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ASSESSING AGRICULTURAL EFFICIENCY IN THE CONTEXT OF THE EU GREEN DEAL AND UN SUSTAINABLE DEVELOPMENT GOALS: A COMPARATIVE STUDY OF POLAND AND ALBANIA

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The study aimed to assess agricultural efficiency in the context of the EU Green Deal and the UN Sustainable Development Goals in Poland (a full EU member) and Albania (an EU candidate country). An index method was used, referring to agricultural efficiency and its structural characteristics, as well as the degree of implementation of selected sustainable development goals in 2010–2022. The research revealed that Poland's labour productivity index in agriculture is significantly higher than Albania's, while Albania's land productivity index is higher. The countries also differed in terms of the structural characteristics of agriculture, as evidenced by the relatively high share of agriculture in Albania's total gross value added and total employment. It was shown that organic farming plays a much greater role in Poland, although its development trends are weak. At the same time, Polish agriculture is characterised by significantly higher levels of mineral fertilisation, which are trending downwards in line with the EU Green Deal's assumptions. Based on the research conducted, a reduction in the emissions intensity of Albanian agriculture has been observed, which is consistent with the assumptions of UN SDG13. However, agriculture in Poland remains a significant emitter of greenhouse gases (GHGs), so an essential direction for reform should be to support climate-friendly agriculture without compromising productivity. Although Albania has reduced malnutrition and improved food availability, the level of severe food insecurity remains higher than in Poland. Both countries must continue to reform agriculture in line with the EU Green Deal and SDG 2.

Keywords: *agriculture; efficiency; Poland; Albania; sustainable development*

INTRODUCTION

Over the last few decades, environmental disasters and social problems associated with development have underscored the need for transitioning to a new model of sustainable development. The European Green Deal (EGD) is the comprehensive strategy introduced by the European Union in 2019 that outlines how the EU will achieve climate neutrality by 2050, and transform economic sectors, public policies and energy systems into sustainable systems (Prandecki & Wrzaszcz 2023). At the same time, the United Nations' Sustainable Development Goals (SDGs) are a global plan for achieving a balance between social, economic, and environmental progress. They are also linked to the agricultural sector, which has significant connections with the natural environment (Mergoni et al., 2024Martinovska, Stojcheska et al. 2024b). Therefore, from the very beginning of the concept of sustainable development, measures have been taken to adapt agricultural and rural development policies to the principles and objectives of sustainability. In the European Union, this was achieved through the coordination of the Common Agricultural Policy (CAP) with environmental, energy, and climate policies (Adamowicz 2021). The EU's Farm to Fork Strategy, part of the Green Deal, aims to enhance soil health, expand organic production, reduce the use of fertilisers and pesticides in agriculture, and promote biodiversity (European Commission, 2020). Scown et al. (2020) state that agriculture is essential to achieving the SDGs. The authors state that there are the numerous linkages between CAP and the SDGs, and that CAP has the potential to contribute to most of the SDGs.

Climate and environmental policy also influences the direction of agricultural development within the EU. This policy is based on three pillars: reducing greenhouse gas emissions, increasing the use of renewable energy, and improving energy efficiency. This creates a need for the continuous adaptation of agricultural production. CAP instruments stimulate this by encouraging farmers, including through financial incentives, to take the desired production measures (Wrzaszcz & Wigier, 2024). National strategic plans indicate the scope of intervention in the agricultural sector to promote the

implementation of sustainable development principles, including those resulting from the European Green Deal strategy. These plans set out the paths and pace for achieving sustainable development goals. However, how these frameworks are treated varies considerably from one country to another, depending on the country's level of development and status in relation to the EU.

The basic premise of sustainable economic development in any industry is the efficient use of production factors (Bervidová, 2002). In the context of the Sustainable Development Goals (SDGs), agricultural efficiency is also important, particularly in relation to Goal 2 (Zero Hunger). Sustainable agriculture, characterised by the efficient use of resources, minimisation of waste, and promotion of innovation, contributes to achieving food security, improving nutrition, and combating poverty (Hiywotu, 2025). The efficiency of agriculture has been extensively studied in international comparisons. The results reveal significant disparities between the 'old' EU countries, the newer member states, and EU candidating countries, particularly those in the Western Balkans. For instance, Horvat et al. (2020) discovered that the relative technical efficiency of agriculture in the Western Balkan countries is notably lower than in EU countries, primarily due to low labour productivity. However, the literature on comparisons of agricultural development paths in the context of implementing sustainable development objectives between EU countries and candidate countries remains limited. This study attempts to address this gap. The paper compares Albania, an EU candidate country, with Poland, which joined the EU in 2004. The two countries have different institutional developments, administrative capacities and access to EU financial mechanisms that support the green transition. They also differ in terms of agricultural production potential and development conditions.

This study aims to evaluate the efficiency of agriculture in Poland and Albania in the context of the EU Green Deal and the UN Sustainable Development Goals. The article seeks to identify similarities and differences in the agricultural sector's selected outcome indicators in the context of the sustainable transition process in two different European countries. The choice of Poland and Albania for comparison is not accidental. Despite significant institutional differences and varying access to EU instruments, agriculture plays an above-average role in the structure of the economy and employment in both countries. Simultaneously, both agricultural systems face similar challenges: fragmented farm structures, a limited pace of modernisation, and pressure to improve efficiency amid increasing environmental requirements. Such a comparison makes it possible to capture the extent to which different political and institutional contexts translate into the effectiveness and adaptability of the agricultural sector to the framework of the Green Deal and SDGs.

RESEARCH METHODS

The aim of this study was to answer the following research question: How does the efficiency of agriculture in Poland and Albania align with the objectives of the EU Green Deal and the United Nations Sustainable Development Goals (SDGs), and what are the key differences between a full EU member and a candidate country? The following specific objectives were adopted:

1. To evaluate the current level of agricultural efficiency in Poland and Albania using international statistical data.
2. To assess the alignment of agricultural practices in both countries with selected goals of the EU Green Deal and UN SDGs.
3. To formulate policy recommendations for improving agricultural alignment with EU and UN sustainability frameworks.

The objectives that were adopted allowed for the verification of the following research hypotheses:

H1: Poland demonstrates higher agricultural efficiency than Albania due to its established integration with EU agricultural and environmental policies.

H2: Albania's agricultural sector exhibits greater variability in sustainability indicators due to transitional policy frameworks and limited access to EU funding and infrastructure.

H3: There is a difference between the countries in the achievement of SDG targets related to sustainable agriculture (e.g., SDG 2, 12, 13).

The research was conducted using data from international databases, particularly FAOSTAT and UNSTAT. The study covers the period from 2010 to 2022 and, in relation to the available indicators, the year 2023.

The following steps were performed in this study:

Step 1: Assessing the structural conditions of agriculture and its efficiency.

Step 2: Analysis of technological efficiency (yields of selected crops) and production intensity (NPK fertilisation).

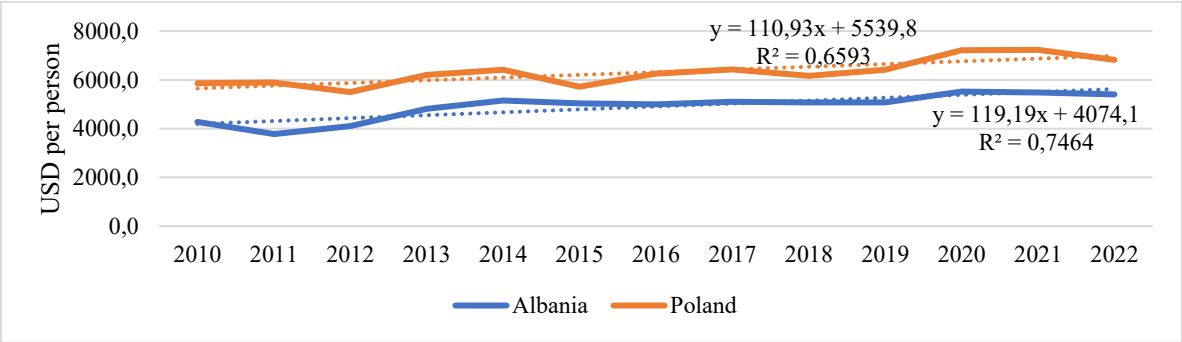
Step 3: Assessment of environmental pressure (GHG emissions) and implementation of selected SDG targets.

To assess the efficiency of agriculture, the following were used: 1) the labor productivity index, defined as the ratio of gross value added to the number of people employed in agriculture, and 2) the land productivity index, defined as the ratio of the value of agricultural production to the area of agricultural land.

RESEARCH RESULTS

To assess agricultural efficiency, labour productivity was calculated as the ratio of the gross value added in agriculture (in constant prices from 2015) to the number of people employed in this sector (see Figure 1). This is an essential indicator of the level of agricultural development, as well as the state of the sector's sustainable development in relation to social and environmental objectives (Steensland & Zeigler, 2021; Huang et al., 2023). Gross value added is a

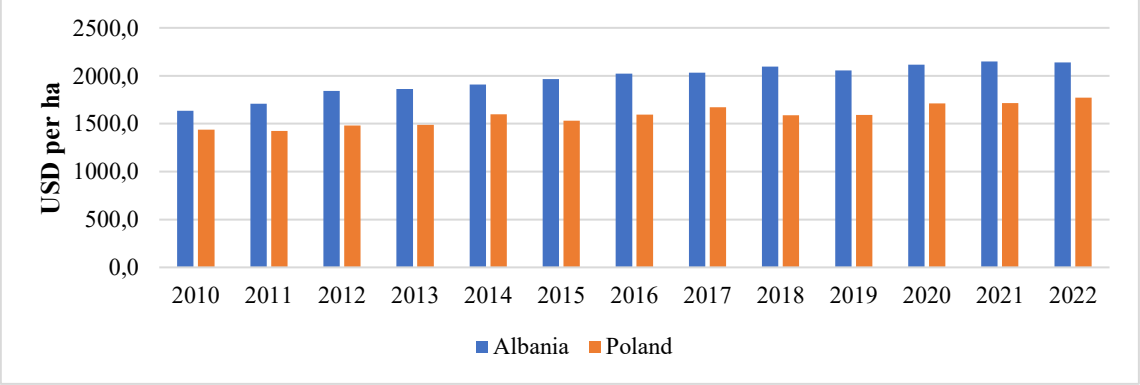
basic income category that indicates the ability to generate new value concerning material costs incurred. On the other hand, it is perceived in the context of the quantity and quality of human capital, which increasingly determines this ability. For this reason, as Gołaś (2010) emphasises, it is one of the most objective categories of business performance assessment used in evaluating labour productivity. In Poland, the labour productivity index remains higher than in Albania; in 2022, it was 26.2% higher. However, Albania experienced a higher growth rate during the period 2010–2022, reaching 126.6%, while Poland's index grew by 116.4%. Taking into account the entire period of Poland's EU membership, the growth rate of labour productivity in agriculture reached 244.6% (Eurostat, 2025). This demonstrates that the support provided to Polish agriculture under the Common Agricultural Policy, which aims to enhance productivity, has contributed to positive transformations within the Polish agricultural sector. Nevertheless, it is worth noting that labour productivity in Polish agriculture remains among the lowest in the EU (Kołodziejczak, 2025). Furthermore, studies by other authors show that the potential for increasing agricultural productivity in Western European countries is limited due to the already high and satisfactory utilisation of production factors. Conversely, there is significant scope for improving the utilisation of production factors in Polish agriculture, which could be realised through further restructuring of agricultural holdings (Ściubeł, 2021). This highlights the need for measures in both countries to improve labour productivity in agriculture, particularly by intensifying structural changes. The increase in labour productivity in Albania in recent years is likely due to financial support for agriculture under pre-accession programmes (Martinovska Stojcheska et al., 2024a).



Source: Own study based on FAOSTAT data

Figure 1. Labour productivity in agriculture in Poland and Albania in 2010-2022 (constant 2015 USD) (USD/person)

The analysis also covered land productivity, which was calculated as the ratio of the value of agricultural production (at constant prices from 2014-2016) to the area of agricultural land. Despite having significantly more fragmented agriculture than Poland (Kucaj et al., 2024), Albania had higher land productivity. In 2022, the land productivity index of Albania was 20.7% higher than that of Poland (Figure 2). This is due to a different crop structure compared to that in Poland. Albania specialises in intensive crops, with vegetables, fruit (such as olives and citrus fruits) and oilseeds dominating, while cereal production is relatively low and declining. In Poland, cereal and rapeseed crops predominateand generate a lower production value per hectare compared to intensive crops.



Source: Own study based on FAOSTAT data

Figure 2. Land productivity in Poland and Albania in 2010-2022 (USD/ha)

In discussions on the role of agriculture in economic development, a fundamental question is how agriculture contributes to economic growth. Typically, as a country's level of economic development increases, the share of agriculture in the gross value-added structure decreases, while productivity in this sector increases (Meijerink & Roza, 2007; Nowak & Marczak, 2021). This does not necessarily imply a decline in agriculture's gross value-added (GVA), but only a declining share of it in the country's total GVA. This is because of the commodity nature of agricultural production. Meanwhile, the market prioritises the final stages of processing raw materials into final products (Nowak et al. 2019). From the data presented in Table 1, it can be seen that the share of agriculture in the GVA generation remained relatively

constant in both countries, with six times higher in Albania than in Poland. This means that agriculture is one of the main sectors of the Albanian economy, generating approximately 18% of national GVA.

Table 1. Selected structural characteristics of agriculture in Poland and Albania in 2010–2023.

Years	Share of agriculture in total gross value added (%)		Employment in agriculture (% of total)		Agriculture area under organic agric. - Share in agricultural land (%)	
	Albania	Poland	Albania	Poland	Albania	Poland
2010	18.0	2.9	42.1	13.0	0.4	3.6
2011	18.2	3.2	45.4	12.9	0.5	4.1
2012	18.8	3.0	46.0	12.6	0.2	4.6
2013	19.6	3.3	44.0	12.0	0.2	4.7
2014	20.0	3.0	42.1	11.5	0.2	4.6
2015	19.8	2.5	41.2	11.5	0.2	4.0
2016	19.9	2.7	40.0	10.5	0.1	3.7
2017	19.0	3.0	38.1	10.2	0.1	3.4
2018	18.4	2.4	37.3	9.6	0.1	3.3
2019	18.4	2.4	36.4	9.1	0.1	3.5
2020	19.2	2.6	36.3	9.5	0.1	3.5
2021	18.4	2.2	36.0	8.3	0.1	3.8
2022	18.6	2.8	35.4	8.2	0.1	3.9
2023	18.3	3.0	34.9	7.6	N/A	N/A

Note: N/A = data not available
Source: Own study based on FAOSTAT data

On the one hand, the yield level is used as a measure of the technological efficiency of land, and on the other hand, it is used as a production-oriented measure of production intensity (Zakrzewska & Nowak, 2022). It is determined not only by yield-forming inputs and the structural characteristics of agriculture, but also by agroecological conditions. Poland has better conditions for root crops and winter cereals, resulting in higher yields of these crops. In 2023, potato yields in Poland were 8.8% higher than in Albania. Sugar beet yields were twice as high as in Albania and wheat yields were 30.2% higher. Corn and sunflower yields in both countries have been comparable in recent years, although in 2023 they were 2.8% and 4.1% higher in Albania than in Poland respectively (see Table 2).

Table 2. Technological efficiency of land - yield of selected crops in Poland and Albania (kg/ha).

Years	Potatoes		Sugar beet		Wheat		Maize (corn)		Sunflower seed	
	Albania	Poland	Albania	Poland	Albania	Poland	Albania	Poland	Albania	Poland
2010	23111.1	21083.8	20000.0	48357.9	3990.5	4429.0	6679.0	5982.4	2000.0	1505.3
2011	24221.1	23033.8	20000.0	57363.5	4230.1	4134.8	5986.9	7177.0	2054.8	1866.3
2012	25053.8	24375.1	20000.0	58247.6	4109.6	4143.8	6729.0	7348.1	1428.6	1761.3
2013	26011.0	21062.4	20000.0	58006.6	4129.2	4436.7	6953.3	6576.1	1500.0	1752.3
2014	25000.0	27766.1	22680.1	68250.4	4000.1	4972.1	6909.1	6588.1	2915.5	1709.0
2015	24257.4	21020.7	27054.2	51990.4	3951.1	4574.4	6959.7	4708.7	2857.1	1645.0
2016	24589.4	28630.4	30378.5	66492.2	3900.0	4580.2	6487.7	7317.3	2899.7	1747.3
2017	25111.0	27850.3	33847.3	67897.6	4036.7	4877.3	6563.2	7154.5	2225.1	1924.6
2018	26171.4	25129.6	39152.4	59864.9	3692.7	3987.1	7227.3	5875.6	2280.3	1629.6
2019	25645.5	21428.3	38142.9	57465.8	4068.0	4303.5	7052.9	5511.0	2307.5	1965.0
2020	26274.2	34765.8	32215.1	60830.3	4327.1	5234.2	7035.9	7076.3	2322.9	2004.0
2021	24943.3	30027.8	32282.9	60956.4	4130.5	4975.3	7107.3	7333.1	2379.2	2274.4
2022	26505.9	30752.8	32250.4	63823.4	4296.3	5239.4	7090.1	6977.2	2369.4	2292.4
2023	27233.1	29642.8	31847.4	64967.1	4053.9	5280.0	7362.2	7153.3	2354.7	2259.2
Dynamics	117.8	140.6	159.2	134.3	101.6	119.2	110.2	119.6	117.7	150.1

Source: Own study based on FAOSTAT data.

Fertilisation is a key factor in crop yield, and fertiliser consumption is an indicator used to assess production intensity (Piwowar, 2021), which is linked to the Sustainable Development Goals. For this reason, the analysis focused on the consumption of nitrogen, potassium, and phosphorus per hectare of agricultural land. Soils in Poland require more frequent fertilisation, particularly with potassium, which is reflected in the high level of consumption in this category (an average of 32.8 kg/ha between 2010 and 2022, compared to 2.5 kg/ha in Albania). In Albania, some Mediterranean soils have different chemical properties and lower fertiliser requirements; however, low levels may also indicate deficiencies and low productivity. It should also be noted that fertilisation levels in Poland decreased during the review period, whereas nitrogen and potassium fertilisation increased and phosphorus fertilisation decreased in Albania (see Table 3). The reduction in fertilisation in Poland is likely due to pro-environmental changes in the instruments of the Common Agricultural Policy (CAP).

Table 3. Cropland nitrogen, phosphorus and potassium per unit area in Albania and Poland in 2010-2022 (kg/ha).

Years	Cropland nitrogen per unit area		Cropland phosphorus per unit area		Cropland potassium per unit area	
	Albania	Poland	Albania	Poland	Albania	Poland
2010	30.6	77.8	8.1	14.3	0.8	30.3
2011	37.1	76.2	9.3	12.7	0.8	27.2
2012	44.1	84.2	9.1	13.2	1.0	26.6
2013	33.8	78.4	9.2	11.9	1.2	33.1
2014	41.2	71.0	9.9	10.5	1.3	32.1
2015	48.3	74.0	11.2	11.3	1.7	34.9
2016	50.9	82.2	14.0	12.0	2.1	37.1
2017	48.0	83.5	11.5	11.8	1.5	37.0
2018	36.4	70.0	6.8	11.9	2.9	37.3
2019	54.7	72.6	8.8	12.4	4.8	36.6
2020	47.8	67.6	11.6	11.4	5.5	34.5
2021	41.9	64.6	7.5	10.6	7.4	32.4
2022	34.5	61.2	2.2	10.2	2.1	27.8

Source: Own study based on FAOSTAT data.

Agricultural activities are a significant source of greenhouse gas (GHG) emissions, which have a negative impact on the environment and accelerate climate change. The level of GHG emissions from agriculture is influenced by various factors, including land use, the intensification of agricultural activities, livestock farming, and the use of fertilisers and pesticides (Murawska et al., 2023). The proportion of total national GHG emissions attributable to the agricultural sector reflects the importance of agriculture as a source of emissions. In Poland, for example, the primary sector accounted for around 12–13% of national emissions between 2010 and 2022 (see Table 4), with only minor variations. This percentage is slightly higher than the EU average and has remained relatively stable for decades (Genstwa & Zmyślona, 2024). However, this is also due to the fact that Poland's agricultural sector is one of the largest in the European Union (Wąs et al., 2020). The stable, high proportion of GHG emissions from agriculture in Poland shows that reductions in this sector are not keeping pace with progress in energy and industry. The European Green Deal aims to achieve climate neutrality by 2050 (with a target of reducing emissions by 55% by 2030). Still, without accelerating GHG emission reductions in agriculture, these targets are at risk. In Albania, however, there has been a significant decrease in agriculture's contribution to emissions, dropping from 11.3% in 2010 to 7.2% in 2022. This suggests a relative reduction in agriculture's emission burden in the Albanian economy. This could be due to the dynamic development of other sectors (energy and transport), while maintaining the relative importance of agriculture in the economy, as well as improvements in agricultural practices. This significant decline can be interpreted as a step towards a more sustainable economy, with agriculture playing a smaller role in emissions while other sectors develop. This trend aligns with the UN Sustainable Development Goals, particularly SDGs 12 and 13 (sustainable production and climate action), which aim to reduce the carbon footprint of food production at the national level.

The emission intensity per hectare of agricultural land reflects the intensity of emissions from agricultural land use. Poland is characterised by high emissions per unit of area, at around 4.8–4.9 t CO_2/ha throughout the analysed decade, increasing slightly to 5.0 t/ha in 2022. In contrast, emissions per hectare in Albania are lower, falling from 3.0 to 2.4 t/ha between 2010 and 2022. This difference suggests that Polish agriculture is more emission-intensive than Albanian agriculture. The higher emissions per hectare in Poland are likely due to greater saturation of intensive livestock production and high-commodity crops. This is accompanied by a higher use of artificial fertilisers, higher livestock density per unit area, and the mechanisation of fieldwork (Sargu et al., 2025).

Emission intensity per economic value of production (kg/Int$) measures the economic efficiency of emissions, i.e. how much greenhouse gas is emitted per unit of agricultural production value. A lower value indicates more sustainable, low-carbon production in relation to the economic benefits obtained. Both Poland and Albania saw a marked improvement in this indicator between 2010 and 2022, indicating the ongoing decarbonisation of agricultural productivity. In Poland, emissions fell from 2.5 to 2.1 kg/Int$, and in Albania from 2.1 to 1.2 kg/Int$. However, Poland started with slightly worse emission efficiency than Albania and still has higher emissions per unit of value (in 2022, it was 2.1 kg/Int$ in Poland versus 1.2 kg/Int$ in Albania). This means that Albanian agriculture currently generates 1 Int$ of value with GHG emissions of approximately 1.2 kg, whereas in Poland, the same value is associated with GHG emissions of 2.1 kg. Both countries have managed to partially decouple growth in agricultural production from growth in emissions, with Albania achieving this more quickly.

Analysis of the data in Table 5 enables assessment of Poland's and Albania's progress in achieving the selected indicators under Goal 2 of the UN 2030 Agenda ('End hunger, achieve food security and improved nutrition, and promote sustainable agriculture') between 2010 and 2023. Regarding indicator 2.1.1 (Prevalence of undernourishment (% of population)), a positive trend can be observed in Albania, where the value has steadily declined from 5.4% in 2010 to approximately 4.3–4.5% between 2020 and 2022. Throughout the analysed period, Poland has kept this indicator below the 2.5% threshold, indicating effective food policy and a high level of food security (Klikocka et al., 2022). In contrast, indicator 2.1.2 (prevalence of severe food insecurity) shows significant differences between the analysed countries. In Albania, this indicator remained relatively high from 2015 onwards, initially standing at 10%, before gradually declining to around 7.5–8.2% between 2020 and 2022. In Poland, however, this indicator was significantly lower, reaching a minimum of less than 0.5% in 2018. This confirms the stability of the food system and the limited occurrence of serious problems accessing food.

Table 4. Greenhouse gas emissions in agriculture – selected indicators for CO2.

Years	Emissions indicators share Farm gate (%)		Emissions per area of agricultural land[1] Farm gate (t/ha)		Emissions per value of agricultural production[2] Farm gate (kg/Int$)	
	Albania	Poland	Albania	Poland	Albania	Poland
2010	11.3	13.3	3.0	4.9	2.1	2.5
2011	10.9	11.4	3.1	4.7	2.0	2.5
2012	9.7	12.0	3.1	4.8	1.9	2.4
2013	9.0	11.8	3.1	4.8	1.9	2.4
2014	9.4	12.4	3.2	4.8	1.9	2.2
2015	10.1	12.3	3.2	4.8	1.8	2.3
2016	9.6	12.1	3.2	4.8	1.8	2.2
2017	9.8	12.0	3.2	4.9	1.8	2.2
2018	9.0	12.0	3.1	4.9	1.6	2.3
2019	9.5	12.9	2.9	4.9	1.6	2.3
2020	8.8	13.5	2.7	4.8	1.4	2.1
2021	7.4	12.2	2.5	4.8	1.3	2.1
2022	7.2	12.8	2.4	5.0	1.2	2.1
2023	N/A	N/A	N/A	N/A	N/A	N/A

Note: N/A = data not available
Source: Own study based on FAOSTAT data.

Regarding indicator 2.a.1, which is government expenditure on agriculture as a percentage of total budget expenditure, Albania has consistently allocated a higher proportion of funding to agriculture than Poland. During the analysed period, this share increased from 1.69% in 2010 to 2.48% in 2023. However, despite Albania's higher share of expenditure, the relative size of its state budget means that real resources may be limited. In contrast, Poland has experienced a downward trend, with the share decreasing from 1.75% in 2010 to 1.17% in 2023. This suggests that Poland may be more dependent on external funds, particularly EU funds, while Albania is increasing its budgetary commitment to the agricultural sector despite its smaller overall resources. Implementing SDG 2 must be aligned with the EU Green Deal, which promotes reducing pesticides, synthetic fertilisers, and CO_2 emissions. As an EU member state, Poland is formally committed to implementing the 'Farm to Fork' and 'Biodiversity 2030' strategies, which will transform the agricultural system. As a country aspiring to join the EU, Albania must gradually adopt these standards, which will entail higher adjustment costs.

Table 5. Selected indicators for the achievement of SDG 2: 'End hunger, achieve food security and improved nutrition, and promote sustainable agriculture'.

Years	2.1.1 Prevalence of undernourishment (%)		2.1.2 Prevalence of severe food insecurity in the population (%)		2.a.1 Agriculture share of Government Expenditure (%)	
	Albania	Poland	Albania	Poland	Albania	Poland
2010	5.4	<2.5	N/A.	N/A	1.69	1.75
2011	4.8	<2.5	N/A	N/A	1.66	1.67
2012	4.5	<2.5	N/A	N/A	1.57	1.51
2013	4.4	<2.5	N/A	N/A	1.74	1.3
2014	4.5	<2.5	N/A	N/A	1.74	0.92
2015	4.4	<2.5	10.0	1.9	1.95	0.88
2016	4.3	<2.5	10.5	1.0	2.95	1.02
2017	4.3	<2.5	11	0.7	2.21	1.05
2018	4.2	<2.5	10	0.5	2.2	1.18
2019	4.3	<2.5	8.8	<0.5	2.04	1.13
2020	4.4	<2.5	7.7	0.8	2.08	1.17
2021	4.3	<2.5	7.5	0.9	2.76	0.95
2022	4.5	<2.5	8.2	0.8	2.54	1.38
2023	N/A	N/A	N/A	N/A	2.48	1.17

Note: N/A = data not available
Source: Own study based on UNSTAT.

Over the past thirty years, considerable discussion has taken place on how to define 'sustainable agriculture'. As agriculture contributes to development in various ways, including as an economic activity, a source of livelihood and a provider and user of environmental services, the 2030 Agenda recommends considering all sectors, including agriculture, in terms of the three dimensions of sustainability: economic, social and environmental.

SDG indicator 2.4.1 is defined as the proportion of agricultural land used for productive and sustainable agriculture. Historically, this was primarily defined in environmental terms. If the soil was poor or water was not managed well, a farm might have been considered unsustainable. However, in recent years, it has been recognised that sustainability

encompasses economic and social dimensions, putting farmers at the centre. A farm cannot be considered sustainable if it is not economically sound, resilient to external shocks or if the well-being of its workers is not considered.

The FAOSTAT statistical databases on sustainable development contain no data for Albania or Poland for SDG indicator 2.4.1. However, estimates for both countries can be found on the UN website. For Albania, the 'Progress towards productive and sustainable agriculture, current status score' indicator (PROXY 2.4.1) was 3.67 from 2015 to 2022, rising to 3.83 from 2022 to 2023. For Poland, this indicator was 4.14 from 2015 to 2023. A trend score calculation of the same indicator is more favourable for Albania, with values of 3.5 in 2015, 4.0 in 2016 and 2019, 4.33 in 2017, 4.5 in 2018, 4.67 in 2020 and 2021, and 4.83 in 2022. The highest value of this trend score indicator for Poland was 5.0 in 2016. From 2017 to 2023, the average was 4.43, except for 2018 and 2019, when it was 4.29 and 4.14, respectively.

DISCUSSION

The evaluation of agricultural efficiency within the EU Green Deal framework requires an examination of farming practices, along with their challenges and opportunities, through a comparative analysis between Poland and Albania. The European agricultural sustainability case studies in Poland and Albania demonstrate the broader EU sustainability patterns. The EU Green Deal, launched in 2019, serves as an extensive plan to achieve sustainability by focusing on multiple industrial sectors, including agriculture. The EU Green Deal establishes environmental targets for emission reduction and sustainable farming operations that align with the UN SDG goals. The Green Deal's goal includes developing a sustainable agricultural system which fights climate change while preserving biodiversity and securing food availability across EU territories (Eckert and Kovalevska, 2021; Wicka & Wicki, 2023). The Common Agricultural Policy (CAP) in Poland moves towards more sustainable environmental practices in its current implementation. The support includes both agri-environment-climate measures (AECM) and organic farming programs which demonstrate this commitment (Boix-Fayos & Vente, 2023; Rudnicki et al., 2021). Farmers receive guidance on reducing environmental impacts through these programs, which support SDG goals for sustainable ecosystem management. The agricultural sector in Albania faces specific challenges due to the prevalence of small-scale ownership and informal cultivation methods (Shkembi et al., 2024; Sinaj & Sulaj, 2024). The agricultural policies in place encounter difficulties in driving major progress because they operate under weak institutional systems, which reduce the success of sustainable development policies in achieving significant progress (Osmani et al., 2022). This determines the level of agricultural efficiency. The research presented in this study has shown that Polish agriculture is characterised by higher labour productivity than Albanian agriculture. However, numerous studies prove that it remains among the lowest in the EU (Ściubeł, 2021; Kołodziejczak, 2025). Differences between the countries studied have also been identified in terms of other agricultural characteristics in the context of sustainable development. These include the scale of organic farming and trends in mineral fertilisation levels. The EU recognises the benefits of organic agriculture for sustainable development. In its Farm to Fork Strategy and EU Biodiversity Strategy for 2030, the Commission set the target of 'allocating at least 25% of EU agricultural land to organic farming and significantly increasing organic aquaculture by 2030'. These two strategies are key documents that point the way towards transforming European agriculture (Nowak & Kobiałka, 2024). Although Poland is far from achieving its target, the percentage of agricultural land under organic production is significantly higher than in Albania. Sustainable agricultural practices supported in the EU include the optimal use of mineral fertilisers. Research has shown that Polish farmers have reduced their use of mineral fertilisers, which is likely due to the implementation of CAP instruments. Similar observations were made in Piwowar's (2021) research. In contrast, farming practices in Albania rely on traditional methods and lack effective sustainable fertiliser strategies, which could result in soil damage and a decline in agricultural productivity over time (Shkembi et al., 2024).

In light of the European and global sustainable development agenda, a comparative analysis of Poland and Albania in terms of agricultural efficiency and GHG emissions provides valuable insights. As an EU member state, Poland is subject to EU policy frameworks such as the European Green Deal and the reformed Common Agricultural Policy (CAP) for the period 2023–2027. Given the high and stable proportion of emissions attributable to agriculture (approximately 13%), Poland must involve the agricultural sector more strongly in climate action if it is to meet its national reduction targets, in line with some other EU countries that have not yet achieved theirs (http://eea.europa.eu). Under the new CAP, each EU country is implementing a CAP Strategic Plan that commits to achieving better environmental outcomes than in the previous period (http://agriculture.ec.europa.eu). In practice, this involves the introduction of eco-schemes, whereby at least 25% of direct payments will be allocated to climate- and environmentally friendly measures such as organic farming, agroecology, soil carbon management and animal welfare. Additionally, 40% of the total CAP budget is earmarked for climate objectives. These measures are expected to result in lower emissions per hectare and per unit of production.

Funding approaches differ substantially between Poland and Albania. The EU funding stream supports various agricultural sustainability and climate resilience programs in Poland, which align with the EU Green Deal goals. Albania depends on internal funding sources yet experiences inconsistent outcomes because its agricultural policies require strong governance systems and effective resource management (Osmani et al., 2022). External geopolitical stressors affecting Albania make it challenging to implement effective agricultural policies (Leonard et al., 2021). The agricultural sector needs complete reforms with supporting structures to help producers switch to sustainable practices which meet domestic and international requirements.

The dual focus on efficiency and sustainability demonstrates the interlinked nature of agricultural operations with environmental targets. The European Green Deal establishes common standards for sustainable practices while enabling Member States to implement their own adjustments (Rudnicki et al., 2021; Wicka & Wicki, 2023). The absence of an established structure in Albania presents a significant challenge to achieving sustainable agriculture (Osmani et al., 2022).

An analysis of agricultural efficiency and the extent to which selected sustainable development goals related to agriculture have been achieved shows significant differences between Poland and Albania. These differences in agricultural systems stem from variations in infrastructure support, institutional systems and capacity for sustainable innovation. Effective agricultural practices in Poland and specific strategies tailored to Albania's needs must be implemented within coordinated national plans to support agricultural efficiency and other sustainable development goals.

CONCLUSIONS

This study evaluates Poland and Albania in terms of the agricultural efficiency these countries have achieved about the Sustainable Development Goals. The study not only verifies the research hypotheses, but also provides practical guidelines for further agricultural reforms in both countries in the context of Agenda 2030 and EU policies. The research hypotheses were verified positively in most cases, i.e., H2 and H3 were confirmed, due to the research conducted using the index method based on data from the FAOSTAT and UNSTAT statistical databases. However, hypothesis H1 was only partially confirmed: while Poland shows higher labour productivity in agriculture, Albania shows higher land productivity. Poland's membership in the European Union for more than twenty years has significantly impacted the state of the agricultural sector, partly through the instruments of the Common Agricultural Policy, which are increasingly pro-environmental. This has increased the productivity of production factors, although labor productivity in Poland remains relatively low due to high employment levels. Comparing Poland and Albania reveals differences that result not only from different development conditions (within and outside the EU) but also from distinct agricultural and production structures. These differences result in higher labour productivity in Polish agriculture, as well as higher yields of cereals and sugar beets, but lower land productivity. This highlights the need for further structural changes in agriculture in both countries, as well as the need to capitalise on development opportunities, such as EU membership for Poland and pre-accession programmes for Albania.

The results of the comparison between Poland and Albania demonstrate that it is possible to improve the environmental performance of agriculture. Greenhouse gas emissions concerning land area and production are decreasing, particularly in countries at an earlier stage of modernisation, such as Albania. However, despite this progress, Polish agriculture is still characterised by high greenhouse gas (GHG) emissions, meaning further adaptation efforts are needed. From an EU policy perspective, these data confirm the validity of the chosen reform path: agriculture must become more climate-friendly without compromising productivity. This requires implementing the best available practices (e.g. precision farming, afforestation and methane-reducing feed additives) and making full use of CAP instruments to finance the green transformation of rural areas. Only by doing so will it be possible to ensure food security (SDG 2) while reducing agriculture's impact on the climate crisis (SDG 13), in line with the principles of responsible production and consumption (SDG 12).

A comparative analysis of Poland and Albania reveals a significant disparity in their progress towards achieving SDG2, which is rooted in differences in economic capacity, policy support and agricultural structure. Poland's success in virtually eliminating hunger and boosting agricultural efficiency demonstrates how coherent policies and investments (supported by EU membership) can achieve the SDG2 targets. Poland's remaining agenda focuses on ensuring nutrition for all and sustainability, addressing issues such as healthy diets and the environmental impact of farming. In contrast, Albania's challenge is more fundamental: it must continue to reduce hunger and food insecurity while simultaneously laying the groundwork for sustainable agriculture. This will require strong political commitment and strategic reforms to the agricultural and food sectors. Encouragingly, however, Albania's undernourishment rate has declined significantly over the past two decades, demonstrating that progress is possible. Boosting public expenditure on agriculture, supporting small farmers with training and credit, improving rural infrastructure and integrating into European markets and standards will help Albania address the root causes of its food insecurity. Such steps, combined with social programmes to protect the poorest in society, are critical for Albania to fulfil SDG2 – Zero Hunger. Poland's experience highlights that achieving SDG2 requires not only economic growth, but also inclusive and sustained policy support. For Albania, leveraging its EU integration process to advance agricultural reforms and food security initiatives could be a pivotal strategy. Ultimately, SDG2 will only be realised when both countries ensure that all people have access to sufficient, nutritious food and that their agricultural systems are efficient, resilient and sustainable, each in their own context. This comparative study highlights this goal, showing how far Poland has come and how far Albania still has to go in the decade of action towards 2030.

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