

Article

Labour Implications on Agricultural Production in Romania

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Abstract: Throughout this paper, the theoretical concepts from the above areas were combined with the analysis and interpretation of statistical data from the same areas of interest, resulting in a detailed analysis of how the agricultural labour force influences the yields of the five most important crops in the Romanian agricultural sector, namely, wheat, maize, sunflower, rapeseed and soybean. The analysis was carried out within the eight NUTS-listed development regions. A bibliometric analysis of the importance of the academic environment for agricultural labour force research was previously carried out using VOSviewer software. The content of this document aims to determine the impact that the agricultural labour force has on the productivity of the five main crops cultivated in Romania over large areas during the period 2015–2019, where, although the population employed in agriculture has decreased, the yields of these crops have increased due to the technological development process started in agriculture. As of 2019, only 9% of the total Romanian population is represented by the population employed in agriculture and 39.41% and 61.37% of the total area of the country are represented by arable/agricultural area, respectively.

Keywords: labour force; population employed in agriculture; production; arable land; labour productivity



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1. Introduction

This paper is based on the term ‘labour force’, and for the analysis in the paper to be understandable, it is necessary to understand this term. Although it may be difficult to explain in simple words, the term labour force can be easily associated with the economically active population, including employed, salaried, and self-employed people and non-employed people. The concept of labour force does not include economically inactive people such as preschool children, school children, students, or pensioners [1]. The interest in the agricultural labour force, which according to the definition of the labour force in general explained above represents the economically active population employed in the agricultural sector, results from the fact that in 2016, at the national level, the main sectors in which 61.6% of all employable persons were employed were the service sector (47%), industry and construction (30%) and the agricultural sector (23%) [2].

Romania has always occupied an important place in the European Union as far as the agricultural sector is concerned. In the inter-war period, it was called the “Grain of Europe”, not only because Romania exported large quantities of wheat to what we now

call the European Union, but also because, at that time, grain prices were set in the Danube ports on Romanian territory [3].

Romania is still recognized at the level of the member states of the European Union as an important country in the agricultural sector, which is also demonstrated by the agricultural area cultivated in Romania and the yields obtained, although as of 2020, it ranks seventh in terms of the contribution of the country's agricultural industry to total agricultural production (an indicator that includes both agricultural production and non-agricultural production from secondary activities that cannot be separated from the main agricultural activity). From the European Union [4], in 2019, among the Member States, Romania ranked first in terms of both cultivated area and production, first in the case of maize and sunflower crops, and fourth in the case of wheat cultivation, after France, Germany and Poland [5], a trend that is expected to continue in 2020, taking into account that in January–April 2020, Romania's cereal exports increased by 38.8% compared to the same period in 2019 [6].

This information as well as the fact that in 2018 Romania ranked fourth in the European Union in wheat production, first in maize and sunflower production, fifth in rapeseed production, and second in soybean production [7], formed the basis for the selection and analysis of the five crops in this study. These two aspects—the importance of the labour force in agriculture and Romania's position among the European Union's performers in terms of cultivated areas and yields—require an analysis to determine the impact of the labour force in agriculture on Romania's agricultural development. Most developing countries are directly or indirectly associated with agriculture. Rationalizing employment in agriculture leads to improving its economic and social sustainability [8].

Romania's trade balance in the agricultural sector shows a significant deficit, but is supported in a positive direction by the important sales of wheat, corn, sunflower, rapeseed, and soybean, determined by the significant production that Romania maintains, as well as by access to the Black Sea basin, which allows the commercialization of these agricultural products [8].

A situation in which the level of employment in agriculture is presented in relation to the other sectors of the economy is presented in the paper 'Employment and Gross Value Added in Agriculture versus Other Sectors of the European Union', according to which the rationalization of employment levels in agriculture in the European Union promotes improving its economic and social sustainability [9]. As agricultural productivity increases, the share of people employed in agriculture decreases and vocational training improves the skills of the rural population, allowing them to develop their agricultural business [10,11]. Another case in which the evolution of agricultural workers' incomes is presented is in the paper "Stability and Social Sustainability of Farm Household Income in Poland in 2003–2020", in which the situation of the countries that have recently joined the European Union, Romania and Poland, is analysed, and the gap between the incomes of farmers and non-farm workers has halved compared to the period before accession to the European Union, due to the improvement in agricultural production [12]. The number of people employed in agriculture in Romania in 2007 was more than 2.5 million, and by 2019 it had dropped to more than 1.9 million, representing a decrease of about 30%, and the percentage of women working in agriculture is 32% [13].

With free access to the labour market throughout Europe, about 500,000 people have chosen to leave Romania, tempted by the much higher wages offered in western European countries. The scale of the phenomenon is likely to be much larger, as there is no exact figure. Most of those who have left Romania have chosen agricultural activities in western European countries. This phenomenon has created imbalances on the Romanian labour market, as happened in all Eastern European countries when they joined the European Union [14,15].

Romania is currently one of the European countries with the most active farmers, about 30% of the total active population. This share is almost 40% of the number of farmers in the European Union, where the share of the active population in agriculture is less than

5%. From the point of view of competition, Romanian farmers are still disadvantaged compared to farmers in other Member States [14–16]. Contrary to what has been said above, there are many studies in Romania that conclude that there is no longer a labour force in agriculture, especially seasonal labour [17,18].

Romanian agriculture remains an important sector in terms of agricultural area used, the contribution to GDP and especially the percentage of the population employed in agriculture [19–21]. To increase productivity in agriculture, it is necessary to stimulate young people and women, to develop business in agriculture and ensure modern technical equipment [22–24].

Labour productivity is a major component of agricultural development, but also of rural development [25,26]. Employment in agriculture is an important component of sustainable rural development policy. There is a need to make good use of the agricultural potential that Romania has and to stabilize the rural population by ensuring incomes that ensure an adequate quality of life [27,28].

For rural areas of Romania, agriculture is the main activity of inhabitants in most development regions. Most of the jobs in these rural areas are concentrated in service activities (small shops) and agricultural activities, either carried out by those who own agricultural holdings or by those who work on agricultural holdings. These agricultural activities are also characterised by seasonality, which has a negative impact on the income of the inhabitants.

Thanks to European funds, farmers have been able to purchase new, high-performance machinery over the last 16 years, which has helped them cope with the labour shortage in Romania, where many agricultural workers have left for western European countries, tempted by much higher wages than those in Romania.

In the first part of the results and discussion section, a bibliometric analysis was carried out to identify the importance given by the academic community to the topic of agricultural labour. Based on these results, the analysis focused on the labour force working in agriculture in Romania, with the aim of determining the impact that the agricultural labour force has on five main agricultural products sourced in Romania between 2015 and 2019.

2. Theoretical Background

Bulgaria has a large number of semi-subsistence farms, where households use small areas of land to produce products for their own consumption. Identifying the determinants of the strategies used by these farms, we analyse the contribution of the farms to food security, as well as farmers' income recognition and prospects for future productivity growth. To achieve this, semi-structured interviews were used through quantitative analysis. Despite the agricultural challenges facing farmers, semi-subsistence production is a staple for low-income households, and policies to increase the marketing of small-scale products must be addressed [29].

Another general problem encountered in agriculture is that of migrants, as in the case of Spain, which depends on the work of Romanian migrants, representing one of the most significant national groups farming in this country. In this regard, questions are raised about the sustainability of migrant agricultural work from a social perspective and the identification of general forms of mobility using a systematic review of legislation and quantitative field work. Circular movement produced by agricultural production systems has been found to be unsustainable, requiring reformulation in the 2030 EU Agenda [30].

According to Patyka, Ukraine's agriculture is characterized by a negative trend in socioeconomic development. To identify the impact factors on employment and to assess the degree of influence, several types of analysis were used, such as system analysis, factor analysis or multiple regression analysis. The rural population aged between 16 and 64 is a decisive socio-demographic factor, while from a social point of view, the most important factor is labour productivity, and by measuring the impact of these factors, it is possible to

establish methods, measures and mechanisms that can solve the problem of agricultural employment [31].

On the other hand, Giarè shows the strategic importance of the agricultural system. The dynamics reflect the economic structure, but also the social transformations that have affected the agricultural sector in the last decade. The inclusion of unemployed migrants in social assistance has been pursued through the synthesis of field research and quantitative interviews. To this end, cooperation and collaboration between 70 companies have been established to organise training courses [32].

According to Yin, in China, labour is a key element in the economic growth generated by traditional agriculture. Production efficiency was determined in three zones: functional crop zone, consumption zone and equilibrium zone, using a stochastic system. The results show an increasing number of employees moving to non-agricultural sectors and the stock of human capital is decreasing, but with all these changes, the positive effects are felt in terms of economic efficiency [33].

Another approach is presented by Kołodziejczak, who presents the problem of hidden employment in agriculture in Poland, which directly impacts the process of stopping rural modernisation. This approach assumes a scenario in which the share of employment in Polish agriculture is the same as in the European Union. Over-employment shows that work is inefficient, and this process is referred to as hidden unemployment. It is shown that this premise is confirmed within 10 to 20 years and an institutional approach to job creation is needed [34].

Nordin researched the link between direct payments to farmers and the agricultural labour force in Swedish municipalities through aggregates. The decoupling reform introduced in 2005 for grasslands is identified as a subsidy and has had a positive impact on agricultural employment, generating additional jobs [35].

3. Materials and Methods

The first step in the development of this study was to carry out a bibliometric analysis of keyword linkages, namely, between agricultural labour force and other associated terms.

Bibliometric analysis is considered an alternative method in various fields of study. This tool provides a systematic and transparent process that broadly examines a particular academic or research field. Specifically, it allows for a quantitative assessment of the generation of structure performance and the identification of building blocks and how they collaborate [36].

The process of carrying out bibliometric analysis involves going through several phases: identification of the reference topic and selection of the database; exporting and entering the database into the software; and analysis of the results (Figure 1).

The study of theoretical information on the aspects necessary to understand the topics mentioned in the paper, as well as the analysis and interpretation of statistical data provided by the National Institute of Statistics, by Eurostat, the body in charge of statistics at the level of the European Commission, and by the Organization for Economic Cooperation and Development by determining trends, arithmetic averages, medians, extrapolation and other statistical methods of analysis will determine the impact of labour in agriculture on the five most important productions, as mentioned in the introduction to this paper.

The main tools in the development of this analysis will be represented by statistical indicators, statistics being itself the science through which numerical data are collected, classified, presented and interpreted in order to formulate conclusions and make decisions [37]. The trend, known as the general trend that a series of values knows, signifies the main direction of development of the values within the series, represented by the movement, the values and the evolution of the series in a predetermined period of time. The arithmetic mean is an individual operation by which all observed values of a variable are added and divided by their number, resulting in a value that could be obtained if each individual value marked the variable equally [38].

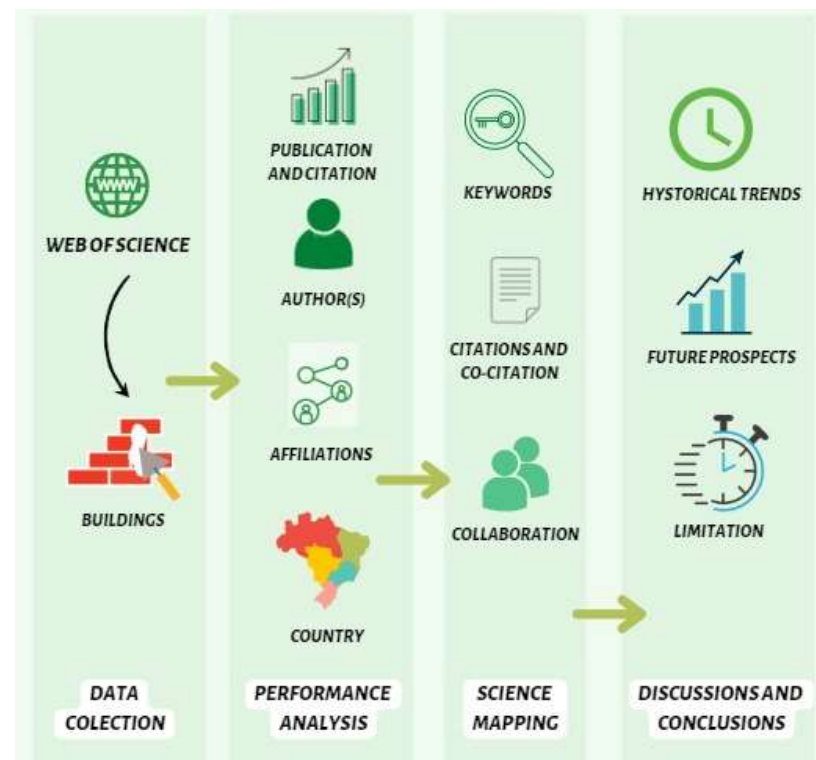


Figure 1. Steps to perform bibliometric analysis. Source: Own representation.

The median is the value of a set of statistical data that divides the set into two equal parts so that half of the data in the set have values lower than the median and the other half larger [39].

By applying the calculation formula for the median, the median of the population employed in agriculture will be calculated, the median of the arable areas will also be calculated, at the level of the Romanian regions, and the results will be presented in graphical form. The median was achieved in the Excel program by applying the MEDIAN formula.

Represented by the method by which a continuous function is determined for values outside a range of known values [40], extrapolation helps predict results outside the analysed period.

By applying the formula for extrapolation, based on existing data between 2015 and 2019, trends in the population employed in agriculture, forecasts on cultivated areas, yields relative to the population employed in agriculture, and the 5 crops analysed (wheat, corn, sunflower, rapeseed and soybeans) will be calculated until 2024. The extrapolation was performed in the Excel program by applying the TREND formula.

The extrapolation formula is as follows:

$$Y(x) = y(1) + \frac{x - x(1)}{x(2) - x(1)} * [y(2) - y(1)]$$

where:

- $[x(1), y(1)]$ and $[x(2), y(2)]$ are two endpoints of the known range;
- x —the value of the point to be extrapolated.

Furthermore, the connection between (1) the population employed in agriculture (x) and the productions of the analysed crops (y) and (2) the population employed in agriculture (x) and the cultivated area with the main crops (y) will be highlighted in the analysed interval from 2015–2019; these variables will be correlated applying:

- the Equation for the correlation coefficient:

$$r = \frac{\sum (x_i - \bar{X})(y_i - \bar{Y})}{\sqrt{(\sum (x_i - \bar{X})^2)(\sum (y_i - \bar{Y})^2)}}$$

where $\bar{x}$ and $\bar{y}$ are the averages for samples, AVERAGE (matrix1) and AVERAGE (matrix2).

- Form linear and polynomial function of second degree:
Linear—linear model (simple regression): $y = a + bx$;
Polynomial: $y = a_0 + a_1x^1 + a_2x^2 + \dots + a_nx^n$.

4. Results and Discussion

“Agricultural labour force” is a subject on which 1255 papers were written between 1975 and 2022 and were included in the fields of Economics (272 papers), Environmental Science (179 papers), Environmental Studies (144 papers), Agricultural Economics Policy (92 papers), Development Studies (86 papers) and Multidisciplinary Agriculture (77 papers). Other areas included are history, geography, sociology, management, agronomy, horticulture, law, social psychology, demography, water resources and urban studies.

With the help of the Web of Science database, a document is exported in editable format with all the specialist papers written during the period on the subject “agricultural labour force”. Using the VOSviewer program, maps are generated containing keywords mentioned at least five times in a publication and countries that attach particular importance to the topic.

The size and colour features provided by VOSviewer make it easier to identify clusters. Thus, five clusters were identified:

- The yellow cluster, named “agriculture”, reveals through keywords some of the problems encountered in rural areas such as migration, education, labour force, evolution, unemployment, transition, labour productivity, youth, structural changes, irrigation, economic growth, entrepreneurship, developing country, rural development, agricultural development, labour market and area used;
- The red box, which can be called “impact”, includes terms such as policy, management, determinate, international migration, biodiversity, agricultural intensification, out-migration, small holders agriculture, conservation, diverse environment, food security, behaviour, climate change, driving forces, agricultural land abandonment, farmland abandonment, influencing factor, mechanization, deforestation, cover change, land-use change and agricultural land;
- The purple key, referred to as “growth”, is represented by agricultural productivity, productivity, food, technology, model, performance, quality, reforms, innovation, transformation, structural change, demand, human capital, productivity growth, industrialization, trade, stimulation, countries, agricultural sector, sector and industry.
- The blue box, which can be labelled ‘work’, includes key terms such as: rural, market, children, mortality, economic, investment, mobility, poverty rights, labour-force participation, security, economic development, history, work, women, race, slavery, non-farm employment, globalisation, family, women, work and health.
- The orange circle, which we can call “climate change”, includes issues such as adaptation, variability, challenges, land use, vulnerability, agricultural-mechanization, water, land, climate, forces, farmworkers and workers (Figure 2).

In terms of keywords used in academic papers by year, the figure above shows the interest in certain topics over a 9-year period.

So, in the years 2012, 2013 and 2014, researchers were concerned with rural, market, economy, behaviour, sustainable agriculture, sustainability, mortality, economics, reforms, countries, productivity growth, simulation, food, farm, patterns, land use, highlands, family, globalization and agricultural intensification.

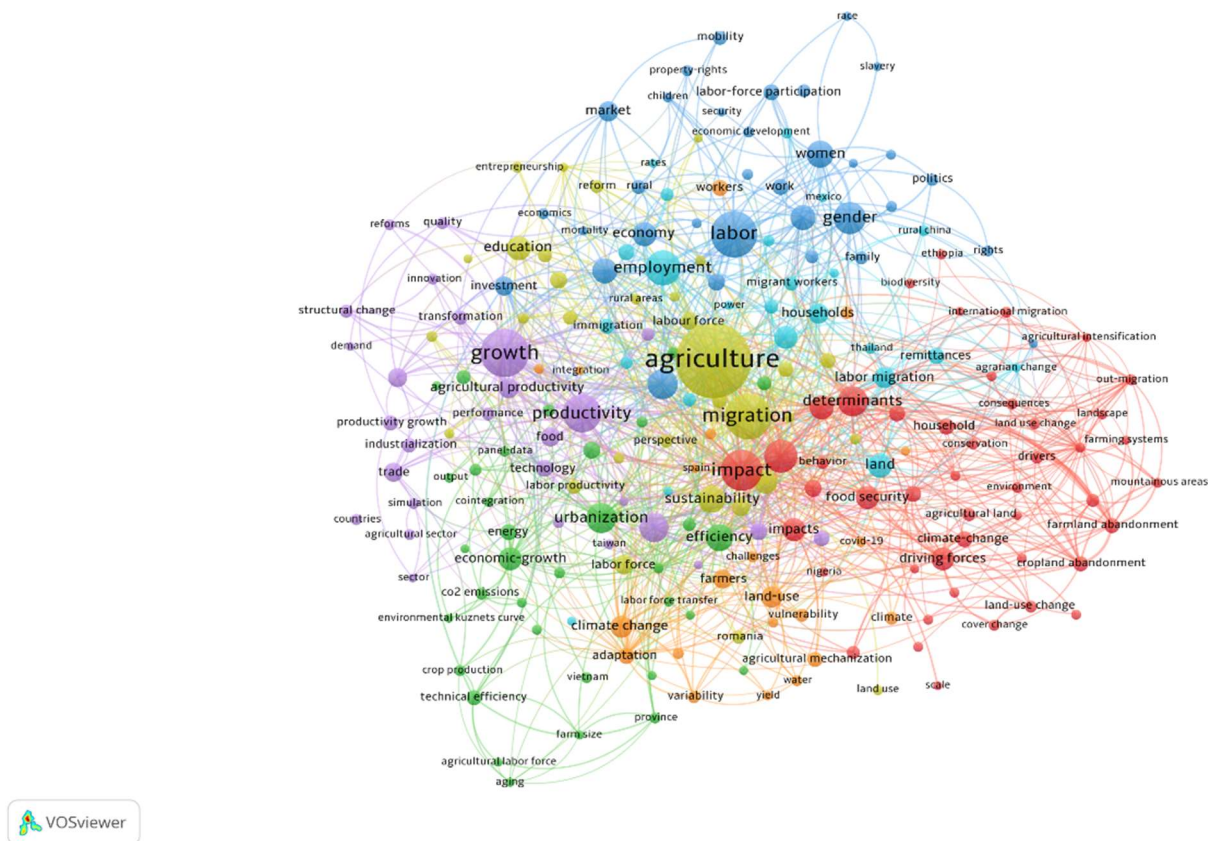


Figure 2. Link between the agricultural labour force and other related terms. Source: Web of Science data processing with VOSviewer software.

In the following years, 2015, 2016 and 2017, the following topics were covered: agriculture, growth, labour, gender women, mobility, determination, labour migration, income, households, migrant workers, power, immigration, transformation, inequality, fertility, rural development, policy, management, determination, transition, population, energy, trade, industry, perspectives and agricultural sector.

Later, in 2018 and 2019, interest was given to productivity, impact, efficiency, land use, climate change, adaptation, technical efficiency, land use change, aging, remittances, biodiversity, politics, non-farm employment, out migration and farm size.

In 2020, the focus was on the following keywords: cropland abandonment, vulnerability, farmland abandonment, COVID-19, services, provinces, urban migration, CO₂ emissions, sustainable development, ecosystem services, access and mountainous areas (Figure 3).

The image above shows the density of the keywords based on the concentration of the elements of the node to which they belong. Specifically, the colour of the node is influenced by the number of elements in the vicinity. The density shows the structure of the map, focusing on the most common keywords used in publications.

In conclusion, in the case of the density map generated on the topic of “agricultural labour force”, the research focus is on agriculture, migration, impact, growth, productivity and labour (Figure 4).

It is important to observe the degree of relationship between the countries of interest in our study. Therefore, the frequency of co-authors and partnerships between institutions is presented as nodes. The colours on the map show us the diversity of research directions, the thickness of the connections and the distance between them show us the level of cooperation between countries.



year, it can be observed that countries such as England, France, Canada and Sweden have produced publications since 2012, while countries such as Russia, India and Bangladesh have done so since 2018 (Figure 5).

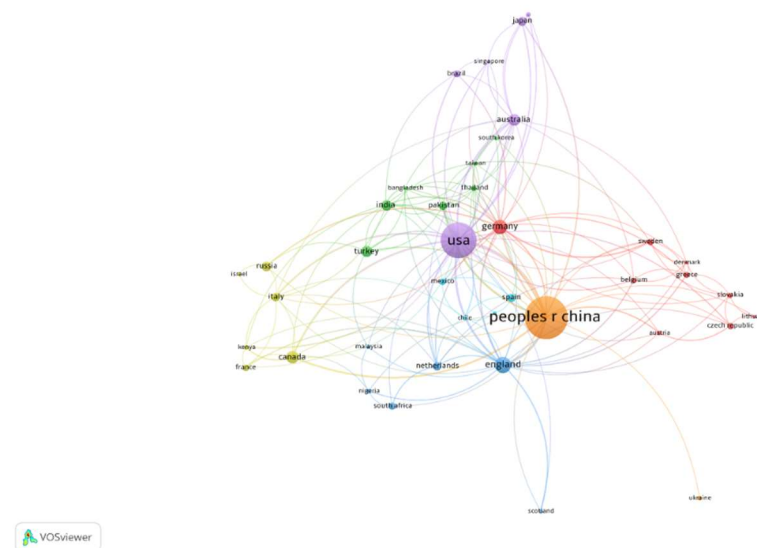


Figure 5. Link between co-author countries. Source: Web of Science data processing with VOSviewer software.

The topic of “agricultural labour force” has been increasingly addressed in recent years. In the year 2020, it was closely related to issues such as cropland abandonment, farmland abandonment, climate change, COVID-19, vulnerability and CO₂ emissions, as discussed in papers in Russia, Pakistan, Singapore, Chile and Malaysia.

The academic community attaches particular importance to the implications of the agricultural labour force, as evidenced by the numerous articles reviewed.

Regulation (EC) No 1059/2003 of the European Parliament and of the Council on the establishment of a common nomenclature of territorial units for statistics (NUTS) has been drawn up to enable the collection, compilation and dissemination of harmonized regional statistical data in the European Community so that the single market can have comparable statistics [41]. Therefore, given that the main objective of the establishment of NUTS is to establish a common nomenclature of territorial units [42], a hierarchical nomenclature with which to divide the economic territory of the Member States into territorial units of NUTS level 1, which are subdivided into NUTS 2 territorial units, which in turn are subdivided into NUTS three territorial units [43], the appropriate level at which a class of administrative-territorial units in a Member State may fall is determined on the basis of threshold demographics [44]. This is corroborated by the history of the relationship between Romania and the European Union, a history marked by a series of events that began in 1993 with the signing of the European agreement that entered into force on 1 February 1995 between European Communities and their Member States [45]. This relationship materialized with the signing of Romania’s Treaty of Accession to the European Union on 25 April 2005, with the effect of declaring Romania as a Member State of the European Union on 1 January 2007 [46]. It was necessary to enact a draft law aimed at implementing the regional development policy [47] in the field of cohesive economic and social objectives in accordance with the objectives of the European Union and with the general objectives and priorities regarding the development of Romania [48]. On the date of entry into force of Regulation (EC) no. 1059/2003, Romania had already adopted a law on regional development, namely, law 151/1988 [49]. Thus, in 2004, law 315/2004 was promulgated, which repealed law 151/1998, a new law that was drafted so as to comply with the objectives of EC Regulation no. 1059/2003 [50]. The objective was to ensure the continuous economic and social development of Romania, thus constituting

the eight development regions of Romania, according to art. 5 [51]. These regions are represented by geographical areas comprising the territories of the counties in Romania as well as that of the Municipality of Bucharest [52], which falls into the class of territorial administrative units of NUTS 2. The average demographic size of each development region is between the minimum threshold of 800,000 inhabitants and the maximum of 3 million inhabitants [44]. At the same time, these regions are meant to reduce the social and economic disproportions between Romania and the rest of the Member States of the European Union [47]. The eight development regions were established based on agreements between the representatives of the county councils and the General Council of Bucharest. They constitute the framework for elaboration, implementation and evaluation of regional development policies and collection of specific statistical data according to European regulations EUROSTAT for NUTS 2, but they do not have legal personality and do not represent administrative-territorial units [53].

Within the annex of law 315/2004, in accordance with Annex 1-NUTS nomenclature of the EC regulation no. 1059/2003 [54], the components of the eight development regions are named and mentioned, as follows:

1. North-East Development Region—in which the counties of Bacau, Botosani, Iasi, Neamt, Suceava, and Vaslui are grouped;
2. South-East Development Region, in which the counties of Braila, Buzau, Constanta, Galati, Vrancea, and Tulcea are grouped;
3. South-Muntenia Development Region—in which the counties of Arges, Calarasi, Dambovita, Giurgiu, Ialomita, Prahova, and Teleorman are grouped;
4. South-West Oltenia Development Region—in which the counties of Dolj, Gorj, Mehedinți, Olt and Valcea are grouped;
5. West Development Region, in which the counties of Arad, Caras-Severin, Hunedoara, and Timis are grouped;
6. North-West Development Region—in which the counties of Bihor, Bistrita-Nasaud, Cluj, Salaj, Satu Mare and Maramures are grouped;
7. Center Development Region—in which the counties of Alba, Brasov, Covasna, Harghita, Mures and Sibiu are grouped;
8. Bucharest-Ilfov Development Region, in which the municipalities of Bucharest and Ilfov County are grouped [53].

Specialists indicate the installation of a sharp demographic decline in Romania, a statement based on the fact that Romania's population is declining from year to year. In the last five years, there has been a decrease of over 2%, which means that in 2020 Romania's population has decreased by 431,747 people compared to 2016. The accentuated demographic decline is also indicated by the birth rate and the mortality rate. In 2018, the birth rate per thousand inhabitants was equal to 9.7, and the mortality rate was 13.3 [55].

Although Romania's population is in a continuous decline, the employed population registered increases by over 2.5% from 2016 to 2020, an increase that, according to forecasts made according to the analysed data, may double by the end of 2025. An insignificant increase was also recorded in the case of the sector of the population employed in agriculture, which, although it registered ups and downs during the analysed period, as can be seen in the first part of Figure 6, it registered an increase of just over 1% for the total analysed period. In the second part of Figure 6, it can be seen that in the next five years of the analysed period, the upward trend of the population employed in agriculture will be maintained. In 2024, there will be an increase of this population sector by almost 3%. However, it is noteworthy that the population employed in agriculture continues to grow if in the region of South Muntenia, there are 16 pensioners to 10 employees [56]. One explanation is that, in terms of agriculture, people reaching retirement age can continue their activity in this field. On the other hand, the number of people employed in agriculture is constantly growing due to national rural development programs, such as submeasure 6.3, "Support for the development of small farms", or submeasure 6.5, "Scheme for small farmers". Both submeasures are part of the National Rural Development Program 2014–2020 [57], for

which payments amounting to 188,885,008 euros were made until 10 June 2021, the date of publication of the PNDR implementation stage 2014–2021, which will finalize payments in transition amounting to EUR 35,170,500, for a number of 13,769 ongoing or completed financing contracts/decisions [58].

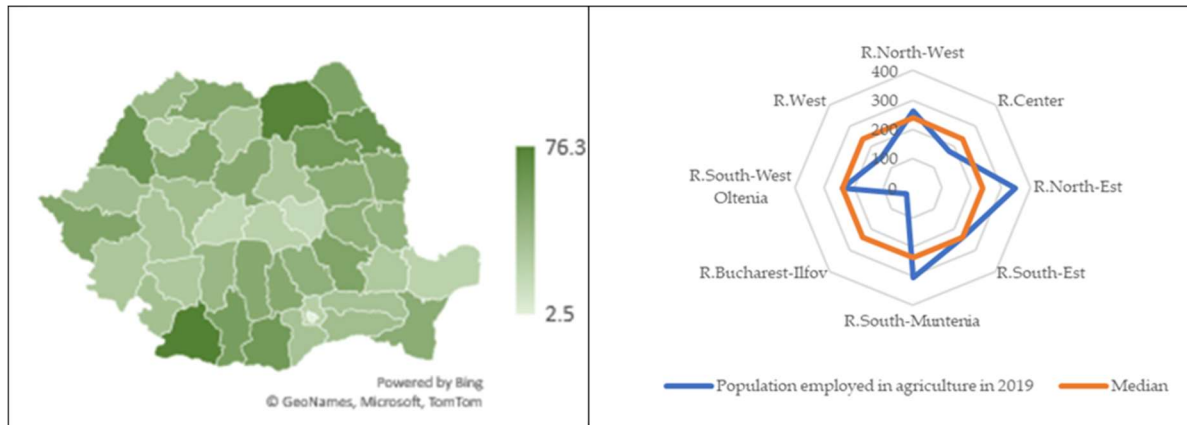


Figure 6. The population employed in agriculture in Romania in 2019. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—May 2021.

A comparison of the eight development regions in Romania, in terms of total population, shows that the North-East region ranks first and the West region ranks last. The median population of the eight regions is 2,349,552 people, representing 12.16% of the total population in the country. Analysing the data on the employed population, as well as the employed population in agriculture in 2019, we observe a very interesting phenomenon, namely, the placement of the Bucharest-Ilfov region on the first position in terms of employed population and on the last position in terms of employed population in agriculture, the last region ranked in the case of the employed population being South-West Oltenia, and the first in the case of the population employed in agriculture being the North-East region. The median employed population was equal to 1082.45 thousand people in 2019, and that of the population employed in agriculture was equal to 238.3 thousand people in the same year (Figure 6).

The share of the agricultural population in Romania's total employed population is set to decline in the coming period. The development regions, such as South-East Oltenia, South-Muntenia and North-East, where about 30% of the employed population works in agriculture, can be highlighted. The agricultural character gives these areas a limited status when it comes to economic development compared to other regions. The share of the population employed in agriculture will be influenced by an increase in the number of medium and large farms, which will absorb subsistence and semi-subsistence farms, contributing to the consolidation process, which has been occurring at a steady pace since 2007. These farms are based on new, high-performance technologies that require fewer employees [58] (Table 1).

Most arable land is concentrated in the regions of South-Muntenia and South-East, as evidenced by the significant share of the population employed in agriculture, which is directly proportional (Figure 7).

In 2014, the latest data on the total agricultural and arable area of Romania were provided, and if we compare the latest data provided by the National Institute of Statistics, during the years 2010–2014, there is an imperceptible change, the total area of the country being the same, the agricultural area decreasing by 0.03% and the arable area by 0.09%. At the same time, the surface of a country can only change under extreme conditions, so we can conclude that the areas we are discussing have not changed considerably in size during the period under consideration (Table 2).

Table 1. Percentage of the population employed in agriculture from the total population employed in Romania. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—May 2021.

Total/Region	2016 (%)	2019 (%)	2024 (%)
TOTAL	20.76	20.57	20.48
Region NORTH-WEST	22.18	22.00	21.94
Region CENTER	16.78	16.73	14.82
Region NORTH-EAST	31.01	30.58	30.16
Region SOUTH-EAST	25.08	25.05	25.28
Region SOUTH-MUNTENIA	27.71	27.55	27.41
Region BUCHAREST—ILFOV	2.00	1.93	1.87
Region SOUTH-WEST OLTENIA	30.64	30.28	29.87
Region WEST	17.54	17.97	18.77

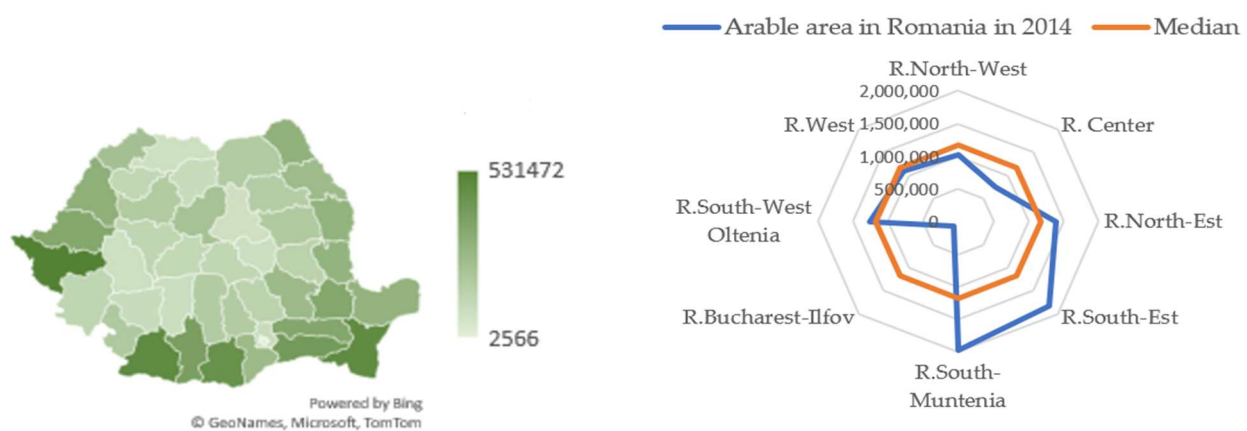


Figure 7. Arable area (ha) in Romania in 2014 Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—May 2021.

Table 2. Percentage of agricultural and arable areas in the total area in Romania. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—May 2021.

Total/Region	Agr Area/Total Area (%)	Arable Area/Total Area (%)	Arable Area/Agr Area (%)
TOTAL	61.37	39.41	64.22
Region NORTH-WEST	60.87	29.90	49.12
Region CENTRE	55.73	22.02	39.51
Region NORDTH-EAST	57.66	37.50	65.03
Region SOUTH-EAST	65.06	51.14	78.61
Region SOUTH-MUNTENIA	70.63	57.15	80.91
Region BUCHAREST—ILFOV	57.38	55.27	96.31
Region SOUTH-WEST OLTENIA	61.50	42.86	69.68
Region WEST	58.19	34.05	58.51

Regarding the cultivated areas, in Table 3, with the five crops that make Romania one of the European players in agriculture—wheat, corn, sunflower, rapeseed and soybean—an analysis of the statistical data shows that the cultivated area with rapeseed decreased by 4.15% in Romania during the analysed period (2015–2019, with 2019 being the last definitive data provided by the National Institute of Statistics), while the cultivated areas

with wheat, corn, sunflower and soybeans increased by 2.93%, 2.82%, 26.81% and 23.4%, respectively. In the year 2019, out of the total area of Romania, 27.85% of the five crops, represent 45.39% of the total agricultural area and 70.67 % of the arable area. The largest contribution to these percentages is the area cultivated with wheat, followed by the one cultivated with corn, then by the one cultivated area the largest increase in the next five years of the analysed period, respectively, by more than 65% because the percentages with which it increased during the analysed period are very high, although the cultivated area in the first analysed year is larger than the cultivated area at the end of the analysed period, the soybean cultivated area with sunflower, followed by the one cultivated with rapeseed, and the smallest contribution is the surface cultivated with soybeans. As in the case of agricultural and arable land, the largest areas cultivated with wheat, corn, sunflower, rapeseed and soybeans are found in the regions of South-Muntenia (wheat, corn, rape and soybeans) and South-East (sunflower), due to the more favourable terrain, climate and soil for agricultural activities [51] in these two areas than the other (Table 3).

Table 3. Percentage of cultivated areas with wheat, corn, sunflower, rapeseed and soybeans from the total area of Romania and from agricultural and arable areas. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—June 2021.

	Wheat (%)			Corn (%)			Sunflower (%)			Rapeseed (%)			Soy (%)		
TOTAL	9.10	14.82	23.08	11.24	18.31	28.51	5.38	8.77	13.65	1.48	2.41	3.75	0.66	1.08	1.68
Region NORTH-WEST	4.30	7.06	14.38	7.74	12.72	25.90	2.14	3.51	7.15	0.96	1.58	3.21	0.54	0.89	1.80
Region CENTRE	2.65	4.76	12.05	4.78	8.58	21.73	0.52	0.94	2.38	0.27	0.48	1.22	0.23	0.42	1.06
Region NORTH-EAST	4.34	7.53	11.57	12.59	21.84	33.58	5.44	9.43	14.51	0.96	1.67	2.57	0.94	1.63	2.51
Region SOUTH-EAST	12.87	19.79	25.17	14.06	21.61	27.49	9.38	14.42	18.34	1.82	2.79	3.55	0.77	1.18	1.50
Region SOUTH-MUNTENIA	17.16	24.29	30.03	15.51	21.96	27.14	7.78	11.01	13.61	3.67	5.19	6.42	0.99	1.41	1.74
Region BUCHAREST—ILFOV	10.47	18.25	18.94	6.58	11.48	11.92	5.79	10.09	10.47	4.13	7.20	7.48	0.07	0.13	0.13
Region SOUTH-WEST OLTENIA	13.97	22.71	32.59	11.54	18.77	26.93	7.13	11.59	16.64	1.12	1.82	2.61	0.07	0.11	0.15
Region WEST	9.13	15.68	26.80	12.50	21.48	36.72	5.28	9.07	15.50	1.36	2.34	3.99	1.04	1.78	3.05

The forecasts regarding the cultivation areas with the five crops, in Figure 8, for the next five years are positive. According to the analysed statistical data, the wheat area would increase by 2024 by less than 1%. Considering the fact that during the analysed period it saw both increases and decreases, the sunflower area will increase by 11%. Due to the largely positive trend over the analysed period, the rapeseed will increase by almost 40%, its trend during the analysed period being, except for the first two years, upward. The area cultivated with maize is the only one that is expected to decrease in the next five years, by almost 5%, a forecast due to the fact that during the analysed period it showed a downward trend.

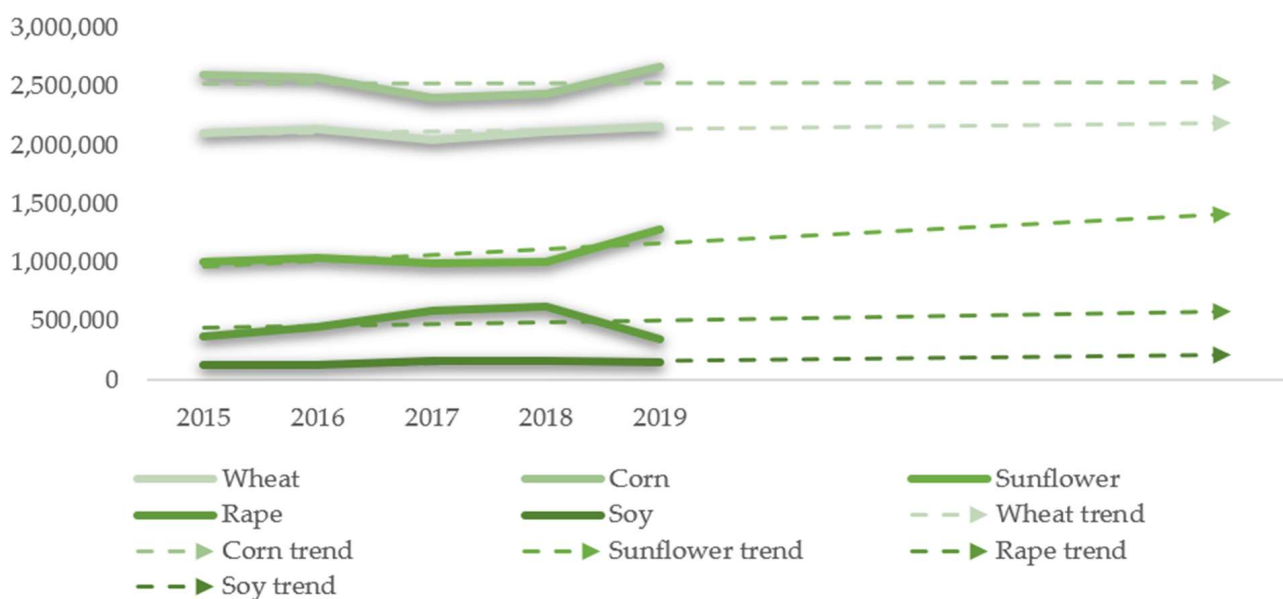


Figure 8. Forecasts for areas cultivated with wheat, corn, sunflower, rapeseed and soybeans in Romania. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—June 2021.

During the five years analysed, in Romania, the productions of four of the five crops analysed increased significantly: wheat production increased by 29.32%, corn production increased by 93.23%, sunflower production almost doubled, and soybeans increased by 58.72%. The only crop whose production decreased during the analysed period is rapeseed, which decreased by 13.19% (Table 4).

Table 4. Productions of wheat, corn, sunflower, rapeseed and soybean crops related to their areas in 2015 and 2019 (t/ha). Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—June 2021.

	Wheat	Corn	Sunflower	Rapeseed	Soy	Wheat	Corn	Sunflower	Rapeseed	Soy
	2015 (t/ha)					2019 (t/ha)				
TOTAL	3.78	3.46	1.77	2.50	2.04	4.75	6.51	2.78	2.26	2.63
Region NORTH-WEST	3.89	3.16	1.65	2.26	1.97	4.04	6.69	2.94	2.33	2.41
Region CENTER	3.74	4.03	2.10	2.53	1.81	4.10	6.27	2.71	2.60	2.39
Region NORTH-EAST	3.03	3.15	1.62	2.24	1.63	4.03	5.78	2.42	1.79	1.96
Region SOUTH-EAST	3.70	3.32	1.64	2.47	2.87	4.57	6.04	2.62	1.98	3.00
Region SOUTH-MUNTENIA	4.04	4.07	1.97	2.64	2.30	5.12	6.70	2.61	2.36	3.18
Region BUCHAREST—ILFOV	4.23	4.27	1.82	2.19	1.39	4.60	6.30	2.65	2.09	1.77
Region SOUTH-WEST OLTENIA	3.33	2.96	1.63	2.33	1.65	4.75	5.71	3.02	2.15	2.25
Region WEST	4.45	3.70	2.11	2.37	1.41	5.25	8.34	3.46	2.77	2.66
Average	3.80	3.58	1.82	2.38	1.88	4.56	6.48	2.80	2.26	2.45

Wheat production increased during the period analysed in all eight development regions. The highest increase was registered in the South-West Oltenia region (60.1%) and the lowest in the North-West region (4.05%). The eight development regions registered increases in corn production, with the highest in the West region (158.52%) and the lowest in the Center region (58.12%). At the same time, there were increases in production in the eight regions and in the case of sunflower culture, which had the highest increase in the West region (210.34%), and the lowest increase in Bucharest-Ilfov (32.2%). In the case of rapeseed production, there were decreases in production in four of the eight regions, the smallest decrease being in the South-Muntenia region (28.11%), and the largest increase being in the North-West region (239.34%). At the level of soybean cultivation, there were decreases in production in two of the eight regions, the Bucharest-Ilfov region being the one with the largest decrease (19.53%), and the West region being the one with the largest increase in soybean production (378.22%) (Table 4).

In 2019, in the South-Muntenia region registered the highest productions of wheat (29.37% of the total in the country), corn (20.53% of the total in the country), rapeseed (37.42% of total in the country) and soybeans (26.17% of the total in the country), while the highest production of sunflower was recorded in the South-East region (24.65% of the total in the country). However, the Western region had the highest values of production relative to cultivated areas, resulting in 5.25 tons/ha of wheat, 8.34 tons/ha of corn, 3.46 tons/ha of sunflower and 2.77 tons/ha of rapeseed. In the case of soybean cultivation, the highest value was registered in the South-Muntenia region, with 3.18 tons/ha.

In the same year, the smallest productions of the five analysed crops were registered in the Bucharest-Ilfov region, which is the smallest region in terms of area in Romania and which also includes the capital of Romania, Bucharest. Therefore, Ilfov County is the only one in the region on whose agricultural crops may be established. However, regarding the production to the cultivated area, the Bucharest-Ilfov region ranks last only in the case of soybean cultivation, with 1.77 tons/ha. The North-East region records the lowest values for wheat cultivation (4.03 tons/ha), for sunflower (2.42 tons/ha) and for rapeseed (1.79 tons/ha), the lowest value in the case of corn cultivation being registered in the South-West Oltenia region, 5.71% (Table 4).

Given that the general trends of wheat, maize, sunflower and soybean crops are positive over the period analysed, an increase in the yields of these four crops is expected for the next five years, with wheat production likely to reach an equal increase of 34% by the end of 2024, corn by almost 80%, sunflower by 65% and soybean by 72%. Moreover, in the case of rapeseed, the forecast for 2024 is positive, with the statistical data indicating the possibility of an increase of 64%, although it is the only crop whose production decreased from 2015 to 2019. However, the trend for the five years analysed still shows increases of almost 82% in the first years analysed, which is why the forecast for this growth is positive (Figure 9).

The ratio of the productions of the five crops to the population employed in agriculture in Romania, from the beginning of the analyzed period, in 2015, until the end of the analyzed period, 2019, registered a considerable, as follows: wheat 3.98–5.89 tons/person, corn 4.5–9.98 tons/person, sunflower 0.89–2.04 tons/person, abducted. 0.46 tons/person in 2015, then registered a slight increase, and in 2019 it reached the value of 0.46 tons/person, and soybeans with values of 0.13–0.24 tons/person (Table 5).

Given that these five crops are the most cultivated vegetable crops in Romania, the ratio of production to population employed in agriculture is expected to increase for both maize and wheat. This is influenced by the decrease in the population employed in agriculture and due to the merger process of farms, as well as to the technological integration process (Figure 10).

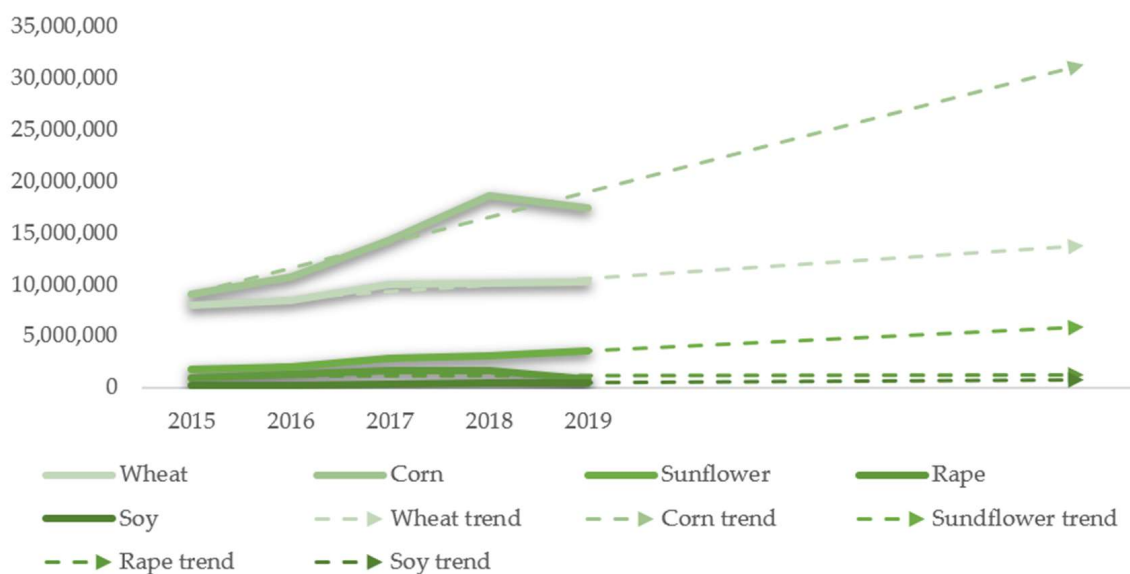


Figure 9. Forecasts for wheat, corn, sunflower, rapeseed and soybean crop production in Romania. Source: National Institute of Statistics-TEMPO-Online [47], data access and processing—June 2021.

Table 5. The ratio of the productions of the five crops to the population employed in agriculture in Romania in the years 2015–2019. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—June 2021.

Field	2015 (%)	2016 (%)	2017 (%)	2018 (%)	2019 (%)
tones wheat/person	3.98	4.88	5.76	5.77	5.89
tones corn/person	4.50	6.22	8.23	10.61	9.98
tones sunflower/person	0.89	1.18	1.67	1.74	2.04
tones rapeseed/person	0.46	0.75	0.96	0.92	0.46
tones soy/person	0.13	0.15	0.23	0.26	0.24

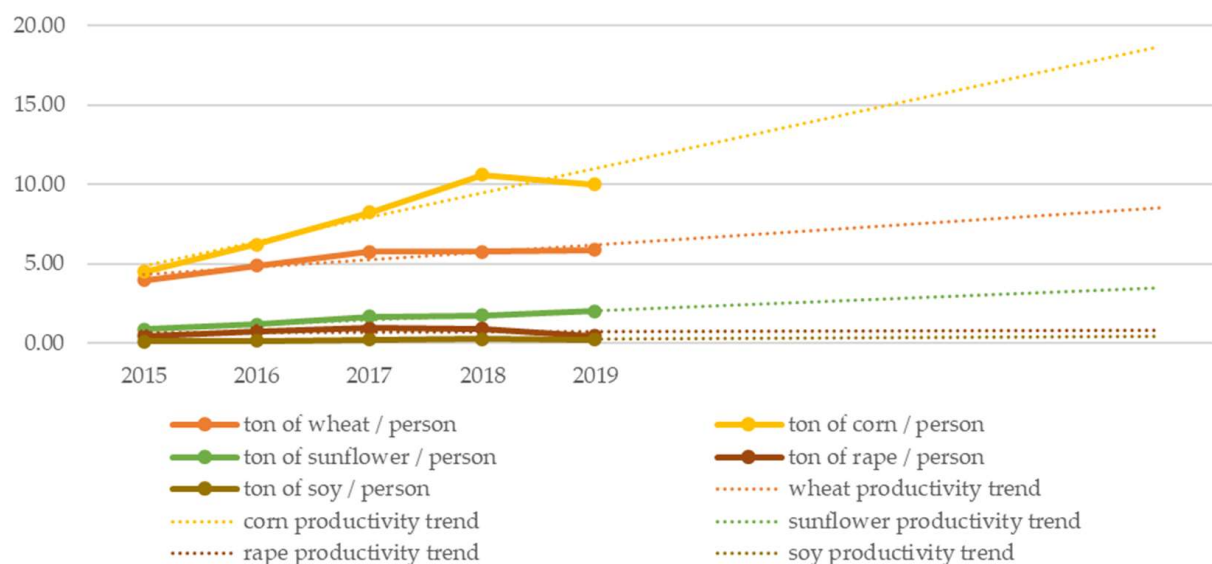


Figure 10. Forecasts regarding the ratio of the productions of the five crops to the population employed in agriculture in Romania. Source: National Institute of Statistics-TEMPO-Online [56], data access and processing—June 2021.

Psychological expectations for the value of farmland are found to be much lower among men due to their disadvantages in receiving information through policy publi-

cization and their greater willingness to transition to non-agricultural employment [59]. Better educated women farmers and those living in areas with greater economic and social development expect farmland to be more valuable [60]. Agribusiness is both a complex social process and a market structure, consisting of many independent economic entities that generate the demand for labour in the sector.

Labour productivity is, without a doubt, one of the most important indicators by which the efficiency of an activity is measured. Starting from the definition of this indicator, namely, labour productivity representing the synthetic expression of the efficiency of the use of factors of production in activities resulting from economic goods, expressed in essence by the ratio between the economic result obtained and the factors of production used, we calculated labour productivity in agriculture, the ratio being made between the production obtained in the five productions analysed as a result obtained and the number of people employed in agriculture as a factor of production used. Romania is currently one of the European countries with the most active farmers compared to the average in the European Union, where the share of the population active in agriculture in all activities is less than 5% [61].

Therefore, in Romania, labour productivity in agriculture, as previously defined, experienced an incredible increase over the period analysed in the case of four of the five crops analysed. In the case of rapeseed, the level of labour productivity in 2019 was almost equal to that of 2015, although during the years taken into account this indicator has both increases and decreases. These increases in labour productivity are expected to be maintained in the next five years, an increase expected even in the case of rapeseed cultivation. Given the existence of a large number of people employed in Romanian agriculture, it is very important to increase labour productivity in Romania because it has a major impact on economic growth and living standards [62]. Investing in agriculture and increasing the level of employment leads to the development of this branch of the economy and implicitly of other branches of industry related to agriculture, such as the food industry [63].

Occasionally, in Romania, the labour productivity in the case of wheat cultivation increased by 48.28% during the analysed period. If the trend of these five years continues ascending, then from the last analysed year, 2019, until 2024, an increase of 45.23% can be expected. In the case of corn cultivation, the increase is spectacular: 121.56%, although from 2018 to 2019 this indicator decreased by 5.93%, which led to the forecast of an increase of only 86.82% by 2024. The prognosis regarding the labour productivity of sunflower culture is also positive: the calculations carried out suggest an increase of 71.88% by 2024 compared to 2019, because in the analysed period it experienced a constant evolution, with this indicator increasing by 129.17% from 2015 to 2019. Data on soybean cultivation showed an increase in labour productivity of almost 82% during the period analysed, and the forecast for 2024 was also positive, with an increase of 81% expected. Although, as mentioned previously, the labour productivity in the case of soybean cultivation decreased by 0.46% in 2019 compared to 2015, there is an average increase of 9.16% per year, which determined the forecast of an increase equal to 79.91% from 2019 in 2024.

Within the eight development regions, the median labour productivity was equal in 2019 for wheat with 5.68 tons/person, corn with 7.89 tons/person, sunflower with 1.84 tons/person, for rapeseed with 0.42 tons/person and soybeans with 0.18 tons/person. In the same year, in the case of wheat, corn, sunflower and soybean crops, labour productivity experienced the highest value in the Western region and in the South-Muntenia region in the case of rapeseed cultivation. The lowest values of this indicator were recorded, in the same year in the Center region in the case of sunflower and rapeseed crops, in the North-East region in the case of wheat crops, and in the Bucharest-Ilfov region in the case of maize crops and soy.

The correlation of the values between the population employed in agriculture and the production of the crops analysed resulted in an indirect correlation ($r = -0.63$). This is due to the fact that in 2015, the reported production had the lowest value, and the population

employed in agriculture had the highest value, while in 2019, the production increased considerably, and the population employed in agriculture was lower than in 2015. However, the trend toward employment in agriculture is growing. It can be stated that starting with the third-degree polynomial function, there is an increasingly close correlation between the two variables (Figure 11).

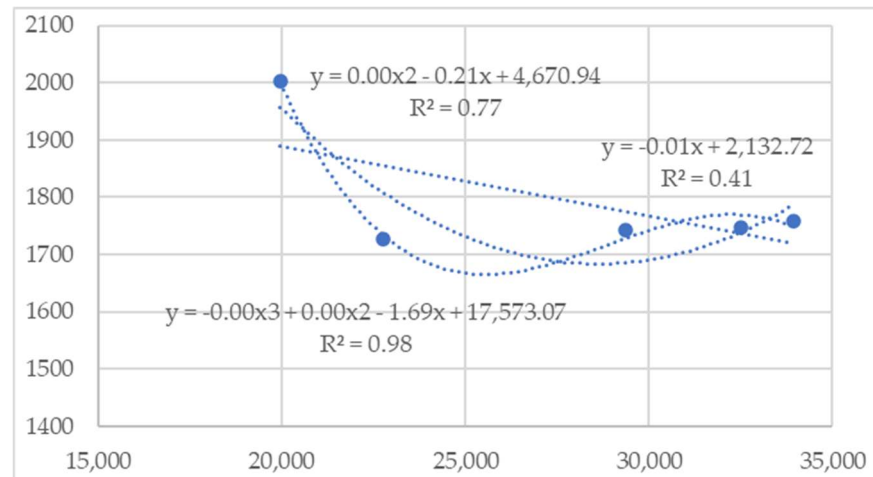


Figure 11. Correlation between the population employed in agriculture and the productions of the analysed crops (2015–2019). Source: in-house processing.

The correlation of values between the population employed in agriculture and the cultivated area with the main crops resulted in an indirect correlation ($r = -0.76$). Therefore, the cultivated area, during the period analysed, increased constantly, while the population employed in agriculture initially saw a decrease, but then remained constant with a slight tendency to increase. It can be stated that starting with the third-degree polynomial function, there is a closer connection between the two variables (Figure 12).

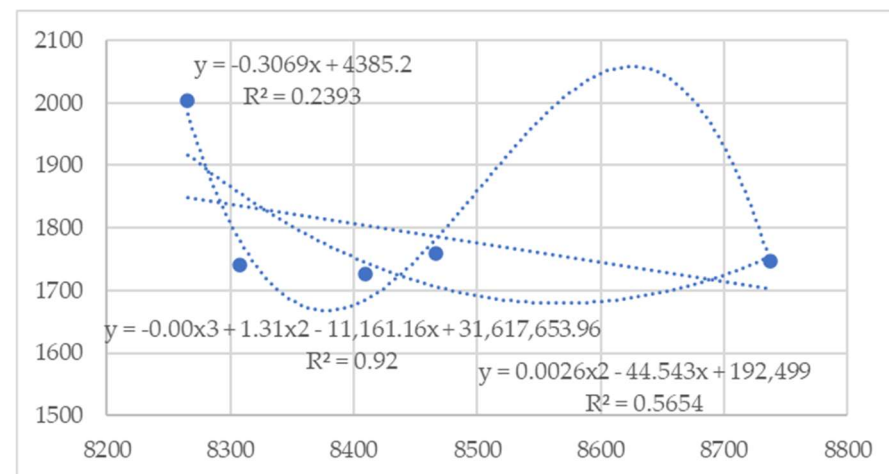


Figure 12. Correlation between the population employed in agriculture and the cultivated area with the main crops (2015–2019). Source: in-house processing.

5. Conclusions

Although in the analysed period in Romania there is a demographic decline, the population employed in agriculture has increased in the same period and is expected to increase in the next five years due to the fact that part of the population continues to work in agriculture after retirement age with the support of people employed in the agricultural sector through national rural development programmes.

In Romania in 2019, the cultivated area with the five analysed crops represented 27.85% of the total area of the country, 45.39% of the total agricultural area and 70.67% of the total arable area.

In the areas cultivated with the five crops analysed in Romania from 2015–2019, it is found that the area cultivated with rapeseed decreased by 4.15%, while the areas cultivated with wheat, corn, sunflower and soybeans increased by 2.93%, 2.82%, 26.81% and 23.4%, respectively. Regarding the forecasts of areas cultivated with these crops from 2020–2024, it is expected that the area of rapeseed will increase by 40%, the area with wheat will increase by 1%, the area with corn will decrease by almost 5% and the area with sunflower will rise by 11%. During the five years analysed, 2015–2019, the production of four of the five crops increased significantly: wheat production increased by 29.32%, corn production increased by 93.23%, sunflower production almost doubled and soybeans increased by 58.72%. The only crop whose production decreased during the analysed period is rapeseed, which decreased by 13.19%. Regarding the production forecasts of the analysed crops, in the period 2020–2024, it is expected that wheat production will increase by 34%, corn production by 80%, sunflower production by 65%, soybeans by 72%, and rapeseed by 82%.

The final conclusion also represents the achievement of the purpose of this work, namely, the determination of labour productivity in the case of the five cultures. The ratio between the obtained production and the number of people employed in agriculture leads to the determination of increases in labour productivity in the case of wheat, corn, sunflower and soybeans and a decrease in the case of rapeseed. The labour productivity yield, from the beginning to the end of the analysis period (2015–2019), evolved as follows: wheat 3.98–5.89 tons/person, corn 4.5–9.98 tons/person, sunflower 0.89–2.04 tons/person, abducted 0.46 tons/person in 2015, then registered a slight increase, and in 2019 it also reached the value of 0.46 tons/person, and soybeans with values of 0.13–0.24 tons/person. For the next five years after the reference period, the labour productivity of the five crops is expected to increase for wheat, maize, sunflower and soybean crops, as well as for rapeseed cultivation.

Sustainable agricultural development requires an approach that addresses all three important areas of economic, environmental and social factors. Further stimulating investment in agriculture (including European funding programmes) can lead to increased profitability of agricultural activities in rural areas, thus increasing contributions at the local level. This facilitates poverty reduction in rural areas and contributes to food security, but also to the depopulation of these areas. Obviously, new technologies are more environmentally friendly and new trends, both at the European and the national level, are moving towards organically grown products.

Although the population employed in agriculture impacts the production obtained in the case of the five crops analysed, as exemplified in this paper, Romanian agriculture is still negatively influenced, to a fairly high degree, by the lack of technology and training of persons employed in agriculture.

The approach of this study reflects the labour force situation taking into account the main agricultural crops in Romania, but even if the crop sector presents the highest value of agricultural production, the implications of the other agricultural crops or the livestock sector, including services, have not been taken into account [58]. Despite these limitations, this research can be extended to the above-mentioned categories, taking an overview of the whole labour market in Romanian agriculture.

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