

THE ROLE OF UNEVEN AGRICULTURAL BUSINESS GROWTH IN SHAPING THE SOCIO-ECONOMIC LANDSCAPE OF RURAL REGIONS

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Abstract: The role of the agricultural sector in ensuring food security and the economic development of countries during the post-pandemic period and the spread of the consequences of the Russia-Ukraine war on global markets is crucial for maintaining food security, supporting domestic demand for agricultural products and ensuring a country's economic resilience. Therefore, the asymmetric development of the agricultural business is relevant, given the need to prevent its potential adverse effects on the overall socio-economic condition of rural areas. This scientific article aims to form the conceptual-categorical framework for the asymmetric development of the agricultural business and to study the current state and prospects for developing rural areas in the EU. Literature analysis, comparative analysis, and methods of systematisation and generalisation were among the general scientific methods of cognition used to form the conceptual-categorical framework and substantiate the problem of asymmetric agricultural business development. During the research, statistical data analysis was used to define the initial data for calculating the cumulative shares of income and the area of agricultural land, forming the Lorenz curve and further calculating the Gini coefficient. Based on the calculation of the Gini Index, the overall level of asymmetry in the development of the agricultural sector of European countries was determined. The obtained value of this index, $G = 0.8$, which lies within the range $0 \leq G < 0.3$, indicates a high level of socio-economic equality in the rural areas of EU member states, despite the potential food crisis and disruptions to sales markets due to external damaging factors. The concept of asymmetric development of the agricultural business is characterised by the uneven distribution of critical resources for the production of agricultural products between enterprises that differ in scale or the level of development in their regions of operation. A high level of asymmetry leads to the spread of negative phenomena in the socio-economic environment of rural areas, such as depopulation, unemployment, and a decline in the quality of regional infrastructure. To prevent excessive asymmetry, EU countries are implementing systematic measures to financially support specific agricultural enterprises and improve infrastructure, particularly logistics, in rural areas, which is reflected in the low level of inequality between rural areas in different regions and EU member states.

Keywords: Agricultural business, rural areas, uneven regional development, agriculture, production, productivity, competitiveness..

1 Introduction

Rural areas within the European Union (EU) cover over 83 % of the territory and are home to 137 million people, or 30 % of the EU population (European Commission, 2024). In contrast, rural areas in the United States are somewhat larger, covering approximately 97 % of the total territory, but they are home to only 19.3 % of the total US population (Ratcliffe et al., 2016). In this context, rural areas' unique economic, social, and cultural characteristics make their development a priority to ensure the country's overall economic growth. The main feature of rural areas is their affiliation with the agricultural sector, which serves as the primary source of income for most rural households (Davis et al., 2010). However, the efficiency of entities in this sector is often characterised by asymmetry, which creates imbalances in opportunities for economic growth and the population's well-being in different regions. An excessive level of asymmetry primarily results in income inequality, disparities in access to services, and the overall standard of living across regions. It also affects the development potential of local businesses, which in most cases focus on agriculture, thus having severe implications for both large agricultural enterprises and small farming households (Zahorodna et al., 2021).

This scientific article aims to develop the concept of asymmetry in the context of agricultural business development and to substantiate the impact of such unevenness on the socio-economic condition of rural areas. The article aims to examine the level of asymmetry in the European economy's agricultural

sector by determining the optimal methodological basis for calculating the "asymmetry index" (Gini coefficient). Based on the conducted analysis, conclusions are drawn regarding the problems of rural development in the EU and the prospects for reducing the level of asymmetry in the future.

2 Literature review

Although the issue of asymmetry in the development of the agricultural business covers a wide range of approaches to studying economic inequality in the agricultural sector, there is currently no clear definition (Tyukhtenko et al., 2021). To form the theoretical basis of this research, the problem of asymmetry in modern scientific works and the factors influencing the development of agriculture were analysed. In this context, Scoones et al. (2016) point out that the uneven development of the agricultural business is due to varying levels of access to financial resources, infrastructure, and modern technologies. A similar view is expressed by Kaplinsky and Kraemer-Mbula (2022), noting that countries with low and middle incomes are at the highest risk of increased asymmetry due to barriers to knowledge creation and technological development and the need for constant implementation of systemic changes. Additionally, Okunlola and Ayetigbo (2024) argue that a significant factor in the asymmetry of agricultural businesses is investment disparities, which are concentrated in a few economically developed regions, affecting the socio-economic growth of less funded rural areas.

In contrast, the socio-economic differentiation of agricultural sector entities of various scales was substantiated in the works of Poulton et al. (2010), Hassan et al. (2021), Steensland (2021), Urugo et al. (2024) and Mironova et al. (2022), where the main focus is on the more significant opportunities for large agribusinesses and agricultural enterprises to integrate innovative technologies, quality material and technical support, and new markets, increasing their competitiveness compared to smaller farms. Besides resource and financial provision, geographic and environmental factors influence this asymmetry. For example, Sgroi et al. (2022) note that climatic conditions, soil quality, and water resources cause variations in the productivity of agro-industrial enterprises, as well as specific resources such as production technologies, types, and varieties, and general resources shared by the region such as landscape, environment, and culture. The authors also highlight the necessity of avoiding asymmetry in access to information and the role of reputation in forming the competitiveness of agricultural businesses.

A moderate level of asymmetry in the development of agricultural businesses does not necessitate implementing large-scale state policies to prevent it. According to Van der Ploeg (2012), Yu and Wu (2018), natural asymmetry is a factor that encourages enterprises to seek innovative solutions and increase business competitiveness at the national or global agricultural market level.

The critical aspects of the growth of asymmetry in the agricultural business, according to Mazur (2017), are, first and foremost, poor infrastructure for the development of rural areas, as well as the problem of rural depopulation, increasing unemployment, and decreasing levels of service for rural populations. In turn, Holden and Binswanger (1998) emphasise the importance of political decisions regarding the support of agricultural enterprises, as excessive taxation can worsen poverty and cash liquidity in the agricultural sector of the economy. Therefore, in countries with significant asymmetry, it becomes necessary to create and implement agricultural subsidies and state support for less developed rural areas (Ciaian et al., 2021).

Another factor noted in the work of Kaplinsky and Kraemer-Mbula (2022) is the lack of access to modern technologies in less-developed rural regions. Furthermore, Steensland (2021) points out the parallel issue of uneven access to markets, with regions with better logistical

infrastructure having a significant advantage over other agricultural enterprises. It should also be noted that the impact of excessive asymmetry in the development of the country's agricultural sector mainly manifests in levels of food security (Yatsenko et al., 2019), the reproduction of rural populations and areas (Pronko, 2022), the provision of material and labour resources for the agricultural industry (Ullah et al., 2020), attracting investments and new production technologies (Zgalat-Lozynska et al., 2023), preserving the socio-cultural characteristics of rural areas (Włodarczyk-Marciniak et al., 2020), and maintaining environmental balance in agricultural regions (Sgroi et al., 2022; Kovalko et al., 2022).

Thus, the concept of asymmetry in the development of the agricultural business, which correlates with the condition of rural areas, involves the heterogeneity of economic indicators of agricultural enterprises across different regions and the uneven distribution of critical resources (financial, infrastructural, technological, material and technical). Primarily, such asymmetry is a consequence of disparities in agribusiness access to markets for their products, state support in the form of grants and subsidies, and the use of information and modern technological solutions, which affects the productivity and competitiveness of the agricultural sector. In addition to pressing issues of financing and infrastructure, asymmetry also negatively affects the socio-economic conditions for rural development, leading to depopulation, unemployment, reduced service levels for rural populations, and exacerbating environmental issues. The concept of asymmetry in agricultural business development entails negative consequences, necessitating its minimisation through systematic state measures and local decisions to support specific agricultural enterprises to ensure the balanced development of the agricultural sector.

3 Methods

The following methods were employed in the course of the research:

- analysis of literary sources was used to form the conceptual-categorical framework of asymmetry in the development of the agricultural business;
- comparative analysis was applied to analyse the changes in agricultural production volumes across macro-regions;

- systematisation method was employed to determine the indicators of the agricultural sector development in EU member states;
- statistical data analysis was used to identify and analyse absolute income indices in agriculture and agricultural land areas in EU member states;
- generalisation method was used to determine the primary socio-economic outcomes of the current European Union policy on agricultural business support.

The study of the asymmetry level in the development of the agricultural business is based on official statistical data from Eurostat (2024) on the actual income index of agricultural enterprises and OECD (2023) on the area of agricultural land in EU member states. Countries for the analysis were selected using random sampling to ensure the results' representativeness. Based on previously developed methodological recommendations, cumulative shares of initial values were calculated, upon which the Lorenz curve was constructed, and the overall indicator of inequality in the development of the agricultural sector was determined (Gini coefficient = 0.08). As a result of the analysis, the main issues of current EU policy and prospects for further socio-economic development of rural areas within its member states were identified.

4 Research results

4.1 Substantiation of the problem of asymmetric development of agricultural business

An essential prerequisite for substantiating the problem of asymmetric agricultural business development in the global economic environment is the climatic conditions, which are a variable phenomenon due to the emergence of new weather phenomena. In recent years, the issue of global warming, which in many macro-regions is accompanied by the El Niño weather phenomenon, has had a destructive impact on crop yields in the Latin American and Asia-Pacific regions due to excessive rainfall, while European countries are also losing capacity due to changing drought conditions (Rossato et al., 2024). These trends in the global agricultural market are reflected in the statistical data shown in Figure 1.

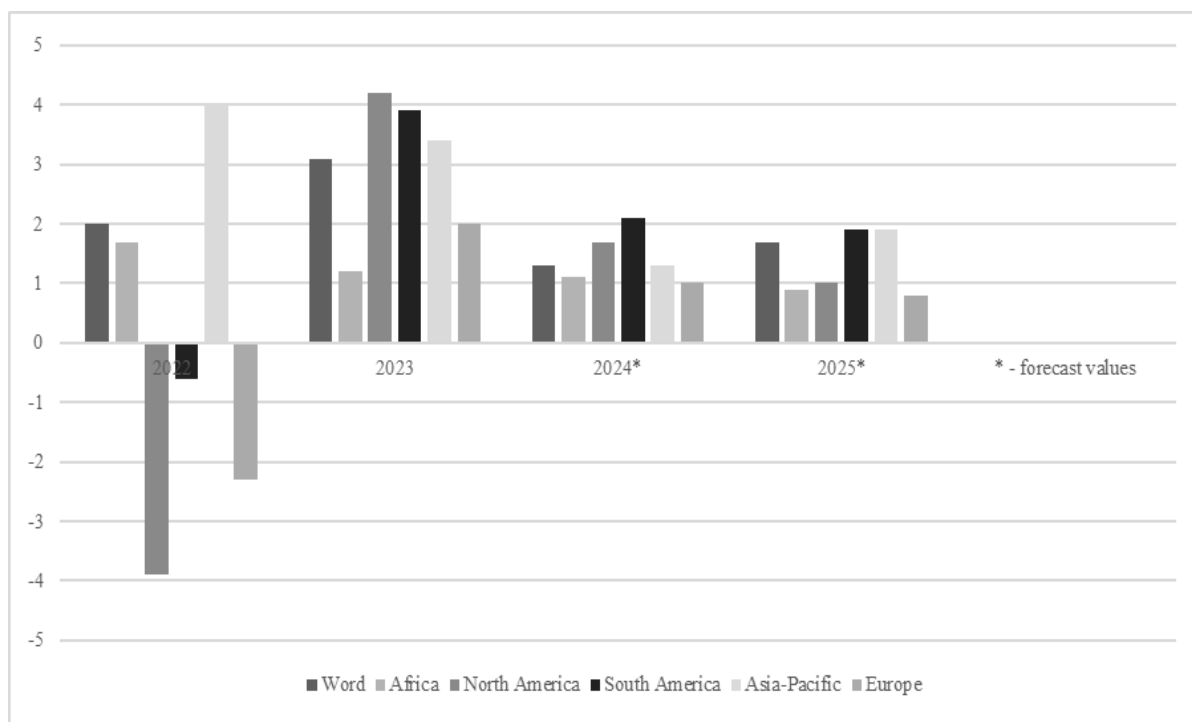


Figure 1: Percentage Change in Agricultural Production by Region in 2022-2025
Source: (Rossato et al., 2024)

Among other factors contributing to the increase in asymmetry in the agricultural sector of the economy, the varying access to financial, material, and human resources should be noted. This situation can arise due to large agribusinesses' monopolisation of the market. At the same time, small farming enterprises have limited land plots, which slows down their ability to scale their business. In this context, there is a need to improve national government policies in countries where the asymmetry between the development of urban and rural areas is growing and to create a support mechanism for agriculture to enhance the overall socio-economic condition of rural areas. Considering the current challenges, including the asymmetric development of the agricultural sector, it is essential to focus on the development and implementation of effective and targeted rural development policies aimed at supporting the economic activities of rural households, emphasising their impact on the socio-economic indicators of the country.

4. 2 Procedure for calculating the level of asymmetry in the development of the agricultural sector of the European Union

The calculation procedure for the level of asymmetry is based on the analysis of critical indicators of the development of the agricultural sector of the European Union (EU), which includes the absolute income indices in agriculture of different member states of the Union and the area of their agricultural lands (Tyukhtenko, 2017). Based on these indicators, to assess the degree of inequality in the development of the intra-European agricultural sector, it is necessary to calculate the Gini Index, which involves calculating the cumulative shares of total income and agricultural land area. The initial data for further calculations are presented in Figure 2.

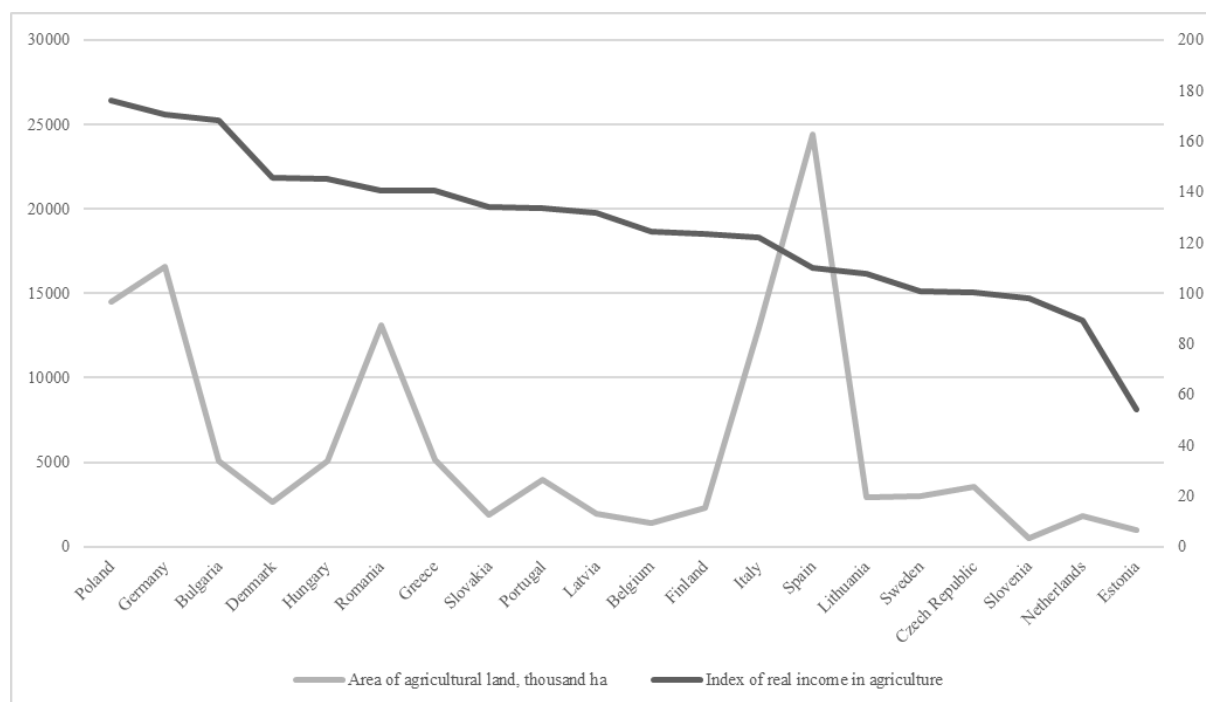


Figure 2: Indicators of Agricultural Sector Development in Selected EU Countries in 2023
Source: Compiled by the author based on (Eurostat, 2024; OESD, 2023)

The first step in determining the level of asymmetry in the development of the agricultural sector is to calculate the share of real income and the area of agricultural land for each of the selected European Union countries. The formula for calculating the share of real income and the area of agricultural land is as follows:

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

where x_i is the value of i of the i -th unit;

$\sum_{j=1}^n X_j$ is the total number of units in the data set.

Based on the calculation of shares, conclusions can be drawn regarding the proportion of real income and agricultural land area distribution among the selected EU countries. This formula allows for an assessment of the degree of inequality between the development of the agricultural sector in different countries. It identifies those with the most effective strategies for using agricultural resources. However, the obtained values do not provide a final understanding of the level of asymmetry. Therefore, the next step in the analysis is the calculation of cumulative shares of real income and agricultural land area, which is calculated 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 cumulative share of the indicator;
 CS_{i-1} is the cumulative share of the indicator for the previous ($i-1$) line;

I_i is the indicator for the i -th line;

$\sum I$ is the total sum of the indicator values.

The obtained cumulative shares are used to construct the Lorenz curve, which is the primary tool for the further calculation of the Gini Index, allowing for the assessment of the degree of inequality in the development of the agricultural sector (Omelchuk et al., 2022). The next step in analysing the European agricultural sector is the calculation of the Gini Index, which is a measure of inequality in the distribution of some value, taking a value between 0 and 1, where 0 indicates absolute equality (the value takes only one value), and 1 indicates complete inequality. The formula for calculating the Gini Index is as follows:

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

where G is the Gini coefficient;

A is the area between the line of equality (45° diagonal) and the Lorenz curve;

B is the area under the Lorenz curve.

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

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

where x_i and y_i is the value of the cumulative share of income and area for the i - the point;

x_{i+1} and y_{i+1} is the value for the $(i+1)$ point.

Thus, based on the results of the Gini Index calculation, the level of asymmetry in the development of the agricultural sector of European countries is determined. A value of this index within the range of $0 \leq G < 0.3$ indicates a high level of social and economic equality; the range of $0.3 \leq G < 0.6$ points to significant inequality in the distribution of resources between the development of agricultural enterprises in different regions; a high degree of asymmetry is defined by an index value within the range of $0.6 \leq G \leq 1$, which may further impact the social and economic levels of the country. This indicator allows for assessing the evenness of resource distribution and the effectiveness of addressing issues related to rural development and agricultural business. A low index value indicates stability and balance in the agricultural sector. In contrast, its sharp increase or consistently high value suggests the need to improve

the region's economic policies and agricultural development strategies.

4. 3 The results of calculating the level of asymmetry in the development of the agricultural sector of the European Union

First, the income and agricultural land area shares for the European Union (EU) countries were calculated. The results of the calculations, presented in Table 1, show a small degree of asymmetry in the development of the agricultural sector. It should be noted that the ratio between the absolute agricultural income index and the area of agricultural land is uneven, meaning there are specific differences in productivity and resource efficiency among EU member states. Moreover, many countries exhibit an imbalance between income and land area share, where some countries with large land areas have relatively low incomes, indicating the insufficient efficiency of their agricultural sector. At the same time, countries with smaller land area shares may show higher income shares, which suggests their ability to achieve higher productivity. The results of the initial analysis highlight the presence of significant structural differences in the development of the agricultural sector among EU countries. Therefore, some regions require comprehensive measures to reduce such asymmetry and ensure the balanced development of the agricultural business.

Table 1: Calculation of Gini Index indicators.

Initial data			Share of income	Share of area	Cumulative share of income	Cumulative area share	The area under the Lorenz curve
Country	Index of real income in agriculture	Area of agricultural land, thousand ha					
Poland	176,18	14521,86	0,070005	0,11745	0,070005	0,11745	0,004111
Germany	170,41	16591,5	0,067712	0,134189	0,137717	0,251639	0,012496
Bulgaria	168,17	5046,6	0,066822	0,040816	0,204539	0,292455	0,018179
Denmark	145,8	2618,4	0,057933	0,021177	0,262472	0,313632	0,017556
Hungary	145,34	5049,01	0,05775	0,040835	0,320222	0,354468	0,019292
Romania	140,71	13078,88	0,055911	0,10578	0,376133	0,460247	0,022776
Greece	140,64	5137,04	0,055883	0,041547	0,432016	0,501795	0,026881
Slovakia	134,26	1856,13	0,053348	0,015012	0,485364	0,516807	0,02717
Portugal	133,67	3980,49	0,053113	0,032193	0,538477	0,549	0,028304
Latvia	131,64	1970,1	0,052307	0,015934	0,590784	0,564934	0,029133
Belgium	124,37	1368,31	0,049418	0,011067	0,640202	0,576001	0,028191
Finland	123,44	2268	0,049049	0,018343	0,689251	0,594344	0,028702
Italy	121,86	12987,42	0,048421	0,10504	0,737671	0,699384	0,031322
Spain	109,91	24420,4	0,043672	0,197508	0,781344	0,896892	0,034857
Lithuania	107,94	2937,81	0,04289	0,02376	0,824233	0,920652	0,038977
Sweden	100,71	3002,91	0,040017	0,024287	0,86425	0,944939	0,037328
Czech Republic	100,21	3529,8	0,039818	0,028548	0,904068	0,973488	0,038194
Slovenia	98,07	479,49	0,038968	0,003878	0,943036	0,977366	0,03801
Netherlands	89,39	1811,91	0,035519	0,014654	0,978555	0,99202	0,034975
Estonia	53,97	986,67	0,021445	0,00798	1	1	0,021359
Total	2516,69	123642,7	x	x	x	x	0,537812

Source: Compiled by the author.

The trend toward growing inequality between rural regions is also reflected in the cumulative shares obtained, mainly due to the concentration of resources and income in a few key regions. The proportional increase in the share of total income and resources concentrated in a few regions, such as Poland, Germany, and Bulgaria, may indicate a high degree of asymmetry between different EU member states. However, based on the calculated cumulative shares, it is necessary to construct a Lorenz curve for further analysis. It visually represents the asymmetry in the distribution of income and resources between different regions. The chart in Figure 3 demonstrates the deviation of the actual distribution from the normative value, highlighting the concentration of income and resources in several EU countries.

Thus, a significant portion of agricultural business income is concentrated in specific regions of the EU, representing a small

fraction of the total number of regions, leading to an imbalance in development and limiting opportunities for less-developed rural areas. In turn, the uneven distribution of resources mainly affects the overall level of rural development and creates negative socio-economic trends between regions. In this case, each country, and the EU's overall policy, requires the development and implementation of a targeted strategy to address the disparities that have arisen due to the asymmetric development of the agricultural business and to create fundamentally new solutions for financial support and resource provision for less productive regions. The overall asymmetry indicator confirms the needs of the modern EU agricultural sector, specifically the Gini Index, which was obtained through the following calculations:

$$G = 2 * 0,537812494 - 1 = 0,075625 = 0,8$$

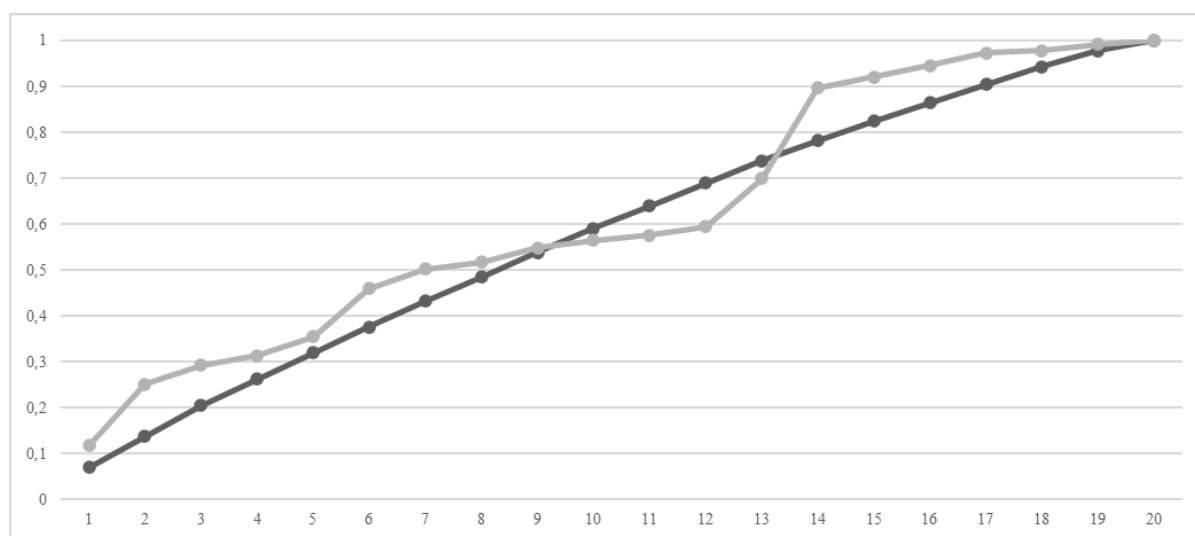


Figure 3: Lorenz Curve for Analysing Resource Allocation in the Agricultural Sector

Source: Compiled by the author.

Given that the Gini coefficient value falls between 0 and 0.3 and is 0.08, the distribution of income and resources among agricultural enterprises in rural areas is relatively even. Therefore, in the agricultural sector of rural regions in the EU, there is no total concentration of resources in one enterprise or area, indicating that sufficient opportunities are provided for developing rural regions and the primary agricultural activities of enterprises in each country. In EU countries, due to balanced government policies and agricultural business support systems, a foundation for the stable development of the agricultural sector has been created, reducing the risks of social and economic inequality across all member states of the union.

5 Discussion

The conceptual-categorical framework of agricultural business asymmetry developed in the article involves the uneven distribution of financial and labour resources, infrastructure, material and technical support, and access to new production technologies. However, Van der Ploeg (2012), Yu and Wu (2018) dispute the harmful nature of agricultural business asymmetry, considering that natural unevenness can stimulate innovation and competitiveness in agricultural enterprises. According to the research conducted, the agricultural sector's asymmetry in Europe, with a Gini coefficient of 0.08, may be a natural phenomenon that does not lead to negative consequences for the well-being of rural areas, or it may be the start of a global crisis accompanied by the decline of domestic agricultural production, depopulation of rural regions, and the loss of a high standard of living for the rural population in EU countries.

Currently, the agricultural sector of European countries has been significantly affected by the start of the full-scale Russian invasion of Ukraine, as Ukraine is one of the largest suppliers of grain and agricultural raw materials to EU countries. Despite Ukrainian programs supporting agriculture during the war, such as compensation for equipment destroyed by missile strikes and micro-grants for new agricultural businesses (Alekseieva et al., 2023), and joint programs with EU member states, supply disruptions of grains and related products have caused a sharp rise in prices and increased costs for domestic production in European countries (Allam et al., 2022). This is especially notable given that Ukraine accounts for almost a quarter of the world's sunflower oil exports. In this context, Ngoc et al. (2022) point out that the bottleneck in the global supply chain is particularly felt in Germany, which is heavily dependent on energy supplies from Russia via Eastern Europe, affecting the ability to supply rural areas and the country's agro-industrial complex with necessary resources, particularly energy. A similar view on the disruption of the global supply chain is noted by Cui et al. (2023), who highlight the problematic nature of the ongoing Russia-Ukraine war in terms of energy price

fluctuations and disruptions in global energy supply and economic and trade orders, which also affect fuel, electricity, fertiliser, and other essential resource prices.

Meanwhile, Carriquiry et al. (2022) found that the Russia-Ukraine war could exacerbate food security issues and carbon emissions. To address the current problems of Europe's agricultural sector, Kovalko et al. (2022) emphasise the need to transition to low-carbon development, which would help reduce greenhouse gas emissions and increase resource use efficiency. Such a transition would also allow EU member states to reduce their dependence on synthetic fertilisers, agriculture's primary carbon footprint source (Zahorodna et al., 2022).

Although there is currently no threat to food availability in the EU, domestic agricultural producers are vulnerable to high prices for fertilisers and energy resources, which increases production costs and economic risks for producers. In this context, the resilience of European agribusiness requires diversification of import sources and markets through reliable multilateral and bilateral trade policies. EU measures to prevent a food crisis include reducing synthetic fertilisers, increasing nitrogen use efficiency, and switching to "green" ammonia for fertiliser application as part of the Horizon Europe project. Also, within the strategic plans of the Common Agricultural Policy (CAP) for 2023-2027, EU member states are enhancing the development of precision farming and joint support to increase the production of protein crops (Miriam & Thérèse, 2022). However, Ihnatenko (2024) notes the inconsistency of these measures in the context of the parallel implementation of the Farm to Fork strategy, as well as the possible slowdown in achieving the goals of green policy and the transition to sustainable agricultural production methods, which, in turn, creates additional risks for the quality and safety of food in the EU.

6 Conclusion

The asymmetric development of the agricultural business is a phenomenon accompanied by the uneven distribution of financial and labour resources, infrastructure support, high-quality production facilities, and opportunities for integrating innovations into production processes among agricultural enterprises of different scales or territorial affiliations. It affects the socio-economic development of rural areas through issues such as rural depopulation, unemployment among the rural population, a decline in regional infrastructure services, and a reduction in the environmental attractiveness of rural areas. Based on the research on the degree of asymmetry in the development of the agricultural sector in EU member states, a sufficient evenness in the distribution of income and critical resources among agricultural enterprises located in rural areas of Europe was identified ($G = 0.8$). Thus, the EU's experience confirms the possibility of achieving a relatively equal level of

productivity and competitiveness among agro-industrial entities through balanced government policies in rural development support and systematic assistance to enterprises in less developed regions.

A critical factor in maintaining rural areas' socio-economic stability is a flexible development strategy that allows for effective forecasting and mitigation of external environmental risks amid challenges such as the COVID-19 pandemic and the full-scale invasion of Ukraine by the Russian Federation. Ukraine is the largest grain exporter to Europe. These challenges have disrupted supply chains, increased production costs, put more pressure on domestic producers, and raised concerns about the environmental sustainability of production in EU member states.

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