Digital model for determining the optimal resource potential in the creation and development of agricultural organizations

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Abstract. The relevance of the study lies in the fact that at present, measures for the creation and functioning of agricultural organizations are not carried out effectively enough. The article examines the process of functioning of the mechanism of state support for agricultural producers and its effectiveness, analyzes the existing target indicators of the state program for the development of agriculture. The need for their clarification and addition is revealed for the development of an optimal digital model that allows determining the zonal need and resource potential for the creation and development of agricultural organizations and other forms of management. The peculiarity of the proposed model is to determine the optimal resource potential and reduce the risk of irrational use of targeted funding. The paper also suggests the development of an earlier non-existing digital model that allows describing and determining the resource potential of the creation of an agricultural organization.

1. Introduction
At present, the Russian Federation has the necessary tools and the amount of financial resources to carry out measures for state support of the organization of agriculture. Barth H notes the “Developing Scalable Solutions” archetype shows how companies deliver sustainable solutions on a large scale to maximize the benefits to society and the environment [1]. Considering the main problems that arise in the form of barriers for agricultural producers, it is possible to highlight the ambiguity in the amount of resource potential available in agricultural organizations. All these restrictions and problems negatively affect the process of determining the organization’s group for state support, which affects the financial condition and economic development. In turn, the increase in the efficiency of receiving state support is associated with the volume and specifics of the organization’s industry, which must be determined in accordance with the resource potential. In this regard, as one of the methods for determining the level and potential
of an organization, it is necessary to develop a digital model with a three-level division of organizations, which describes and allows you to determine the integral indicators of the resource potential in each industry in accordance with the scale of the organization. Government action is required to support a nutrition-sensitive or managed agriculture that “seeks to ensure the production of a diverse range of affordable, nutritious, culturally acceptable and safe food in sufficient quantity and quality to meet the dietary needs of the population in a sustainable approach”. This goal involves an integrated approach that covers all stages of the food system: from production, post-harvest processing, processing and retail sales to consumption [2].

Many authors have considered the relevance of the development of digital technologies in agriculture. The analysis of the applied technologies was carried out. The possibilities of digital transformation in the agro-industrial complex were described [3-5].

Other authors focused their research on solving strategic tasks of socio-economic development and implementing competitive advantages associated with innovative technologies in agriculture (including the development of an easy-to-use mobile application to improve the interaction between the producer of agricultural products and its consumers) [6, 7].

Third researchers calculated the forecast indicators of the value of money and the discount coefficients necessary to build a strategic horizon of proposals for the implementation of individual investment projects of digitalization tools in agriculture. They analyzed the cash flow indicators for the implementation of individual investment projects for the acquisition of digitalization tools and determined the main economic indicators of the effectiveness of the implementation of investment projects [8].

All researchers came to the conclusion that the introduction of modern digital technologies in agricultural production allows creating favorable conditions for increasing labor productivity, reducing costs, and improving the efficiency of organizations.

In 2019, the Ministry of Agriculture of the Russian Federation developed the program “Digital transformation of agriculture in Russia”. It contains a description of the problems of digital transformation of agriculture in Russia, the need for such transformation, goals and objectives, measures for the digitalization of agriculture.

However, at the moment there is no model in the literature for determining the necessary resource potential of agricultural organizations for state support. Therefore, the purpose of the research is to substantiate the need to develop an optimal digital model that would allow determining the zonal need and resource potential for the creation and development of large, medium and small agricultural organizations. This model is necessary to reduce the risk of irrational use of targeted financing.

2. Methodology
The issues of digitalization of agriculture, the efficiency of the functioning of agricultural organizations in conjunction with state support for the agricultural sector are devoted to the work Frolova O, Yukhлина Ј, Efremcev A, Dozorova T, Voronov Y [3], Bessonova E, Battalov R [9], Semin A, Yalunina E, Dyachkova S [10], Kostyukova E, Yakovenko V, Germanova V, Frolov A, Grishanova S [11], Trukhachev V, Kostyukova, E, Gromov E, Gerasimov A [12] and other scientists (table 1). The methods of this study are a single and group indicator of the integrated assessment of the resource potential of agricultural organizations, tabular and graphical methods.

3. Results and discussion
To date, the creation and development of the organization of agriculture can’t be effectively built, as the specifics of the activity cannot participate in inter-sectoral competition. This factor needs to be effectively regulated by the State.

Such regulation, in the form of support from the state, is necessary not only for existing organizations, but also for agricultural enterprises that are at the initial stage of creating an organization. For faster and better creation of an effective ecosystem of support from the state, it became necessary to determine the resource potential of the organization at each level of development and creation. This will allow working
organizations to get out of the crisis situation, and new organizations will be able to effectively join the market process and rationally use the allocated funds from state support.

### Table 1 Analysis of the author’s approved on the discussed problem of digitalization.

| Authors                          | Content of the problem under discussion                                                                 |
|----------------------------------|----------------------------------------------------------------------------------------------------------|
| Frolova, O, Yukhлина J, Efremcev А, Dozorova T, Voronov Y | To realize the economic benefits of the digital transformation of agricultural activities, Russia must constantly conduct research and develop a global architecture in cooperation with the state to build a modern business model |
| Bessonova E, Battalov R          | Improvement of an integrated innovative approach to the implementation of production sectors, implies an analysis of the resource potential of each dig, in the context of the agro-industrial complex |
| Semin A, Yalunina E, Dyachkova S  | Support by state bodies of the agricultural sector, using resources reproduction of resources            |
| Imatchoeva Z                     | Support for export production, including agricultural products, are priority areas of transformation into the digital environment and the creation of new enterprises to expand the industry base |
| Kostyukova E, Yakovenko V, Germanova V, Frolov A, Grishanova S | The main indicators for assessing the level of social development of the agricultural sector of production are demographic, infrastructural, economic and social |

At the first stage of determining the resource potential, it is necessary to form a system of quantitative indicators to determine the available resources and determine the level and group in the classifier of the digital model, which will allow for an even distribution of resources across agricultural production sectors. These indicators and features include: reliability, comparability, objectivity, completeness.

All these indicators allow us to fully determine the availability and need to increase the resource potential by calculating the economic indicators of stock availability, labor availability, profitability, stock availability, agricultural land area and indicators of infrastructure condition. When choosing an indicator, it is necessary to take into account not only quantitative indicators, but also qualitative ones, which will allow determining the potential of each resource.

At the next stage of determining the resource potential of the organization in the digital model, it is necessary to consider each type of activity point-by-point and determine the effective indicator in accordance with the group economic indices $I_{gr,ef}$, which are calculated using the formula (1):

$$I_{gr,ef} = \frac{\sum_{i=0}^{l} ed_{i} \cdot ef_{i} \cdot n}{n}$$

where $n$ is the number of unit indices of the level of resource potential of the agricultural sector of the economy.

To calculate the resource potential of the agro-industrial complex in a digital model, we consider it appropriate to apply the following system of indicators:

- labor security per 100 hectares (ha) of agricultural land, thousand dollars per block-number of employees;
- availability of funds per 100 ha of agricultural land, thousand dollars for the block-mechanized and information infrastructure;
- material availability per 100 ha of agricultural land thousand dollars for the block-mechanized and information infrastructure;
- profit per 100 ha of agricultural land thousand dollars for the block-the volume of investment.
At the third stage, the indicators of the efficiency of using the resource potential for all factors of production are calculated. To do this, it is also necessary to use the group efficiency index, which is a consequence of the arithmetic mean of the unit indices (formula (2)):

$$I_{gr.ef} = \frac{\sum_{i=0}^{n} l_{ed.ef} \cdot n}{n}$$

(2)

where $n$ is the number of unit indices of the level of resource potential of the agricultural sector of the economy.

To calculate the resource potential of the agro-industrial complex in a digital model, we consider it appropriate to apply the following system of indicators:

- labor productivity by block – number of employees;
- labor intensity by block – number of employees;
- volume of production per 100 ha of agricultural land in the block – the area of production sales;
- capital ratio by block – number of employees;
- capital turnover by block-mechanized and information infrastructure;
- ratio of profit to the wage fund.

If we consider all the factors together as an index of the group level, it is advisable to use a single index determined by the formula (3) when calculating the resource potential of the agricultural sector of the economy:

$$i_{ed.ef} = \frac{i_{ed.ef}}{i_{ed.ef}}$$

(3)

where $i_{ed.ef}$ – indicator value, $j$ – ago enterprises, $i_{ed.ef}$ – the average value of the indicator for the aggregate of enterprises.

At the fourth stage, determining the integral index indicator and the level of effective use of the resource potential of the agro-industrial complex, it is necessary to distinguish three enlarged groups of organizations. Groups are formed in three blocks, based on the vertical and horizontal borders. All the implemented stages are considered according to the blocks and types of the branch specification of agricultural activity in the digital model (table 2). Increasing the level of efficiency of the digital model of resource potential can be carried out in two directions: increasing the level of use of resource potential and increasing the level of interaction between agricultural producers and state bodies for support and development. Looking at the structure of the digital model presented in table 2, we can analyze a three-level block consisting of five indicators that directly affect the size and level of the organization in the economic market environment, which allows us to determine the level of resource potential and the necessary resources for development. At the first stage, the groups of enterprises were divided by industry component. At the second stage, by type of activity in the agricultural sector. In the third stage, the division and analysis of resources are necessary for the functioning of the organization. These include: number of employees; sales area production; investment volume; mechanized infrastructure; information infrastructure.

The choice of these indicators as key ones is justified by the author’s approach to building a digital model. When choosing the indicators, the authors took into account the information publication “Digital Transformation of Agriculture in Russia”, developed by the Ministry of Agriculture of Russia [4]. All these indicators affect the state of the organization and are dependent on measures of state regulation and state support. Since each industry has its own specifics of the implementation of production activities, it is necessary to take into account all the factors of the index indicator, which subsequently provides for a cluster division into groups in accordance with the indicators of functioning. In accordance with the digital model, the implementation of activities for the creation and development of the organization is carried out according to certain criteria. These criteria are distributed by level and by the state of the mechanized and information infrastructure. Considering the three-level digital model, the distribution by indicators and by levels occurs according to the state of
organizations. The developed model gives a clear picture of the economic state of the organization and the investment attractiveness for state support.

**Table 2.** Classification of agricultural enterprises by scale of activity and level of economic conditions for small, medium-sized and large enterprises.

| Enterprise groups | Number of employees | Production sales area, thousand ha | Investment volume, thousand USD | Mechanized infrastructure | Information infrastructure, thousand USD |
|-------------------|---------------------|----------------------------------|---------------------------------|--------------------------|---------------------------------------|
| Grain production  | 3                   | 1,500                            | 16,192                          | 2                        | 0.269                                 |
|                   | 70                  | 7.5                              | 6,746                           | 18                       | 0.269                                 |
|                   | 100                 | 20,000                           | 269,870                         | 25                       | 2,698                                 |
| Beet farming      | 4                   | 0.1                              | 13,493                          | 3                        | 0.134                                 |
|                   | 40                  | 0.1                              | 2,698                           | 10                       | 0.134                                 |
|                   | 110                 | 20,000                           | 134,935                         | 20                       | 1,754                                 |
| Potato growing    | 3                   | 0.05                             | 13,493                          | 3                        | 0.067                                 |
|                   | 60                  | 0.05                             | 2,698                           | 10                       | 0.067                                 |
|                   | 80                  | 20,000                           | 134,935                         | 20                       | 1,079                                 |
| Vegetable growing | 4                   | 0.005                            | 4,048                           | 1                        | 0.067                                 |
|                   | 30                  | 0.005                            | 9,445                           | 2                        | 0.067                                 |
|                   | 70                  | 0.3                              | 40,480                          | 5                        | 1,079                                 |
| Cattle breeding   | 4                   | 0.05                             | 13,493                          | 4                        | 0.134                                 |
|                   | 15                  | 0.15                             | 134,935                         | 10                       | 1,079                                 |
|                   | 110                 | 5,000                            | 674,675                         | 20                       | 2,698                                 |
| Pig farming       | 3                   | 0.005                            | 6,746                           | 2                        | 0.134                                 |
|                   | 14                  | 0.01                             | 67,467                          | 8                        | 0.539                                 |
|                   | 70                  | 0.05                             | 404,805                         | 15                       | 1,079                                 |
| Sheep farming     | 3                   | 0.005                            | 4,048                           | 2                        | 0.134                                 |
|                   | 10                  | 0.1                              | 40,480                          | 8                        | 0.539                                 |
|                   | 50                  | 0.3                              | 404,805                         | 15                       | 1,079                                 |
| Poultry farming   | 2                   | 0.002                            | 6,746                           | 1                        | 0.107                                 |
|                   | 5                   | 0.005                            | 20,240                          | 3                        | 0.404                                 |
|                   | 20                  | 0.008                            | 13,493                          | 10                       | 0.674                                 |

In accordance with table 3, we will carry out the distribution by groups in the ranking with different indicators, determining the level of the organization (figure 1). Looking at figure 1 by the distribution of groups by agricultural industries in accordance with criteria and indicators, several organizations fall into the first level, in terms of the number of employees and the area of agricultural land. the fourth organization will fall into the 3rd level in accordance with the indicator of the volume of agricultural area and the volume of investment.

Table 4 presents recommendations for choosing a plan and measures, in accordance with the level and scale of an agricultural organization, to improve the effectiveness of implementing a digital model of the resource potential of agricultural organizations.
Table 3. Organizations of the Nizhny Novgorod region for the production of goods in the agricultural sector.

| Businesses                      | Number of employees | Production sales area, thousand ha | Investment volume, thousand USD | Mechanized infrastructure | Information infrastructure, thousand USD |
|---------------------------------|---------------------|-----------------------------------|--------------------------------|---------------------------|----------------------------------------|
| JSC “POKROVSKAYA SLOBODA”      | 78                  | 7,899                             | 13,610                         | 76                        | 0.14                                   |
| IP Zaripov Timur Akhlyamovich   | 15                  | 0.5                               | 2,700                          | 12                        | 0.07                                   |
| Joint-Stock Company “Niva”      | 205                 | 10,455                            | 27,200                         | 51                        | 0.7                                    |
| LLC Agrofirma Nizhegorodskaya   | 122                 | 17,252                            | 40,820                         | 85                        | 1,360                                  |

*Compiled by the authors on the basis of the organizations’ reports.

The analysis of the distribution by groups allows us to set the criteria for selecting state support for agricultural organizations. In accordance with the digital model, the implementation of activities for the creation and development of the organization is carried out according to certain criteria. These criteria are distributed by level and by the state of the mechanized and information infrastructure. Considering the three-level digital model, the distribution by indicators and by levels occurs according to the state of...
organizations. The developed model gives a clear picture of the economic state of the organization and the investment attractiveness for state support.

Table 4. Recommendations.

| Groups | Recommendations for improving the efficiency of using the resource potential using a digital map |
|--------|-----------------------------------------------------------------------------------------------|
| AI     | The entrance to the structure of the integral association. Technical re-equipment of the digital space. Expansion of efficient production structures. |
| AII    | Introduction of resource-saving technologies, search for new opportunities or measures to increase the level of resource potential. |
| AIII   | Full and comprehensive participation in state events to support agricultural organizations. Development of resource-saving and digital technologies. |
| BI     | Choosing a new direction of production. Search for preferred areas of development in the enterprise. |
| BII    | The gradual development of automated technologies and digital production, which suggests an effective resource potential. |
| BIII   | The use of programs or activities, state support for agricultural producers. Search and implementation of modern digital installations and innovative approaches in agriculture. Division of production, according to industry specifics. Increasing labor productivity by optimizing the current wage structure. |
| CI     | Improving the functional structure of the resource potential according to the digital model. Selection of new priority areas production of new products. |
| CII    | Development of the direction of product sales. Purposeful change in the digital and technological structure of development. Increase in labor productivity and motivation of employees, due to new competencies, knowledge and acquired skills, which will directly affect the employee’s salary. |

Recommendations for the choice of an enterprise in accordance with the three-level digital model involves the gradual introduction and implementation of the resource potential of each enterprise, at different stages of development and production. This model will allow you to rationally and competently determine the level of the organization's location in the digital economic ecosystem, which will subsequently allow you to correctly use the resources of state support and determine the minimum necessary amount of resources for creating an agricultural organization.

4. Conclusion

As part of the research, a digital model and a methodology for determining the resource potential of agricultural enterprises that are interrelated with measures and measures of state support for the agricultural sector were proposed. The digital model allows you to determine the structure of economic indicators and the minimum amount of resources that are necessary for the creation and development of the organization of agriculture.

Also, when determining the main indicators and calculating the resource potential of each organization in the group, the relationship between state support measures and the main indicators of the organization at each level of the digital model is traced. It allows to determine the degree of influence and timely adoption of measures for the implementation of state support measures. Considering the proposed methodology of the digital model in the international space, we found that the available resource potential allows us to simplify the procedures for creating an organization of the agricultural industry, both from the point of view of interaction between the consumer and the head of the organization as a whole. The proposed digital model allows to determine in a timely manner the minimum level of resources necessary for the creation or expansion of the organization of the agro-industrial complex.
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