Assessment of reproduction of agricultural products

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Abstract. To expand the reproduction in the agricultural industry (a priority task of Russia), to achieve the goal of import substitution and food security, it is necessary to ensure continuous renewal and replenishment of resources. To assess the type of reproduction in agricultural organizations, average annual growth indicators taking into account resource (labour, land, capital) and economic conditions (profitability, liquidity, financial stability, turnover) were used. According to the method used for assessing the type of reproduction, organizations can be categorized into three clusters. Development problems within each cluster were determined to evaluate conditions of reproduction taking into account cluster characteristics. Agricultural organizations using the method of expanded reproduction have modern agricultural equipment, high-yielding crop varieties and highly productive animal breeds. Organizations of the second and third clusters have limited resources (labour, land, basic and working capital) and low profits.

1. Introduction

Expanded reproduction of agricultural products is a priority task of the Russian government to achieve the goal of import substitution and food security which is provided for in “The Strategy of the National Food Security of the Russian Federation until 2020”. It is implemented through “The National Agricultural Development Program and Regulation of Agricultural and Food Markets” and “The Doctrine of Food Security of the Russian Federation”.

2. Problem statement

Agricultural products are produced continuously as the society needs them; the demand is growing. Production is a basis for subsequent consumption, and consumption is a principal customer. Consequently, production and consumption are closely related, they complement each other. To produce products, resources are required [1]; to ensure production continuity, resources should be constantly reimbursed. In order to maintain expanded reproduction, it is necessary to renew and replenish resources using profits obtained [2,3]. Otherwise, the reproduction process will not exist [4].

To assess the type of reproduction in agricultural organizations, a generalized system of indicators was used. Their average annual growth rates were estimated taking into account resource and economic conditions. According to the method used for assessing the type of reproduction, organizations can be categorized into three clusters. Development problems within each cluster were determined to evaluate conditions of reproduction taking into account cluster characteristics.
3. Research questions
For any type of reproduction, the most important factors are labor and salaries which have a considerable share in the structure of expenditures. Reproduction of the workforce involves restoration of human ability to work, replacement of old generations of workers with new ones having sufficient professional skills. It covers restoration of working capacity and continuous improvement of skills, technical and general cultural level of workers, reproduction of new generations of people, their upbringing and professional training in. The main condition is a level of salaries which performs reproduction, stimulation and motivation functions [5].

The main means of agricultural production is land. Its condition can be improved under the rational economic use. However, to maintain a level of fertility, significant logistical and financial investments are required.

The availability of fixed and current assets is the most important economic condition for reproduction in the agricultural industry. Advanced positions in the economy can be preserved by improving basic means of production based on scientific and technological achievements, through the replacement of outdated equipment with modern one. The advanced economy is determined by a large size and a technical level of basic production facilities [6-8].

Expanded reproduction requires the working capital, its constant replenishment. At the same time, it is important to optimize the volume and structure of current assets, their sources and the ratio between them, long-term production and active financial activities. Development of the reproduction process depends on the amount of invested funds. It is important to use investments to replenish and renew fixed and circulating funds, implement advanced technologies [9]. In modern conditions, reproduction should be innovative, based on scientific and technological achievements [10].

To characterize the reproduction process, a system of indicators of availability, state and efficiency of production factors (labour, land, capital) was used. Economic conditions were considered as internal and external. Organizations cannot influence external economic conditions directly. Internal economic conditions include profitability, financial stability, solvency, and the state of receivables and payables [11-12].

To assess the type of reproduction, indicators of the dynamics of agricultural production and indicators characterizing resource and economic conditions were summarized and systematized. This system of indicators reflects the industry specifics, takes into account the resumption of production factors. Many authors consider the renewal of the fertile soil layer, labour and fixed assets as reproduction. It is not correct as only products can be reproduced.

The article aims to assess the type of reproduction in agricultural organizations of Irkutsk region taking into account resource and economic conditions on the basis of the cluster approach and reporting data.

4. Research methods
To assess the reproduction process in the agricultural organizations of Irkutsk region, a number of indicators calculated on the basis of accounting and statistical data were used. To assess the type of reproduction in agricultural organizations, indicators were selected; the method taking into account resource and economic conditions was developed. It allowed us to classify organizations into clusters, identify development problems, assess reproduction conditions, suggest recommendations and predict development trends.

The method was applied to agricultural organizations of Irkutsk region (117 collective agricultural organizations of various organizational and legal forms operating in 2011-2015, ensuring the reproduction process of the entire industry and having reached sustainable production indicators).

The calculations were carried out in STATISTICA10 which allowed us to divide the objects into homogeneous clusters (groups) taking into account all cluster features. In contrast to most mathematical-statistical methods, the cluster analysis does not impose any restrictions on the type of objects and takes into account a lot of initial data. This is significant if indicators are different and it is difficult to use traditional econometric methods [8].
The method used for determining the type of reproduction on the basis of dynamics indicators and indicators characterizing the conditions of reproduction involve the analysis of objects $Y_j$ $(j = 1, 2, 3 \ldots m)$ which are agricultural organizations. Each object is characterized by $n$ features; it can be represented as $Y_j = \{x_{j1}, x_{j2}, x_{j3}, \ldots, x_{jn}\}$, where $x_{ji}$ is the value of the $i$-th feature of the $j$th object. For the formation of a set of features that characterize the objects belonging to a particular type of reproduction, the following variables were used:

- $x_1$ - average annual increase in the number of agricultural employees, %;
- $x_2$ - average annual increase in labor performance, %;
- $x_3$ - average annual increase in the agricultural land area, %;
- $x_4$ - average annual increase in profits per one hectare of agricultural land, %;
- $x_5$ - average annual increase in the cost of fixed assets, %;
- $x_6$ - average annual increase in equity, %;
- $x_7$ - average annual increase in the cost of working assets, %;
- $x_8$ - average annual increase in the coefficient of working asset turnover, %;
- $x_9$ - average annual increase in profitability, %;
- $x_{10}$ - average annual increase in the current liquidity ratio, %.

The indicators have the same dimension, as the average annual growth rate for 2011-2015 is used.

The objects were classified using the k-means method. This method is iterative. It allows for the optimal division of agricultural organizations by the type of reproduction. The sum of intragroup dispersions is minimal.

The correlation analysis does not reveal a strong relationship between dynamics and reproduction indicators.

Agricultural organizations of Irkutsk region were divided into three clusters (see Table 1). When dividing the aggregate of agricultural organizations into three clusters, differences between the clusters are more evident. The dynamic comparison of average normalized values of the characteristics indicates their stability and confirms the accuracy of the method.

### Table 1. Distribution of agricultural organizations of Irkutsk region by clusters depending on the type of reproduction.

| Indicator                                    | cluster 1 "Expanded" | cluster 2 "Simple" | cluster 3 "Narrowed" | Average  |
|----------------------------------------------|-----------------------|--------------------|-----------------------|----------|
| Number of organizations, units               | 53                    | 31                 | 33                    | 117      |
| Average annual rate of increase in the number of agricultural workers, % | -7.51                 | -8.83              | -9.64                 | -8.46    |
| Average annual growth rate of labor productivity, % | 8.12                  | 3.89               | 1.24                  | 5.06     |
| Annual average increase in farmland, %      | 0.16                  | -0.96              | -2.13                 | -0.78    |
| Annual average increase in revenue per one hectare of agricultural land, % | 0.26                  | -4.84              | -8.04                 | -0.03    |
| Annual average increase in the value of fixed assets, % | 16.50                 | 5.79               | 0.58                  | 9.17     |
| Annual average increase in equity, %        | 16.49                 | 7.06               | 3.06                  | 10.20    |
| Annual average increase in the cost of working capital, % | 5.72                  | 7.41               | 5.91                  | 6.22     |
| Annual average increase in the coefficient of working capital circulation, % | 9.42                  | -1.13              | -2.82                 | 3.18     |
| Annual average increase in cost recovery, %  | -7.39                 | 35.30              | -212.49               | -53.93   |
| Annual average increase in the liquidity ratio, % | -2.55                 | 53.26              | 21.72                 | 19.08    |

### 5. Findings

Agricultural organizations of the first cluster (45%) are characterized by expanded reproduction of agricultural products. They have the highest values of labour productivity, yield per one hectare of
agricultural land, capital supply, working capital turnover, and profitability (despite a 7.39% decrease, the average annual growth rate is higher than that in other groups).

The second cluster includes agricultural organizations (28%) with a level of profitability (4-10%) within the average; they are supported by the government. These organizations have an average annual growth rate. They are characterized by simple reproduction of agricultural products.

The third cluster includes organizations (30%) characterized by narrowed reproduction; the values of all indicators are lower than the average; the cost recovery does not exceed 100%; production is not profitable. These organizations do not gain profits and recoup their costs. They also have the lowest rate of increase in the value of fixed assets (0.58%). Taking into account an inflation rate, the value is lower. The working capital turnover ratio is less than 1.

Thus, more than 50% of the organizations are not able to renew facilities, lack working capital, do not implement advanced technologies which increases the cost and makes the industry unprofitable.

6. Conclusion
Based on the indicators of the development of agriculture in Russia determined by “The State Program for the Development of Agriculture and Regulation of Agricultural and Food Markets for 2013-2020”, it is necessary to implement an expanded type of reproduction in agricultural organizations. It is necessary to increase the volume of production and reduce its cost. Reproduction has to be of intensive type. This is possible when using financial resources of agricultural organizations, modern agricultural equipment, high-yielding varieties of agricultural crops and highly productive breeds of animals. Organizations of simple and narrowed reproduction clusters lack these resources. To activate the reproduction process in the agriculture industry, investment and government support are needed.

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