southern and eastern regions of Ukraine to provide a comprehensive assessment of the economic efficiency of growing niche crops in different agro-climatic conditions. In particular, the regional analysis includes examples from Chernihiv, Zhytomyr, Lviv, Mykolaiv, Odesa, Kirovohrad, Kherson and Zaporizhzhia regions. Official statistics from the State Statistics Service of Ukraine (2023), the Ministry of Agrarian Policy and Food of Ukraine (2025), and the Ukrainian Agrarian Business Club (n.d.) were used to assess production costs, yields, profitability, and the impact of agro-technologies.

The input data included information on buckwheat and oat production costs, yields, selling prices, costs of seeds, fertilisers, fuel, land lease, machinery and labour. The analysis of the regional specifics of buckwheat cultivation was carried out mainly for the northern and western regions of Ukraine, where favourable soil and climatic conditions for this crop have been formed (Chernihiv, Zhytomyr, Lviv regions). For oats, regional peculiarities were studied in the southern and central regions (Mykolaiv, Odesa, and Kirovohrad regions), where this crop demonstrated stable yields in continental climate conditions. At the same time, the overall analysis incorporated data from the northern, western, southern and eastern regions on soil and climatic conditions and the level of agricultural technology used. Official documents of state support programmes for farmers, such as the terms and conditions of subsidies, soft loans and compensation for organic production, were obtained from the web portal of the Ministry of Agrarian Policy and Food of Ukraine (2025).Data was also collected from specific farms for the case study, including Stepova Rosa farm (Kherson region), Pivden-Agro (Mykolaiv region), and Zorya farm (Zaporizhzhia region). Data on the production performance of these farms were also obtained from open sources Ministry of Agrarian Policy and Food of Ukraine (2025), as well as analytical materials of the Ukrainian Agrarian Business Club (n.d.). The selection of these enterprises was based on their location in the southern and eastern regions of Ukraine, which are most affected by climate stress, including droughts. In addition, these farms have already had experience in implementing adaptation technologies (irrigation, drought-resistant varieties, crop insurance), which was used for targeted analysis of the effectiveness of such measures in real production conditions. The representativeness of the selected cases ensured the reliability of the assessment of the economic feasibility of adaptation strategies in the most vulnerable agroclimatic zones.

The cost of growing buckwheat and oats was estimated based on an analysis of the main cost items, which included the cost of seeds, fertilisers, plant protection products (PPPs), land lease, fuel, machinery and labour costs. For the comparative analysis, the method of normative costing based on average resource consumption was used. The impact of technologies was analysed by comparing the average yields of conventional, intensive and ecological methods, which determined the economic effects of each approach. The dynamics of buckwheat and oats prices were assessed by statistical analysis of annual price fluctuations using a weighted average change rate (1):

$$C_{avg} = \frac{C_i}{N}, \quad (1)$$

where C_{avg} is – the average price for the period (UAH/t), C_i is – price in each year, N – number of years of the study.

Seasonal fluctuations were determined by calculating the seasonality coefficient (2):

$$S_i = \frac{C_i}{C_{avg}} \times 100\%, \quad (2)$$

where S_i – seasonality index for month i.

Gross income was analysed using formula (3):

$$VD = Y \times P_{unit}, \quad (3)$$

where VD – gross revenue (UAH/ha), Y – crop yield (t/ha), and P_{unit} – average selling price (UAH/t).

Net profit was calculated using formula (4):

$$NP = VD - C, \quad (4)$$

where NP – profit (UAH/ha).

The level of profitability was determined using formula (5):

$$R = \frac{P-C}{C} \times 100\%, \quad (5)$$

where R – profitability level (%), P – gross revenue from sales (UAH/ha), and C – cost of production (UAH/ha).

To analyse the export of organic products, data from the European Commission on EU Organic certification requirements was used (Regulation (EU) No. 2018/848 of the European Parliament and of the Council "On Organic..., 2018). The assessment of the profitability of organic production was conducted incorporating the costs of certification and additional costs of biological products. All calculations were made on average for 2020-2024 based on regulatory production indicators and market data. Statistical data processing was carried out in Microsoft Excel and Stata, which provided correct weighted averages and determined the economic efficiency of different approaches to buckwheat and oats cultivation.

RESULTS

Cost analysis and the impact of agricultural technologies on production efficiency. The economic efficiency of growing niche crops is determined by their cost, which is shaped by technological features, input costs and agro-climatic conditions of the region. Buckwheat and oats account for a relatively small share of Ukraine's grain production, but their demand in the domestic market makes them promising for specialised farms. An analysis of the costs of growing these crops identified the main economic factors that influence the feasibility of their production. A comprehensive analysis showed that the total cost of buckwheat production was higher than that of oats, due to higher costs of seeds, fertilisers and agrochemicals. At the same time, oats had higher costs for mechanised operations, which affected the final financial result. The overall difference between the crops was 6-8% in favour of oats (Table 1).

***Table 1**. Comparison of buckwheat and oat cultivation costs (2020-2024, average values UAH/ha)*

Expenditure	Buckwheat	Oats
Seeds	3.200	2.400
Fertilisers and plant protection products	4.600	3.650
Land lease	1.800	1.750
Fuel	2.200	2.450
Technique	3.100	3.400
Salary	2.000	2.250
Total	16.900	15.900

***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

Growing buckwheat required higher initial investment due to more expensive seeds and significant costs for fertilisers and protection products. However, the potentially high market price of buckwheat offsets these costs and ensures profitability. Oats, despite having a lower cost, had higher mechanised labour costs, requiring more fuel and labour. The analysis of buckwheat and oat yields in Ukraine revealed significant regional differences due to climatic conditions, soil characteristics and the level of agro-technological support. The highest average yields of buckwheat were observed in Chernihiv, Zhytomyr and Lviv regions, which belong to the northern and western agroclimatic regions, respectively, due to favourable soil and climatic conditions, in particular high humidity and acidic soils. At the same time, the highest oat yields were recorded in the southern regions due to black soil and continental climate. In contrast, Zaporizhzhia and partly Kherson regions, which belong to the eastern and southeastern regions, recorded the lowest results for both crops, due to frequent droughts and lower soil fertility (State Statistics Service..., n.d.).

The analysis of average purchase prices for buckwheat and oats in 2020-2024 revealed significant differences in the dynamics of both crops. According to the State Statistics Service of Ukraine (2023), the average price of buckwheat ranged from 12.5 thousand UAH/t (2020) to 21.0 thousand UAH/t (2022), while oats showed more stable indicators from 7.8 thousand UAH/t to 9.5 thousand UAH/t for the same period. The sharp jump in buckwheat prices in 2022 was due to the reduction of acreage due to the military actions and panic purchases in the domestic market (Fig. 1). In contrast, oats, being a less export-oriented crop, were less affected by geopolitical factors. Average prices were calculated using the weighted average of changes according to formula (1).

Seasonal price fluctuations were closely linked to the harvesting stages. Buckwheat was characterised by a 15-20% drop in prices in October-November due to new supplies entering the market. However, by spring, prices recovered by 25-30% due to a decrease in stocks and increased demand from processors (Ministry of Agrarian Policy and Food of Ukraine, 2025). For oats, the seasonality was less pronounced: the maximum price decline of 10-12% was recorded in September, and stabilisation occurred by the end of the year (Fig. 2).

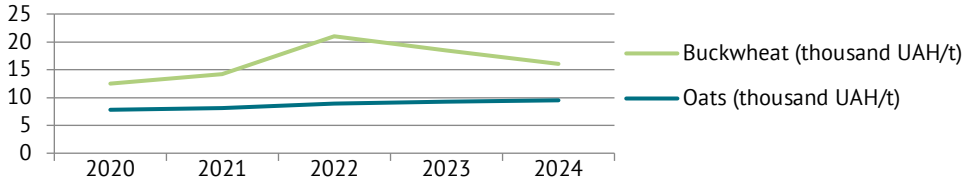

***Figure 1**. Buckwheat and oats price fluctuations (2020-2024, annual average, thousand UAH/t)*
***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

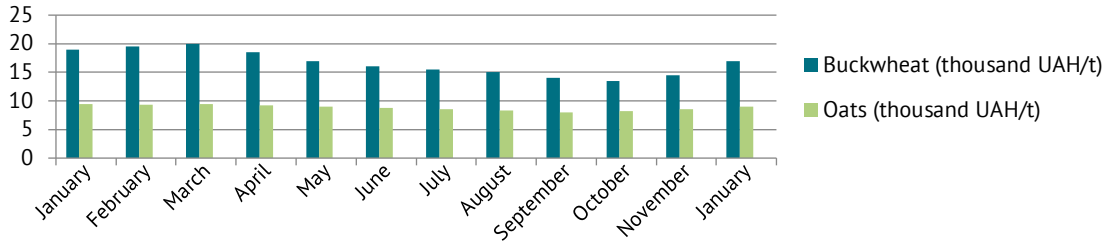

***Figure 2**. Seasonal price fluctuations for buckwheat and oats during the year (average for 2020-2024, thousand UAH/t)*
***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

An analysis of the seasonal dynamics of buckwheat and oats prices in 2020-2024 showed distinct patterns. For buckwheat, the highest prices were observed in the winter and spring months (December-March), due to limited stocks and increased demand for cereals during the cold season. In contrast, after the harvest (August-September), prices temporarily declined due to increased supply on the market. For oats, price fluctuations were less pronounced: a gradual increase in demand for feed purposes in autumn led to a stabilisation of prices. During the period under review, the average annual amplitude of seasonal price changes for buckwheat exceeded 22%, while for oats it did not exceed 10%. The seasonal indices (calculated using formulas (1) and (2)) reflected the characteristic peaks and troughs in both crops.

An analysis of production figures for 2020-2024 revealed a high degree of dependence of yields of niche crops, in particular buckwheat and oats, on climatic factors. The eastern regions of Ukraine were particularly indicative in this regard, as they faced extreme drought conditions twice during the period, in 2020 and 2024. In these years, average temperatures during the flowering phase exceeded long-term norms by 2.32.8°C, and precipitation during critical periods did not exceed 40-50 mm per month, which led to a significant reduction in the vegetative potential of plants. As a result of these conditions, buckwheat yields decreased by 25-30% from the baseline of 1.5 t/ha to 1.1 t/ha, which had a significant impact on the economic performance of the farms. Oats, despite being somewhat more resistant to moisture deficit, also showed yield losses in the range of 15-20% from 2.4 t/ha to 2.0 t/ha. At the same time, in the western regions, in Lviv, Ivano-Frankivsk, and Chernivtsi regions, where soil moisture levels consistently exceeded 70%, buckwheat yields of 1.8-1.9 t/ha were stable (State Statistics Service of Ukraine, 2023; Ministry of Agrarian Policy and Food of Ukraine, 2025; Ukrainian Agrarian Business Club, n.d.). This demonstrated the importance of water supply during flowering and grain formation, as well as the potential of regions with a moderate hydrothermal regime as strategic areas for growing this crop (Fig. 3).

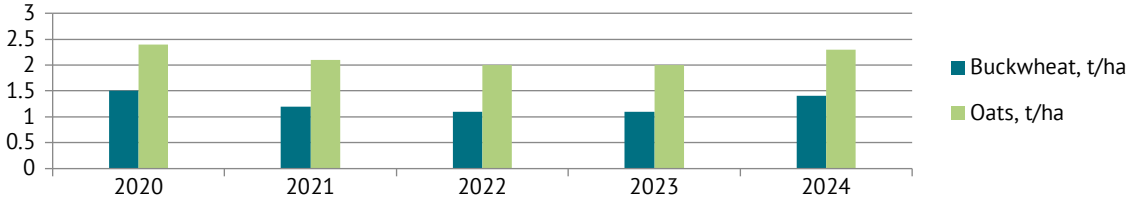

***Figure 3**. Impact of drought on buckwheat and oat yields (2020-2024)*
***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

Thus, the differences in yields between regions confirmed the high degree of sensitivity of niche cereals to hydrothermal conditions. Buckwheat was particularly vulnerable to water shortages, while oats showed somewhat greater adaptability but also suffered significant losses during prolonged periods of drought. A comparison of the results of the eastern and western regions pointed to the need for regionalisation of agrotechnological approaches, including the introduction of water-saving practices and the use of varieties resistant to extreme weather conditions. This became the basis for further analysis of adaptation measures aimed at reducing climate risks in buckwheat and oat production. In addition to directly reducing yields, climate risks had a significant impact on the overall economic efficiency of production. Price increases in the years of poor harvest partially compensated for the crop losses, ensuring that some farms maintained or even increased their net profit. During the drought of 2022, the average net profit from buckwheat production increased by 12-15% compared to years with stable weather conditions, which showed the importance of fluctuations in the assessment of risks and planning of agricultural activities (State Statistics Service of Ukraine, 2023; Ministry of Agrarian Policy and Food of Ukraine, 2025).

A comprehensive analysis of adaptation practices has shown the effectiveness of integrating technological innovations with government support instruments in the context of minimising climate risks. For example, in the Kherson region, Stepova Rosa farm introduced drip irrigation on 50% of buckwheat crops, which increased yields from 1.2 t/ha to 1.6 t/ha (+33%) in high temperatures, while state compensation of 1.0 thousand UAH/ha reduced costs by 8% (Ministry of Agrarian Policy and Food of Ukraine, 2025). In the Mykolaiv region, Pivden-Agro used the Orion oat variety adapted to water shortages, which increased yields to 2.7 t/ha (+12%) and increased profitability by 18%, despite the higher cost of seeds. Between 2022 and 2024, national support programmes, including compensation of 40% of the cost of installing irrigation systems, stimulated the expansion of drip irrigation by 15% in the southern regions, helping to reduce the cost of buckwheat production by 10-12% compared to non-irrigated areas (Ukrainian Agrarian Business Club, n.d.). An additional element of the adaptation policy was the implementation of the Agrostrakh programme, which in 2024 provided coverage for up to 70% of losses caused by drought. In particular, the Zorya farm in the Zaporizhzhia region received an insurance payment of 3.2 thousand UAH per hectare, which maintains its profitability level at 28% despite adverse weather conditions (State Statistics Service of Ukraine, 2023). In summary, these examples demonstrate the practical effectiveness of adaptation strategies both at the level of microeconomic actors and within the framework of the state policy to increase the climate resilience of agricultural production.

An assessment of the effectiveness of the implemented adaptation measures showed that they were able not only to mitigate the impact of adverse climate factors but also to increase the overall economic efficiency of agricultural production. The introduction of irrigation systems, the selection of drought-resistant varieties and the use of insurance mechanisms created additional opportunities to stabilise agricultural production in the face of growing climate uncertainty. The use of such solutions optimised resources, reduced technological risks and ensured predictability of financial performance in the medium term. The analysis demonstrated that the effectiveness of adaptation measures depended largely on the type of crop: buckwheat, being more vulnerable to drought, responded more strongly to the introduction of irrigation, while for oats, breeding characteristics and agroecological suitability of varieties were crucial. In addition, the level of adaptation varied by region: in the southern regions with low rainfall, infrastructure measures (such as drip irrigation) were most effective, while in the central regions, agro-technological solutions were prioritised. The role of state support has proved to be crucial in minimising risks and increasing the efficiency of growing niche crops. For example, the Stepova Rosa farm (Kherson region) implemented a drip irrigation system in buckwheat growing areas with the support of the state programme for compensation of equipment costs, which increased crop yields by 33% and reduced production costs by 8% on average in 2022-2024 (Ministry of Agrarian Policy and Food of Ukraine, 2025).

The Vovsianyi Krai farm in the Khmelnytskyi region has integrated the use of drought-tolerant oat varieties as part of a regional programme to support adaptive agriculture. This contributed to a 12% increase in yields even in dry years without significantly increasing production costs (State Statistics Service of Ukraine, 2023; Ukrainian Agrarian Business Club, n.d.). In addition, Pivden-Agro (Mykolaiv region) actively used crop insurance mechanisms with the support of the state programme to reduce insurance premiums. As a result, in 2023, up to 70% of oat crop losses due to extreme weather conditions were compensated, which ensured income stability and avoided bankruptcy (Ministry of Agrarian Policy and Food of Ukraine, 2025). Thus, the practical examples of farms show that the integration of anti-crisis measures with state support significantly increased the sustainability of niche crop production, reduced risks and ensured yield growth even in difficult climatic conditions.

Climate risks significantly affected the yields and economic efficiency of buckwheat and oats in Ukraine, especially in the eastern and southern regions. Buckwheat proved to be the most vulnerable to drought, while oats showed relative stability but also required adaptation measures. The practical introduction of drip irrigation, the use of drought-resistant varieties and

participation in government insurance programmes proved to be effective in increasing yields, reducing costs and maintaining profitability even in adverse weather conditions. The application of these strategies created the preconditions for increasing the climate resilience of the agricultural sector and formed the basis for further scaling up adaptation practices in the context of climate change.

Profitability and economic attractiveness of growing buckwheat and oats. The analysis of the profitability of buckwheat and oats cultivation was based on the comparison of gross income, net profit and margin per 1 ha, incorporating the data on cost, yield and sales prices for 2020-2024. Gross income was calculated as the product of the average yield and the sales price (formula 3), while net profit was determined by subtracting the cost from the gross income (formula 4, 5) (Table 2). The margin was displayed as a percentage of net profit to gross income (State Statistics Service of Ukraine, 2023).

***Table 2**. Comparison of buckwheat and oats profitability (average values for 2020-2024)*

Metric	Buckwheat	Oats
Average yield (t/ha)	1.9	2.8
Average selling price (thousand UAH/t)	16.5	8.7
Gross income (thousand UAH/ha)	31.4	24.4
Cost (thousand UAH/ha)	16.9	15.9
Net profit (thousand UAH/ha)	14.5	8.5
Margin (%)	46.2	34.8

***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

The data show that buckwheat, despite its higher cost, provided a higher net profit due to high selling prices. Its margin exceeded that of oats by 11.4%, which underlined its economic attractiveness in favourable years (Ukrainian Agrarian Business Club, n.d.). However, buckwheat margins fluctuated significantly: in 2022, they reached 62% due to peak prices, while in 2024 they fell to 35% due to market correction. For oats, the margin remained stable (30-38%), making it a less risky asset (Ministry of Agrarian Policy and Food of Ukraine, 2025). Buckwheat proved to be the most economically profitable crop, given stable access to export markets and high prices. However, its production was accompanied by significant risks associated with price volatility and climatic factors. Lower-margin oats remained a strategy for conservative farms focused on stability and domestic demand. The optimal strategy to minimise risks is to combine both crops in a crop rotation, with buckwheat as a profitable component and oats as a stabilising component.

The study of the economic efficiency of buckwheat and oats production in Ukraine in 2020-2024 showed that the choice of business model directly affects the profitability and sustainability of farms. To evaluate conventional and organic production, key indicators such as cost, yield, sales prices, net profit and margin were analysed. The conventional production model is based on intensive technologies that involve the use of mineral fertilisers, herbicides and mechanised cultivation of large areas (over 100 hectares). The advantages of this model are high yields (buckwheat 1.9 t/ha, oats 2.8 t/ha) and fast capital turnover. The main risks remain dependence on prices for agrochemicals and energy and high levels of internal competition (State Statistics Service of Ukraine, 2023). The organic production model requires compliance with the EU Organic certification requirements (Regulation (EU) No. 2018/848 of the European Parliament and of the Council "On Organic…, 2018), the use of biological products, and the prohibition of synthetic fertilisers and pesticides. Despite the higher cost (buckwheat 21.5 thousand UAH/ha vs. 16.9 thousand UAH/ha in the traditional format), premium prices (22.0 thousand UAH/t vs. 16.5 thousand UAH/t) partially compensated for the lower yield (1.6 t/ha vs. 1.9 t/ha) (State Statistics Service of Ukraine, 2023; Ministry of Agrarian Policy and Food of Ukraine, 2025; Ukrainian Agrarian Business Club, n.d.). Comparative results are presented in Tables 3 and 4.

***Table 3**. Comparison of conventional and organic buckwheat production*

Metric	Traditional	Organic
Cost (thousand UAH/ha)	16.9	21.5
Average yield (t/ha)	1.9	1.6
Selling price (thousand UAH/t)	16.5	22.0
Net profit (thousand UAH/ha)	14.5	13.7
Margin (%)	46.2	38.9

***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

***Table 4**. Comparison of conventional and organic oatmeal production*

Metric	Traditional	Organic
Cost (thousand UAH/ha)	15.9	18.0
Average yield (t/ha)	2.8	2.5
Selling price (thousand UAH/t)	8.7	12.0
Net profit (thousand UAH/ha)	8.5	12.0
Margin (%)	34.8	40.0

***Source:** compiled by the authors based on State Statistics Service of Ukraine (2023), Ministry of Agrarian Policy and Food of Ukraine (2025), Ukrainian Agrarian Business Club (n.d.)*

The data analysis showed that in traditional buckwheat production, the cost price was 16.9 thousand UAH/ha with an average yield of 1.9 t/ha and an average selling price of 16.5 thousand UAH/tonne. As a result, the net profit reached 14.5 thousand UAH/ha, and the margin was 46.2%. At the same time, organic buckwheat production was characterised by a higher cost of 21.5 thousand UAH/ha and a lower yield of 1.6 t/ha, but the premium selling price of 22.0 thousand UAH/t maintained a fairly high level of profitability, although slightly lower than in conventional production (13.7 thousand UAH/ha), with a margin of 38.9%) (State Statistics Service of Ukraine, 2023; Ministry of Agrarian Policy and Food of Ukraine, 2025). In the case of oats, the traditional model showed a cost price of 15.9 thousand UAH/ha, a yield of 2.8 t/ha and a selling price of 8.7 thousand UAH/ton. This provided a net profit of 8.5 thousand UAH/ha and a margin of 34.8%. Organic oat production provided a higher level of net profit of 12.0 thousand UAH/ha at a premium price of 12.0 thousand UAH/t, despite lower yields (2.5 t/ha) and slightly higher costs (18.0 thousand UAH/ha). The margin of organic oat production reached 40.0% (State Statistics Service of Ukraine, 2023; Ministry of Agrarian Policy and Food of Ukraine, 2025; Ukrainian Agrarian Business Club, n.d.).

The comparative analysis showed that for buckwheat, conventional production remains more profitable due to higher yields and moderate costs. In contrast, for oats, organic production proved to be more economically viable due to a significant increase in the selling price and higher profitability (Ukrainian Agrarian Business Club, n.d.). Thus, the choice of model depends on the crop: for buckwheat, investments in organic production are justified only if access to premium foreign markets is guaranteed, while for oats the organic model shows stable advantages even for domestic sales. An analysis of the distribution channels for buckwheat and oats in Ukraine showed that the key players are grain traders, processing companies and organic producers. Grain traders, such as Cargill or Louis Dreyfus, provided bulk sales through export contracts, offering stability of supply, but at prices that were often 10-15% below market prices (Ukrainian Agrarian Business Club, n.d.). In contrast, processing companies, including cereal producers (Yarmarochka, Extra M), bought raw materials at higher prices but demanded strict quality standards. The highest margins were achieved through organic brands (Eco Hata, Zhmenka), where prices were 25-30% higher than the market average, but required certification and narrow specialisation (Ministry of Agrarian Policy and Food of Ukraine, 2025). Demand for organic buckwheat and oats on the Ukrainian domestic market showed positive dynamics but remained limited due to higher prices (+25-30% over conventional products). Most organic products (over 65%) were exported to the European Union (EU), where demand for organic grains was consistently high. Increased exports of organic buckwheat increased the average net profit of farms by 2035% compared to domestic sales, making exports a priority for small and medium-sized farmers (Ukrainian Agrarian Business Club, n.d.).

The impact of export demand was particularly noticeable for buckwheat. For example, in 2023, after the resumption of logistics routes through the EU, prices increased by 18% due to increased supplies to Poland and Germany (Ukrainian Agrarian Business Club, n.d.). For oats, the domestic market remained the main driver, in particular demand from feed producers and the food industry. Market conditions also depended on competition from other grains: the drop in wheat prices in 2021 temporarily reduced the attractiveness of oats for farmers (State Statistics Service of Ukraine, 2023). Buckwheat cultivation had a higher level of risk due to greater price volatility, but under favourable conditions, it offered higher profitability. Oats remained a more stable crop, which minimised market risks and ensured stable farm incomes. The optimal strategy is to combine both crops in the crop rotation. The prospects for buckwheat and oats exports remained strong despite geopolitical challenges. Until 2022, the main export destinations for buckwheat were the EU (Poland, Germany), the Middle East (Turkey) and Asia (Japan). After the Black Sea ports were blocked, land corridors through Poland and Romania became the key route, which increased logistics costs by 2025% but maintained access to European markets (State Statistics Service of Ukraine, 2023). For oats, Turkey remained the main importer, using it for feed production, as well as North African countries (Tunisia, Algeria).

Government programmes helped to expand export potential in 2020-2024. For example, participation in

international agricultural exhibitions (e.g., Grain Tech in India) with the support of Minagro enabled Ukrainian farmers to sign contracts for the supply of organic buckwheat to Germany and France (Ukrainian Agrarian Business Club, n.d.). For small farms, cooperatives such as Agroexport, which aggregated products for sale to large importers, remained relevant. The optimal marketing strategy depends on the scale of production. Large agricultural holdings focused on grain traders and exports, while small farms benefited from cooperation with processors and organic brands. To increase exports, the development of logistics infrastructure and government support for participation in international platforms remain critical.

State support and financial instruments for farmers. State support for buckwheat and oats in Ukraine includes several programmes aimed at reducing costs and stimulating innovation. In 2020-2024, the Ministry of Agrarian Policy and Food of Ukraine (2025) implemented seed subsidies, soft loans and compensation for organic production. Subsidies for the purchase of certified buckwheat and oat seeds compensated 30-50% of the cost, enabling small farms to reduce their seed costs by 1.2-1.8 thousand UAH per hectare (Ministry of Agrarian Policy and Food of Ukraine, 2025). Concessional loans at 5% per annum, available through state-owned banks, have facilitated the renewal of machinery and the purchase of quality fertilisers. For example, in 2022-2023, about 45% of buckwheat farmers used these loans to upgrade 20% of their equipment (State Statistics Service of Ukraine, 2023). Since 2020, farms that switched to organic buckwheat or oat cultivation have received an annual compensation of 3,000 UAH per hectare. According to the Ukrainian Agrarian Business Club (n.d.), this covered up to 15% of the additional costs of certification and biological products. Such measures enabled farms to enter European markets with premium prices. Examples of successful use of state support included farms from different regions. For example, in Poltava region, Zernovyk farm reduced the cost of growing buckwheat from 17.5 to 15.8 thousand UAH/ha due to subsidies for seeds, which increased profitability by 12% (Ministry of Agrarian Policy and Food of Ukraine, 2025). In the Zhytomyr region, Eco-Zerno purchased precision seeders with concessional loans, which increased oat yields from 2.5 to 3.1 t/ha. In the Lviv region, the organic farm Bio-Pole used compensation to enter EU markets, selling buckwheat at a price 25% higher than the market average (Ukrainian Agrarian Business Club, n.d.).

The effectiveness of state support programmes depends on regional conditions and the size of farms. The use of state subsidies and soft loans enables small and medium-sized farms to reduce production costs by 8-12% and increase the profitability of buckwheat and oats by 10-15% in the medium term (2-3 years) (Ministry of Agrarian Policy and Food of Ukraine, 2025). In particular, seed subsidies (following the programme of partial compensation of the cost of agricultural seeds approved by Resolution No. 106 "On Approval of the Procedure for the Use of Funds Provided for in the State Budget for Providing Financial Support for the Development of Farms" (2018)) are most effective for small farms in the northern and western regions, such as Stepova Rosa farm (Kherson region) and Zorya farm (Zaporizhzhia region). Instead, concessional loans under the programme "Financial Support to Agricultural Producers" (Resolution No. 300 "On Approval of the Procedure for the Use of Funds Provided for in the State Budget for Financial Support of Activities in the Agro-Industrial Complex by Reducing the Cost of Loans", 2023) are more actively used by large agricultural enterprises, such as Pivden-Agro (Mykolaiv region), which enables expansion production and introduce adaptive technologies. Further development requires expanding support for organic production and simplifying bureaucratic procedures (Ministry of Agrarian Policy and Food of Ukraine, 2025). Government initiatives not only reduce production costs but also provide access to new markets, which is key to increasing the competitiveness of buckwheat and oats in the face of global challenges.

DISCUSSION

The results of the study confirmed that the economic efficiency of buckwheat and oat production was determined by a set of factors, including the level of agro-technological support, adaptation of technologies to regional conditions, the effectiveness of marketing policy and access to markets. The use of local fertilisation and plant protection technologies contributed to an increase in the efficiency of inputs in buckwheat and oat production. Similar conclusions were drawn by B.W. Warneke *et al.* (2021), noting that the introduction of precision spraying in specialised crops increased the efficiency of agrochemicals and reduced their negative impact on the environment. The study demonstrated that the use of ecological technologies led to a decrease in the yield of buckwheat and oats by 10-15%, which is consistent with the results of J. Ryschawy *et al.* (2021), stating that the transition to ecological farming methods reduced the negative impact on the environment, but required the adaptation of technologies to the reduced productivity of crops. The study confirmed the effectiveness of mulching technologies in buckwheat and oat production. It was found that the use of biodegradable materials contributed to the improvement of the soil water regime and the reduction of erosion processes. Similar results were reported by G. He *et al.* (2021), proving that the use of black mulching films had advantages over transparent ones, as they provided better soil temperature control and moisture conservation.

A comparative analysis of the cost of buckwheat and oat production showed that the main cost items were seeds, fertilisers, fuel and mechanised operations.

The study determined that buckwheat cultivation required higher costs for seed and plant protection products, while for oats, a larger share of the cost was accounted for by tillage costs. Similar trends were found by P.B. Angon *et al.* (2023), noting that minimum tillage technology systems contributed to lower production costs by reducing fuel and mechanised labour costs. The results of the study confirmed that the level of buckwheat and oat yields was largely determined by the agrotechnological approaches used in production. It was found that intensive technologies contributed to an increase in crop productivity but were accompanied by an increase in production costs. Similar conclusions were presented by S.E. Wuest *et al.* (2021) in an assessment of the impact of using different variety mixtures on crop productivity. The study determined that the introduction of mixed varietal groups contributed to increasing the resilience of crops and their adaptation to changing climatic conditions.

The results of the study confirmed the effectiveness of mulching technologies in grain production. It was found that the use of biodegradable films had the potential to improve moisture retention and optimise soil temperature. Similar results were obtained in A. Abduwaiti *et al.* (2021) in the verification of alternatives to traditional plastic films in the production of vegetable crops. The study determined that the use of biodegradable materials helped to reduce the negative environmental impact and increase the economic performance of cultivation. The assessment of the prospects for the development of niche crops showed that their production remained economically viable and provided an effective marketing strategy and access to international markets. The study by G.A. Manganaris *et al.* (2022) confirmed that the prospects of specialised crops were largely determined by the adaptation of cultivation technologies to changing climatic conditions and market requirements. The analysis of the structure of production costs showed that the greatest impact on buckwheat production costs was made by the costs of seeds, fertilisers and plant protection products, while for oats the key cost items were mechanised labour and fuel. Similar results were obtained by A.W. Driscoll *et al.* (2022), noting that diversification of agricultural production contributed to the economic stability of farms by spreading costs across different crops and adapting to changing market conditions. The results of the study were consistent with the findings of C.P. Huss *et al.* (2022), who determined that crop rotation and the use of intercropping systems provided pest resistance and had a positive impact on yields.

The results of the study confirmed that the economic efficiency of buckwheat and oats cultivation largely depended on the applied agricultural technologies. The study determined that the use of intensive methods contributed to an increase in yields but was accompanied by an increase in production costs. Similar conclusions were drawn by R.W. Brooker *et al.* (2023), who determined that ecological intensification in agricultural production provided increased crop productivity, provided that agrotechnological processes were optimised. The study determined that the diversification of agricultural production contributed to the stability of profitability, which correlated with the findings of K. Mekonnen *et al.* (2022). The study confirmed that mixed systems of agricultural production ensured resource optimisation and reduced the risk of losses due to adverse weather conditions. The results of the study confirmed that the level of economic efficiency of buckwheat and oats cultivation depended on the technological approaches used in production. The study determined that intensive cultivation methods contributed to higher yields but were accompanied by higher production costs. Similar conclusions were presented by P. Nilsson *et al.* (2022), who determined that the introduction of functional diversity in agricultural systems contributed to increased crop productivity and reduced dependence on external resources.

The analysis of the cost structure showed that the cost of buckwheat production was formed mainly by the cost of seeds, fertilisers and plant protection products, while for oats the main components were mechanised operations and fuel costs. Similar trends were observed by S. Kumar *et al.* (2022), who noted that the introduction of legumes into crop rotation helped to restore soil fertility, which reduced the need for mineral fertilisers and optimised agricultural production costs. The results confirmed that the application of ecological technologies for growing buckwheat and oats was accompanied by a decrease in yields but ensured the stability of agroecosystems. Similar findings were reported in a study by S.P.S. Yadav *et al.* (2023), which examined approaches to biodiversity conservation and its role in improving the environmental sustainability of agricultural land. The analysis of market dynamics showed that buckwheat had significantly higher price volatility, while the oat market remained stable. The study determined that the profitability of niche cereals largely depended on access to premium markets and export opportunities. Similar conclusions were drawn in the study by R. Dhillon and Q. Moncur (2023), which analysed the challenges and opportunities for small farmers in the context of technological innovation and the development of niche markets.

The results confirmed that the local application of fertilisers and plant protection products contributed to lower production costs and increased resource efficiency. Similar patterns were found in the study by P. Boczar and L. Błażejczyk-Majka (2024), which analysed the economic efficiency of energy use in EU agricultural enterprises. The assessment of the prospects for the development of niche crops showed that

their production remained economically viable and provided an effective marketing strategy and adaptation to market requirements. The study by C.K. Phiri *et al.* (2024) confirmed that the prospects for speciality crop production largely depended on access to marketing infrastructure and production incentive policies. The results were consistent with the findings of L.E. Balis *et al.* (2024), determining that speciality crops had the potential to increase the environmental and economic sustainability of agrosystems, especially if adaptive cultivation technologies were introduced. The results of the study confirmed that the economic efficiency of buckwheat and oat cultivation depended on the applied agricultural technologies and market factors. It was found that intensive technologies increased yields but were accompanied by an increase in production costs. Similar conclusions were drawn in the study by M.R.B. Júnior *et al.* (2024), which examined modern technological solutions in specialised crop production. The study determined that automation of agricultural production contributed to increased productivity, reduced labour costs, and optimised resource use.

The analysis of the cost structure showed that the greatest impact on the cost of buckwheat was made by the cost of seeds, fertilisers and plant protection products, while for oats the key cost items were mechanised work and fuel. Similar patterns were observed in the study by M. Vályi-Nagy *et al.* (2024), which assessed the economic benefits of mixed cropping. It was found that optimisation of resources through the integrated use of fertilisers and tillage contributed to increased profitability of agricultural production. The results confirmed that the application of environmental technologies in buckwheat and oat production was accompanied by a decrease in yields but ensured the stability of agroecosystems and access to premium markets. Similar conclusions were reached in the study by D. Duval *et al.* (2024), which analysed the economic contribution of agricultural production to regional development. The study determined that the adaptation of production systems to environmental standards expansded export opportunities and increased the added value of products. Comparison with scientific sources has shown the expediency of applying adaptive approaches in the cultivation of niche crops to increase competitiveness and stabilise economic performance.

CONCLUSIONS

The study of the economic efficiency of buckwheat and oats in Ukraine revealed significant differences in the profitability of these crops. Buckwheat, despite the higher production cost (16.9 thousand UAH/ha versus 15.9 thousand UAH/ha for oats), provided a higher net profit (14.5 thousand UAH/ha) due to the high average selling price (16.5 thousand UAH/t). The study determined that buckwheat production is vulnerable to geopolitical factors: in 2022, there was a sharp increase in its price to 21.0 thousand UAH/t due to a reduction in acreage and domestic demand, and a gradual correction in subsequent years. Oats, with more stable prices (7.8-9.5 thousand UAH/t) and higher yields in southern Ukraine (2.8 t/ha), proved to be a less risky crop for domestic market-oriented farms.

The impact of climatic factors was analysed: the droughts of 2020 and 2024 in the eastern regions led to a 25-30% decrease in buckwheat yields and a 15-20% decrease in oats. The regional analysis confirmed that the highest buckwheat yields (1.8-1.9 t/ha) were achieved by farms in Chernihiv, Zhytomyr, and Lviv regions due to favourable hydrothermal conditions. The effectiveness of adaptation measures was summarised: the introduction of drip irrigation increased buckwheat yields by 33%, and the use of drought-resistant oat varieties contributed to a 12% increase in yields even in years with limited moisture. Organic production, despite a 10-15% reduction in yields, provided premium prices (+25-30%) and access to EU markets. The study determined that state support programmes (compensation for organic production, seed subsidies, soft loans) reduced production costs by 8-12% and increased production profitability by 10-15% in the medium term. Prospects for further research include modelling the impact of climate change on yields and analysing the effectiveness of adaptive technologies and government support in the agricultural sector.

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Економічна ефективність вирощування нішевих культур в Україні

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Анотація. Метою роботи було дослідити економічну ефективність вирощування гречки та вівса в Україні за період 2020-2024 років, з урахуванням виробничих витрат, урожайності, змін цін, кліматичних ризиків і впливу державної підтримки. Регіональне охоплення дослідження включало північні, західні, південні та східні області України – зокрема Чернігівську, Житомирську, Львівську, Миколаївську, Одеську, Кіровоградську, Херсонську та Запорізьку – що забезпечувало комплексний аналіз у межах різних агрокліматичних умов. Методологія дослідження базувалася на аналізі офіційних статистичних даних Державної служби статистики України, Міністерства аграрної політики та продовольства України, кейс-аналізі господарств, нормативних розрахунках витрат, оцінці врожайності, динаміки цін та рівня рентабельності з використанням методів економічного та статистичного аналізу. Було проаналізовано собівартість основних виробничих елементів, зокрема витрат на насіння, добрива, засоби захисту рослин, оренду землі, паливо та техніку. Було визначено, що середня собівартість вирощування гречки (16,9 тис. грн/га) перевищувала відповідний показник для вівса (15,9 тис. грн/га), проте завдяки вищій середній ціні реалізації гречка забезпечувала вищу рентабельність (46,2 % проти 34,8 %). Було встановлено суттєвий вплив агротехнологій і регіональних умов на врожайність: гречка продемонструвала найкращі результати у Чернігівській, Житомирській та Львівській областях, а овес – у Миколаївській, Одеській та Кіровоградській областях. Було узагальнено сезонні та середньорічні коливання цін: у роки посух ціни на гречку зростали на 20-25 %, на овес – до 12 %, що компенсувало втрати врожаю. Було проаналізовано роль державних програм субсидування, пільгового кредитування і агрострахування у підвищенні рентабельності на 10-15 т% у середньостроковій перспективі. Додатково було досліджено ефективність традиційних та органічних моделей виробництва з урахуванням преміального ціноутворення на ринках Європейського Союзу. Результати дослідження можуть бути використані керівниками фермерських господарств, агроконсалтинговими компаніями, органами державної влади та місцевого самоврядування для прийняття рішень щодо вибору технологічних підходів, планування виробничих стратегій, оптимізації витрат і розвитку експортного потенціалу нішевих зернових культур

Ключові слова: гречка; овес; сільське господарство; урожайність; рентабельність; експортний потенціал