European Journal of Sustainable Development (2025), **14**, 2, 293-306 ISSN: 2239-5938
Doi: 10.14207/ejsd.2025.v14n2p293

Impact of Uneven Agricultural Business Development on Rural Socio-Economic Dynamics

By Svitlana Belei[1], Yuri Lopatynskyi[2], Nina Petrukha[3], Nazar Lahodyn[4], Yuliia Nezhyd[5]

ABSTRACT:
Modern countries pay attention to the significant economic importance of the agricultural sector. The situation remains increasingly severe due to some unfavorable socioeconomic circumstances, as the pandemic and the wars between Russia and Ukraine coincided. Agricultural activities contribute to economic stabilization, while local consumption and food supply for the territory can also occur through agricultural activities. In this regard, the study of asymmetric development of agrarian business is becoming quite relevant since it can prevent its negative impact on the economic and social life of rural areas. The purpose of the academic paper is to develop a theoretical and methodological apparatus for the asymmetric development of agrarian business and analyze the current situation and possible prospects for the development of rural areas in the countries of the European Union. General scientific and specific scientific research methods were used in the research. In particular, the methods of generalization, systematization, analysis of modern scientific sources and comparison were applied. A statistical approach was used to gather the required data and estimate the data on cumulative income shares in order to determine the extent of agricultural land in the research area. The Lorenz curve was constructed using a graphical method. The Gini coefficient was calculated using a mathematical method. The Gini index was used to determine the current level of asymmetry in the development of agribusiness in the European Union countries. The index sums up to a value of $G = 0.08$, which falls within the range $0 \leq G < 0.3$; therefore, it can be argued that there is a high and stable level of socio-economic inequality in rural areas of the European Union member states. If such information is properly linked to the general imbalance of changes and the probable food crisis at the moment, then in the EU countries it can be said that the agricultural landscape is relatively stable. Thus, the asymmetry of development concerns agribusiness, which may be uneven in terms of the main production factors necessary for the creation of agricultural products, and production relations exist between all levels of enterprises, within which the conditions differ in terms of the level of development and the scale that exist within the socio-economic territory. The deterioration of the qualitative and quantitative state of infrastructure provision, the increase in the aging of the population – all the outlined bring asymmetric development to high levels as one of the negative socio-economic factors. Thus, the members of the European Union introduce systemic financial measures for periodic

[1]PhD in Economics, Associate Professor, Department of Business and Human Resource management Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine. ORCID: https://orcid.org/0000-0001-6406-5389
[2] Doctor of Economic Sciences, Professor, Department of Business and Human Resource Management Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine. ORCID: https://orcid.org/0000-0002-9125-7818
[3]Ph. D. (Economics), Associate Professor, Docent, Department of Management in Construction Kyiv National University of Construction and Architecture, Kyiv, Ukraine. ORCID: https://orcid.org/0000-0002-3805-2215
[4]PhD student (Entrepreneurship and Trade), Department of Business Economics and Human Resource Management, Yuriy Fedkovych Chernivtsi National University, Chernivtsi, Ukraine. ORCID: https://orcid.org/0009-0006-0996-5425.
[5]PhD in Management, Senior Researcher, Accounting and Taxation Department, National Scientific Centre «Institute of Agrarian Economics», Kyiv, Ukraine. Researcher, Institute of Accounting and Finance of the NAAS of Ukraine, Kyiv, Ukraine. ORCID: https://orcid.org/0000-0003-2807-0687

financing of priority areas of agribusiness and infrastructure solutions to improve logistics for rural areas, which reflect very unequal levels of rural inequality in different EU Member States.

Keywords: agribusiness, productivity, agricultural production, rural settlements, productivity

1. Introduction

Statistical information at the moment (European Commission, 2024) shows that the share of the rural population in the European Union is around 30% (137 million people). The territories cover 83% of the total area of the EU. In comparison, rural areas of the United States of America reach 97% of the total area, while covering only 19.3% of the population (Ratcliffe and Al. 2016).The sources of income for most of the rural population are agricultural activities; therefore, their feature, close to the agricultural sector, is their dependence on income in rural areas (Davis and al. 2010). As a rule, efficiency in this sector often occurs at the expense of asymmetry, which, in turn, leads to corresponding disadvantages associated with the level of economic development and well-being of the population in different regions (Omelchyk et al., 2022). Greater asymmetry mostly results in disparities in living conditions, access to services, and income across different regions. Furthermore, it does not support the growth of local businesses, which are primarily in the agricultural sector, and the losses resulting from this will be felt by both large and small farms.

The present academic paper is devoted to a more in-depth consideration of the concept of asymmetry in the development of agribusiness and substantiation of its impact on the socio-economic status of rural areas. Current research on the concept of asymmetry in agribusiness does not demonstrate a unified approach to the main determinants of the industry's development, combining theoretical perspectives and historical evolution. In addition, there is a lack of research on asymmetries in the regional context. The study of these aspects will strengthen the theoretical basis of the problem under study and contribute to the search for effective practical solutions. Cross-sectional analysis is utilized in the present research to examine the agriculture sector's asymmetries in the EU economies from the standpoint of the best possible methodological framework for determining the "index" of asymmetry. An analysis of the findings based on the above and leading to conclusions about the problems of agricultural sector development within the European environment and the potential for reducing the level of asymmetry is presented.

2. Literature review

Despite the large number of concepts aimed at studying economic imbalances in the agricultural sector, the issue of asymmetric development of agribusiness does not have a single, universal definition yet. The methodological and theoretical basis of this study is the asymmetry of positions and determinants of development in modern scientific activity.This statement by Scoones et al. (2016) was subsequently supported by the heterogeneous development of agribusinesses stemming from unequal access to innovation, credit and investment opportunities.

Their postulate is confirmed by the statement of Kaplinsky, & Kraemer-Mbula (2022) that lower- and middle-income countries will be the main losers from growing imbalances due to barriers to knowledge creation and new technologies as well as to compelling and sustainable systemic change. The scholars argue that the underlying asymmetry in agribusiness is largely driven by investment inequality directed towards some economically developed areas, which also hampers the socio-economic development of those rural areas that are underfunded. Furthermore, Okunlola and Ayetigbo (2024) point out that investment inequality, which is mainly directed towards some economically developed areas, is a major factor in agribusiness asymmetry; this, in turn,

The publications of Hassan et al. (2021), Poulton et al. (2010), Urugo et al. (2024), Steensland (2021) and Mironova et al. (2022) analyze the specifics of socioeconomic differentiation of agricultural producers, thus, large agricultural enterprises provide significantly better opportunities for the integration of new technologies, high-quality logistics and new markets, compared to small farms, where the asymmetry is not only provided by financial and other material resources but also by geographical and natural-climatic factors. For example, Sgroi et al. (2022) noted that differences in the productivity of agro-industrial enterprises are provoked by climatic conditions, soil quality and water resources, as well as uneven use of other specific resources, that is, the production technologies, types and varieties of agricultural crops. To summarize, if asymmetry in access to information is avoided, then reputation gives leadership in the competitiveness of agribusiness.

The degree of asymmetry in the dynamics of agribusiness development is something that should not be the primary focus of a large-scale state policy to prevent. Such orientation is typical for Van the Ploeg et al. (2012) and Yu & Wu (2018), who emphasize that natural one-sidedness stimulates companies to invent new solutions and strengthen their competitiveness in business on the national level or global levels agricultural market.

Mazur (2017) specifies that poor infrastructure in developing rural areas and the process of rural depopulation, which leads to increased unemployment and reduced services for the rural population, are critical for escalating asymmetries. Meanwhile, Holden, & Binswanger, (1998) argue that the main policy decisions to accelerate support for agribusiness are that high taxes will increase liquidity in agriculture. Thus, states with a high incidence of asymmetry should consider introducing agricultural subsidies and state aid for poor rural areas.

According to the viewpoint of Kaplinsky, & Kraemer-Mbula (2022), all of this means that people from underdeveloped rural districts may not have access to modern technologies. According to Steensland (2021), a related issue is unequal market access since agriculture operates more effectively in areas with the best logistical facilities than in others. Possible losses from excessive asymmetry in the country's agro-industrial complex are usually focused on the issues of food security (Yatsenko et al. 2019), reproduction of the rural population and territories through the development of human resources and financial support for agricultural production (Ullah et al 2020); investment and innovation support (Zgalat-Lozynska et al. 2023), actualization of socio-cultural regional specificity (Włodarczyk-Marciniak et al. 2020) and balanced development of agro-landscape ecosystems (Sgroi et al. 2022; Kovalko et al. 2022). Uneven distribution of agricultural

economic performance and basic resources is observed among farms in certain regions and the above-mentioned countries, although this is mainly due to different access to agricultural markets, state aid in the form of grants and subsidies, as well as information and new technologies to increase productivity and competitiveness in agriculture. This includes acute financial and infrastructure problems, as well as worsening socio-economic conditions for rural development, such as: population loss, unemployment, deterioration of social services for rural residents, and environmental problems (Pronko 2022). Thus, the very essence of the asymmetry of agribusiness development is the presence of negative consequences. These negative effects should be minimized by state systemic solutions and agricultural development support projects.

3. Research methods

The main methods were used in the study:

- analysis of literature sources, publications and statistical data to study the specifics of the asymmetry of agribusiness development;
- comparative analysis to verify changes in agricultural production in macro-regions;
- systematization as a method of determining indicators of agricultural sector development for EU countries.
- analysis of statistical data to determine and present absolute values of income indices in agriculture, as well as the size of agricultural land in the EU countries.

A synthesis approach was used in this research to highlight the main social and economic impacts of current EU agribusiness support policies.

The indicator is calculated on the basis of a weighted average index of agricultural business income using official Eurostat statistics on the index of actual farm income and agricultural land area in member states provided by the OECD, and countries were randomly selected, thus, ensuring absolute representativeness of the results obtained. In accordance with the principles of existing methodological approaches, the initial value of shares was calculated, which was used to build a Lorenz curve that reflects the overall imbalance in the development of the agricultural sector. The value of the Gini coefficient reaches 0.08. This analysis should reveal the main shortcomingsof the EU policy on leveling the asymmetry of agricultural development and ways to improve the socio-economic development of the member states.

4. Results

4.1 On the issue of defining the problem of asymmetry in the development of the agricultural sector of the economy

The climatic factor in the territory of any country is of approximately an order of magnitude greater importance in influencing the level of agribusiness development and its asymmetry with other factors. Climatic conditions change over time, and new weather conditions, such as increased intensity of natural phenomena, global warming, changes in moisture conditions, and changes in the state of the earth's atmosphere, are characteristic features of climatic conditions over the centuries. In recent decades, El Niño has had a significant impact on countries. In particular, the highest negative impact is typical for the

countries of the Asia-Pacific region as well as for Latin America, where it causes a complete loss of crops due to the destruction of crops in some countries (Rossato. et al. 2024). In European countries, there is another unfavorable phenomenon – a tendency to increase the level and duration of droughts and a tendency to decrease the average annual rainfall, as evidenced by the yield of drought-resistant crops of agrarian production. Such trends indicate a certain level of asymmetry in the world farming sector, the specifics of which, based on the aggregate generalization of statistical materials, are shown in Table 1 (Table 1).

Table 1: Indicators of the dynamics of agricultural production for the period 2022 – 2025

Region	**2022**	**2023**	**2024**	**2025**
World	2	3.1	1.3	1.7
Africa	1.7	1.2	1.1	0.9
North America	-3.9	4.2	1.7	1
South America	-0.6	3.9	2.1	1.9
Asia	4	3.4	1.3	1.9
Europe	-2.3	2	1	0.8

Source: created by autors based on Rossato et al. (2024).

During the period under study, all regions of the world have been experiencing a downward trend in the level of agricultural production. This, in turn, will have a negative impact on overall global food security. Another important factor that determines the asymmetry of agribusiness is the level of resources. Resources mean the availability of material, human, and financial support. Such investments include qualified personnel to stimulate innovation, availability of modern high-tech infrastructure, and levels of modern infrastructure that will provide the potential for theft for the development of small and medium-sized agribusinesses (Ciaian et al. 2021). This is lacking globally at a time when large agroholdings are the main force in the agricultural market. In fact, small agribusinesses have only a limited set of resources compared to agroholdings, and therefore, have only limited opportunities to develop their business. Therefore, it is equally important and necessary to adjust and harmonize government policies on the uniform development of agribusiness, especially in countries characterized by increasing asymmetry in the development of agricultural areas: scientific and innovative activities in the field of investment increase the volume of revenues in the agricultural economy, material support for agribusiness, supplies, etc. This will improve socio-economic living conditions in rural areas and create synergies between urban and rural areas (Nenko et al 2021).

4.2 Assessment of the level of asymmetry of agricultural production development in the EU member states

An assessment of the main critical indicators of the level of agricultural production development in the representatives of the European community makes it possible to diagnose the level of asymmetry in the agricultural business. Land measurements and agricultural income indices are shown in Figure 1 (see Figure 1).

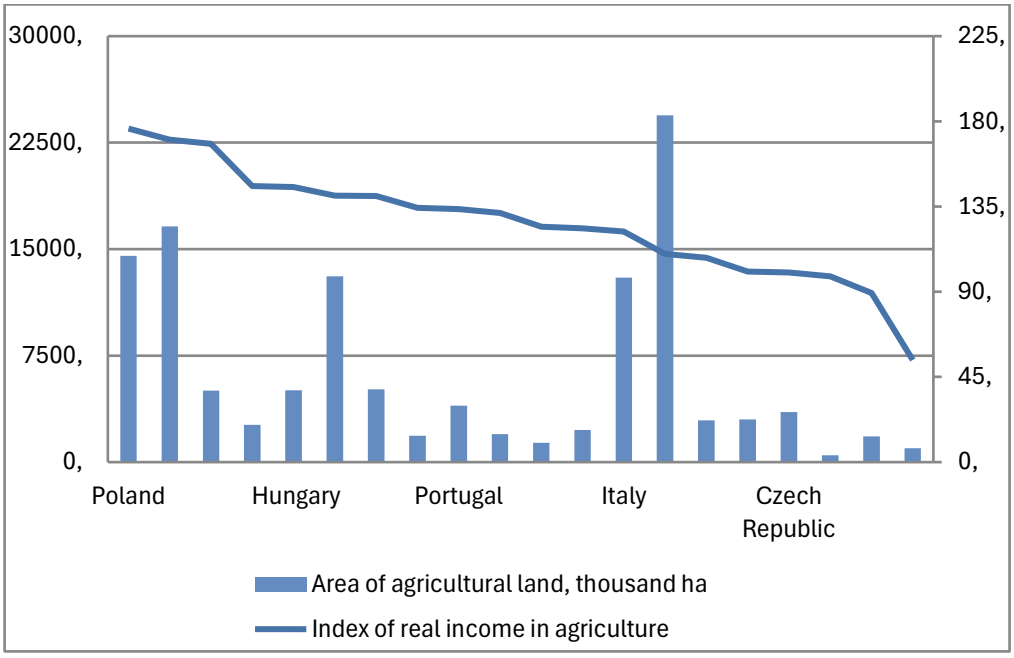

Figure 1. Indicators equal development of the agricultural sector in EU countries in 2023
Source: compiled by the author based on (Eurostat 2024; OECD 2023)

The Gini coefficient of inequality in the distribution of value added in European agriculture was calculated using the data in Figure 1. It summarizes the cumulative shares to give a single measure of inequality of both shares of total agricultural land and total income.

First of all, the share of agricultural areas for each country and the share of real income were calculated. This was done using the following formula:

$$S_i = \frac{X_i}{\sum_{j=1}^{n} X_j} \quad (1)$$

where X_i- the value of the i - unit;;
$\sum_{j=1}^{n} X_j$- the total number of units in the data set under study.

After determining the shares, the level of existing income on agricultural land in the countries under study was estimated. At the same time, the calculated values do not

allow to obtain the existing level of asymmetry but only provide a subjective idea of the degree of unevenness in the development of agriculture of individual countries.

Given this, the cumulative shares of real income and agricultural land area were calculated, which is defined as the product of the current value and the previous one, using the following formula:

$$CS = CS_{i-1} + \frac{I_i}{\sum I} \quad (2)$$

where $CS$is the accumulated share of the indicator;
CS_{i-1} accumulated fraction index for the previous (i −1) row; ;
I_i- indicator for the *i* - row;
$\sum I$- the total sum of the indicator values.

At the same time, the obtained calculations, that is, the accumulated shares, allow us to construct a Lorenz curve, which further helps to determine theGini index, which is a measure of inequality in the distribution of a certain value in the range from 0 to 1, where 0 is absolute equality and 1 is complete inequality.

The formula for determining the Gini index is:

$$G = 2 * A = 1 - 2 * B \quad (3)$$

Where, G is the Gini coefficient;

A is the area between the line of equality (diagonal at an angle of 45°) and the Lorentz curve;

B is the area under the Lorenz curve.

According to this formula, A is calculated as the sum of the areas of the trapezoids between the points of the Lorenz curve using the following formula:

$$\mathrm{A} = \frac{(x_{i+1} - x_i) * (y_i + y_{i+1})}{2} \quad (4)$$

where $x_i$andy_i value accumulated income and area shares for the i - point ;
x_{i+1}andy_{i+1} value for the (i +1) point .

The results of the Gini index calculations allow us to determine the level of inequality in the agricultural sector of the EU countries. The limits of this index $0 \leq G < 0.3$ indicate a high index of economic equality; $0.3 \leq G < 0.6$ is an average level of socio-economic inequality; and - $0.6 \leq G \leq 1$ - high inequality of socio-economic development of the agricultural sector.

The Gini index helps to assess the level and efficiency of resource allocation and to take measures to ensure the effective agricultural development. A high value and growth of the index indicate the need for policy adjustments in agricultural production, while a low value shows the stability of the sector.

4.3. Assessment of the level of asymmetry of the EU countries based on the results of calculations

At the first stage, the area of agricultural land and the share of income for EU member states were estimated, which are summarized in Table 2. The calculations performed show a slight the level of asymmetry in the agrarian development of the EU territories.

Table 2: Results of calculating the Gini index indicators

Country	Earth agricultural purpose (thousand hectares)	Actual income indices in rural areas business	Shares areas	Revenue shares	Cumulative fraction areas	Cumulative revenue share	Area under the Lorenz curve
Poland	14521.86	176.18	0.11745	0.070005	0.11745	0.070005	0.004111
Germany	16591.5	170.41	0.134189	0.067712	0.251639	0.137717	0.012496
Bulgaria	5046.6	168.17	0.040816	0.066822	0.292455	0.204539	0.018179
Denmark	2618.4	145.8	0.021177	0.057933	0.313632	0.262472	0.017556
Hungary	5049.01	145.34	0.040835	0.05775	0.354468	0.320222	0.019292
Romania	13078.88	140.71	0.10578	0.055911	0.460247	0.376133	0.022776
Greece	5137.04	140.64	0.041547	0.055883	0.501795	0.432016	0.026881
Slovakia	1856.13	134.26	0.015012	0.053348	0.516807	0.485364	0.02717
Portugal	3980.49	133.67	0.032193	0.053113	0.549	0.538477	0.028304
Latvia	1970.1	131.64	0.015934	0.052307	0.564934	0.590784	0.029133
Belgium	1368.31	124.37	0.011067	0.049418	0.576001	0.640202	0.028191
Finland	2268	123.44	0.018343	0.049049	0.594344	0.689251	0.028702
Italy	12987.42	121.86	0.10504	0.048421	0.699384	0.737671	0.031322
Spain	24420.4	109.91	0.197508	0.043672	0.896892	0.781344	0.034857

Country	Earth agricultural purpose (thousand hectares)	Actual income indices in rural areas business	Shares areas	Revenue shares	Cumulative fraction areas	Cumulative revenue share	Area under the Lorenz curve
Lithuania	2937.81	107.94	0.02376	0.04289	0.920652	0.824233	0.038977
Sweden	3002.91	100.71	0.024287	0.040017	0.944939	0.86425	0.037328
Czech Republic	3529.8	100.21	0.028548	0.039818	0.973488	0.904068	0.038194
Slovenia	479.49	98.07	0.003878	0.038968	0.977366	0.943036	0.03801
Netherlands	1811.91	89.39	0.014654	0.035519	0.99202	0.978555	0.034975
Estonia	986.67	53.97	0.00798	0.021445	1	1	0.021359
Total	**123642.7**	**2516.69**	**x**	**x**	**x**	**x**	**0.537812**

Source: compiled by the author

The differences in productivity and resource use efficiency across the EU countries stem from their agricultural incomes and the ratio of agricultural land, which again varies greatly from country to country. The higher the value of the share of income with a smaller share of land is, as shown in some countries, the more productive the country will be. In contrast, the higher the share of income with a larger share of land is, as it is the case in some countries, the lower the productivity and measures to increase it must be taken.

Taking all of the above into account, it can be stated that the results of the primary analysis indicate significant structural differences in the development of the EU agricultural sector. The regions must take effective measures to synergize the development of agribusiness and overcome imbalances.

Given the limited sample in Table 2 to the countries of the European community, it is important to note the importance of taking into account the specifics of agribusiness asymmetry in developing countries. This will allow us to identify global trends in agribusiness development under the influence of the dynamics of economic, geographical and political conditions. In developing regions, the need to increase the productivity and efficiency of the agricultural sector in order to create significant competitive advantages in accordance with the current requirements of the market environment requires special attention. The development of the agricultural sector of these countries is characterized by a gradual transition to organic farming, although the scale of the dynamics is not significant today. Optimization of the agricultural sector's balance will be facilitated by intensification of domestic and foreign investment, implementation of innovative

solutions and practical developments of successful international experience, and establishment of financing mechanisms.

It is also important to note the constructed Lorenz curve for further analysis based on the calculation of accumulated shares. Figure 3 shows the deviation of the actual distribution from the normative value, which is some evidence of the accumulation of resources and revenues in several EU countries.

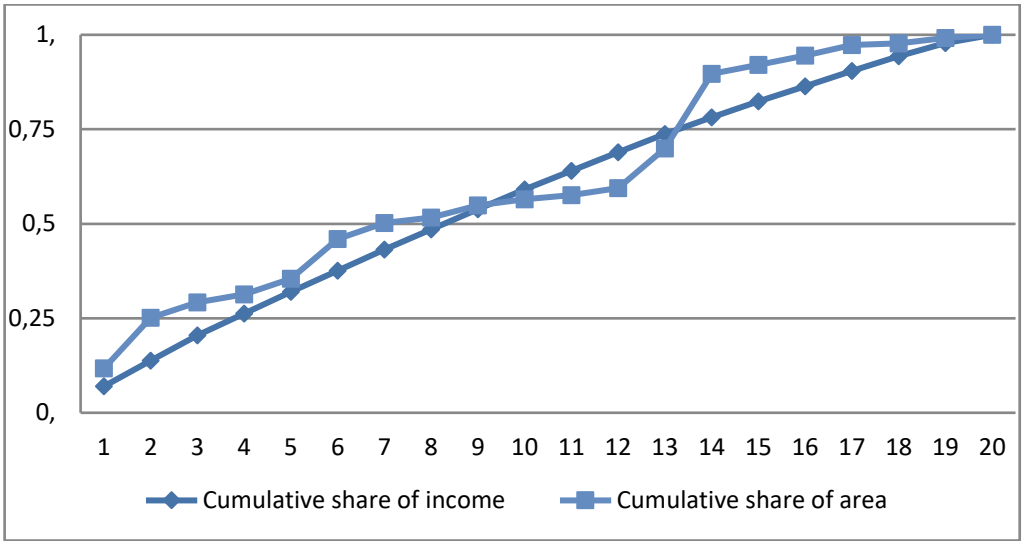

Figure 2. Lorenz curve for analyzing resource allocation in the agricultural sector of the EU region
Source: compiled by the author

Thus, most of the revenues identified from agribusiness go to some EU zones, which constitute a small share of all zones; this creates uneven growth and limits opportunities for lagging rural areas. Thus, the unbalanced provision of resources largely disrupts the development of other regions and contributes to poor socio-economic differences. In the meantime, each country and the EU's main board should develop a defined plan to combat the disparities that arise from the uneven nature of agribusiness growth and introduce entirely new adjustments to help less productive regions in terms of finance and resources. The main indicator of unevenness indicating the preconditions of the new EU agricultural sector is the Gini index:

G=2*0.537812494-1=0.075625=0.08

In the agricultural sector of rural EU regions, achievable Gini coefficient values for the distribution of income and resources range from 0 to 0,3, and if it is equal to 0,08, then resources and income are distributed fairly evenly among agricultural enterprises. This means that, as a matter of public policy, support systems check the balance of the grain business, create opportunities for rural regions of developing countries, and, based on the leading agricultural activities of firms in each country, create conditions for the sustainable development of agricultural areas. The European Union's publicly funded agricultural support system is also a major contributor to the reduction of inequality of conditions for the development of the European community members.

5. Discussion

The theoretical and methodological tools of agribusiness asymmetry developed in the research are an uneven resource distribution, technical and material equipment, and the availability of modern innovative production technologies (Zahorodna et al., 2022; Tyukhtenko et al. 2021). Scientists such as Van der Ploeg et al. (2012), Yu and Wu (2018) emphasize that they do not see any danger in the uneven development of agribusiness, but the so-called "natural unevenness" negatively affects innovation and competitiveness of agribusiness. According to scientific studies, the asymmetry of the EU agricultural sector with a Gini coefficient of approximately 0,08 is also a reflection of natural adverse processes and it is not the root cause of the negative consequences, along with the shrinking domestic agricultural market, rural depopulation and the decline in the quality of life of rural residents in the EU.

EU policy to mitigate asymmetries should be endowed with long-term levers of influence. Its main vectors should be ensuring the sustainability of the agricultural sector in the concept of practical support for stable and fair income of producers, increasing their competitiveness; climate-oriented development, mitigation and adaptation to climate change; upgrading the agricultural sector in the context of innovation, digitalization and knowledge sharing (Beillouin 2022).

Technology should also play an important role in reducing the imbalance in agribusiness development. The innovative technology of precision agriculture involves the identification of reliable field characteristics, the creation of electronic maps, and the use of the GPS system.

Currently, there is no threat of a food crisis in the European Union, however, the agricultural sector is becoming vulnerable to price dynamics and increased economic risks, which requires diversification of import sources and markets through an adequate multi-sectoral trade policy (Tyukhtenko 2017). This is in addition to further formalizing the development of precision agriculture in line with the strategic plans of EU member states for the period 2023-2027 under the Common Agricultural Policy strategic plans, as well as combined assistance to strengthen protein crops (Miriam & Thérèse 2022).

The war in Ukraine has caused numerous disruptions in the supply of agri-food products, which has led to a rapid rise in prices in the European community. In this respect, there is a specific generalization made by Ngoc et al. (2022) that impediments to the global supply chain and it is intensely felt in Germany since it receives energy from Russia via Eastern Europe, which in turn affects the ability to deliver the necessary resources, mainly energy, to rural areas and the country's agriculture. A similar view of the point at which the global supply chain is disrupted is expressed by Cui et al. (2023), who emphasize the challenges following the Russia-Ukraine war, which are related to energy price fluctuations and global energy supplies as well as economic and trade relations and distribution, which in turn affect fuel, electricity, fertilizers, and other essential resources.

According to Ihnatenko O. (2024), these measures may be quite inconsistent due to parallel implementation with the "Farm to Fork" strategy and may slow down the achievement of the "Green Deal" policy goals of transferring a sustainable agricultural sector strategy, which creates additional risks for the European community's food supply.

In other studies, Kaplinsky et al. (2022) and Alekseieva et al. (2023) note that the Russian-Ukrainian war will worsen food security and emissions problems. Improving the current situation with the problems of Europe's agricultural sector implies a transition to building a low-carbon sector, which involves reducing greenhouse gas emissions and increasing resource efficiency, including reducing the use of synthetic fertilizers, which are the main source of the carbon footprint in agriculture in all the above-mentioned member states.

6. Conclusions

Unbalanced growth of agribusiness is a process that is carried out within the framework of uneven distribution of agricultural enterprises of different sizes and geographical conditions in terms of their financial and human resources, quality of production conditions and the possibility of introducing new technologies into the production process, on the one hand, and socio-economic development of rural areas, on the other hand. The main problems are the depopulation of the rural population, unemployment of farmers, a decrease in the level of regional sectoral development.

The imbalance of this indicator among the EU member states has revealed the existence of significant heterogeneity in terms of income and material resources of agricultural enterprises in rural regions of Europe (G=0.8). Thus, the practice of the European Union proves that relatively equal productivity and competitiveness of agribusinesses can be achieved only with a balanced state policy to promote the rural sector and a well-functioning system of support for enterprises in weakened regions. The paradigm of modernizing the policy of balanced development of the agricultural sector in the concept of ensuring sustainable strategic development of the industry is seen in ensuring support for stable and fair income of producers, increasing their competitiveness; climate-oriented agriculture in the context of mitigation and adaptation to climate change; modernization of the agricultural sector in the direction of development of processing, innovation, digitalization and knowledge sharing. This approach, along with targeted investments and economic incentives, can guarantee a reduction in the asymmetry of agricultural production not only in the context of the countries of the European region, but also on a global scale.

An adaptive development strategy that can anticipate and adequately address external environmental risks in times of challenges such as the onset of the COVID-19 pandemic and Russia's large-scale invasion of Ukraine can be a harbinger of socioeconomic well-being for the rural population. Ukraine is the number one exporter of grain to Europe. Ultimately, however, these challenges have led to an increase in production costs and put additional pressure on agricultural producers as EU member states have become critical about environmental sustainability.

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