

## ARTICLE

# PERFORMANCE AS THE MAIN FACTOR OF EXPANDED REPRODUCTION

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## ABSTRACT

Scientific and technological progress increasingly replaces aged equipment with more efficient and less expensive one. This makes it possible to significantly reduce labor costs for a unit of output and increase the total production volume. In the agrarian economy of Russia, the important issue remains the problem of labor productivity growth, the solution of which is largely achieved through factors that affect the reduction of labor costs per unit of output. To increase the efficiency of production, it is necessary to use all factors of labor productivity growth; only then the agricultural commodity producer can obtain tangible results of saving labor and financial resources [1]. Accelerating the growth of labor productivity is an important stage in the further development of production and the raising of human wellbeing. The purpose of the study is to analyze the productivity of labor in the Ulyanovsk region of the Russian Federation, to identify the main factors affecting the level of labor productivity and the reserves of growth of these indicators. When analyzing indicators reflecting the effectiveness of labor in agriculture in the Ulyanovsk region, econometric methods (time series analysis and forecasting, statistical grouping, multifactor correlation-regression modeling) were used. The main factors influencing the level of labor productivity in the region are determined. Point and interval predictions of analyzed labor productivity indicators are made. In the agrarian sector of the Ulyanovsk region, there are enough reserves for the growth of labor productivity in the form of raising the capital-labor ratio level in the agrarian sector, wages in agriculture, and the professional and qualification level of workers. The conducted research and the presented conclusions can be used as an example of the development of a separate agricultural enterprise when planning production and economic activities or when developing programs aimed at improving the efficiency of the agrarian branch of the region [1].

## INTRODUCTION

One of the important indicators reflecting the results of production activities, that characterize the efficiency and level of production intensification is labor productivity. This indicator most deeply reflects economic factors and characterizes the socio-economic level of labor productivity, and outlines the prospects for labor relations.

The growth of labor productivity is a complex system changing under the influence of many factors. At the same time, it is important that the influence of groups of factors on the increase of labor activity is achieved only when a new economic mechanism for managing is developed and new economic relations based on it is organized.

## MATERIALS AND METHODS

Labor productivity in agriculture is changing under the influence of many factors.

Preliminary assessment of factors allowed us to form a set of factorial indicators that determine the quantitative assessment:

- Capital/labor ratio of agricultural labor (X 1), thousand rubles / person;
- Specific weight of the active part of fixed assets in enterprises (X 2), %;
- Degree of replacement of fixed assets (X 3);
- Level of wages of agricultural workers (X 4), thousand rubles;
- Share of the wage fund in total production costs (X 5), %;
- Share of agricultural workers in the total number of employees (X 6), %.

A resultant indicator is the annual labor productivity calculated with the use of the gross product value.

Correlation-regression analysis of the influence of selected factors on the simulated indicator was carried out based on data of 137 agricultural organizations in the Ulyanovsk region and using the integrated program Statistica 10.0.

The estimation of the partial correlation coefficients made it possible to select the most significant indicators and exclude the weak influence and multi collinearity:

- Capital-labor ratio of agricultural labor (X 1), thousand rubles / person;
- Level of wages of agricultural workers (X 4), thousand rubles;
- Share of the labor compensation fund in total production costs (X 5), %.

### KEY WORDS

labor productivity, factors, prediction, efficiency, qualification, engineering and technical personnel.

Received: 10 Oct 2018  
Accepted: 11 Dec 2018  
Published: 2 Jan 2019

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The first indicator is caused by the influence of scientific and technological progress on the productivity of agricultural labor, the other two are organizational indicators and they reflect the labor potential of an enterprise, the use of modern forms of labor organization and its payment, and the system of motivation and stimulation of labor in agriculture.

The degree of relationship strength between the selected indicators and the resultant indicator is reflected in [Table 1].

**Table 1:** Matrix of Pairwise Correlation Coefficients

Indicators	Convention	Labor productivity, Y, thousand rubles / person
Capital-labor ratio of agricultural labor, thousand rubles	X <sub>1</sub>	0.403
The level of remuneration of agricultural workers, thousand rubles	X <sub>4</sub>	0.565
The share of payroll in total production costs, %	X <sub>5</sub>	-0.400

As a result, the equation of the simulated indicator, labor productivity, has the following form:  
 $Y = 1087.20 + 0.91X_1 + 14.80X_4 - 89.11X_5$ .

According to the equation obtained, the share of agricultural capital-labor ratio labor and the level of have a positive effect on the result. Thus, an increase in the capital-labor ratio on average by 1 000 rubles (with the invariability of the remaining facts of the model) promotes growth of labor productivity in agricultural organizations in an average by 910 rubles. The increase in the level of labor remuneration by 1,000 rubles leads to an increase in the effective indicator by an average of 14.8 thousand rubles.

The share of the wage fund in total production costs is characterized by a negative impact on the productivity of agricultural labor. The growth of the share of wages in the total costs of enterprises for production promoted the reduction of the labor productivity level by 89.11 thousand rubles.

The statistical significance of the corresponding regression coefficients can be judged from the t Student's t-test which value corresponds to  $t_{b1} = 6.11$ ;  $t_{b4} = 11.2$ ;  $t_{b5} = -6.97$ .

The multiple correlation coefficient equal to 0.791 indicates a close relationship between the selected factors and the effective indicator. The coefficient of determination equal to 0.626 indicates that the cumulative influence of the three factors determines 62.6% of changes in the annual labor productivity, and the remaining 37.4% are the factors unaccounted for in the model.

The multiple coefficient of determination corrected for loss of degrees of variation freedom  $R^2_{correct} = 0.617$ ;

The resulting equation is statistically significant, since Fisher's F-test is significantly higher than the critical value for a given probability level, F table- 2.7.

Correlation-regression analysis made it possible to determine that the capital-labor ratio is one of the main factors in the growth of production efficiency associated with scientific and technological progress. The value of the beta coefficient of capital-labor ratio indicates that if the capital-labor ratio increases by 1%, then labor productivity will increase by 0.33%.

**Table 2:** Grouping of agricultural enterprises by the level of annual labor productivity

Labor productivity, thousand rubles	The average level of labor productivity, thousand rub.	Number of enterprises	Capital-labor ratio, thousand rubles	Average monthly wage, thousand rub.	Fund's share of wages in total production costs, %
Less than 1094.0	601.0	46	658.1	105.9	29.5
1094.0 - 2278.4	1533.6	45	795.6	143.4	16.7
More than 2278,4	5629,0	46	1466.4	192.3	7.4
Total, average	2562,1	137	974.7	147.2	17.9

The grouping of 137 agricultural enterprises in the Ulyanovsk Region according to the level of their annual labor productivity showed that with the increase in the capital-labor ratio from 658.1 to 1466.4 thousand rubles and the average level of wages from 105.9 to 192.3 thousand rubles there is an increase in labor productivity from 601.0 to 5629.0 thousand rubles, that is in 9.4 times [Table 2]. The share of the wage fund is characterized with the opposite tendency: with an increase in labor productivity, the share of wages in total production costs is reduced from 29.5 to 7.4%, or in 4.0 times.

It should be noted that the agricultural enterprises of the region that are part of the first and second groups by the level of labor productivity are characterized by the values of the variables and the

performance factors lower than the average for the aggregate. Consequently, these organizations have a significant reserve to improve their level of labor productivity.

According to the tree of solutions built in the Deductor software, a high level of labor productivity in the region is achieved in the following cases:

- 1) The share of the wage fund in production costs does not exceed 8.7%;
- 2) The share of the wage fund in production costs is from 8.7 to 21.7%, the average wage level in agriculture is from 149 thousand rubles, and the capital-labor ratio has two values: less than 377.4 or more than 940.4 thousand rubles.

To construct a decision tree to achieve a high level of labor productivity in agriculture, the quantization method was used, what allowed us to break all the factors and the resultant indicator into three groups and to reveal the relationship within each group. As shown by the analysis, an average wage value in agriculture has the greatest impact on the formation of a high level of labor productivity. The level of the capital-labor ratio in agriculture labor plays an essential role in this.

## RESULTS AND DISCUSSION

The main direction in the growth of labor productivity is the development of scientific and technological progress. However, the introduction of world scientific achievements depends, first of all, on the agrarian enterprises themselves, and primarily on their financial capabilities. In this case, the main factor in the growth of the financial well-being of an organization is its technical re-equipment. Technical progress manifested in increasing the quantity and quality of agricultural machines is an important process of the gradual replacement of manual labor by machinery, that is, the most active part of fixed productive assets [2].

Intensive and effective use of fixed assets is essential in the increase of labor productivity, what makes it possible to reduce downtime of agricultural machinery and to increase the output per unit of equipment by 19-26% [3, 4]. Drawback of this fact on technical re-equipment is the seasonality in the use of much agricultural machinery. All this leads to an extension of the payback period and financial instability for farmers, because the main problem of crop production is a short period of use of planting and harvesting equipment. In this regard, the production of new high-tech agricultural machinery is most relevant.

Growing of the equipment status of agriculture due to equipping with machinery made it possible to strengthen its material and technical base, to increase energy supply and energy capacity of labor, to create the necessary conditions for increasing its productivity.

The machine and tractor fleet of agricultural organizations in Russia is losing ground every year. For the period since 1995, only 22.2% of the tractor fleet, 17.4% of tractor plows, 20.5% of various seeders, 11.0% of beet harvesters, 19.9% of mowing machines, 12.7% of sprinkling and irrigation machines, and 16.0% of milking plants remained [Table 3].

**Table 3:** Dynamics of technical equipment level of agriculture in the Russian Federation, thousand pieces

Type of technology	1995	2000	2005	2012	2013	2014	2015	2015 in % to 1995
Tractors	1052.1	746.7	480.3	276.2	259.7	247.3	233.6	22.2
Plows	368.3	238.0	148.8	76.3	71.4	67.8	64.1	17.4
Cultivators	403.5	260.1	175.5	108.7	102.2	97.8	93.2	23.1
Seeders	457.5	314.8	218.9	115.4	107.5	100.7	93.6	20.5
Combine harvesters	291.8	198.7	129.2	72.3	67.9	64.6	61.4	21.0
Forage harvesters	94.1	59.6	33.4	17.6	16.1	15.2	14.0	14.9
Potato harvester	20.6	10.0	4.5	2.7	2.6	2.4	2.3	11.2
Beet harvesting machines	20	12.5	7.2	2.8	2.5	2.4	2.2	11.0
Mowers	161.6	98.4	63.9	37.5	35.6	33.9	32.2	19.9
Irrigation systems and installation	46.3	19.2	8.6	5.2	5.2	5.7	5.9	12.7
Milking machines	157.3	88.7	50.3	28.6	27.3	26.3	25.1	16.0

Also there is a decrease in the number of combine harvesters of all types and purposes. In the year of 1995, Russia had 291.8 thousand combine harvesters, by 2015, this indicator decreased to 61.4 thousand, or by 21.0%. Of the 94.1 thousand units forage harvesters, there were 14.0 thousand units, or 14.9%, the reason was a sharp decrease in the number of livestock, which affected the number of equipment. The number of potato harvesters has changed quite dramatically and amounted to only 12.8% of this equipment in 2015 in relation to 1995.

Since 2010, production assets have increased annually, and the capital-labor ratio had increased, but this is due to a decrease in the number of agricultural workers. If the index of capital-labor ratio in agriculture as compared to 2005 by 2016 has doubled, then labor productivity has grown insignificantly.

Rational specialization and the strengthening of agricultural production to the optimum level facilitate more efficient use of machinery, mechanisms, material and labor resources. Expensive and high-performance machines and equipment can be used with their maximum loading in large specialized farms. This will significantly increase the yield of gross agricultural products and reduce the labor intensity of their production.

Reducing the labor intensity of products is also observed when introducing intensive and progressive technologies in agricultural production. If we apply intensive technologies in plant growing, we can provide a lower cost per unit of output by approximately 19 - 23%. This can be achieved using more intensive technologies, new kinds of crops or fertilizers in agricultural production [3,5]. In this regard, we consider the dynamics and prediction of the level of labor productivity in agricultural organizations in the Ulyanovsk region.

**Table: 4.** Dynamics of labor productivity in agricultural organizations in the Ulyanovsk Region

Years	The average annual labor productivity, thousand rubles / person	Average hourly productivity, rub / person-h
2008	527.7	301.2
2009	494.8	265.7
2010	546.5	432.3
2011	829.0	495.5
2012	915.5	615.6
2013	1077.6	814.6
2014	1223,0	929.8
2015	1662,1	1215.6
2016	2100.4	1276.3

The dynamics of 2009 - 2016 years shows that in the agricultural organizations of the Ulyanovsk region there was a tendency of an increase in the average annual labor productivity by 189.9 thousand rubles. At the same time, the average annual output in the period under study was 1041.8 thousand rubles per employee. The average hourly production [4, 5] during this period also tended to increase by 134.4 rubles annually, and its average level was 705.1 rubles [Table 4]

To compile a point prediction of labor productivity, an analytical equalization for a dynamical series of the indicators of the average and average hourly labor productivity using the straight line equation was applied:

$$Y_t = a + bt, \tag{1}$$

Where  $Y_t$  - equalized (fluctuation-free) level of labor productivity, thousand rubles;

- a - the average level of labor productivity in the period under study, thousand rubles (since 2009 to 2016);
- b - the value of the average change in labor productivity in the period under study, thousand rubles;
- t - time periods (years).

The results of the analysis are shown in [Table 5].

**Table 5:** Results of the labor productivity prediction in agricultural organizations in the Ulyanovsk region

Indicators	The average annual labor productivity, thousand rubles / person	Average hourly productivity, rub / person-h
Trend equation	$Y_t = 1041.84 + 189.91x$	$Y_t = 705.18 + 134.4X$
Coefficient of fluctuation, %	5.2	2.1
Stability factor, %	94.8	97.9
Point prediction for 2018	2373.2	1645.9
Interval prediction for 2019	$2373.23 \pm 187.37$	$1645.9 \pm 82.87$

According to the study, the average annual labor productivity in agricultural organizations of the Ulyanovsk region in 2018 will be 2373.2 thousand rubles per person, and the average hourly productivity will be 1645.9 rubles. The prediction of the labor productivity level for 2019 is determined taking into account the intervals of the indicator change (the mean statistical error). As a result, in 2019, the level of average

annual labor productivity upon introduction of intensive and progressive technologies in agricultural production will fall within the range from 2185.9 to 2560.6 thousand rubles per person, and the average hourly rate will make from 1563.0 to 1728.8 rubles per person per hour.

However, introduction of new technologies in production does not guarantee the growth of labor productivity in the case of low skill of workers. At the present stage, many suppliers of agricultural machinery, together with the supply of equipment, conduct training for a representative of the buyer enterprise. In the main, agrarian enterprises send their engineering personnel for training, with the subsequent training of workers of the enterprise. However, due to the increase in the age of a significant proportion of agricultural workers, there are no highly skilled workers at enterprises that can cope with digital technology and new computer programs. All this once again raises the question on interconnection between all aspects of the development of the agrarian sector and the necessity to involve young personnel into the agricultural production process.

## CONCLUSION

The use of new and intensive industrial technologies [6, 7] leads to a rationalization in the organization of labor and labor processes. The organization of labor must be directed towards the use of labor resources and the growth of labor productivity. To date, the lowest level of labor productivity is observed in livestock production, where, in comparison with crop production, there are differences not only in the degree of mechanization of labor-intensive processes in industries but in organizational matters. In livestock production there is a discrepancy between the forms of division and cooperation of the labor of workers in basic and auxiliary occupations and the progressive level of production mechanization and the requirements of progressive technologies, what has led to a difference in the degrees of loading level of milkmaids and cattlemen. Labor productivity in livestock is dependent on the sanitary and hygienic criteria of production and microclimate in livestock buildings [4]. Thus, enterprises using the achievements of scientific and technological progress in their work [8, 9] use a combination of organizational, managerial, socio-economic and moral-psychological principles of labor motivation and have highly qualified specialists, can compete effectively in the direction of increasing labor productivity and reproduction of fixed assets, and are able to provide the country with sufficient food and create food security.

### CONFLICT OF INTEREST

There is no conflict of interest.

### ACKNOWLEDGEMENTS

The work is carried out according to the Russian Government Program of Competitive Growth of Kazan Federal University.

### FINANCIAL DISCLOSURE

None

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