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LABOUR PRODUCTIVITY AND THE AGE OF THE FARM OPERATOR IN POLAND

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Purpose: The main objective of this study was to determine how the age of the farm operator in Poland affects the level of labour productivity. In addition, the study also examined changes in labour productivity over time and included a causal analysis.
Design/methodology/approach: Labour productivity was measured as gross farm income (GFI) per annual work unit (AWU). Indicator changes over time were assessed using an index of dynamics, and a causal analysis of the changes observed during the study period was carried out using the functional method.
Findings: The analysis indicates that the highest labour productivity was achieved by farm operators in the 30-39 age group, amounting to PLN 102,261.53 per AWU in 2023. The curve illustrating the relationship between age and labour productivity has a convex shape, resembling an inverted U. Labour productivity increased across all age groups during the study period. Farms managed by the youngest operators recorded the highest increase in labour productivity, with a 53% growth. The analysis of changes in the labour productivity indicator showed that the overall increase in labour productivity of Polish farms between 2014 and 2023 was primarily driven by an increase in the capital-labour ratio, and, to a lesser extent, by higher productivity of fixed assets.
Research limitations/implications: An interesting direction for future research could be an in-depth analysis of the extreme age groups of farm operators. This would allow for a better understanding of intergenerational relations and their effect on production outcomes and farm labour productivity.
Social implications: The results indicate that all analysed age groups of farm operators require systemic support aimed at improving labour productivity in agriculture. Particular attention should be given to farmers aged above 50.
Originality/value: This article fills a gap in research concerning the relationship between age and labour productivity in Polish agriculture. Existing studies have mainly focused on the ageing of farmers and the need to support young agricultural producers. This publication highlights the remaining age groups and identifies possible measures that can be undertaken.
Keywords: labour productivity, agriculture, age.
Category of the paper: Research paper.

1. Introduction

In every economic system or process, the human factor plays a fundamental role (Ślusarz, 2024). The significance of human involvement in the production process and in the development of enterprises was recognised more than two centuries ago; however, it was only in the twenty-first century, together with dynamic changes in the operating mode of organisations, that human capital came to be regarded as the most important of all resources (Załoga, Ciekanowski, 2017).

It should be emphasised that the importance of the human factor and its impact on outcomes increase with the overall level of economic development. This is reflected in the ability to adapt effectively to constantly changing natural, economic, organisational and social conditions. Agricultural holdings, like all economic entities seeking to remain on the market and develop, must undergo change (Gradziuk, 2008).

Many authors emphasise that the efficiency with which farm resources are used largely depends on the individual, particularly their knowledge, experience, skills, ambitions, and motivations, beliefs and predispositions (Kozera, 2010; Grzybowska, 2015). Such an approach is consistent with the definition of human capital adopted by the OECD, according to which human capital refers to the knowledge, skills, competences and attributes of individuals that facilitate the creation of personal, social and economic well-being (Keeley, 2007). In agriculture, human capital is limited to the owners of agricultural holdings and their immediate family members, including potential successors (Brodzińska, 2017).

Food security remains a key issue in the contemporary world (Nowak et al., 2023). To ensure food security, it is necessary not only to secure sufficient agricultural land and increase food production, but also to maintain and develop human resources.

At present, this task is difficult to accomplish mainly due to unfavourable demographic changes, such as population ageing and the lack of generational succession, as well as the movement of labour to other sectors of the economy, which ultimately leads to the abandonment of agricultural production.

Therefore, particular attention should be paid to the role of human capital in the specific and important sector of the economy that agriculture represents, as well as to the values that determine the direction of change and shape the competitive advantage of entities operating in agriculture (Kołoszko-Chomentowska, 2008).

The article is structured as follows: the next section presents a literature review on the impact of farmers' age on labour productivity, followed by an overview of the demographic situation in Polish agriculture compared with that of the European Union (EU), the research material, and the methods. The remaining sections provide the results obtained and the concluding remarks.

2. Literature review

Farmers' age is considered an important factor shaping labour productivity and the capacity of farms to adopt new technologies. Studies in this area demonstrated that the relationship between age and productivity is generally non-linear: productivity increases with experience, reaches a maximum in middle age, and then gradually declines (Karinika-Murray et al., 2024). This mechanism has been empirically confirmed by the studies of Tauer (2019) and Tauer and Lordkipanidze (2000), which observed an inverted U-shaped curve, where both young and older farmers exhibit lower efficiency than middle-aged agricultural producers.

In recent years, research on human labour productivity in agriculture has primarily focused on the issue of workforce ageing (Tong et al., 2024; Zhang et al., 2025). It is anticipated that an increasing share of older farmers in the population structure of agricultural holdings will lead to a decline in labour productivity, particularly in less mechanised farms (Satoła, 2019; Liu et al., 2023). Furthermore, several authors (e.g. Tong et al., 2024; Kasztelan et al., 2019) indicate that workforce ageing hampers technological progress and reduces the efficiency of resource allocation, negatively affecting total factor productivity in agriculture. One of the most frequently cited reasons for older farmers' reluctance to modernise is their lower propensity to invest, especially over the long term (Russo et al., 2024; Hamerska, Roczkowska-Chmaj, 2008). Research by Brown, Daigneault and Dawson (2019) confirms that investment decisions are less frequently undertaken on farms operated by older farmers, as they tend to be more risk-averse and less willing to adopt innovations. Older farmers, in contrast, tend to operate their farms according to established family patterns, continuing production until formal requirements are met, and then transferring the farm to successors upon retirement or pension (Hamerska, Roczkowska-Chmaj, 2008).

There are also other studies which provide slightly different findings. Liu et al. (2020) found that the ageing of the agricultural workforce has no negative effect on agricultural production. According to these authors, a decline in physical strength with age clearly compromises productivity. On the other hand, older farmers tend to have more experience in agricultural production than younger workers, which contributes to improved productivity. Due to their experience, they can rely on their knowledge and skills to deploy inputs more effectively (Latruffe, 2010).

The literature review indicates that labour-related issues in agriculture are a significant area of interest among researchers. Farmers' age is an important determinant of their productivity, particularly in the context of an ageing workforce. However, the relationship between age and labour input productivity in Polish farms has not been examined in recent studies. For this reason, it was considered important to assess how the age of the farm operator relates to the level of and changes in labour productivity of agricultural holdings in Poland, which constitutes the main objective of this article. Therefore, the following research hypotheses were formulated:

1. The relationship between a farmer's age and their labour productivity is non-linear (inverted U-shaped curve).
2. The youngest farm operators achieve the highest growth rate in labour productivity due to a higher rate of increase in the capital-labour ratio compared with other age groups.

3. The Demographic Situation of Agriculture in Poland in the Context of the European Union

Over the last decade, employment in agriculture in the EU declined from nearly 10,000 thousand to approximately 7,205 thousand, representing a decrease of almost 26%. In Poland, agricultural employment decreased by approximately 500 thousand, meaning that the rate of decline was slightly stronger and amounted to nearly 28% (Fig. 1). In 2023, the share of employment in agriculture in Poland accounted for approximately 8% of total employment (GUS, 2024).

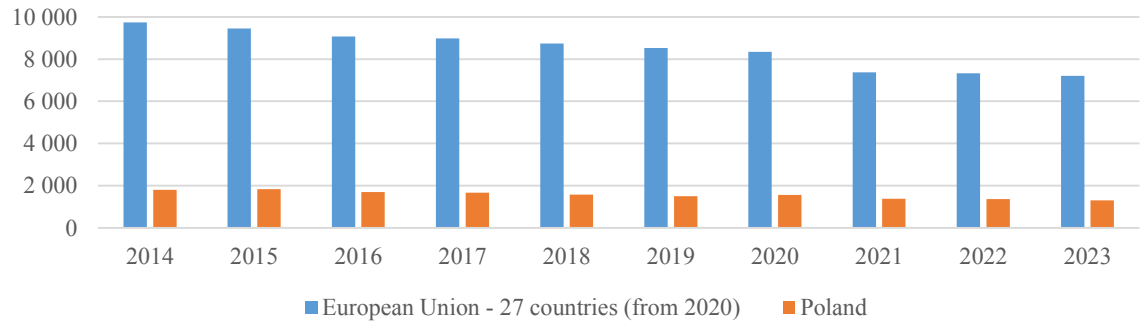


Figure 1. Employment in agriculture in the EU and Poland (thousand persons) from 2014 to 2023.
Source: Compiled by the author based on Eurostat.

Similar downward trends were also observed regarding the Gross Domestic Product (GDP) share of agriculture. In 2023, Polish agriculture generated 3.3% of the GDP, while industry and services each accounted for approximately 24%. The value added generated in agriculture increased from EUR 7 billion to more than EUR 22 billion over the past two decades. Over the twenty years following accession to the European Union, the added value generated by Polish agriculture increased from 3.7% to 8% of the total value added of agriculture in the EU, corresponding to a shift from eighth to fifth place **(**Instytut Finansów Publicznych, 2024).

In the age structure of employment across most sectors of the economy, middle-aged, that is, 40-64 years old workers were predominant (Fig. 2). In the agricultural sector, young people (15-39 years) accounted for nearly 32%. Middle-aged workers were the most numerous group, representing nearly 61%. The oldest farmers, aged over 65, accounted for just over 7% of the agricultural workforce in the EU.

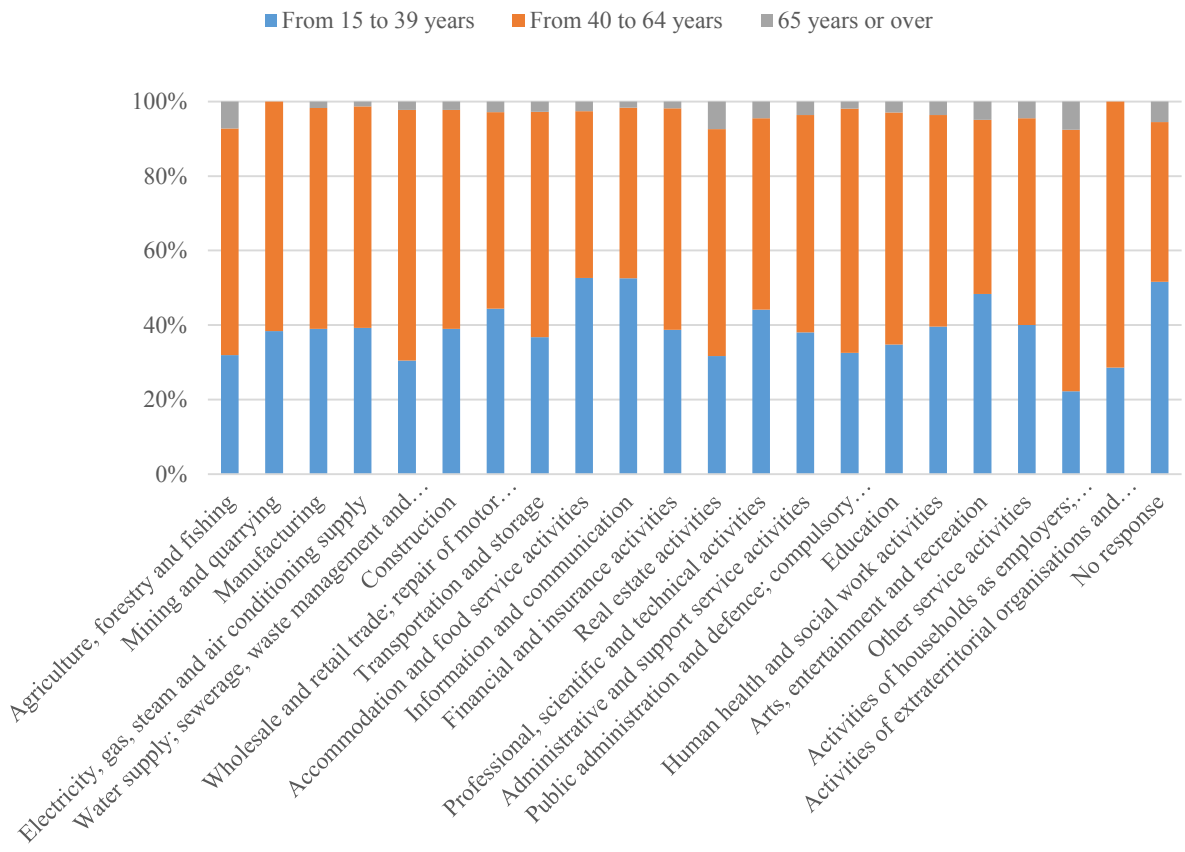


Figure 2. Employment structure by age in the EU economic sectors in 2023.

Source: Compiled by the author based on Eurostat.

Agriculture in the EU Member States is characterised by an ageing demographic profile, with the average age of farmers exceeding 57 years since 2020. Approximately 30% of agricultural holdings are managed by farmers aged below 40. Both the number and the share of young farm operators have been declining, which may be viewed as part of the broader trend of population ageing in the EU, particularly in rural areas (Commission…, 2026).

Significant differences in agricultural demographics exist among Member States. The largest number of farmers in the EU is recorded in Romania, which also translates into the highest percentage (over 33%) of the overall structure of farmers in the EU. Poland and Italy rank next, each accounting for approximately 14% of the EU farmer population. Spanish farmers constitute slightly less than 10% of the total population, Greek farmers more than 5%, and French farmers slightly below 5%. Farmers from the remaining countries together account for just under 19% (Fig. 3).

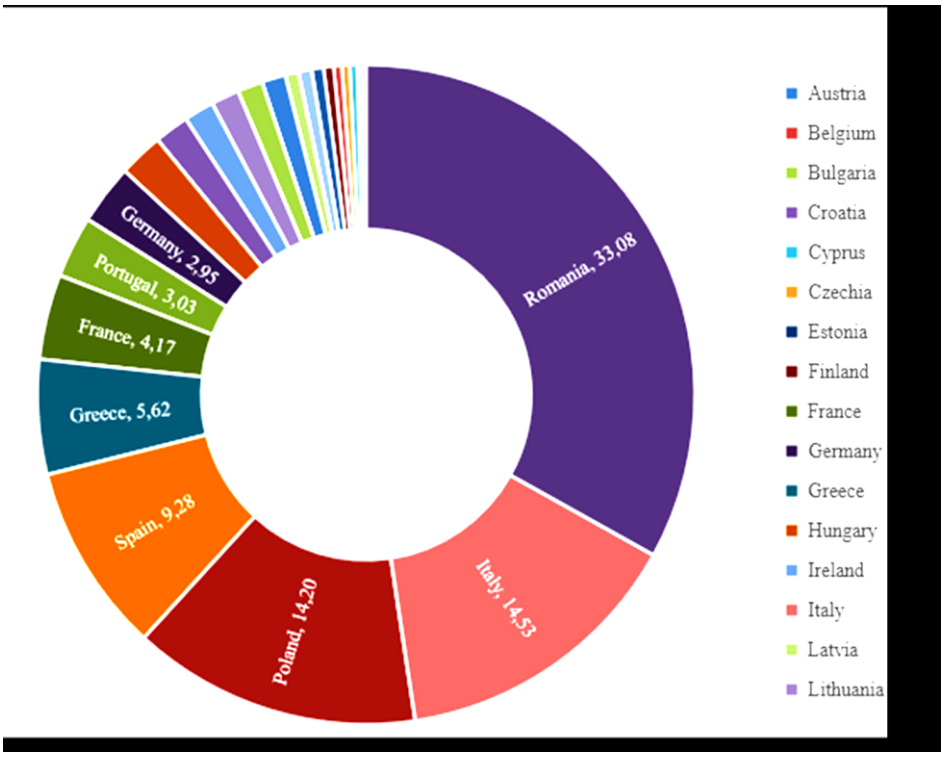


Figure 3. Structure of farmers in EU countries in 2023 (in %).

Source: Compiled by the author based on Agri-food Data Portal.

These relationships are also reflected in the structure of young farmers in the EU. The largest number of young farmers in the EU is found in Romania, accounting for 27% of the total population of young farmers in the EU, followed by Poland with 25% and Italy with 10%. Consequently, the overall EU results are strongly influenced by the situation in these Member States. The share of agricultural holdings managed by individuals under the age of 40 ranges from 23% in Austria to only 5% in Cyprus. The average age of farm operators is highest in Southern Europe (Commission…, 2026).

4. Material and Methods

The analysis presented in this article was carried out using unpublished and legally protected data from Poland, covered by the European Farm Accountancy Data Network (FADN). Data from the FADN system are used to shape the EU Common Agricultural Policy. Calculations were performed at the Institute of Agricultural and Food Economics – National Research Institute (IERiGŻ–PIB). A limitation of the research is that the FADN's scope is restricted to commodity farms, which are characterised by market-oriented production and a minimum production value of EUR 4,000. The research period extends from 2014 to 2023. The data used in this article were the most recent available in the FADN database. All calculations were performed taking into account the following age groups (Tab. 1).

Table 1.
Age groups and sample sizes in 2014 and 2023

Age	Sample size	
	2014	2023
<18-29)	823	853
<30-39)	2618	2395
<40-49)	3776	3090
<50- 59)	4111	2945
≥60	793	1738
Total	12121	11029

Source: Authors' elaboration based on the FADN.

Labour productivity of Polish farms was assessed using the labour productivity index. The numerator of this index included gross farm income (GFI), as indicated in the literature as one of the most frequently used categories for analysing the efficiency of production factors (Kubik, Zakrzewska, 2024). GFI includes the total production value minus direct and overhead costs (excluding external factor costs such as depreciation, hired workforce, lease payments, and interest), adjusted for the balance of subsidies and taxes related to operating activities (Pawłowska-Tyszko, Osuch, Płonka, 2023). The denominator of the index consisted of annual work units (AWU).

In the next step, the dynamics of labour productivity were assessed, taking into account the direction and magnitude of the effects of the following factors:

a) capital-labour ratio (*FA/AWU*),

b) productivity of fixed assets (*TO/FA*),

c) gross farm income ratio (*GFI/TO*).

The impact of changes in individual factors on the labour productivity development in the analysed period was estimated using the functional method (Kubik, Zakrzewska, 2024). This method enables the identification of the sources of deviations in the analysed phenomenon and the determination of the direction and magnitude of the impact of individual factors (Sierpińska, Jachna, 2004).

5. Results and Discussion

Gross farm income per full-time worker in the analysed agricultural holdings was highest in the 30-39 age group in both 2014 and 2023 (Fig. 4). Labour productivity in this group amounted to PLN 76,313.67 per AWU and PLN 102,261.53 per AWU, respectively.

In subsequent cohorts, labour productivity declined in the group of farms managed by farmers aged over 60, where the value of the indicator was higher than that recorded for the youngest age group (18-29 years) in 2014. In 2023, in contrast, it was slightly lower than in that group. Such a phenomenon has not been previously reported in the literature. This situation

may result from farms being effectively operated by successors, i.e. young people, even though formal ownership remained with representatives of the older generation.

The resulting curve illustrating the relationship between age and labour productivity is convex, initially rising and then declining as the farmer's age increases. At later stages of life, farm operators tend to reduce their involvement in farm management in favour of ensuring material stability, increasing consumption, and allocating more time to rest. Particularly in the absence of a successor, farmers often withdraw from agricultural activity by reducing the scale of operations in order to decrease the workload, leasing out or selling land, and cultivating the remaining land less intensively. Lobley et al. (2010) describe this phenomenon and refer to it as the "retirement effect". The resulting curve is consistent with the findings reported by Tauer (2019), which show that the highest labour productivity was achieved by the 35-44 age group and that the curve takes the form of an inverted U-shape. This supports the first hypothesis concerning the non-linear relationship between farmer age and labour productivity.

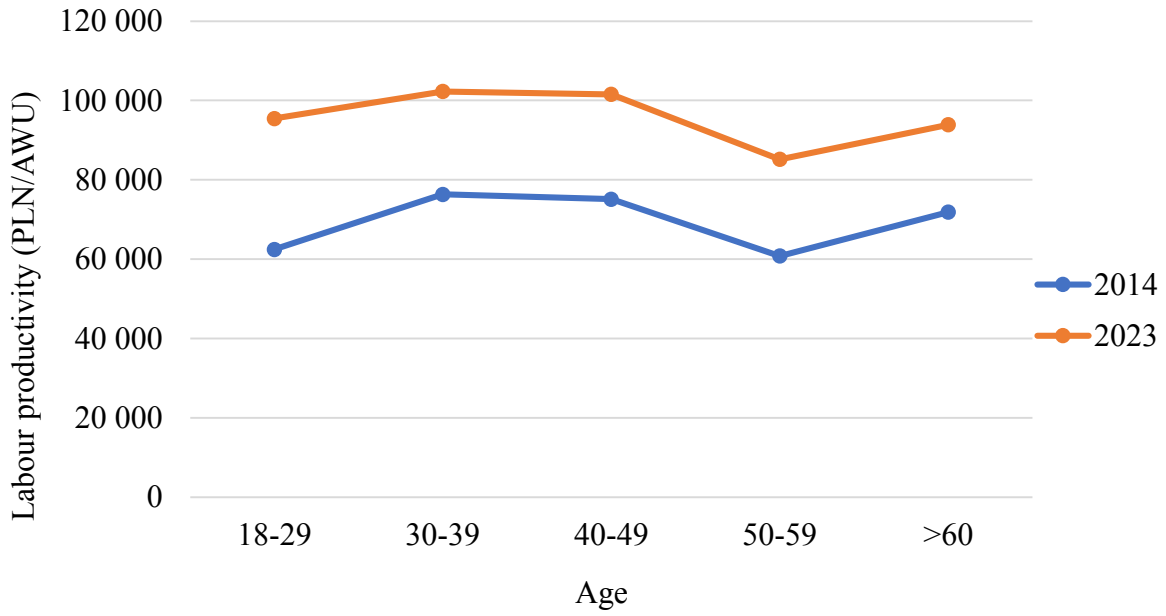


Figure 4. Labour productivity (PLN/AWU) by age groups in 2014 and 2023.

Source: Authors' elaboration based on the FADN.

The labour productivity dynamics indices for all age groups exceeded 100%, with an average value of 138%. This means that in all analysed farms, each full-time worker contributed to generating a higher GFI in 2023 compared to 2014. The largest increase in labour productivity over the analysed period was recorded in farms managed by the youngest farm operators (dynamics = 153%). Notably, farms with the highest labour productivity levels were characterised by dynamics below the average. Farms from the second and third cohorts recorded indices of 134% and 135%, respectively. In contrast, the lowest dynamics were observed in farms managed by the oldest farmers (131%).

The results of a deterministic analysis of changes in labour productivity ratio showed that the observed overall increase in the labour productivity of agricultural holdings Poland between 2014 and 2023 was 96% due to an increase in the capital-labour ratio, 33% due to an increase in the fixed assets productivity and 28% due to an increase in the share of gross farm income in total output (Fig. 5).

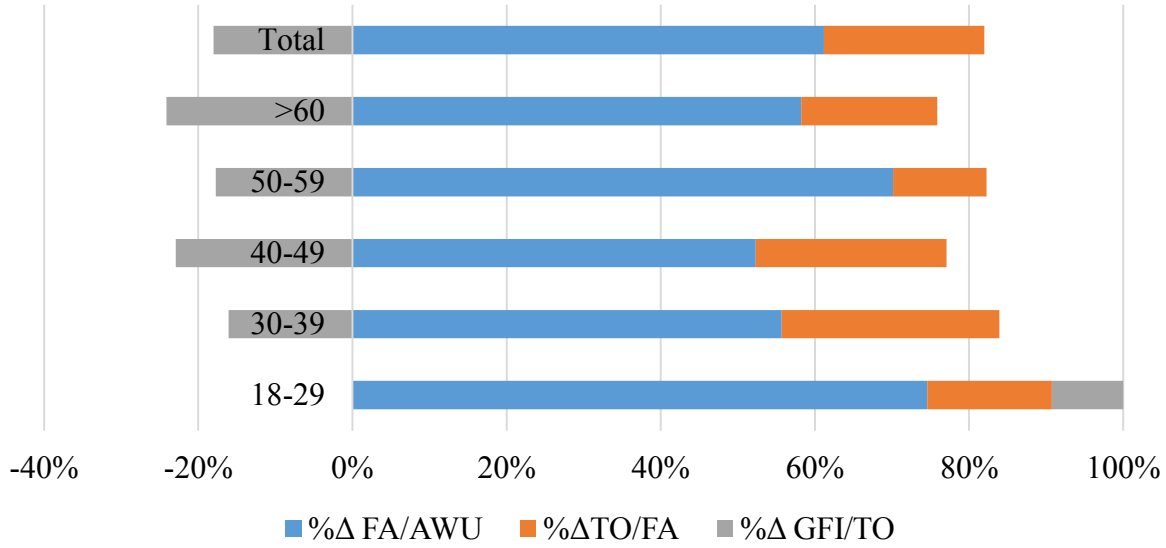


Figure 5. The impact of changes in the capital-labour ratio (ΔFA/AWU), productivity of fixed assets (ΔTO/FA), and the gross farm income ratio (ΔGFI/TO) on changes in labour productivity (ΔGFI/AWU) by age group of farm operators in Poland in 2014–2023 (PLN/AWU).

Source: Authors' elaboration based on the FADN.

The most significant factor influencing labour productivity across all age groups was the capital-intensive factor (capital–labour ratio), although, considering the absolute value, the differences between cohorts were not substantial.

The contribution of the gross farm income ratio was negative for labour productivity changes in almost all age groups. Only in the youngest cohort was this parameter higher in 2023 than in 2014, indicating that this group is able to generate a larger surplus from farm operations. This may result from younger farm owners seeking highly profitable agricultural production directions and, consequently, more flexibly adapting to turbulent market conditions. Based on the results obtained, the second hypothesis cannot be fully supported. During the analysed period, the youngest farm operators achieved the highest growth rate of labour productivity, but this was not due to a higher dynamics of the capital–labour ratio than in other age groups. Instead, it resulted from the favourable impact of the gross farm income ratio relative to total output.

Farmers from cohorts with the highest labour productivity (2 and 3) stood out during the analysed period due to the highest contribution of fixed asset productivity to growth. More experienced farmers are often more attached to their chosen production direction (e.g. cereal cultivation) and the resulting specialisation, which allows for better adaptation and utilisation of available farm machinery.

6. Summary

The study aimed to determine labour productivity level, measured as gross farm income per annual work unit, of agricultural holdings in Poland depending on the age of the farm operator, and the reasons for its change between 2014 and 2023.

The analysis indicates that the highest labour productivity was achieved by farm operators in the 30-39 years group and amounted to PLN 102,261.53 per AWU in 2023. The curve illustrating the relationship between age and labour productivity has a convex shape, resembling an inverted U, which supports the first hypothesis.

It was noted that the group of farmers aged over 60 achieved higher labour productivity than the 50–59 age group during the analysed years, and also exceeded that of the youngest age group (18–29 years) in 2014; although, in 2023, the indicator was slightly lower than for the youngest farmers. This may be due to situations in which a young farmer is effectively managing the farm while the parents (aged over 60) remain the formal owners.

During the analysed period, labour productivity increased across all age groups. The largest growth was recorded in farms managed by the youngest operators (an increase of 53%), which supports the first part of the second hypothesis. However, the second part of this hypothesis cannot be confirmed, as the growth in labour productivity was achieved due to a higher increase in the gross farm income ratio than in other age groups, rather than through changes in the capital–labour ratio. Young farmers do not immediately invest in new technologies. This may result from a lack of experience or resources for investment, or from seeking alternative ways to improve farm profitability (e.g. choosing the most profitable production directions). As reported by Hamerska and Roczkowska-Chmaj (2008), this situation may also arise because, in many cases, young farmers become owners only formally, while the actual management practices continue to be determined by their parents.

The analysis of changes in the labour productivity ratio showed that, for all age groups, the overall increase in labour productivity of Polish farms between 2014 and 2023 was primarily driven by an increase in the capital-labour ratio, and, further, by higher productivity of fixed assets.

In summary, encouraging young people to become more actively involved in agricultural production is a positive step towards increasing labour productivity. The average income in EU commercial agricultural holdings managed by young farmers is rising, although it remains lower than in other age groups (European Commission, 2025). Supporting young farmers and attracting young people to work in agriculture is one of the objectives of the European Commission's Strategy for generational renewal in agriculture under the planned Common Agricultural Policy for 2028-2034 (Commission…, 2026). Advisory programmes and support should also be targeted at other age groups. In particular, programmes that promote the continuation of investments by farmers aged over 50 would be highly beneficial, as they could help prevent a decline in labour productivity.

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