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DO FARMS LOCATED IN LESS FAVOURED AREAS DEAL WITH WORSE INCOME SITUATION? EMPIRICAL EVIDENCE FROM POLAND

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ABSTRACT: Environmental determinants may increase or decrease the income potential of farms, therefore, research on the income situation of farms located in areas with diversified natural farming conditions may be justified. The main aim of the article was to identify differences in the income situation, as well as to assess income inequalities between farms located in less favoured areas (LFA) and other entities (non-LFA). Changes in the scale of inequality in the years 2014-2021 in farms located in LFA areas can be divided into three main phases: a decline until 2017, a sharp increase in 2018 and another decline from 2019. Income inequality on LFA farms measured by the Gini coefficient in 2014-2021 decreased by 5.5%, while on non-LFA farms by 5.3%. This implies the need for in-depth monitoring of the economic and financial situation of farms located in LFA. An in-depth assessment of income inequalities for individual types of LFA may be important, including from the point of view of shaping new tools in the context of updating the CAP, which emphasises the imperative of improving the resilience of farms.

KEYWORDS: LFA, farm income, income inequalities, natural constraints, CAP

Introduction

The issue of farm income is one of the most important categories of reality analysis in the social sciences, especially economic sciences, and a point of reference for normative judgements. The phenomenon of economic stratification of the agricultural sector is deepening, and this is related to the widening of the income gap between the highest and lowest earning farmers (Czyżewski et al., 2020). Income inequalities are evident not only between farms of different scale and farm economic strength, but also between different types of farms (Kata, 2020). In this context, and in view of the increasing environmental pressure to maintain sustainability in agriculture, research on the measurement of the income situation of farms differentiated by farming conditions may be relevant. Environmental conditions that may increase or decrease the income potential of farms appear to be particularly important, and hence research on the income situation of farms located in areas with differentiated natural farming conditions may be justified.

The European Union's "Less Favoured Areas" (LFA) idea is important since it acknowledges the particular difficulties that some regions confront in the agricultural sector. LFA are regions with challenging production conditions because of a variety of environmental and socioeconomic issues. As Dax (2005) underlined, in order to protect the farming community in certain regions, prevent land abandonment, and preserve cultural landscapes, the LFA policy was initially intended to be a structural measure. The instrument shows a strong coincidence with High Nature Value (HNV) farming systems because it was among the first to address ecologically beneficial farming systems. The high environmental, economic and social importance of LFA provides the basis for financial support to farmers whose farms are located in these areas. The LFA payment, implemented on the basis of Article 31 of the European Parliament and of the Council (EU) No 1305/2013, is intended to make it easier for "farmers to continue agricultural use of the land and to enable the countryside to retain its scenic value and to maintain and promote sustainable farming systems in these areas. As a result, this support will influence the maintenance of the vitality of rural areas and the preservation of biodiversity" (Regulation, 2020). Taking into account the environmental classification of LFAs, 3 types of payments were distinguished (Ministerstwo Rolnictwa i Rozwoju Wsi, 2022).

The primary objective of the article is to identify differences in the income situation, as well as to assess income inequalities between farms located in less favoured areas (LFA) and the rest: (Non-LFA). The following research hypotheses were adopted to achieve the objective:

- *H1: LFA farms are characterised by lower levels of total income than Non-LFA.*
- *H2: Income inequalities in LFA farms are higher than in the rest of the group.*

Data from the Farm Accountancy Data Network (FADN) agricultural accounting system were used to empirically investigate the variation in family farm income between farms in less favoured areas (LFA) and rest (non-LFA). Data on total agricultural production, Utilised Agricultural Area (UAA), farm debt and family farm income were used for the calculations. The time span of the study was 2014-2021. The study used a critical literature review and statistical analysis based on the Gini and Theil index.

This paper contributes to the literature on assessing the income situation of LFA farms in terms of income inequality. It can also provide important information for policymakers to understand how to shape agricultural policy for farms in LFA. This paper significantly contributes to the empirical literature on agricultural economics at the micro level (farm economics). The issue of farms that deal with environmental constraints is still a heated debate in agricultural policies, including the changing CAP. We propose empirical evidence based on a sample of FADN farm households. Our article may extend the scope of economic and financial analysis of LFA farms, which play a significant role in Polish agriculture. Furthermore, at the sectoral level, identifying income inequalities for farm households may be important to designing development paths.

There is a perceived research niche concerning the relationship between income inequality and farming conditions. To our knowledge, our research is one of the first studies of its kind in Central and Eastern Europe on agricultural income inequality between farms in LFA and those in ordinary farming conditions. The paper therefore fills a gap in the area of studying differences in income inequalities between LFA and non-LFA farms, thereby also having not only cognitive, but above all, practical significance.

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Section 1 of this article briefly presents the literature review focused on the income inequalities in agriculture, also in relation to the role of less favoured areas. Section 2 describes FADN data and the research methodology in our paper. Then, Section 4 and 5 present our empirical findings and discuss the results. Our article concludes with final remarks and recommendations.

An overview of the literature

The economic, social and environmental role of less-favoured areas

Agriculture provides many important private and public goods (economic, environmental, socio-cultural), hence it is recognised as an important sector for society as a whole. Viewed through the prism of the implementation of the strategic development objectives of farms, the natural environment plays an important role in shaping agricultural production, which not only depends on environmental conditions but is primarily achieved through the use of natural resources. These resources, together with human and economic capital, form the basis for achieving the primary objectives of the farm, which is their sustainable development, which is achieved through the income generated on the farm. Hence, environmental factors, which significantly influence the economic performance of farms, cannot be ignored in research on farm profitability. This is particularly important because, if we look at agriculture from a broader perspective, it turns out that it is one of the main sectors responsible for the degradation of the natural environment (Rendon et al., 2022; Panagos et al., 2016), which, from the perspective of sustainable development, is in conflict with the pursuit of overarching management goals. Hence, all kinds of measures aimed at protecting natural resources and preserving the natural environment in a good state are a prerequisite for sustaining the well-being of society in the long term. In this area, as Zieliński (2023) notes, the activities of institutions supporting agriculture in efforts to protect the natural environment, including in areas with natural or other specific limitations (LFAs), may be important. Dax (2005) synthetically presented EU regulations and national priorities related to less favoured areas. It should be noted that support to farms located on LFAs may be explained by a set of various factors, in particular related to the land management system (Table 1).

Table 1. Less favoured areas from perspective of EU regulations and national priorities

EU regulations	National priorities
• Maintenance of agricultural land use and the associated rural community through the development of the rural environment; • Contribution to the settlement and land use management systems under difficult production conditions; and • Remuneration of the public goods produced by farms in less-favoured areas.	• the general objective of maintaining farming in the LFAs, thereby combating land abandonment trends and marginalisation trends; • compensating income differences between LFA & non-LFA agricultural production; • maintaining population density in areas threatened by a population decline; – preserving rural livelihoods; • constituting an element of income support; and • contributing to specific functions provided by farming in LFA, e.g. for other sectors, like tourism, environmental performance, like biodiversity and impact on landscape characteristics, like in the arctic space.

Source: authors' work based on Dax (2005).

In Polish conditions, the following types of less favoured areas are distinguished from 2019:

- mountain areas – are those where agricultural production is hampered by unfavourable climatic and terrain conditions. Mountain areas include municipalities where more than half of the agricultural land is above 500 m above sea level;
- lowland areas – areas where there are limitations to agricultural productivity associated with poor soil quality, unfavourable climatic conditions, unfavourable water conditions, unfavourable relief, low population density and a high proportion of the population associated with agriculture;

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- areas with specific natural handicaps – include municipalities and geodesic districts of foothill regions where at least 50% of the total area is above 350 metres above sea level and which meet at least two of the following criteria:
  a) the average farm size is less than 7.5 ha,
  b) there are soils at risk of water erosion,
  c) agricultural activity has been discontinued on at least 25 % of the total number of farms,
  d) the share of permanent grassland in the agricultural area structure is higher than 40% (Regulation, 2020).

Until 2018, lowland areas (lowland area I and II) were an issue, as well as the lack of distinction of areas with high natural values that contribute to the preservation of landscape and environmental biodiversity, favouring agricultural sustainability. This division was dictated by the characteristics of the LFA categories in terms of natural and socio-economic features. This resulted in LFAs containing areas whose conditions allowed relatively stable agricultural production that did not require support. Unfortunately, the area of farms covered by LFAs was considerable and did not allow for distinguishing farms in lowland zones I and II. In view of such a large area qualified for LFAs, it would be necessary to narrow down the number of persons eligible for aid by setting boundary conditions defining both the production system and the location of holdings within protected areas. Then, with a reduced number of beneficiaries of the programme, the payment per hectare could be multiplied by applying the maximum rates set out in the EU Council Directive. The effect of a change in the way of allocating support under LFAs would be the achievement of the objectives of the programme, i.e. the preservation of the landscape and an increase in environmental biodiversity. The extent of areas classified as LFAs should be more in line with achieving environmental objectives, preserving the landscape and promoting traditional, environmentally sustainable agriculture.

In 2019, newly designated LFA areas were adopted, according to criteria set by the European Commission (EC). The changes mainly concerned areas with natural constraints, i.e. the so-called lowland-type LFAs (Zone I and Zone II). As a result, new LFA zones were delimited in our country in the lowlands: LFA with natural constraints I and II (representing 28.5 and 18.5% of Poland's arable land, respectively) and additionally, an LFA specific type zone I characterised by high natural value (7.0% of Poland's arable land). It should also be added that, as part of the work on the new delimitation of LFAs, the LFA specific type zone II was also updated, mainly covering foothill areas (3.0% of the UAA in Poland) and the LFA mountain type zone (1.7% of the UAA in Poland) (Pastusiak et al., 2021).

According to FADN data, Less Favoured Areas (LFAs) currently account for approximately 59% in Poland. If we take a closer look at the definition, these are areas with a relatively low (in relation to the whole region or country) development potential for agricultural and non-agricultural activity due to the shortage of basic resources: natural, social, technical and institutional as well as economic underdevelopment. Despite these limitations, the importance of these areas from the point of view of environmental, ecological, as economic aspects is indisputable. Scientific research and economic practice unequivocally show that land not used for agricultural purposes goes wild, which is expressed, among other things, in a narrowing of biodiversity and environmental degradation in ecosystems (Baldock et al., 1996; Riedel et al., 2007). Such a situation translates into limited production possibilities and thus results in lower incomes for the agricultural population and their departure from agriculture to other non-agricultural activities, often far from their place of residence. This is also confirmed by Sobiecki (2007), who notes that as a result of these processes, unfavourable phenomena may occur in mono-functional areas or areas with a dominant agricultural economic function, e.g. depopulation of areas and their impoverishment and degradation of the natural environment, landscape, disappearance of tradition and cultural identity.

There is a belief in the economic and agricultural literature that the ability of agriculture to generate a surplus depends to a large extent on the natural farming conditions possessed and the characteristics of the surrounding landscape. This is confirmed by the research of Terluin et al. (1995), who show that as the natural conditions of the regional economy improve, the differences in agricultural income between LFAs and other areas widen, to the disadvantage of LFA farms. Similar conclusions were reached by Henshall Momsen (1996), who noted that as California agriculture became increasingly efficient and productive, upland farms in the Sierra Nevada became relatively more marginal.

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Therefore, if we look at the environment from a broader perspective, it is undoubtedly a public good, and the increasing threats to it necessitate its reasonable management. Hence, as Czyżewski and Kułyk (2011) note, farms as entities benefiting from the environment should not only provide high-quality agricultural products but, above all, should be responsible for providing society with public goods. Hence, there is a need to support LFA in public policies designed to assist the development of these areas, which by definition are a reservoir for farm development. This is also emphasised by Zieliński (2023), who, based on a review of the literature, notes that the level of provision of public goods by agriculture to society is strongly linked to the possibility of obtaining satisfactory financial compensation for the additional costs incurred in their production. The need to support LFA areas in public policies is also pointed out by Bojnec and Ferto (2018), and the importance of agricultural support institutions in conservation efforts is increasingly mentioned in EC policy documents. Galluzzo's (2021) research confirms the need to support areas with natural environmental constraints. He explored the role of CAP subsidies in 'reducing socio-economic marginalisation in Romanian rural areas'. She underlined the role of LFA payments: to assess, through a quantitative approach, if there are some relationships between poverty, emigration, and the financial subsidies allocated under the first and second pillars of the Common Agricultural Policy such as the payments to less favoured rural areas (LFA payments) and the direct support provided through the Rural Development Programme" (Galluzzo, 2021). This is also emphasised by Kryszak (2016), who notes that the specific agrarian structure in Poland manifests itself in inequalities in land use and production, with production inequalities growing faster than income inequalities, which can be linked to the inclusion of Polish agriculture in CAP payments, which are compensatory in nature. Średzińska (2018) used the FADN database to study the income disparities between farmers in EU countries with different economic size classes. The analysis covered the year 2015. Some of the results were compared with data from 2004. The variable studied was the income from a family farm per full-time family member. Średzińska›s (2018) results showed that the degree of income inequality varies between different size classes. She noted that income inequality has worsened in some size classes.

The need to take special care of agriculture in LFAs is exceptionally important in the context of Polish agriculture, which often carries out farming activities in difficult or even particularly difficult conditions and with different specific constraints. Therefore, studies that analyse the disproportions in the economic performance of farms with different farming conditions seem to be important.

Income inequalities in agriculture

Farm income is the economic outcome of the farmer's decisions and thus the measurable effect of the farmer's agricultural activity. In economic terms, income should be considered as a means to achieve the objectives of the farm, which determines its development possibilities and, in a broader perspective, as a determinant of social and cultural change in the countryside. Hence, it is important for farmers not only to achieve increasingly higher incomes, but also to reduce income inequalities both extra-sectoral and intra-sectoral (within agriculture itself). This is because, as Kata (2020) emphasises, an excessively large and persistent income gap leads to economic and social imbalance, which is evident, inter alia, in the rural-to-urban exodus, the outflow of land from agricultural use, or the unfavourable allocation of resources in agriculture from less to more profitable branches. Although the phenomenon of income inequality has always existed, it is natural and cannot be avoided, it is one of the most important economic problems (Dabla-Norris et al., 2015). Growing income inequality causes serious socio-economic and political consequences and is one of the most serious obstacles to achieving sustainable economic development worldwide (Vu, 2021; Anyanwu et al., 2021). Already Keynes (1936) argued that the most important flaws in the socio-economic system are the inability to realise full employment and the arbitrary and inequitable distribution of wealth and income. Although the improving economic situation in many regions is resulting in a reduction in poverty and significant improvements in social welfare, income disparity remains a problem. Many studies show that rising inequality can undermine investment and consumption and thus growth, causing economic, financial and political instability (Kakwani, 1980; Dabla-Norris et al., 2015; Cingano, 2014). Income inequality increases social discontent, which can cause social unrest. Social unrest increases the likelihood of upheaval, uncertainty and disruptions in productive activities and therefore often leads investors to postpone projects and investments and also leads to a decline in

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labour and capital productivity. A decline in labour and capital productivity implies a decline in economic growth (Alesina & Perotti, 1996; Claessens & Perotti, 2007).

Measuring income inequality in the agricultural sector is an important issue. According to Heady (1962), the problem of income inequality in agriculture is due to certain regularities of economic growth. Development, as a rule, results in disparities and an unequal distribution of benefits and losses in society. Certain population groups or certain sectors benefit more from this development, others less, and still others suffer losses. Agriculture is, according to Heady (1962), one of the areas that is generally exposed to losses, and this is the case when there is an increase in national income and also when there is technical progress in agriculture itself (a faster increase in the supply of agricultural products than in the demand for them). Farm income inequality has negative impacts on: economic well-being, including the health of the farm family, the adoption of agricultural technology, agricultural productivity and the development of the agricultural sector (Mishra et al., 2009). This is also indicated by the research of Jędrzejczyk and Pekasiewicz (2017) which shows that Polish farms are the group with the relatively greatest income inequalities and the most diverse in terms of poverty and wealth indicators compared to other socio-economic groups (employees). Wołoszyn (2013) came to the same conclusions, pointing out that income inequality is higher in farmers' households than in households in general. There is a wide range of research in the literature on income inequality in agriculture, both within and outside of sectors, and urban-rural inequality has been studied. However, there is a lack of research that identifies income inequalities that may be due to environmental factors.

As tackling income inequality remains a difficult task not only for developing countries but also for developed economies, identifying the determinants of income inequality has always been a focus of attention for policymakers and researchers alike (Dabla-Norris et al., 2015). However, explaining the determinants of income inequality is not straightforward, as it is influenced by various determinants: political, economic, social and institutional (Acemoglu et al., 2001; Stiglitz et al., 2010).

Research methods

The farm-level data for our analyses were collected by the Polish FADN. The variables/margins used are fully consistent with FADN Standard Results published annually by the Directorate-General for Agriculture and Rural Development of the European Commission. The FADN field of observation covers commercial holdings. In practice, the FADN field of observation covers farms producing at least 90% of the standard output value generated by all the farms in a given country (so-called commercial holdings). "Polish FADN farms sample is representative according to three grouping criteria: FADN region, economic size and type of farming. Currently, about 11,000 farms deliver data for the Polish FADN survey" (Juchniewicz & Zagaja, 2023).

On average, during the period of 2014-2021, there were approx. 12 thousand individual farms in the FADN sample. The number of farms was a statistically representative sample for the observation field of the Polish FADN, which averaged 733,000 commodity farms in Poland during that period. The number of farms in particular years was relatively stable, allowing for obtaining reliable and comparable results for long-term analyses. We presented typical descriptive statistics for key variables describing economic situation of farms for our research sample (Juchniewicz & Zagaja, 2023):

- SE025: Total Utilised Agricultural Area, TUAA [hectares];
- SE131: total output = sales, transfers to household, consumption for farm use, stock difference, difference in value of animals [PLN];
- SE485 (total liabilities)/SE131 (total output) [multiplicities];
- SE420: Family Farm Income: income from the family farm, i.e. "Charge for the involvement of the farmer's own factors of production (in the case of incorporated farms, only land and capital) in the operating activities of the farm and a charge for the risks taken by the farmer during the accounting year", this income includes "the addition to net value added of the balance of subsidies and taxes on investments and the subtraction of the cost of external factors" [SE415- SE365 + SE405].

Then, we presented descriptive statistics for LFA and non-LFA farm households and results from the Student's t-test for means between aforesaid groups. A statistical test called the Student's t-test is

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used to determine whether or not there is a statistically significant difference between the responses of two groups.

We presented two income distribution/inequality metrics (two typical: Gini index, Theil index) to quantify the distribution of net farm income between LFA and non-LFA farms:

Gini index: The Gini index is the most frequently used inequality index: a summary statistic that measures how equitably a resource is distributed. The Gini is the sum, over all income-ordered population percentiles, of the shortfall, from equal share, of the cumulative income up to each population percentile, with that summed shortfall divided by the greatest value that it could have, with complete inequality. The range of the Gini index is between 0 and 1 (0% and 100%), where 0 indicates perfect equality and 1 (100%) indicates maximum inequality. The Gini index is the most frequently used inequality index (Damgaard, 2024);

Theil index: Because a transfer between a larger income & a smaller one will change the smaller income's ratio more than it changes the larger income's ratio, the transfer-principle is satisfied by this index. A Theil index of 0 indicates perfect equality. A Theil index of 1 indicates that the distributional entropy of the system under investigation is almost similar to a system with an 82:18 distribution (Theil, 1979).

Results of the research

The number of surveyed farms in the analysed years included in the FADN database ranged from 12121 in 2014 to 11053 in 2021 (Table 2). During the analysed period, the number of farms located in less-favoured areas constituted, on average, about 57.3% of all surveyed entities and, starting from 2014 until 2020, their share gradually increased from 49.7% in 2014 to 63.5% in 2020. In 2021, this number decreased by 4.5 p.p. This means that in Poland, more than 50% of farms are located in problem areas, which may be a reason for systemic measures. What is more, it is justified to conduct research aimed at recognising the income situation and income stratification in farms with different farming conditions.

Table 2. Number of surveyed farms located in less favourable (LFA) and favourable (non-LFA) farming areas

Years		Number	%			Number	%
2014	Non-LFA	6095	50.3	2018	Non-LFA	5186	42.9
	LFA	6026	49.7		LFA	6898	57.1
	Total	12121			Total	12084	
2015	Non-LFA	5437	44.9	2019	Non-LFA	4798	39.8
	LFA	6666	55.1		LFA	7267	60.2
	Total	12103			Total	12065	
2016	Non-LFA	5181	42.8	2020	Non-LFA	4424	36.5
	LFA	6925	57.2		LFA	7692	63.5
	Total	12106			Total	12116	
2017	Non-LFA	5260	43.4	2021	Non-LFA	4532	41.0
	LFA	6873	56.6		LFA	6521	59.0
	Total	12133			Total	11053	

Source: authors' work based on PL FADN data.

The studied group of farms is a poorly diversified group in terms of area size. The average size of the farm, measured by the agricultural area, varied between 32.05 ha and 35.8 ha and, what is worth emphasising, decreased successively during the studied period (Table 3). The difference in the value of production between its lowest value in 2018 and its highest value in 2021 amounted to 27.4%,

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while it is worth emphasising that the median, in the surveyed farms, was at the level of 131.3 thousand PLN in 2019 to 162.3 thousand PLN in 2021, which indicates a relatively high differentiation of farms in terms of the achieved production. This is also confirmed by the value of the standard deviation, which indicates a high variability of this parameter. The income from the family farm is also characterised by high variability, with the difference between the highest value in 2015 and the lowest value in 2021 amounting to 63.2%. The analysis of income showed that income declined twice in the period under review, in 2015 and 2018, due to unfavourable weather conditions and a weak economy. The strongest year-on-year increase in revenue (by 31.8%) was recorded in 2021. The share of liabilities in the value of production shows a declining trend, which, with increasing total production, may indicate their relatively constant level (Table 4). Generally, from the perspective of the production and economic results achieved, the situation of the surveyed farms is improving, the income of agricultural holdings is growing faster than the value of production, which may indicate the generation of added value from the agricultural production carried out.

Table 3. Basic production and economic parameters of FADN farms for the years 2014-2021

Specification	Year	Mean	Median	SD	Min.	Max.
TUAA [hectares]	2014	35.83	23.97	41.99	0	703.43
	2015	35.56	24.03	40.9	0	703.43
	2016	34.88	23.81	38.36	0	741.34
	2017	34.77	23.73	38.86	0	739.94
	2018	33.9	23.12	36.8	0	753
	2019	33.33	22.56	36.73	0	862.88
	2020	32.58	21.88	36.22	0	792.65
	2021	32.05	21.43	35.08	0	757.98
Total output [PLN]	2014	250824.7	148068.5	377494.6	-55711.2	10132511
	2015	230938.8	137181.3	370944.1	-27464.4	11459235
	2016	227725.1	135832.7	388285.9	-65650.8	14224759
	2017	246085.9	146755.8	392548.7	-160543	14483513
	2018	227354.3	133217.8	346974.4	-368763	14673538
	2019	234132.5	131334.6	385631.3	-31122.6	15508146
	2020	232962.1	129293.0	369261.5	-269614	11982477
	2021	289714.4	162305.1	424379.9	-260224	11615522
Total liabilities/total output [multiplicites].	2014	0.32	0.01	3.04	-307.27	61.29
	2015	0.44	0	5.19	-5.7	559.64
	2016	0.37	0	1.11	-2.23	65.64
	2017	0.34	0	1.22	-5.51	100.81
	2018	0.33	0	1.57	-115.98	62.35
	2019	0.31	0	0.91	-42.23	21.46
	2020	0.27	0	0.99	-13.4	47.87
	2021	0.22	0	3.51	-25.57	362.12

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Specification	Year	Mean	Median	SD	Min.	Max.
Family Farm Income [PLN]	2014	89141.78	50086.12	144478.9	-1758833	4678531
	2015	77242.38	45637.41	129769.4	-526870	5581616
	2016	79079.15	47398.51	122523.1	-493704	3563781
	2017	98401.93	59468.84	135771.2	-494472	2022287
	2018	85997.81	48723.74	132107.7	-961531	2382627
	2019	92849.54	49935.17	149143.7	-537213	3680451
	2020	95650.46	53528.39	144223.3	-508126	3992163
	2021	126089.9	70670.5	180874.1	-579276	3977357

Source: authors' work based on PL FADN data.

A comparison of farms with different farming conditions shows significant differences in both farming conditions and performance. Farms located in less favoured areas are characterised by a slightly weaker production potential when viewed from the perspective of the area available for agricultural production, which translates into the possibility of achieving benefits from the scale of production. This situation translates into weaker production results for farms located in LFAs. The value of total production in these farms was 13.6 p.p. lower in the period under study than in the other surveyed units. This translated into the value of obtained income, which was, respectively, nominally lower in the whole period under study by approximately 10.8 p.p. on average.

Analysis of FADN farm incomes shows that in 2021, average family farm income was 141.4% higher in nominal terms than in 2014 (Table 4). Over the same period, the income of farms located in LFA areas increased nominally by 132.8%, while that of farms located in NonLFA areas increased by 155.%. These data clearly indicate that between 2014 and 2021, during the period of high agricultural support under the RDP, farmers' incomes were clearly increasing. At the same time, it should be noted that the incomes of farmers with favourable conditions for agricultural production grew faster than those on farms with production constraints. The improvement in agricultural incomes may have resulted, inter alia, from an increase in the sector's productivity, both globally and in the productivity of individual production factors. The increase in agricultural productivity in the period in question was to some extent a result of an increase in budget transfers to this sector under RDP, which made it possible to implement modernisation investments and increase the production potential of holdings, resulting in an increase in the profitability of agricultural production.

Despite the increase in income in the agricultural sector, there are still intra-sectoral disparities in farmers' incomes, as indicated by the Gini coefficient. The value of this coefficient in the analysed period, determined for farm income, indicates greater income disparities for farms located in less favoured areas (LFAs) compared to other farms. It is worth noting that the greatest income inequalities are particularly evident in periods when farming conditions are less favourable than in other years. This was the case in 2018, which saw the greatest disparities, with the Ginni coefficient in LFA areas being as much as 20.8% higher than in NonLFA areas. The FADN data shows that 2018 was the year of the largest income decline in the last five years across the FADN population.

It is worth emphasising that the analysis of income differentiation should be supported by the observation of both its trends and changes over time. In the studied set of LFA and NonLFA households, the income disparity showed a decreasing trend (2018 was the exception) (Figure 1). Between 2015 and 2016, the income inequality gap between LFA and NonLFA households was small and showed a decreasing trend. Since 2017, a narrowing of the income inequality gap has been observed, and the extreme was reached, as previously highlighted, in 2018. Since 2019, a narrowing of income inequality is observed in both analysed groups. In 2021, the gap between households in LFA and NonLFA areas has narrowed to 6.9%. (Table 5, Figure 1). However, it should be emphasised that throughout the analysed period, the Gini coefficient reached a value between 60 and 80%, well above the value typical of inequality in the income distribution of developed countries.

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Table 4. Comparison of production and economic parameters of FADN farms in 2014-2021 in LFA and NonLFA farms

Specification		Non-LFA farms					LFA farms				
		Mean	Median	SD	Min.	Max.	Mean	Median	SD	Min.	Max.
TUAA [hectares]	2014	36.04a	23.86	42.40	0.00	670.42	35.62a	24.17	41.58	0.00	703.43
	2015	35.77a	23.65	41.87	0.00	582.36	35.38a	24.40	40.10	1.01	703.43
	2016	35.69a	23.92	39.90	0.00	495.81	34.28b	23.74	37.16	1.01	741.34
	2017	35.45a	23.61	40.80	0.00	739.94	34.26a	23.82	37.30	1.03	708.95
	2018	35.26a	23.21	40.83	0.00	753.00	32.88b	23.06	33.41	0.00	518.34
	2019	34.93a	22.76	41.74	0.00	862.88	32.26b	22.46	32.97	0.00	483.45
	2020	34.36a	22.11	41.22	0.00	792.65	31.55b	21.73	32.96	0.00	483.56
	2021	33.23a	21.53	38.62	0.00	757.98	31.23b	21.35	32.37	0.80	480.41
Total output [PLN]	2014	262643.10a	162246.71	373144.93	-55711.22	9746093.95	238871.06b	134313.97	381502.25	-42328.37	10132510.53
	2015	250410.53a	156686.01	359359.49	-27464.41	11406325.72	215057.07b	121893.09	379419.12	-14635.81	11459234.53
	2016	247637.48a	154563.67	381141.00	-2237.91	12966147.07	212827.46b	121199.45	392914.60	-65650.80	14224759.07
	2017	259519.12a	163269.44	345795.15	-160543.24	6119941.89	235805.21b	135154.88	424606.51	-22606.08	14483513.24
	2018	248278.72a	154079.46	329499.14	1620.37	5745931.55	211623.15b	119327.05	358774.54	-368763.01	14673537.95
	2019	257204.24a	153812.37	358656.37	-309.45	6017195.49	218899.47b	116066.73	401750.25	-31122.60	15508145.97
	2020	258947.08a	152549.48	371577.04	-269614.40	7022816.42	218016.98b	117928.11	367115.08	-210378.05	11982477.24
	2021	321138.94a	188787.60	426597.46	-98077.93	7001750.32	267874.79b	145940.74	421486.76	-260223.93	11615522.42
Total liabilities/ Total production	2014	0.34a	0.033	0.795	-33.15	10.65	0.296a	0.00	4.24	-307.27	61.29
	2015	0.377a	0.005	0.778	0.00	12.95	0.487a	0.00	6.95	-5.70	559.64
	2016	0.394a	0.000	1.335	-2.23	65.64	0.352b	0.00	0.90	0.00	29.02
	2017	0.351a	0.000	0.791	-5.51	20.74	0.335a	0.00	1.47	0.00	100.81
	2018	0.338a	0.000	0.812	0.00	27.44	0.322a	0.00	1.96	-115.98	62.35
	2019	0.321a	0.000	0.964	-42.23	10.73	0.299a	0.00	0.87	0.00	21.46
	2020	0.279a	0.000	0.932	-2.03	47.87	0.263a	0.00	1.02	-13.40	32.69
	2021	0.190a	0.000	0.518	-10.64	10.21	0.242a	0.00	4.55	-25.57	362.12
Family Farm Icome	2014	91793.70a	52958.54	148138.40	-330230.79	4678531.33	86459.50b	47211.81	140642.10	-1758833.03	2436168.70
	2015	83785.97a	50421.54	147710.01	-526869.80	5581616.47	71905.23b	42362.53	112778.46	-213554.49	2738290.12
	2016	83274.59a	49698.18	128180.65	-493704.14	3563780.56	75940.30b	45811.97	118025.15	-473382.45	2880425.97
	2017	99763.94a	61386.68	137298.45	-357712.80	2022287.27	97359.56a	57746.97	134591.35	-494472.37	1793404.86
	2018	92423.19a	53919.17	137408.39	-472098.62	2045973.13	81167.13b	45052.82	127775.49	-961530.65	2382626.82
	2019	99151.96a	55168.69	155542.95	-537212.87	3680450.63	88688.40b	46497.81	144624.07	-323145.69	3261756.97
	2020	104117.87a	59216.32	155224.73	-508125.90	3992163.35	90780.48b	50064.20	137271.80	-448553.55	3226780.15
	2021	142295.36a	81467.58	197038.63	-446222.96	3794781.76	114827.39b	63701.80	167826.79	-579276.20	3977357.11

Note: Mean values in the same row without the same subscript (footnote) are significantly different at p values < 0.05 in a two-tailed test of equality.

Source: authors' work based on PL FADN data.

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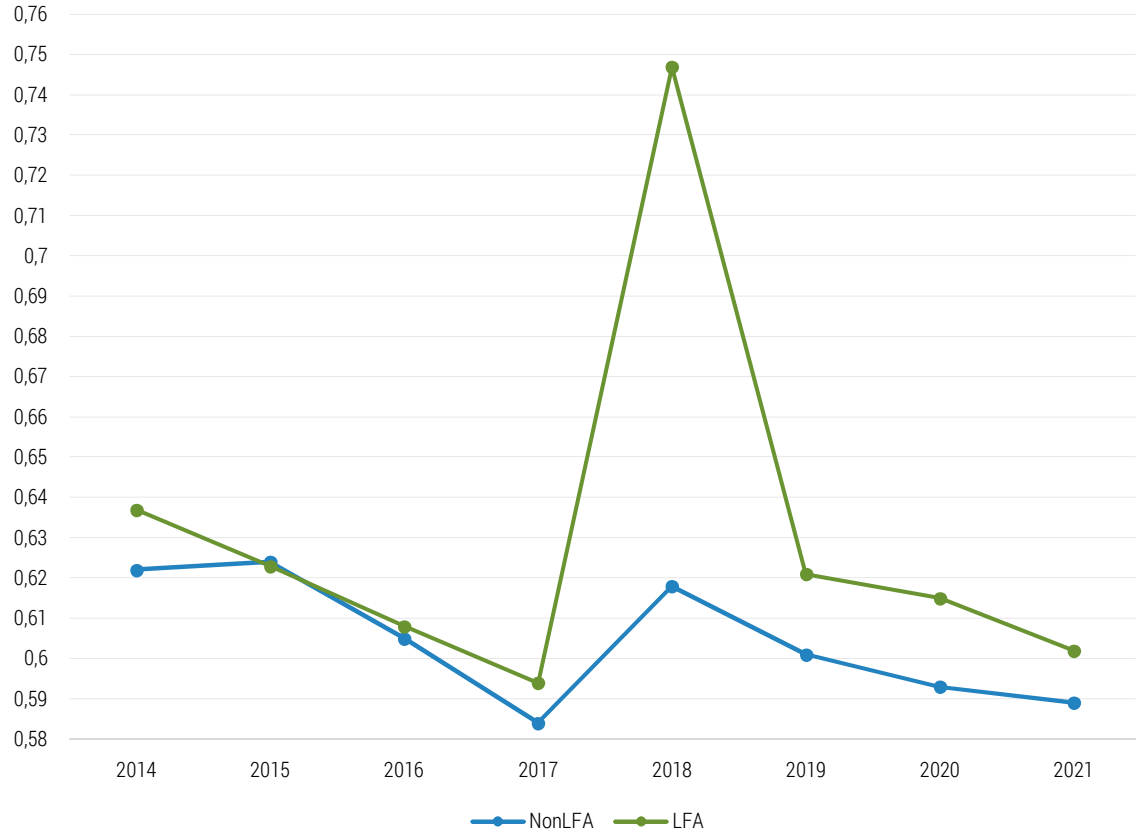

Figure 1. Gini coefficient in Poland for farms located in LFA and NonLFA areas

Source: authors' work based on PL FADN data.

Analysis of the Gini coefficient indicates the existence of income inequalities between the groups analysed. In the case of LFA farms, the level of income inequality was also confirmed by the high value of the Theil Index (Table 5).

Table 5. Gini and Theil coefficient values for the farm located in the LFA and NonLFA from 2014 to 2021

Year	Income from family agricultural holding in PLN	Variation in farm income as measured by the Gini I Theil coefficient			
		Farms			
		NonLFA	LFA	NonLFA	LFA
		Gini coefficient		The Theil factor	
2014	89 142	0.622	0.637	0.755	0.779
2015	77 242	0.624	0.623	0.624	0.756
2016	79 079	0.605	0.608	0.714	0.720
2017	98 402	0.584	0.594	0.646	0.668
2018	85 998	0.618	0.747	0.747	0.819
2019	92 850	0.601	0.621	0.701	0.759
2020	95 650	0.593	0.615	0.667	0.723
2021	126 090	0.589	0.602	0.639	0.683

Source: authors' work based on PL FADN data.

Discussion/Limitation and future research

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The problem of income inequality is an extremely important issue often addressed in the economic literature (Poterba, 2007; Ni et al., 2021). This topic is important given that one of the main objectives of agricultural policy is to support farm incomes, despite the fact that transfers support environmental, sustainability and rural development measures (Severini & Tantari, 2013). However, it should be noted that, with regard to the less favoured area, it has not been adequately reflected in the empirical literature. Raczkowska's research (2015) concerned the assessment of income inequality in Poland for the years 2005-2013, using the Gini coefficient. The economist studied them, among other things, in the classification system of the main source of household income. Farmers were characterised by the highest income inequalities compared to, for example, pensioners or employees, for whom the Gini coefficient values were relatively stable over time.

Several areas of research can be identified in the field of agricultural income inequality. On the one hand, many studies have been concerned with depicting the level of agricultural income inequality and showing the impact of individual factors on it. On the other hand, many authors have studied the impact of agricultural policy instruments, especially direct payments, on the level of farm income inequality (Gould & Saupe, 1990; Freebairn, 1995; Mishra et al., 2009; Ding et al., 2011; El Benni & Finger, 2014; Allanson et al., 2017; Keeney, 2008). Pawłowska-Tyszko and Soliwoda (2014) also conducted research into the factors affecting the level and diversity of income in Poland and EU countries, and pointed to a strong link between income growth and EU accession and related payments or the increasing scale of production.

In summary, both the impact of government payments on income inequality and the receipt of off-farm income affect income inequality in different ways. Some researchers indicate that, for example, off-farm income contributes to reducing inequality (Mishra et al., 2009; Pawłowska-Tyszko, 2003), while others show quite the opposite (Gould & Saupe, 1990). According to Terluin et al. (1995) farmers in LFAs receive a higher amount of income subsidies than farmers in normal areas. However, this higher amount of subsidies translates into a reduction of income inequalities between different areas. That was indicated by research by Harkness et al. (2021), who employed data from 2333 farms in England and Wales, from 2007 to 2015. By implementing environmentally friendly farming techniques, such as agri-environment programs, expanding agricultural diversity, and lowering input intensity, many farm businesses may become more stable while also lessening the damaging effects of farming on the environment.

Galluzzo's (2021) results underlined the necessity to provide farmers and rural areas with more financial support going forward in order to prevent rural areas from becoming more socioeconomically marginalised as a result of the EU's decreasing financial resources allocated to the primary sector within the framework of the CAP's first and second pillars.

Empirical research by Pawłowska-Tyszko and Soliwoda (2017) has shown that one of the financial instruments that can prevent the marginalisation of rural areas, including influencing the stabilisation of income and the sustainable development of farms, can be supported in the form of appropriately constructed economic insurance systems. This is also confirmed by the research of Soliwoda et al. (2017), who emphasise that, in addition to factors already well recognised by agricultural microeconomics (concerning, among others, the organisation of agricultural production: intensification/extensification, diversification/specialisation, utilisation of economies of scale), from a mesoeconomic point of view, changes related to the implementation of new agricultural policy programmes play an important role in shaping the level and structure of income.

The empirical findings of Klima et al. (2020) indicate that compared to the LFA area in the hilly Low Beskids, Carpathians, the average yield of cereal units of crops grown outside the LFA, under favourable conditions for agricultural production, was higher by 12.7%. Despite yield losses in the LFA area varying from 9% to 19% based on the crop, the implementation of subsidies resulted in an equal productivity index for all crops. Bojnec and Ferto (2018) found that while farm income risk is lowered by subsidies, off-farm income, and farm specialisation for both LFA and non-LFA farms, it is raised by subsidies, farm size, and financial immobility for LFA farms and both non-LFA and LFA farms. For LFA farms, the connection between farm size and income risk is nonlinear.

Weltin et al. (2017) employed data from a survey of 2154 farms "from 9 European regions to identify distinct farm types in order to investigate differences regarding the willingness to diversify in the future" (p. 172). They idenfied amongst 6 clusters type 3: "LFA-adapted mixed farms" repre-

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senting mainly mixed farms (59%). This type was common amongst rather young and average-sized households. This farm type was distinguished by its highly educated households (the most common category being "first stage of tertiary education") and its high proportion of impoverished areas (88%). Of them, 23% are in mountainous regions. A fairly good adaptation to unfavourable external conditions may be made possible by education.

Zieliński et al. (2020) inter alia assessed "the functioning of farms located in such municipalities against the background of analogous farms in non-LFA municipalities which kept accounts for the Polish FADN continuously in 2016-2018". According to their findings, farms in LFAs had older farm owners, lower capital values, and worse-quality used soils. They also have poorer production effects, lower factor productivity, and lower costs per ha of UAA. Additionally, they had fewer development opportunities due to their lower income per ha of UAA.

Bojnec and Ferto (2018) investigated the structure and evolution of farm household income and examined the contribution of different sources of farm household income, particularly the impact of Common Agricultural Policy reform on farm household income inequality in Slovenia. They employed data from Slovenian FADN for the period 2007-2013. The entire income of farm households was divided into two parts: 1) total income consisting of market income and off-income; and 2) subsidies (Pillars 1 and 2 support, including subsidies for LFA, agri-environmental measures, and other rural development initiatives). To calculate the impact of each source of income and the change in policy from market to government support on farm household income and overall inequality, they employed the Gini decomposition method. They discovered that the primary shift was a rise in the significance of Pillar 2 subsidies, which is in line with a strategy of concentrating support on farms in underserved regions. Pillar 1 subsidies decreased, but market revenue led to a rise in farm household income inequality.

Pastusiak et al. (2020) employed PL FADN data in order to assess financial differences between LFA and non-LFA farm households. They analysed a sample of Farm Accountancy Data Network (FADN) farm households, "to evaluate the influence of chosen factors on financially sustainable farm development and verify less-favoured area (LFA) farms' growth compared with non-LFA household "s. They used the Sustainable Growth Challenge (SGC) model and DuPont decomposition, which is based on indicators and financial measures taken from corporate finance, to identify farm households.

A study by Terluin et al. (1995) on the income situation of farmers farming in less-favoured areas (LFAs) in three different geographical areas (North-West, Central and South) shows that in each of these areas, farm incomes in LFAs are lower than in normal areas (Non-ONWs), confirming our findings.

The following research limitations can be identified. The research concerned only Polish farms located in LFAs. An assumption was made (verified empirically, e.g. in the research of Pastusiak's team in 2020, that entities located in LFAs also receive payments related to such environmental constraints. In the future, in-depth empirical research on the determinants of agricultural income would be desirable, also including qualitative independent variables (e.g. related to the education of the manager) from the set of FADN variables. In the longer term, it would be desirable to identify behavioural determinants, related, for example, to heuristics or attitudes of farm managers towards risk. Changes in income levels over time are a consequence not only of the agricultural business cycle (including the agricultural price scissors index), but also of the actors' relationship to the market. Research using the FADN resources of, for example, central and eastern European countries with different institutional and socio-economic determinants of total income.

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Conclusions

Hypothesis H1, stating that farms in LFAs are characterised by lower income than other LFA farms, was positively verified. Hypothesis H2 was also positively verified, but the study of inequalities using the Gini coefficient indicated an increase in intra-sectoral differences in farmers' incomes compared to using the Thiel coefficient. The greatest inequalities are revealed in periods when farming conditions are less favourable than in other years, as indicated by the Thiel coefficient and the Gini coefficient.

Changes in the scale of inequality between 2014 and 2021 on LFA farms can be divided into three main phases: a decrease until 2017, a sharp increase in 2018 and a renewed decrease from 2019 onwards (Table 4). Overall, income inequality on LFA farms as measured by the Gini coefficient decreased by 5.5% between 2014 and 2021, while it decreased by 5.3% on NonLFA farms. Although these are not significant differences, this provides an apex for a more in-depth study of these inequalities, e.g. between different types of LFAs, especially as the Gini coefficient reached a value between 60 and 80%, well above the value typical for inequality in income distribution in developed countries.

The results of the conducted analyses imply a need for in-depth monitoring of the economic and financial situation of farms located in LFAs. A deeper assessment of income inequalities for individual LFA types may be important, including from the point of view of shaping new tools in the context of the CAP update, which exposes the imperative of improving the resilience of farms.

The research points to the need to monitor the economic and financial situation of farms in LFAs. A deeper assessment of income inequalities for individual LFA types may be important. This is important from the point of view of shaping new agricultural policy tools in the context of the CAP update, which exposes the imperative of improving the *resilience of* farms. Particularly important is the maintenance of a socially desirable level of agricultural income, which is not only a remuneration for the use of factors of production, but also a compensation for the risk of entrepreneurial activity.

The contribution of the authors

Conceptualisation, M.S., J.P.-T. and A.B.-J.; literature review, M.S., J.P.-T. and A.B.-J.; methodology, M.S. and J.P.-T.; formal analysis, M.S. and J.P.-T.; writing, M.S., J.P.-T. and A.B.-J.; conclusions and discussion, M.S., J.P.-T. and A.B.-J.

The authors have read and agreed to the published version of the manuscript.

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CZY GOSPODARSTWA POŁOŻONE NA OBSZARACH O NIEKORZYSTNYCH WARUNKACH GOSPODAROWANIA RADZĄ SOBIE Z GORSZĄ SYTUACJĄ DOCHODOWĄ? DOWODY EMPIRYCZNE Z POLSKI

STRESZCZENIE: Determinanty środowiskowe mogą zwiększać lub obniżać potencjał dochodowy gospodarstw rolnych, stąd też uzasadnione mogą być badania sytuacji dochodowej gospodarstw rolnych położonych na obszarach o zróżnicowanych naturalnych warunkach gospodarowania. Celem podstawowym artykułu było zidentyfikowanie różnic w sytuacji dochodowej, a także ocena nierówności w zakresie dochodów między gospodarstwami położnymi na obszarach o niekorzystnych warunkach (ONW) a pozostałymi podmiotami (poza ONW). Zmiany skali nierówności w latach 2014-2021 w gospodarstwach położonych na obszarach ONW można podzielić na trzy zasadnicze fazy: spadek do 2017 roku, gwałtowny wzrost w roku 2018 oraz ponowny spadek od 2019 roku. Nierówności dochodowe w gospodarstwach ONW mierzone współczynnikiem Giniego w latach 2014-2021 zmniejszyły się o 5.5%, natomiast w gospodarstwach nie położonych na OWN o 5.3%. Implikuje to potrzebę pogłębionego monitoringu sytuacji ekonomiczno-finansowej gospodarstw położonych na ONW. Istotna może być pogłębiona ocena nierówności dochodowych dla poszczególnych typów ONW, w tym z punktu widzenia kształtowania nowych narzędzi w kontekście aktualizacji WPR, która eksponuje imperatyw poprawy odporności (***resilience***) gospodarstw.

SŁOWA KLUCZOWE: ONW, dochód rolniczy, nierówności dochodowe, ograniczenia środowiskowe, WPR

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