Labor productivity modeling in the agricultural sector

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Abstract. The article examines the relevance of the study of productivity and wages, highlights the specificity of their relationship in the agricultural sector. On the basis of agricultural organizations of the Kursk region, an analysis of the dynamics of labor productivity in comparison with the dynamics of wages was carried out. A degressive model of wage growth has been identified that does not contain an incentive to increase the productivity of employees. On the basis of the constructed mathematical models for the growth of productivity and wages in agricultural enterprises of the Kursk region, conclusions are drawn about the imbalance of material motivation due to the fact that labor productivity increases in the form of a polynomial function with an increase in wages that is closer to a linear function. The thesis about the disproportions in the growth of productivity and wages was confirmed, and the need for corrective actions and the development of recommendations for both managerial decisions at the level of economic entities and for state regulation of the industry was substantiated. At the level of organizations, more active use of differentiated pay systems is justified, in which the level of remuneration will be directly related to the productivity of workers and the results that they contribute to financial indicators, as well as providing employees with the opportunity to participate in the capital of the enterprise and the distribution of profits with direct participation in organization management. Recommendations have been developed on the need to link the allocation of state support to the level of wages in the organization and more active use of methods of non-material incentives for managers and owners of agricultural organizations from the state.

1. Introduction
Labor productivity is an important economic category. Expressing the relationship between labor costs and the volume of production, it reflects the performance of a particular employee's work and the effectiveness of an employee's activities during a particular working time. Labor productivity is a concentrated expression of the efficiency of the use of labor and other resources in an organization. Material incentives for employees are most often considered as the main factor affecting labor productivity, which is mainly realized in the form of wages or remuneration for labor - remuneration for labor depending on the qualifications of the employee, the complexity, quantity, quality and conditions of the work performed, as well as compensation and incentive payments.

2. Modeling productivity and wages
The specificity of the study of labor productivity in the agricultural sector is associated with the absence of a direct correlation between the volume of labor expended and the result obtained, both in physical and in value terms. The factors of influence in this case are the unpredictability of natural and climatic
conditions, a long production process, the influence of biological transformations on the final product, the discrepancy between the volume of sales and the amount of labor expended, etc. [1]. In this aspect, studies of the interdependence of productivity and wages, the study of the dynamics of labor productivity in conjunction with the dynamics of wages in the organization, become especially relevant from the economic and managerial points of view.

The analysis of these interrelations will make it possible to substantiate the process of making managerial decisions - both at the level of specific agricultural organizations and at the level of government bodies that develop programs for state regulation of the development of the agricultural sector.

Figure 1 shows labor productivity and wages in the form of annual income of employees of agricultural organizations in the Kursk region.

![Figure 1. Dynamics of labor productivity and average annual income of employees.](image)

According to figure 1, we can note the outstripping growth rate of labor productivity relative to employee wages. If labor productivity increased from 256 thousand rubles in 2006 to 4447 thousand rubles in 2019, then the salary of employees - from 46,4 thousand rubles in 2006 to 398 thousand rubles in 2019. The salary of employees increased annually, and also during the analyzed period, labor productivity increased annually, with the exception of 2017, when there was a decrease in this indicator. In relative terms, we can conclude that with an increase in labor productivity by 17.4 times over the past 13 years, the average wage has increased only 8.6 times.

A significant difference is also confirmed by a comparative assessment of the dynamics of the accumulated growth rates of labor productivity and wages - we see that not only the absolute size of productivity increases rapidly in comparison with wages, but also the growth rates of this indicator significantly increase in comparison with the growth rates of employees’ wages.

At the same time, if at the beginning of the analyzed period the growth rates of the analyzed indicators practically coincided, and in 2006-2007 the growth rate of wages even slightly exceeded the growth rate of labor productivity, the divergence that began in 2009 continued to increase steadily in the future. An
exception was 2017, when, with a decrease in labor productivity by 4.8%, wages increased, as in all other years within the analyzed period, by 9.8%.

It should be noted that these trends are observed not only in the agricultural sector, but in the economy as a whole. In particular M.V. Radosteva notes a significant advance of wage growth rates over labor productivity growth rates, which does not correspond to the dynamics of similar indicators in economically developed countries, and the lack of necessary investments to increase labor productivity, insufficient use of modern technologies, and a low level of real wages compared to developed countries of the world allow to conclude that in Russia the problem of increasing the level of real wages is in the first place. [8]

It should be noted that if the accumulated wage growth index increased linearly, by about 6% annually, the graph of the growth rate of labor productivity is rather parabolic. In fact, we can talk about an explosive rapid growth of labor productivity in the agrarian complex of the Kursk region with a consistently linear growth in wages.

According to the classification proposed by A.A. Popkov, there are three main models that determine the ratio of growth rates of labor productivity and wages: 1. The growth of wages is proportional to the growth of labor productivity; 2. The growth of wages lags behind the growth of labor productivity (degressive model); 3. The growth of wages is ahead of the growth of labor productivity (progressive model) [7]. Obviously, the presence of the second (degressive) model is noted in the agricultural sector of the Kursk region. This model does not generate inflation, but it also does not contain an incentive to increase the productivity of employees.

Mathematical models characterizing the dynamics of absolute indicators and growth rates of labor productivity and wages for the period 2006-2019, are presented in table 1.

| Table 1. Models of productivity growth and wages in agricultural enterprises of the Kursk region. |
|---|---|---|
| Index | linear | polynomial |
| | Equation | $R^2$ | Equation | $R^2$ |
| Dynamics of labor productivity growth rates | $y = 1.430x - 1.782$ | 0.951 | $y = 0.064x^2 + 0.522x + 0.485$ | 0.972 |
| Dynamics of growth rates of average wages | $y = 0.594x + 0.650$ | 0.995 | $y = 0.007x^2 + 0.483x + 0.926$ | 0.997 |
| Labor productivity dynamics | $y = 346.2x - 619.8$ | 0.943 | $38.839x^2 - 135.79x + 478.53$ | 0.975 |
| Dynamics of average wages | $y = 2.259x + 0.602$ | 0.994 | $y = 0.033x^2 + 1.763x + 1.925$ | 0.997 |

The constructed models allow us to draw a conclusion about the peculiarities of the dynamics of labor productivity in the agricultural sector and the growth rate of wages, and also not only to characterize the growth of each of the modeled indicators, but also to compare these characteristics with each other. First of all, it should be noted that there is a significant difference between these indicators. Linear equations with slightly less confidence, but at a very high level describe the dynamics of changes in indicators, and at the same time they are easier to interpret compared to polynomial functions.

According to the model, the average growth in labor productivity for the period 2006-2019 was 1.43%, while the wages of workers in the agricultural sector for the same period of time increased by 0.59%. There is a significant gap (2.4 times) between these indicators, which indicates an imbalance in material motivation in agricultural organizations in relation to the productivity of employees.

The excess of the growth rate of labor productivity over the rate of growth of wages is characteristic of the implementation of the expanded production process, which allows us to conclude that there are positive changes in the efficiency of the functioning of agricultural organizations. In the opposite situation, when the growth rate of wages exceeds the growth rate of productivity, the activities of an agricultural organization can be considered ineffective. But at the same time, it is necessary to take into account the value of the growth rates of the analyzed indicators, since effective functioning of the
organization in the long term is possible only if remuneration is consistent with the achieved results and staff satisfaction with the level of remuneration.

Comparison of absolute data on labor productivity and wages does not reflect the ongoing economic processes so accurately, but, nevertheless, it allows confirming the presence of disproportionate dynamics in the field of productivity and wages. With an average increase in labor productivity by 346.2 thousand rubles annually, wages increased by 2.3 thousand rubles a year, i.e. exactly 150 times less.

The characteristic of polynomial models does not allow interpreting the values of variables as economic values, but, nevertheless, it allows us to draw certain conclusions about the interrelationships of productivity and wages studied in this article. First, these models also reflect higher growth rates of labor productivity, and secondly, which is more informative from an economic and managerial point of view, significant information can be obtained by comparing the coefficients of determination. The slight difference between them, however, allows us to draw certain conclusions. We see that the coefficients of determination for all polynomial functions exceed the corresponding coefficients of linear functions, which allows us to conclude that the dynamics of all analyzed indicators is parabolic, not linear.

At the same time, it should be noted that if the coefficients of determination in the models describing the growth rates of wages and the size of wages by linear functions are lower than those described by polynomial functions by only 0.002 and 0.003, respectively, then the corresponding difference in linear and polynomial models of growth rates and the dynamics of labor productivity is more significant - 0.021 and 0.023, respectively. Comparison of these characteristics allows us to substantiate the conclusion that if the growth of labor productivity is of a polynomial - parabolic nature, then the growth of wages is closer to linear values.

The analysis showed that during the studied period of time, remuneration in the agricultural sector played the role of a stimulating factor providing a significant increase in labor productivity. But, at the same time, the identified trends determine the need to improve the current system of remuneration and adjust the state programs for the development of the agricultural sector.

3. Conclusion
Confirming the thesis about the disproportions in the growth of productivity and wages, we conclude that it is necessary to develop recommendations for corrective actions, both for managerial decisions at the level of economic entities and for state regulation of the industry.

At the level of organizations, it is necessary to actively use differentiated payment systems, in which the level of remuneration will be directly related to the productivity of workers and the results that they contribute to financial indicators. Agricultural organizations should be interested in resolving the issue of increasing wages through specific motives and mechanisms, norms and standards, by purely economic means.

One of the options for improving the system of material incentives may be to provide employees with the opportunity to participate in the capital of the enterprise and the distribution of profits with direct participation in the management of the organization. This approach is practically not used in Russian conditions due to a number of factors, but it has a certain potential for use.

The state policy for the development of the agricultural sector should be more balanced, both taking into account the need to promote the development of efficient production, and taking into account the necessary attention to workers of agricultural organizations.

For example, when implementing state development programs, it is possible to link the allocation of the volume of state support to the level of wages in the organization. Of course, the management of a private company operating in market conditions must independently make decisions on the use of one or another system of material incentive, on the level of wages and the number of employees at the enterprise. But we are not talking about direct interference in the process of human resource management, but about indirectly stimulating the development of corporate social responsibility of domestic agricultural enterprises.

Along with this, public authorities can use methods of non-material incentives for managers and owners of agricultural organizations, for example, assign honorary titles and use the mechanism of
 awarding state awards. Only joint efforts of state bodies and owners can ensure the effective functioning of the heads of agricultural organizations and the balanced development of the agricultural sector.

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