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Romania's Agricultural Labour Force – Trends, Mutations And Disturbances

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Abstract:- Liberalisation of the labour market is resulting in greater flexibility in the supply of agricultural workers, which is particularly noticeable within the European Union. The aim of the study is to identify the causes that have led to a decrease in the number of jobs in agriculture, given that it is a basic activity for rural inhabitants in Romania. In order to identify the causes that contributed to the decrease in the number of jobs in agriculture, the data were analysed quantitatively and qualitatively, using two statistical methods to describe the variability between the observed elements: factor analysis and Pearson coefficient. The results of the study indicate that the degree of mechanisation leads to better land use, bringing considerable increases in yields. At the same time, the degree of mechanisation leads to a decrease in the need for manual (unskilled) labour, as many activities are now automated.

Keywords:- *Labour Force; Agriculture; Rural; Mechanisation.*

I. INTRODUCTION

Agriculture can be considered one of man's most important discoveries, changing the way we eat and therefore the way we live. On the other hand, agriculture has altered eco-systems and led to the emergence or disappearance of different civilisations [1]. While in the early days agriculture consisted of planting and tending wild vegetation, today it is a highly complex industry [2,3].

Modern agriculture began between the 16th and 19th centuries in Britain, with con-siderable increases in agricultural production brought about by the introduction of new techniques and technologies. As a result of the development of agriculture, the population grew and contributed to the Industrial Revolution [4,5].

Although agriculture cannot absorb all of the rural labor force, it contributes signifi-cantly to job creation. Access to the labour market is particularly important for rural peo-ple, as for many it is their only source of income [6-8].

Between 1980 and 1990, data collected by the International Labour Organisation showed that the share of wage employment in agriculture increased in relation to rural economic activities. The share of women in employment has also increased in this sector [2,3,5].

Employed workers in this sector are represented by women and men working in ag-ricultural fields, orchards, greenhouses or in livestock units [9]. They also include those working in primary processing plants for food production. They work on small and me-dium-sized farms as well as on large, highly industrialised farms. Because they do not own or rent the land they work on, nor do they own the equipment they use [10,11].

Agricultural workers cannot be considered as a homogeneous group, so the terms and conditions of employment can vary widely, from permanent farm workers to tempo-rary (casual) workers or seasonal workers. At the same time, there are many indigenous agricultural workers, paid either in cash or in kind (including mixed) [9-11].

Labour requirements in agriculture fluctuate according to the season, which is re-flected in the nature of the labour force, which also influences the intensity of remunera-tion.. Most agricultural work is physically demanding, putting a strain on the worker's health [7]. There are also many risks associated with this work. Although technological change has brought improvements in terms of reducing physical effort through the intro-duction of sophisticated machinery, it is most often associated with new risks caused by a lack of information for users [10-12].

Due to globalisation, agriculture in many countries has undergone significant trans-formations, with production oriented toward export, becoming highly dependent on mi-grant labour, whose situation is disadvantaged in terms of wages, social protection, housing, or health protection [13,14]. Pressure from consumers and supermarket chains to keep prices low forces farmers to produce at a low cost. This leads to lower labour costs, which affects workers [15,16].

Liberalization of the labour market results in greater flexibility in the supply of agri-cultural workers, and this is particularly noticeable within the European Union [17].

Small farmers' incomes also depend on paid work as a regular source of income, so a large proportion of them have other jobs in addition to farming [18,19]. However, recently, the need to increase agricultural wages has been taken into account both at the European level and by governments through various programs and strategies [20,21].

Sustainable agriculture, rural development and food security have many aspects in common and affect agricultural workers and small farmers [22]. As employment in rural areas becomes increasingly vulnerable, the distinction between the employed and the working population becomes less clear [23,24]. Thus, agricultural workers are included in disadvantaged rural groups such as subsistence farms, the unemployed or the rural land-less.

Throughout the world, children are involved in agricultural activities that affect their well-being and hinder their education and therefore their development. They work along-side with their parents (indirect employment, with only the head of the family directly employed) [25].

The employment relationship is a legal concept between a person (employee) and another person (employer), to whom he provides a certain service under certain condi-tions and in return for which he is remunerated. This concept is applied under all sys-tems, but obligations and rights vary from country to country [26,27].

At the same time, another threat for jobs in general, and agriculture in particular, is the phenomenon of high-technology, so in the study "The Future of Employment: How Susceptible are Jobs to Computerisation?" they looked at how sensitive jobs are to com-puterisation for 702 US occupations [28].

No. crt.	Probability	Occupation
1	0.0075	Farm and Home Management Advisors
2	0.047	Farmers, Ranchers, and Other Agricultural Managers
3	0.41	Graders and Sorters, Agricultural Products
4	0.49	Agricultural Engineers
5	0.57	First-Line Supervisors of Farming, Fishing, and Forestry Workers
6	0.75	Farm Equipment Mechanics and Service Technicians
7	0.77	Purchasing Agents, Except Wholesale, Retail, and Farm Products
8	0.87	Buyers and Purchasing Agents, Farm Products
9	0.87	Miscellaneous Agricultural Workers
10	0.94	Agricultural Inspectors
11	0.97	Farm Labor Contractors
12	0.97	Agricultural and Food Science Technicians

a.[28]

Table 1:- The probability that the main agricultural occupations are sensitive to computerization [28]

According to the researchers' predictions, agricultural professions with a manage-ment role are less likely to be computer-sensitive. However, occupations such as agricul-tural and food science technicians and agricultural labour contractors have a high proba-bility of computer sensitivity.

A. The Situation of Agriculture in Romania

Due to the collectivisation process, which began during the communist period and was completed immediately after the communist period by the restitution of agricultural land back to the population, there has been a marked fragmentation of agricultural land. Therefore, in 2002 the number of agricultural holdings was 4.5 million, reaching approx-imately 2.9 million holdings in 2020, due to the effects of national rural development pro-grammes. Also through these programmes, there has been an improvement in the level of technology on farms, driven by the co-financing made available to Romanian farmers through European instruments [29,30].

One of the biggest challenges facing agriculture in Romania is the polarisation of farms, where a small number of farms use a large area of agricultural land. Unfortunately, the agricultural production obtained is not processed, and therefore much of it is exported, and returns as imports, as finished products [31,32].

The aim of the study is to identify the reasons for the decline in the number of jobs in agriculture, which is a basic activity for rural residents in Romania [33,34].

The labour force in agriculture in Romania suffers disruption for many reasons, this paper has determined the dynamics of the labour force and the main exogenous factors that can influence this activity [35,36].

Agriculture in Romania is still considered extensive, which leads to the need for a large amount of manual labour, which is currently lacking in the market, given the migra-tion and ageing of the rural population in Romania [37,38].

At the same time, it is important to study the influence of the development of mecha-nisation on the workforce and on wage levels, given that machinery and equipment are becoming increasingly sophisticated and staff need to be increasingly skilled, which also leads to higher wage costs [37,38].

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II. MATERIALS AND METHODS

To identify the causes that contribute to the decline in agricultural employment, the data were analyzed quantitatively and qualitatively. The data used in the analysis came from the National Institute of Statistics of Romania. Two statistical methods were used to describe the variability between the observed elements:

- factor analysis
- Pearson correlation coefficient.

Factor analysis was used to explain possible correlations between variables, taking into account other factors that are not observable.

The second step was to determine the Pearson coefficient for the analysed data set, identifying the strength of the linear relationship between x and y, using IBM SPSS STA-TISTICS 20 software, according to the following formula:

$$r = \frac{n(\Sigma xy)-(\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2-(\Sigma x)^2][n\Sigma y^2-(\Sigma y)^2]}} \quad (1)$$

III. RESULTS AND DISCUSSION

Therefore, the first part of the research is based on the analysis of the dynamics of machinery and equipment to determine the degree of mechanization and automation in Romanian agriculture.

As is only natural, most machines are in the category of agricultural tractors, they ranged between 174 thousand tractors and 232 thousand tractors in the period under re-view, the highest being reached in the last year, as can be seen from the figure, this cate-gory of machinery is growing. On average, about 196 thousand tractors were registered annually, and from this average there was a standard deviation of 19 thousand tractors, which means a variation in the number of agricultural tractors of about 10%, which is a homogeneous data series. Analysing in dynamics, determining the average annual growth rate, an increase of 2.26% per year in the number of tractors was established (Figure 1.).

The next category of agricultural machinery, according to the number registered in Romania, was that of mechanical seed drills, very important for the development of agri-culture and its intensification. There is a more constant trend for this category, with be-tween 67.6 thousand and 81.25 thousand mechanical seed drills in Romania. On average there were 74 thousand mechanical seed drills each year, and there was a deviation of 4.4 thousand from this average, giving a variation of 6%. In terms of dynamics, there is a slight upward trend, averaging 0.7% per year (Figure 1.).

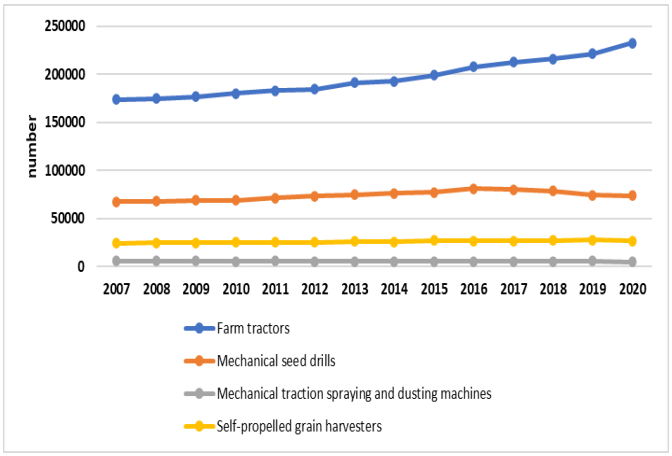

Fig. 1. Dynamics of the main agricultural machinery in Romania. Source: Processing based on INS data

In third place among the categories analysed are self-propelled combine harvesters, which, over the 14 years analysed, ranged from 24.6 thousand combines to 27.6 thousand combines. The average number of self-propelled combine harvesters per year is 26.13 thousand combines, with an average standard deviation from this average of 1060 com-bines, resulting in a variation of only 4.1%, and a slight upward trend in terms of dynam-ics, averaging 0.65% each year (Figure 1.).

The last category analysed, i.e. spraying machines ranged from 5 thousand to 6 thousand, on average each year there were 5.6 thousand spraying machines, and there was a deviation from this average of 301 machines, resulting in a variation of 5.4%. It should be noted that this category is the only one to show a negative dynamic, with an average annual rate of change of -1.16% (Figure 1.).

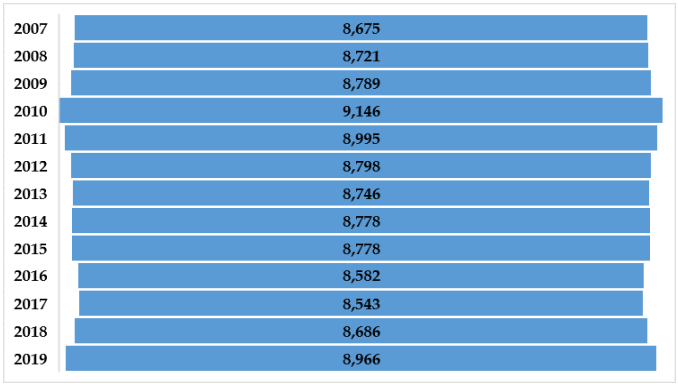

Fig. 2. Dynamics of arable land in Romania, thousands of hectares. Source: Processing based on INS data

As regards the arable area in Romania, during the period analysed, it can be deter-mined that there are oscillations from one year to the next, depending also on the destina-tion of the other categories. The arable area fluctuated between the minimum of the period, 8.5 million hectares (in 2017) and 9.15 million hectares, the maximum recorded in 2010. On average, Romania's arable area over the last 13 years was 8.785 million hectares, with a deviation from this of 167 thousand hectares, resulting in a rather small variation of on-ly 1.9%. The overall trend is one of slight increase, perhaps

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better said a maintenance trend, with an average annual growth rate of only 0.27% (Figure 2.).

The dynamics of the arable area in Romania can be compared with that of the Euro-pean Union, even if the extent is at a completely different level, it can be seen that in the European Union, the variation is even smaller, as is natural, being a unitary whole, of only 1.1%, but the dynamic trend is different, the arable area at European level registers a de-crease, on average by 0.18% per year (Figure 2.).

In order to be able to compare Romania's level of mechanisation with other similar countries in terms of the agricultural sector, as well as with the European Union average, a common indicator must be determined that can allow comparisons. Thus, the number of tractors per hectare, i.e. the number of tractors per 100 square kilometres of arable land, will be determined. The calculation of this indicator will be preceded by an analysis of the dynamics of the arable area in Romania (Figure 3).

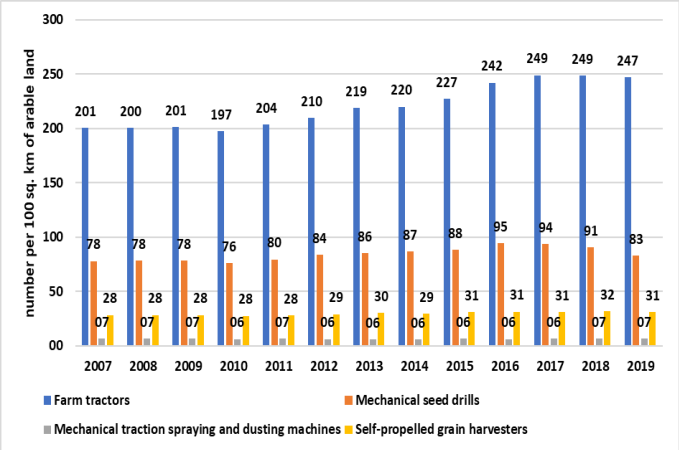

Fig. 3.Agricultural machinery per 100 sq. Km of arable land. Source: authors' calculations

Determining the load per hectare for physical agricultural tractors, it can be seen that it is increasing, given the increasing dynamics of the number of tractors, even though ara-ble land has also increased, although at a much slower rhythm. Thus, the level of tractors per 100 square kilometres of arable land ranges from 200.6 tractors to 249 tractors, with an average of 220.4 tractors per 100 square kilometres of arable land. However, we should also mention some values from countries similar in agricultural terms to Romania and the EU average (Figure 3.).

The average number of mechanical seed drills was 84 per 100 square km of arable area, the average number of self-propelled combines was 30 and the average number of sprayers was 6.5 per 100 square km of arable area in Romania (Figure 3.).

While Romania has an average level of 220 tractors per 100 square km of arable land, Bulgaria has a slightly lower level of 172 tractors, but Poland has a level of 1307 tractors and the EU average is 708 tractors per 100 square km of arable land, thus showing once again the extensive nature of agriculture in Romania and the still present need for manual labour (Figure 3.) [37,38].

To further measure the performance of the agricultural sector, average yields per hec-tare were determined for the cereal category for grains category, as well as the dynamics of total production, trying to determine the differences and identify the factors that contribute the most, that is, area or yield (Figure 3.).

Comparative analysis, according to data provided by national data institutions, from 2007 to the latest year, i.e. 2020, the area under grain cereals has increased by 4.3%, but the yield has increased by 123.4% and the total grain cereals production has increased by 133% in the same period, which may lead to an opening for intensification of agriculture with improved production technologies [37,38].

However, since the total production result is the product of the area under cultivation and the average yield per hectare, a factor analysis of the component elements can be car-ried out to determine the impact of changing each factor individually. Therefore, the time period has been divided into the 2007-2013 and 2014-2020, which also correspond to the Common Agricultural Policy programming periods, in order to determine the influence of changes in area and yields on total output. A brief centralisation of the data has been made in the following table (Table 2.).

Specification	2007-2013	2014-2020
Surface (ha)	5,249,882	5,395,137
Yield (kg/ha)	3,012	4,520
Total production (kg)	15,811,895,031	24,384,477,127

[b.]Source: own calculations

Table 2:- Average values of area, yields and total production for cereals in the two comparative periods

On average, the area under cereals for grain in 2007-2013 was 5.25 million hectares and in 2014-2020 it was 5.395 million hectares, an increase of 2.76%. The average grain cereal yield in the period 2007-2013 was 3012 kg per hectare and in the period 2014-2020 it was 4520 kg per hectare, representing an increase of 50%. On average, the total grain ce-real production in the period 2007-2013 was 15.8 billion kg and in the period 2014-2020 it was 24.38 billion kg, representing an increase of 54%.

The following proposes the development of factor analysis to identify the contribu-tion of factors to changes.

- ΔQ = Q2014-2020 - Q2007-2013 = 8,572,582,095 kg
- ΔS = (S2014-2020 - S2007-2013) * Y2007-2013 = 437,486,449 kg
- ΔY = S2014-2020 * (Y2014-2020 - Y2007-2013) = 8,135,095,647 kg

The absolute difference between the 2014-2020 production and the 2007-2013 pro-duction was 8.5 billion kilograms, of which 437.5 million kilograms changed because

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the area changed and the yield change resulted in a change of 8.135 billion kilograms. Ex-pressed as a percentage, 5.1% of the increase in total cereal production is estimated to be due to an increase in the cultivated area and 94.9% to an increase in yield. Therefore, it can be considered that equipping with additional machinery compared to the previous period has led to an increase in yield and implicitly to an increase in total production, where the factor of labour force factor comes into play, which this time does not need to be large in volume, but rather to be qualified.

The dynamics of the agricultural labour force and the level of its earnings over the same analysis period will be analysed below.

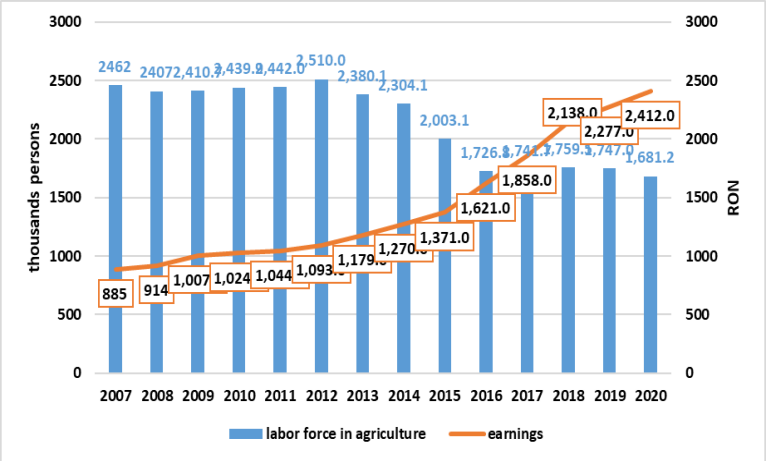

Fig. 4. Dynamics of labour volume and earnings. Source: Processing Based on NSI data

Regarding the labour force, it has decreased during the period analysed, as can be seen, from 2.46 million people working in agriculture in 2007 to 1.68 million people working in agriculture in 2020. There is a year-over-year decrease in this indicator of 2.9% and a variation of 15.9%. This decrease may have several causes, including the moderni-sation of production technologies and the increased use of mechanical power, the ageing of the rural population, the migration of the rural population either to urban areas or abroad, and the lack of skills required for new machinery (Figure 4.).

In terms of wage earnings, this has been increasing over the period under analysis, with an average monthly earnings of RON 1435, but the variation has been quite large, starting from earnings of RON 885 in 2007 and RON 2412 in 2020, resulting in a variation of 37%. The average annual increase was 8%, this increase occurring in the background of an increase in standard of living, inflation, and the increase in the level of skill required to use the new high-performance agricultural machinery (Figure 4).

	Tractors per 100 square kilometers of arable land	**Yield (kg/ha)**	**Labor force (thousands of people)**	**Earnings (RON)**
Tractors per 100 square kilometers of arable land	1			
Yield (kg/ha)	0.816532684	1		
Labor force (thousands of people)	-0.95536504	-0.78013574	1	
Earnings (RON)	0.944977861	0.873715828	-0.91802391	1

[c]Source: own calculations

Table 2:- Determination of Pearson's correlation coefficients between variables

Pearson's correlation coefficients between the variables analysed above were deter-mined, with high absolute values, resulting in close links between variables, but both di-rectly proportional and inversely proportional links (Table 3).

The correlation coefficient between the number of tractor per 100 square kilometers of arable land and the yield per hectare is 0.816, representing a close and directly propor-tional relationship, as is natural, given the increase in mechanisation leading to better land use and therefore to an increase in yield (Table 3).

There is a correlation coefficient of -0.955 between the number of tractors per 100 square kilometers of arable land and the agricultural labour force, representing a close and inversely proportional relationship, which is natural, given that the increase in mechani-zation leads to a decrease in the need for manual labour, so that there is no longer a need for

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such a large number of workers, as many technological tasks are becoming automated (Table 3).

The correlation coefficient between the number of tractor per 100 square kilometres of arable land and wage earnings is 0.9449, representing a close and directly proportional relationship, as specified above, the increase in the number and technology of machines leads to an increase in earnings, given the high level of skill that each worker should have (Table 3.).

There is a correlation coefficient of -0.78 between average yield per hectare and labour force, which leads to a strong correlation between variables, inversely proportional, i.e., when one variable increases, the other decreases and vice versa, which is determined by the fact that the increase in yield is influenced by new technologies and machinery devel-opment, and is less based on manual labour (Table 3.).

There is a correlation coefficient of 0.873 between the average yield per hectare and wage earnings in agriculture, which establishes a strong and directly proportional link between these variables, so that with the increase in yield there is also an increase in wage earnings, given that a large proportion of farms in Romania are household farms (Table 3.).

There is a correlation coefficient of -0.918 between the agricultural labor force and wage earnings, which leads to a close but inversely proportional relationship, which also confirms the economic theory of supply and demand, given that there are fewer and fewer workers on the market, leading to an increase in earnings in order to keep existing staff (Table 3).

The regression equation for the dependent variable agricultural labour force and the independent variables, individually, ie, the number of tractors per 100 km2 arable land, yield and wage earnings, will be determined next (Figure 5.).

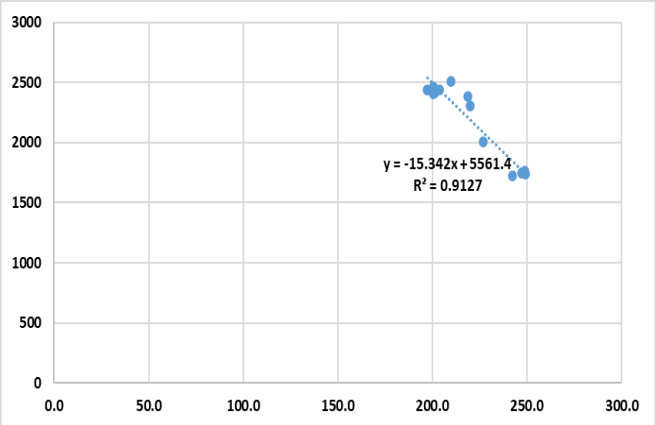

Fig. 5. Determination of the regression equation between the labour force and the number of tractors per 100 km2 of arable land. Source: authors' results

It is observed that the coefficient of determination registers a value of 0.9127, which determines that the dependent variable (i.e. labour force) is explained by the independent variable (number of tractors per 100km2 of arable area) in the proportion of 91.27%. Ana-lyzing the coefficient of the regression equation, it is -15.34, which determines that an in-crease in the number of tractors by one unit per 100 km2 of arable area results in a reduc-tion of the labour force by 15 units (Figure 5).

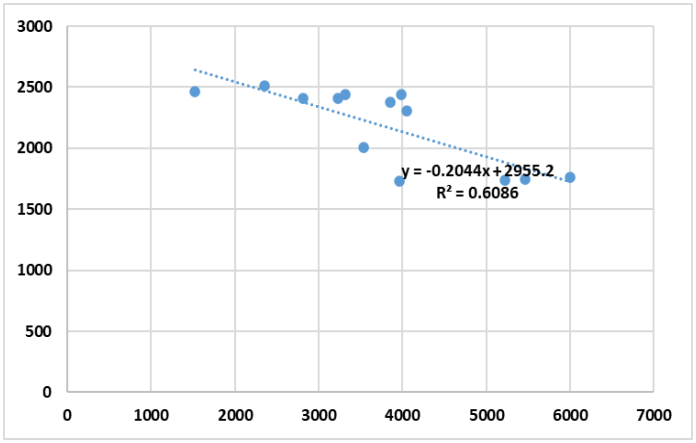

Fig. 6. Determination of the regression equation between labour force and yield per hectare. Source: authors' results

It is observed that the coefficient of determination has a value of 0.6086, which de-termines that the dependent variable (i.e. labour force) is explained by the independent variable (average return) in a proportion of 60.86%. Analyzing the coefficient of the regres-sion equation, it is -0.2044, which determines that for an increase of one unit in the yield, there is a reduction of 0.2 units in the labour force (Figure 6.).

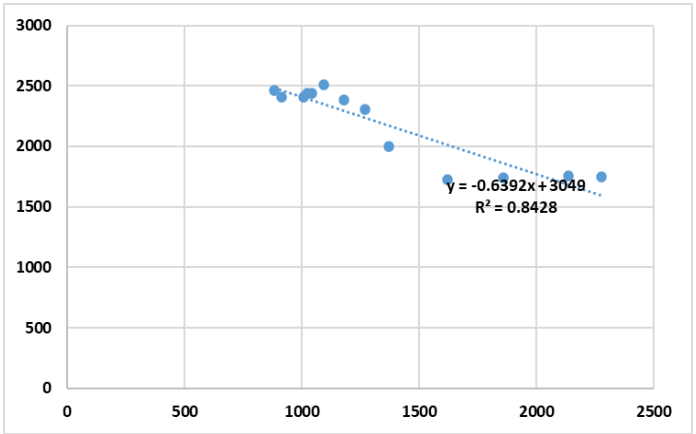

Fig. 7. Determination of the regression equation between labour force and wage earnings. Source: au-thors' results

It is observed that the coefficient of determination registers a value of 0.8428, which determines that the dependent variable (i.e. labour force) is explained by the independent variable (wage earnings) in a proportion of 84.28%. Analyzing the coefficient of the regres-sion equation, it is -0.639, which determines that for an increase in the wage gain by one unit, there is a reduction in the labour force by 0.64 units (Figure 7.).

IV. CONCLUSIONS

Since 2007, when Romania joined the European Union, it has benefited from non-reimbursable funds aimed at revitalising the technological equipment of farms. This is evidenced, particularly among tractors, by an average growth rate of 2.26% [37,38].

The influence of European funds, through the purchase of new, high-performance machinery, can be seen in the load per hectare, where the new agricultural machinery are more efficient than morally and physically depleted machines [36].

As a result of innovation in plant protection industry and the development of agri-cultural machinery that has also manifested in Romanian agriculture, there have been significant increases in the yields of cereals, which are grown on more than 50% of the country's agricultural land. This has led to significant increases in total cereal production in the two programming periods under comparative analysis [32,33]. It should also be noted that the new agricultural equipment eliminates most of the unskilled workers on the farm, but requires well-trained staff, adequately remunerated for their responsibilities [35].

The need for qualified workers who can operate new and modern machinery effi-ciently and effectively means a proper remuneration. Also, the shortage of labour in agri-culture, which used to be predominantly rural, has changed dramatically in recent years as young people grow older and migrate to urban centres, has forced farm owners to raise wages [39].

Until 2015, the wage in agriculture could be considered equal to the (compulsory) minimum wage offered on the Romanian labour market, a situation that has changed considerably with the migration of young people to urban centres and Western European countries [40].

The results of the study show that the degree of mechanization leads to better land use, resulting in considerable increases in yields. At the same time, the degree of mecha-nisation leads to a decrease in the need for manual (unskilled) labour, as many activities are now automated [41].

The increase in the number of machines also contributes to an increase in the income of agricultural employees, so that farmers are obliged to compensate their staff accordingly.

The agricultural workforce is and will be going through a complicated situation in the coming period, offering advantages and disadvantages alike. The development of new machinery and technology in this sector tends to replace more and more labour, but the new jobs created will have to be remunerated in line with the responsibilities they entail.

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