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Labour Productivity and Employment in Agriculture in the European Union

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Abstract:

Purpose: *The aim of the study is to estimate the level of agricultural employment at which labour input productivity is equal to non-agricultural productivity, i.e. in a situation of intersectoral labour productivity equilibrium.*
Design/methodology/approach: *This paper considers agricultural labour inputs in the context of their productivity as measured by gross value added (GVA) per AWU. The level of agricultural employment at which GVA per AWU in agriculture will equal the GVA created by 1 AWU outside agriculture is sought. This is conventionally referred to in the article as 'optimal' employment. Excess employment above this level is called "unproductive" employment in the article. The calculated employment level does not take into account the actual demand for labour. It is therefore a reference point in the formulation of policies for the evolution of the sectoral structure of employment and not its objective sensu stricto.*
Findings: *The existence of potential over-employment is a common phenomenon in the EU, but it places more of a burden on less developed and less prosperous countries. The situation varies between countries. The relatively largest scale of overemployment in agriculture concerns Romania, Bulgaria and Poland, so the pursuit of optimal employment will be most difficult in these countries. The technologically determined labour demand in EU agriculture is higher than the calculated "optimal" level and varies seasonally. It is therefore necessary to strive in parallel to reduce labour demand and shape the "flexibility" of agriculture-related workers so that they can earn income from outside agriculture at times when their work is not necessary on the farms, and make up for labour shortages at times when work on the farms is concentrated.*
Practical implications: *modernisation and structural transformation processes in agriculture should continue to be supported. Support mechanisms should include, above all, the modernisation of production technologies, the implementation of innovations replacing human labour, including digitisation and artificial intelligence solutions, land concentration and complementary measures, i.e. the increase in the importance of services in production processes and the merging of farmers into production cooperatives and producer groups. Vocational education in rural areas should also be promoted, aimed at better matching the skills of the agricultural population with the needs of the non-agricultural labour market, and communication barriers should be countered so that reaching non-agricultural jobs does not mean having to move to the city or make long and costly commutes. Another area is the stimulation of non-agricultural or agriculture-related economic activities.*

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Originality/value: *The contribution of the article comes from setting a benchmark for the 'optimal' level of employment in EU agriculture and from estimating the distance between agricultural labour productivity in individual EU countries and non-agricultural sectors. The article also shows the differences that exist in this respect between the countries studied and points out the resulting practical implications.*

Keywords: *Labour productivity, labour input, agricultural employment, gross value added, European Union, international comparisons.*

JEL codes: *J21, J24, J43.*

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1. Introduction

The optimal use of factors of production and the level of productivity achieved is one of the most important elements influencing the rate of economic development (Kołodziejczak, 2020). High productivity facilitates investment decisions, motivating employees with satisfactory remuneration for their work and building their loyalty to their employer, as well as their well-being and personal freedom based on the certainty provided by financial self-reliance and private ownership (Block, 2002; Wegrzyn, 2005; Lawson 2026).

For countries, productivity means easier achievement of fiscal goals and effective pursuit of economic, social and environmental policies as well as a stronger international position and greater security through the ability to finance defence-related objectives (Neu and Wolf, 1994; Denamiel *et al.*, 2024).

According to the assumptions of the three-sector economic model, three sectors are distinguished: agriculture, industry and services. Their importance for the creation of employment and added value changes over time along with the development of the country, starting from the dominant role of agriculture, towards an increase in the importance of industry and then towards the dominance of the service sector. The direction of these changes has to do with the productivity of these sectors and their limited development potential under changing conditions. Factor productivity differs between sectors of the economy and changes occur in such a way that more productive sectors increase their importance while less productive sectors lose their importance (Kołodziejczak, 2024).

Developed and rich countries are characterised by the dominance of the service sector in the structure of employment and gross value added (GVA) creation. In some developed countries, industry is slightly more important alongside services. However, in both cases, the least productive sector and characterised by the lowest share in employment and gross value added (GVA) is agriculture (Kołodziejczak, 2020). The least developed and poorest countries are dominated by low-productivity agriculture, which, however, can also drive economic development at some stage (Herger, 2020).

In more developed countries, agriculture is more modern and productive, but despite this, productivity is most often significantly lower in agriculture than in non-agricultural sectors. In the European Union, there are no countries with a dominant role of agriculture in the economy, but the sectoral structure of their economies varies in terms of the share of sectors in employment and value added created (Kołodziejczak, 2020).

Notwithstanding the productivity debate, agriculture as a sector must exist to feed the resident population and has other, non-productive functions (FAO, 2007). It is also a sector that directly interacts with the environment and uses its resources (Yang *et al.*, 2024; Gallardo, 2024). All this makes agriculture, and with it the broader agri-food system, find an important place in the discussion of sustainable development including economic, social and environmental elements (Christiaensen, 2020; 2021; Coca *et al.*, 2023; Herman, 2024; Erdiaw-Kwasie *et al.*, 2024; Cristea *et al.*, 2022).

Agriculture is a sector where there is relatively low labour productivity and, at the same time, there may be a seasonal or long-term shortage of labour. This raises two issues to be addressed: increasing labour productivity in agriculture and ensuring the availability of sufficient labour to carry out production.

Agricultural labour surplus can be defined in relation to current agricultural production conditions (area structure of farms, level of production and mechanisation, development of the agricultural service zone, state of rural infrastructure, etc.) or potential, the release of which from agriculture is desirable, but depends on changes in agricultural production conditions related to production mechanisation and progress, which usually leads to a significant reduction in the need for agricultural labour (Frenkel, 2003; Kołodziejczak and Wysocki, 2015). Independent of technological conditions, with a relatively constant GVA created in agriculture and limited possibilities to increase it, it is advantageous to achieve the highest possible GVA with the lowest possible labour input.

This paper considers agricultural labour inputs, expressed as Annual Work Unit (AWU), which is the equivalent of the labour input of a full-employed person of 2120 hours of work per year, i.e., 265 working days of 8 hours of work per day (FADN, 2024) in the context of their productivity as measured by GVA per 1 AWU.

The aim of the study is to estimate the level of agricultural employment at which GVA per AWU in agriculture will be equal to the GVA created by 1 AWU outside agriculture , thus in a situation of cross-sectoral labour productivity equilibrium. In the study presented here, this level of employment will be conventionally referred to as "optimal employment" in agriculture.

The surplus of employment in agriculture above this level will be treated as "unproductive" employment or disguised potential unemployment, which takes into account productivity but does not take into account the technologically determined demand for labour.

Achieving, or approaching, 'optimal' employment requires changes in actual labour demand on farms, as it relates to labour productivity and not to actual labour demand. The calculated 'optimal employment' is therefore a reference point in the formulation of a policy for the evolution of the sectoral structure of employment and not its objective *sensu stricto*.

The article's contribution comes from setting a benchmark for the 'optimal' level of employment in EU agriculture and estimating the distance between agricultural labour productivity in individual EU countries and non-agricultural sectors. Knowing this level makes it possible to determine the scale of the necessary reduction in agricultural labour input, which is important information especially for agricultural policy.

The article also shows the differences in labour productivity between the countries studied and indicates the resulting practical implications. On the basis of the study, recommendations are made on the courses of action needed to improve labour productivity in agriculture.

2. Literature Review

Over-employment hinders the achievement of agricultural productivity growth (Plantinga *et al.,* 2002), especially in view of natural, market and institutional constraints, and is also an obstacle to achieving the goals of economic sustainability of agriculture (Borchers *et al.,* 2014). With limited possibilities to increase agricultural production and its profitability, this parameter determines to a large extent the income level of farmers, as it determines the number of people among whom the income obtained from the farm will be shared.

The excessive labour resources tied up in agriculture discourage efforts to modernise production, as investment or the use of services is often economically uncompetitive against the use of a cheap (low-paid) labour resource, especially if it is the farmer's own labour and that of assisting family members, and increasing its input does not change the real cost incurred. This is because the number of people in a farmer's household is relatively constant, and the mere fact of the real participation of some

or all people in the production process does not change the total stock of farm income to be distributed among household members, nor the number of people among whom this income has to be divided (Kołodziejczak, 2020)

Baer-Nawrocka (2016) points out that between 2000 and 2015, in terms of quantitative characteristics, the agricultural sector was losing importance in terms of its share in employment and domestic product creation, which was particularly evident in the group of post-socialist countries, and assesses these changes as the right direction of transformation in the economic structure of the countries studied.

This was associated with an increase in agricultural labour productivity in most EU countries, and especially in almost all the countries of Central and Eastern Europe. This was determined both by a systematic decline in the number of people employed in the agricultural sector and an increase in the added value generated by this sector. A special role in this process was played by capital functioning in agriculture in the form of modern means of production and the Common Agricultural Policy (CAP) instruments stimulating investment activity of farms.

Kołodziejczak (2020) examined the gross value added and agricultural employment of the European Union countries between 2000 and 2018. The research showed that the highest share of employment in agriculture was mainly characterised by post-socialist countries such as Romania, Bulgaria and Poland, while the lowest was found in Western European countries such as Luxembourg, Belgium, Germany, Sweden, and some Eastern European countries such as Slovakia and the Czech Republic.

The shares of employment in agriculture are a consequence of historical background, natural conditions and different farming traditions, so also in the group of Western European countries there were countries with a high share of employment in agriculture (Greece) and among Eastern European countries, countries with a low share (Slovakia, Czech Republic, Hungary).

Using the assumption that optimal use of labour resources occurs when labour is used in the most productive sectors, he compared GVA per full-time employee in agriculture and non-agriculture and estimated the surplus employment in agriculture of EU countries. The research showed that there is significant surplus employment in EU agriculture.

Popescu *et al.* (2021) report that the EU is a large employer in agriculture due to the specificity of production processes in this field, but that the share of agricultural employment in total employment is decreasing over time. Member States with agricultural employment higher than 8% are Poland, Romania, Italy, Spain and France. The level of labour productivity in European agriculture is mainly influenced by the value added obtained in the sector and agricultural labour input per annual work unit (AWU).

Based on a study covering the period 2011-2020, the authors conclude that value added showed an overall upward trend and labour inputs declined. More than three quarters of the EU's agricultural output came from seven countries: France, Germany, Italy, Spain, the Netherlands, Poland and Romania.

The largest contributors to value added are: Italy, France, Spain, Germany, Poland, the Netherlands, Romania and Greece, together accounting for almost 83%. Significant discrepancies were also noted regarding the value of agricultural production and value added across countries, and consequently different labour productivity.

Despite the relatively small added value produced by EU agriculture, the production structure and the technologies used require the involvement of significant labour resources, especially during periods of rush of field work, resulting in periodic labour shortages (Siudek and Zawojska, 2016; OECD, 2023). Agriculture is a sector in which the demand for labour fluctuates seasonally, so there can be alternating shortages and surpluses of employment on the same farm.

Christiaensen *et al.* (2021) in considering the problem of employment in sub-Saharan African agriculture list four pathways for dealing with technological employment shortages, these are, *Satisfy*, *Stretch*, *Substitute* and *Supplement*. Some of these may also be relevant to European agriculture. In the case of a labour shortage, farmers can satisfy and retain existing workers by offering them higher wages, less onerous working conditions, benefits and bonuses to make farm work more competitive (Satisfy).

This, however, requires sufficient farm income and does not solve any structural problem in the long term, other than the temporary or seasonal provision of labour. Agricultural employers can also increase the productivity of workers and thus reduce their numbers by better organising their work, improving technical equipment, increasing the degree of mechanisation and exploiting the gains of agrotechnical progress (*Stretch*). This path requires costly investments and openness to new agro-technical solutions and new technologies.

Another option (*Substitute*) may involve completely or partially replacing labourers with labour-saving technologies or relying on food imports instead of domestic production. Replacing human labour with machine labour through automation, digitisation and artificial intelligence (AI) technologies can accelerate the withdrawal of labour from agriculture in developing countries and transform farms and food processors in developed countries.

Alternatively, relying on food imports instead of domestic production requires policy decisions and the determination to implement them, as well as a skilful accurate assessment of the risks associated with losing some food self-sufficiency. Finally, farmers can supplement their existing labour force with foreign guest

workers (*Supplement*), but, like *Satisfy*, this does not solve the problem of low labour efficiency and productivity.

An opportunity to optimise agricultural employment and free up potentially redundant labour resources may also lie in the use of agricultural services, which not only replace in-house labour, but enable the use of modern and efficient machinery without burdening farms with the cost of purchasing it. By making fuller use of the potential of the machinery and its efficiency and reducing labour input, the service can also be cost-competitive and profitable for the farm (Kolodziejczak, 2024).

Therefore, to the four pathways proposed by Christiaensen *et al.* (2021) four pathways, a fifth can be added: *Services*. A similar effect can be achieved by bringing farmers together in production cooperatives or producer groups, which not only represent their members in the market for agricultural products and inputs, but can also jointly invest in efficient machinery and innovations that improve labour efficiency and productivity.

The issue of optimising agricultural employment is gaining importance in relation to the increasingly emphasised environmental objectives of sustainable development, especially the European Green Deal (EGD) regulations (European Commission, 2024). According to the United States Department of Agriculture (USDA, 2020), the implementation of Green Deal solutions will result in a 12% reduction in food production in the European Union and an average 17% increase in food prices. As a result, food exports will decrease by 20% and imports will increase by 2%.

A report by Wageningen University and Research (2021), on the other hand, states that a significant reduction in the use of pesticides and fertilisers will lead to significant crop losses and a reduction in livestock by up to 15%. This situation necessitates a drive to optimise inputs and seek ways to reduce production costs.

If a reduction in the technologically conditioned labour demand is achieved, the possibilities of employment reduction in agriculture will be determined by the absorptive capacity of the non-agricultural labour market and the match between the structural characteristics of the agricultural population and the needs of the non-agricultural labour market especially in terms of their qualifications and mobility (Kołodziejczak, 2020).

In the long term, GVA in EU agriculture increases more slowly than in non-agriculture, so it is not possible to "catch up" in this sector with labour productivity achieved outside agriculture without reducing labour input in agriculture (Kołodziejczak, 2020). From the point of view of agricultural and economic policy, it is therefore important to define a benchmark, i.e., the level of employment in agriculture and its share in the sectoral employment structure, which should be pursued in the long term.

Although such a benchmark is not an objective of the goal in the literal sense, it can nevertheless serve to measure the distance in labour productivity between sectors of the economy and facilitate the optimal allocation of labour between sectors of the economy towards the highest possible productivity

3. Research Methodology

In view of the relatively constant GVA created in agriculture, improving labour productivity in this sector on an aggregate scale requires a reduction in its inputs, so that the GVA created in agriculture is shared among fewer workers. According to this assumption, it is economically advantageous to keep agricultural employment as low as possible. However, as the different countries studied are at different levels of economic development, the labour productivity achieved in their national industrial and service sectors was used as a benchmark for estimating the desired employment in agriculture, conventionally referred to as the 'optimum'.

According to the accepted assumption, "optimal" employment in agriculture refers to a situation in which the labour productivity per full-time employee is equal in agriculture and non-agricultural sectors. The level of optimal employment can therefore be estimated as the ratio of total GVA produced in agriculture to GVA per full-time employee outside of agriculture:

$$OEa = \frac{GVAa}{GVAisp}$$

where:
OEa - optimal employment in agriculture (full-time employees),
GVAa - GVA in the agricultural sector.

And:
GVAise - GVA per full-time equivalent employee in industry and services on average:

$$GVAisp = \frac{(GVAi + GVAs)}{Eis}$$

where:
GVAi - GVA in the industry,
GVAs - GVA in the services,
Eis - total employment in industry and services (full-time employees).

The target share of agriculture in the employment structure can be determined as follows:

$$OEra = \frac{OEa}{Etotal} * 100$$

where:
OEra - optimal employment rate in agriculture (share of the total number of full-time employees in the economy),
Etotal - total number of full-time employees in the economy.

Subtracting the optimal employment level in agriculture *OEa* from the initial employment level in agriculture *Ea*, we get the number of full-time employees who would have to leave agriculture in order for the added value generated in this sector per full-time employee to be the same as outside of agriculture:

$$UEa = Ea - OEa$$

where:
EUa - "unproductive" employment in agriculture.

The share of 'unproductive' employment *EUa* in initial employment in agriculture *Ea* can be calculated as:

$$UEra = \frac{UEa}{Ea} * 100$$

where:
EUra - "unproductive" employment rate in agriculture.

The abbreviation *GVAae* is also used in the tables and in the presentation of results. This stands for gross value added per full-time agricultural employee (AWU).

The study was based on EUROSTAT (2024) data and literature. The situation in the individual countries of the European Union (EU-27) was examined and two groups were distinguished among them: EU-14, consisting of countries that were part of the European Union before 2004, and EU-13, consisting of countries that joined the EU in 2004 or later. This division is justified by the different economic situation, economic traditions and lower productivity of the EU-13 economies.

4. Research Findings and Discussion

Table 1 shows the sectoral structure of employment and gross value added in the EU countries in 2023. In 2023, there were almost 211.8 million people working in the EU economy, of which almost 168.8 million (77.6%) in the EU-14. The GVA generated in the EU-27 was €15540.2 million, of which the EU-14 accounted for €13607.6 million (86.6%). In the EU-14, only 2.7% of total employment worked in agriculture, generating 1.6% of total GVA. In the EU-13, the share of employment in agriculture averaged 9.1% and agriculture generated 3.0% of GVA.

Table 1. *Employment and value of gross value added (GVA) in the sectors of the European Union economy in 2023*

Member State	Total number of employees (thousands of people)	Share of sectors in total employment (%)			GVA total (€1,000)	Share of sectors in GVA creation (%)		
		Agriculture	Industry	Services		Agriculture	Industry	Services
EU-27*	217478.7	4.1	15.4	80.5	15540239.6	1.8	20.1	78.1
EU-14*	168774.3	2.7	13.7	83.6	13607646.8	1.6	19.6	78.8
Austria	4723.0	2.9	16.0	81.0	424979.6	1.4	21.4	77.1
Belgium	5092.4	1.1	11.1	87.8	539071.6	0.9	15.1	84.0
Denmark	3202.4	2.0	10.7	87.3	333780.7	0.9	21.4	77.8
Finland	2763.9	3.2	13.9	82.9	239296.0	2.6	21.1	76.3
France	30423.6	2.3	10.1	87.6	2536590.0	1.9	14.9	83.2
Germany	46011.0	1.2	17.7	81.1	3824577.0	0.9	24.0	75.1
Greece	5044.0	10.3	9.5	80.2	196528.1	3.8	15.4	80.8
Ireland	2684.2	4.0	12.1	83.8	484189.7	0.9	32.3	66.7
Italy	26030.0	3.6	16.4	80.0	1910056.4	2.1	19.8	78.1
Luxembourg	512.6	0.7	7.6	91.7	72410.3	0.3	5.7	94.0
Netherlands	10233.0	1.9	8.3	89.8	962084.0	1.9	15.8	82.3
Portugal	5191.8	4.9	15.5	79.5	232693.6	2.4	16.1	81.5
Spain	21399.2	3.6	11.3	85.1	1367656.0	2.7	16.1	81.1
Sweden	5463.2	2.5	11.9	85.6	483733.8	1.1	19.3	79.6
EU-13*	48704.4	9.1	21.2	69.7	1932592.8	3.0	24.0	73.0
Bulgaria	3481.4	14.9	19.1	66.1	83042.4	2.9	21.4	75.7
Croatia	1703.0	3.9	19.5	76.6	65124.0	4.0	18.3	77.7
Cyprus	489.4	3.3	8.6	88.1	27679.2	1.3	6.8	91.8
Bohemia	5387.9	2.9	27.4	69.7	291434.1	1.9	27.7	70.4
Estonia	689.5	2.6	19.2	78.2	33685.2	2.2	18.4	79.4
Hungary	4765.3	3.4	20.2	76.4	170095.8	3.2	23.3	73.4
Latvia	907.4	7.9	14.6	77.5	34283.3	4.4	18.3	77.3
Lithuania	1475.8	5.0	17.8	77.2	66444.8	3.0	19.6	77.4
Malta	306.3	1.3	8.8	89.9	19198.9	0.7	8.3	90.9
Poland	17493.0	8.1	21.6	70.2	676413.7	3.0	26.2	70.7
Romania	8471.1	20.9	20.4	58.6	296141.6	4.2	20.9	74.8
Slovakia	2434.1	2.8	23.1	74.1	112152.4	2.2	27.6	70.2
Slovenia	1100.2	6.2	22.5	71.2	56897.4	1.7	26.4	71.9

Note: ** Arithmetic average.*
Source: *Own compilation based on Eurostat data (EUROSTAT, 2024).*

The industrial sector accounted for 13.7% of employment in the EU-14 and 21.2% of employment in the EU-13. Industry accounted for 19.6% of GVA and 24.9% of GVA in the EU-14 and EU-13 respectively. The share of services in employment was 83.6% in the EU-14 and 69.7% in the EU-13, with GVA shares of 78.8% and 73.0% respectively.

The smaller share of agriculture in the structure of employment and GVA generation first in favour of industry and later of the service sector informs about a more modern and productive economy, and with the decreasing role of agriculture in the economy its productivity increases (Kołodziejczak 2024).

Thus, this brief analysis allows us to conclude that the countries of the 'old' EU-14 are at a higher level of economic development than those of the EU-13. Also within the EU-14 and EU-13 aggregates there are significant differences, regarding the sectoral structure of employment and the sectoral structure of GVA.

Among the EU-14 countries, Luxembourg (0.7%), Belgium (1.1%) and Germany (1.2%) had the lowest share of employment in agriculture and Greece the highest (10.3%) (Table 1). Greece's result stood out clearly from the rest of the EU-14, as the next highest share was more than twice as low (4.9% in Portugal). Even among the economically weaker EU-13 countries, double-digit shares of employment in agriculture were recorded in only two cases: Romania (20.9%) and Bulgaria (14.9%).

The consequence of the different shares of employment in agriculture is the different shares of GVA generated in this sector of the economy. However, there is no simple relationship here, as this parameter also depends on the productivity of industry and services. In all countries surveyed, services dominate the employment structure and the GVA structure. However, it can be noted that in the EU-14 the share of services is higher than in the EU-13, while most of the EU-13 countries have a higher share of industry than in the EU-14.

Table 2 presents gross value added in agriculture (*GVAa*) gross value added per employee in agriculture (*GVAae*) and also (on average) in industry and services (*GVAise*) of the surveyed EU countries in 2023. The GVA created in the agricultural sector in the EU-14 stood at €222831.7k and was almost 3.9 times higher than in the EU-13, where it reached €57336.8k. On average, GVA per person employed in agriculture was €48.9k in the EU-14 and only €13.0k in the EU-13.

The differences between countries were even greater. Among the EU-14, the highest labour productivity was in agriculture in the Netherlands (€93.4k) and Belgium (€78.5k) and the lowest in Greece (€14.5k) and Portugal (€22.1k). Among EU-13 countries, the highest GVA per employee was recorded in Estonia (€40.0k), slightly lower in Croatia (€40.0k) and lowest in Bulgaria (€4.6k) and Romania (€7.1k). Labour productivity in the agriculture of some EU-13 countries was higher than in the less productive countries inside the EU-14. However, GVA per worker in the least productive agriculture in the EU-14 in Greece was 3.2 times higher than in Bulgaria.

Between the most productive agriculture of the Netherlands and that of Bulgaria, the difference in GVA per worker was 20.3 times. Analysing labour productivity in EU-

14 and EU-13 agriculture thus describes two different realities that are separated by a development gap. Large differences between these aggregates of countries occur also in the case of labour productivity in industry and services, but in this case the difference between the most productive Ireland (186.2 thousand) and the least productive Bulgaria (127.2 thousand) is 6.8 times.

This is very high, but at the same time relatively small compared to the differences in agricultural labour productivity found between the Netherlands and Bulgaria.

Table 2. *Gross value added in agriculture (GVAa), per 1 person employed in agriculture (GVAae) and per 1 person employed outside agriculture (GVAise) in 2023*

Member State	*GVAa* (€1.000)	*GVAae* (€1.000)	*GVAise* (€1.000)
EU-27*	280168.5	31.2	73.2
EU-14*	222831.7	48.9	81.5
Austria	6137.6	44.3	91.4
Belgium	4586.2	78.5	106.2
Denmark	2848.5	43.6	105.5
Finland	6323.0	71.9	87.1
France	49124.9	69.2	83.7
Germany	35242.0	61.6	83.4
Greece	7529.3	14.5	41.8
Ireland	4465.7	41.3	186.2
Italy	39511.7	42.5	74.5
Luxembourg	181.6	49.2	141.9
Netherlands	18390.0	93.4	94.0
Portugal	5664.3	22.1	46.0
Spain	37454.0	48.3	64.5
Sweden	5372.9	38.6	89.8
EU-13*	57336.8	13.0	42.3
Bulgaria	2384.4	4.6	27.2
Croatia	2620.3	40.0	38.2
Cyprus	369.5	23.0	57.7
Bohemia	5494.5	35.5	54.6
Estonia	735.7	41.1	49.1
Hungary	5498.0	33.5	35.8
Latvia	1502.6	21.1	39.2
Lithuania	2003.8	27.3	45.9
Malta	141.7	36.0	63.0
Poland	20576.6	14.4	40.8
Romania	12576.6	7.1	42.3
Slovakia	2461.5	35.6	46.4
Slovenia	971.6	14.2	54.2

Note: ** Arithmetic average.*
Source: *Own calculations based on Eurostat data (EUROSTAT, 2024).*

Table 3 shows the estimated potential surplus employment in agriculture and the target level of employment in this sector. The level of the estimated indicators depends on the baseline employment in agriculture and the relationship between labour productivity in agriculture and the average labour productivity in industry and services, separately for each of the countries studied.

Table 3. *Employment in agriculture (Ea), its "unproductive" (UEa, UEra) and "optimal" level (OEa, OEra) and the distance to the "optimal" level (Ea – OEra) in the European Union in 2023*

Membe State	*Ea* (thousands of people)	*UEa* (thousands of people)	*OEa* (thousands of people)	*UEra* (%)	*OEra* (%)	*Ea – OEra* (pp.)
EU-27*	8981.4	5153.4	3827.9	57.4	1.8	2.4
EU-14*	4560.8	1826.9	2733.8	40.1	1.6	1.1
Austria	138.4	71.2	67.2	51.5	1.4	1.5
Belgium	58.4	15.2	43.2	26.0	0.8	0.3
Denmark	65.3	38.3	27.0	58.6	0.8	1.2
Finland	87.9	15.3	72.6	17.4	2.6	0.6
France	710.3	123.5	586.8	17.4	1.9	0.4
Germany	572.0	149.4	422.6	26.1	0.9	0.3
Greece	518.2	337.9	180.3	65.2	3.6	6.7
Ireland	108.1	84.2	24.0	77.8	0.9	3.1
Italy	929.8	399.6	530.2	43.0	2.0	1.5
Luxembourg	3.7	2.4	1.3	65.3	0.2	0.5
Netherlands	197.0	1.4	195.6	0.7	1.9	0.0
Portugal	256.8	133.7	123.1	52.1	2.4	2.6
Spain	775.6	194.9	580.7	25.1	2.7	0.9
Sweden	139.2	79.4	59.8	57.0	1.1	1.5
EU-13*	4420.6	3066.6	1354.0	69.4	2.8	6.3
Bulgaria	517.0	429.4	87.6	83.1	2.5	12.3
Croatia	65.6	-3.1	68.6	-4.7	4.0	-0.2
Cyprus	16.1	9.7	6.4	60.1	1.3	2.0
Bohemia	154.8	54.3	100.6	35.1	1.9	1.0
Estonia	17.9	2.9	15.0	16.2	2.2	0.4
Hungary	164.1	10.4	153.7	6.3	3.2	0.2
Latvia	71.3	33.0	38.3	46.2	4.2	3.6
Lithuania	73.3	29.7	43.6	40.5	3.0	2.0
Malta	3.9	1.7	2.2	42.9	0.7	0.6
Poland	1424.4	920.3	504.1	64.6	2.9	5.3
Romania	1774.4	1477.4	297.0	83.3	3.5	17.4
Slovakia	69.2	16.2	53.1	23.3	2.2	0.7
Slovenia	68.5	50.6	17.9	73.8	1.6	4.6

Note: ** Arithmetic average.*
Source: *Own calculations based on Eurostat data (EUROSTAT, 2024).*

This shows the situation of equalisation of labour productivity (equalisation *of GVAae* to the initial level of *GVAise*) in a given country. Employment in the agricultural sector in the E U-14 and EU-13 countries was similar at 4560.4 thousand and 4420.6 thousand respectively.

However, due to differences in labour productivity, the over-employment (*EUra*) in the EU-14 was on average 57.4% and in the EU-13 it was 69.4%. This means that the EU-14 agricultural 'surplus' employment (*UEa*) was 5153.4 thousand people and the target share of agriculture in the sectoral employment structure (*OEra*) is 1.8%, or (*OEa*) 3827.9 thousand people. For the EU-13 *UEa* was 3066.6 thousand people, *OEra* was 2.8% and the target *OEa* was 1354.0 thousand people.

The highest *EUra* is characterised by Romania (83.3%) and Bulgaria (83.1%) and the rich EU-14 countries, Ireland and the Netherlands, 77.8% and 65.3% respectively. For Romania and Bulgaria, this is due to high employment and low GVA in agriculture. The high *UEra* in Ireland and the Netherlands is mainly due to high GVA *per capita* among non-agricultural workers. The target level of employment in *Eaos* agriculture took values ranging from 0.2% of the total number of people working in the economy in Luxembourg to 4.0% in Lativa.

Achieving target employment would be least affected in the countries with the lowest *Eaos*, so that in the Netherlands, for example, OEa was almost identical to *Eaos*. The relatively largest scale of employment reduction in agriculture is in Romania, where it is 17.4 pp., followed by Bulgaria (12.3 pp.) and two EU-14 countries, namely Greece (6.7 pp.) and Ireland (3.1 pp.).

The scale of the reduction in employment expressed in terms of full-time equivalents was highest in Romania (1,477.4 thousand persons) and Poland (920.3 thousand persons), followed by Bulgaria (429.4 thousand persons), Italy (399.6 thousand persons) and Greece (337.9 thousand persons) and lowest in the Netherlands (1.4 thousand persons), Malta (1.7 thousand persons) and Luxembourg (2.4 thousand persons).

A special case among the analysed countries is Croatia, where *UEra* took negative values, which means that labour productivity in agriculture was higher than the average in industry and services, and the share of employment in agriculture was lower than the share of agriculture in the structure of the generated GVA (Table 1).

An explanation for this situation could be the underestimation of GVA, especially in the service sector and the consequent underestimation of non-agricultural GVA. There is a grey area of considerable size in the Croatian economy (Misztal, 2018; FATF 2024). Therefore, it is not possible to conclude that agriculture in Croatia achieves high labour productivity or that employment in it is too low.

It is likely that there is a potential over-employment here as well, but its size is difficult to determine. The total scale of employment reduction in the EU-14 was 1826.9 thousand people with a target *OEa* of 1.6% and a reduction in agricultural employment of 2.4 pp. For the EU-13, the over-employment was 1354.0k, the *OEa* target was 2.8% and the scale of reduction as high as 6.3 pp.

Such a large scale of reduction in the EU-13 compared to the EU-14 is indicative of the development gap still existing between these groups of countries, all the more so as the GVA per non-agricultural employee used to estimate *EURa* was significantly lower than in the EU-14.

The calculated surplus employment does not take into account current technological and organisational conditions (Kołodziejczak and Wysocki, 2015; Kołodziejczak 2020). Therefore, the results obtained are only a benchmark and not a target *sensu stricto*. Once surplus labour resources, which are actually redundant in the production process, have been released from agriculture, a further reduction in employment is only possible through changes in technology and organisation of work, which will reduce the demand for labour accordingly.

This is further complicated by the seasonality of agricultural production (especially crop production) and the resulting periods of labour shortages and surpluses (Christiaensen *et al.,* 2020). There is therefore no single, calendar-year-specific level of optimal agricultural employment.

Instead, a seasonal optimum must be sought, and this in turn implies the need to periodically meet labour demand through seasonal labour and to maintain a certain level of fixed labour input (hired or own labour) necessary for the operation of the farm outside the period of peak labour demand. Even with the labour shortages observed nationally, within countries the situation can vary widely.

Depending on the production profile, the size of the farm, the technologies used, the organisation of work, natural conditions and legal regulations, there will be farms with surpluses or shortages of labour within each country. This points to the desirability of combining agricultural and non-agricultural livelihoods of the agriculture-related population. The aim should therefore not only be to reduce the number of people involved in agricultural production, but above all to optimise labour inputs seasonally and supplement income through non-agricultural activities or off-farm employment

Reducing agricultural employment makes sense until the level of employment necessary for agricultural production under given technological assumptions is reached. An increase in agricultural labour productivity requires a reduction in the technologically determined labour demand on farms and a correspondingly large demand for labour outside agriculture.

These processes may be hindered by a structural mismatch between the demand for labour outside agriculture and the characteristics of the labour force associated with agriculture, especially in terms of its qualifications and its remoteness from the place of potential employment outside agriculture. An opportunity to facilitate these transitions is to combine work in agricultural production with work outside agriculture or non-agricultural activities undertaken, including agricultural and agro-

tourism services. This can also be advantageous because, despite off-farm work, during periods of concentrated fieldwork, farms will have a workforce ready to engage strongly in technological processes.

Appropriately targeted measures of the Common Agricultural Policy can support farm modernisation processes by reducing the need for agricultural labour. Also, the merging of farms into cooperatives or producer groups can help to finance costly investments and optimise the use of purchased fixed assets, as well as help to obtain higher selling prices for the food produced.

Consequently, this will enable a reduction in labour inputs and an increase in GVA, thus increasing agricultural labour productivity. The labour surpluses released from agriculture, provided they are absorbed by industry and services, will contribute to the growth of gross domestic product through higher productivity.

5. Conclusions, Proposals, Recommendations

The existence of potential over-employment is a common phenomenon in the EU, but it weighs more heavily on the less developed and less prosperous EU-13 countries, where the share of employment in agriculture is higher than in the richer EU-14 countries. The situation varies from country to country, also within the EU-14 and EU-13 aggregates.

The relatively largest scale of over-employment in agriculture concerns Romania, Bulgaria and Poland, which belong to the EU-13 group, and therefore the pursuit of "optimal employment" will be most difficult in these countries. The total scale of employment reduction in the EU-14 was 1,826.9 thousand people with a target "optimal" agricultural employment level of 1.6% and a reduction of 2.4 pp from the baseline. For the EU-13, the over-employment was 1354.0 thousand, the "optimal" level was 2.8% and the scale of reduction was as high as 6.3 percentage points.

Such a large scale of reduction in the EU-13 compared to the EU-14 shows that there is still a development gap between these groups of countries, all the more so as the non-agricultural GVA used in the estimation was much lower than in the EU-14.

However, due to the structure of agricultural production in the EU and the technologies used, the actual labour demand is higher than the calculated 'optimal' employment. In addition, labour demand on farms fluctuates seasonally, so there can be alternating surpluses and shortages of workers.

It is therefore necessary to work in parallel to reduce the technologically determined labour demand and to shape the "flexibility" of agriculture-related workers so that they can earn an income from outside agriculture in times of lower labour demand on the farms and make up for labour shortages in times of peak work on the farms.

Recommendations for policy are as follows. Modernisation and structural transformation processes in agriculture should continue to be supported. Support mechanisms should include, above all, the modernisation of production technologies, the implementation of innovations replacing human labour, including digitisation and artificial intelligence solutions, land concentration and complementary measures, i.e., the increase in the importance of services in the production process and the merging of farmers into production cooperatives and producer groups.

Vocational education in rural areas should also be promoted, aimed at better matching the skills of the agricultural population with the needs of the non-agricultural labour market, and communication barriers should be countered so that reaching non-agricultural jobs does not mean having to move to the city or make long and costly commutes. Another area is the stimulation of non-agricultural or agriculture-related economic activities, especially in the field of services.

Further research is required to analyse the determinants of processes that can facilitate the pursuit of an 'optimal' level of employment in agriculture. In particular, it is necessary to clarify the desired directions of agricultural transformation so that the optimisation of employment and the increase in labour productivity proceed as smoothly as possible, in line with the achievement of the social and environmental objectives of sustainable agriculture.

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