Digital and engineering solutions for the intensive development of regional agricultural producers

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Abstract. The article examines the structure of agricultural production in the Tyumen region; the authors note that agrarians in the south of the Tyumen region have to work in a zone of risky farming, sharp fluctuations in temperature and precipitation. In such conditions, farmers specializing in the production of crop products have to use intensive, resource-saving and modern industrial technological solutions in the production process to increase labor productivity and output per unit of land area. The authors noted the practical implementation of digital solutions used in large agricultural enterprises. There has been a trend of active development in the region of the production area for growing fruit crops, restoring nurseries and fruit trees. In this regard, the authors propose to introduce an installation for watering and fertilizing fruit trees, which is a very relevant technological solution for farmers; calculations of the financial model of this installation are presented, which presents the main economic indicators from its implementation.

1 Introduction

An indispensable condition for the further intensive development of the basic branches of the agro-industrial complex, which ensures the food security of our state and forms the export potential, is the use of modern technological solutions in the context of absolutely all producers forming food security, and these are large agricultural holdings, agricultural enterprises and small businesses. The rational use of scientific achievements and digital solutions for agricultural producers make it possible to increase the efficiency of using basic factors of production, increase labor productivity and increase financial results of activities, which will allow for an expanded reproduction process in the agricultural sector of the region. It is these studies, the process of applying rational solutions in the context of agricultural production, that are reflected in this publication.

2 Materials and Methods

During the research, methods of expert assessments, analysis of socio-economic processes, tabular, questioning and economic-statistical methods were used. When processing initial

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information and substantiating research results - methods of analysis and synthesis, statistical and logical analysis. The information base for the study was the works of scientists, data from the Federal State Statistics Service of the Russian Federation, Decrees of the President and Resolutions of the Government of the Russian Federation, materials from the Ministry of Agriculture of the Russian Federation and the Department of Agro-Industrial Complex of the Tyumen Region, as well as the developments of the authors on the problem under study.

3 Results and Discussion

An indispensable condition for ensuring food security is the state and development of the agro-industrial complex, which is why economic and food security is largely determined by the level of development of agricultural production. In the structure of commercial products of the agricultural sector of the Tyumen region, 43% are crop production and more than 57% are products of the livestock industry. The total volume of agrarian products is formed by both large agricultural enterprises, their share reaches 47%, and smaller enterprises, 4.5% is the share of peasant (farm) farms and 48.5% the share of households. Agrarians in the south of the Tyumen region have to work in a risky zone agriculture, which is subject to fluctuations in temperature and precipitation. In such conditions, farmers, especially those engaged in the production of crop production, have to use intensive, resource-saving and modern industrial technological solutions in the production process to increase labor productivity, output from a unit of land area [1].

There are 22 administrative districts located in the southern part of the Tyumen region, almost every one produces crop production, depending on the location of the district, the yield of grain and leguminous crops may vary, and the average for the region reaches 35.3 centners per hectare.

Various digital solutions are actively used as the basis of industrial technological solutions in the Tyumen Region, for example, a digital cartographic database of field contours of various municipal districts of the Tyumen region has been created, an information monitoring system has been introduced that allows them to be recorded, fields are certified and all land users are reasonably accounted for. On the basis of the agrarian university, research is being conducted on the fertility of soils for agricultural purposes with the digitization of fields carried out in advance.

Currently, 53% of large enterprises in the Tyumen Region use on-board navigation and information equipment based on GLONASS/GPS technologies, which allows the use of elements of the "Precision Farming System". The equipment is installed on more than 25% of the units of equipment of agricultural producers engaged in the production of crop production.

Today, field breeders actively use: GIS technologies (elements of precision agriculture in crop production) to manage agro technological operations in the context of individual field sites, drones for more detailed analysis and assessment of agricultural land; monitoring combines using built-in services that control the route, speed, fuel consumption, which helps agribusiness optimize traffic flows, costs of technical maintenance of equipment [2].

The system of differentiated fertilization for sowing crops is actively engaged in by scientists of the State Agrarian University of the Northern Urals, who believe that it is advisable to use differentiated mineral fertilizers, and the use of navigation systems can reduce costs by almost 5%, reduce the cost of grain by almost 10%, and increase profitability by 25% [3].

In the process of studying practical developments used by agaric, regional enterprises that create an offer of agricultural products in the field of crop production, during a
conversation with the heads of enterprises such as Agrofinma "KRiMM" Uporovsky district, LLC "Openovskoye" Ishim district, LLC "Zapsibkhleb-Iset" Isetsky district, LLC "Siberia" Isetsky district. It is in these areas that the maximum volume of grain production is created, these enterprises are leaders in yield, the variation of which is 30-35 quintals per hectare. As the studied experience at these enterprises has shown, they all actively use digital tools in the process of organizing the production process in crop production, table 1 presents digital solutions for these enterprises and identifies the problem that is achieved through the use of a particular tool.

### Table 1. Practical implementation of digital solutions by agricultural producers of the Tyumen region

<table>
<thead>
<tr>
<th>Company</th>
<th>Digital solution</th>
<th>The solution to the problem</th>
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<tbody>
<tr>
<td>Agrofirm &quot;KRiMM&quot;</td>
<td>The use of innovative technology (the Veritas mapping system) allows you to instantly obtain three main indicators of soil condition (electrical conductivity, PH, organic substances).</td>
<td>Adjustment of the schedule of agro technological works.</td>
</tr>
<tr>
<td></td>
<td>New generation control and measuring devices for creating a moisture diagram in the soil and calculating the required rate and watering period.</td>
<td>Instant transmission of information for operational measures.</td>
</tr>
<tr>
<td>«Openovskoye» LLC</td>
<td>Green Seeker leaf diagnostics system.</td>
<td>Determines the state of the crop by vegetative mass.</td>
</tr>
<tr>
<td>«Zapsibkhleb-Iset» LLC</td>
<td>A monitoring system for agricultural machinery that allows you to track the movement of vehicles in real time</td>
<td>The following parameters are recorded: mileage, driving speeds, fuel consumption, parking places and times, and total operating time. Their control helps to increase labor productivity and improve the economic efficiency of transport.</td>
</tr>
<tr>
<td></td>
<td>Trimble Autopilot system with Autopilot ™ electric drive.</td>
<td>Choosing the optimal course, reducing the overlap when sowing to 2 cm and removes flaws. Maximum productivity and savings in fuel, seeds and chemicals.</td>
</tr>
<tr>
<td>«Sibir» LLC</td>
<td>Technologies for the use of liquid mineral fertilizers.</td>
<td>Optimize the cost of mineral fertilizers by about 30%, increases crop yield due to more efficient absorption of nutrients by plants.</td>
</tr>
</tbody>
</table>

Analyzing the presented technological solutions, it can be noted that all of them are implemented by large agricultural enterprises. But at the moment in the Tyumen region there are both large agricultural enterprises, of which there are more than 1,000, and over 150,000 private subsidiary farms, which sowed more than 1 million hectares of fields in the reporting year. Therefore, an important point will be the development and implementation of technological solutions aimed also at farms and personal subsidiary farms, which form a significant share of agricultural production in the region and form the growth points of the total production potential [4,5].

According to modern economists, at the present stage of economic development, the most stable form of farming in rural areas is precisely personal subsidiary farms [6].
In the Tyumen region, the production line for growing fruit crops is actively developing, fruit tree nurseries are being actively restored, the products of these enterprises are being sold for processing to the Tyumen Technopark TPK "Berries Plus", on the basis of which processing and freezing of fruit and berry products is carried out, this company concludes contracts for the supply of products from both farmers and personal subsidiary farms of the population, gardeners who receive surplus products, which they willingly hand over for further processing.

I would like to note that in the region, in the context of this area, there are various areas of state support for farmers and personal subsidiary farms ready to cultivate fruit and berry crops. The existing huge demand for fruit and berry crops in the Tyumen region forms the supply of this product, so more and more manufacturers are ready to master this direction. Scientists economists have repeatedly noted the huge role in the viability of private farms of state support, which is carried out in the region at a fairly high level, taking into account the contribution of small businesses in the formation of food security in the region.

The regulatory framework for supporting this area in the Tyumen region is the law of the Tyumen Region dated 12/28/2004 No. 305 "On State support for agricultural production in the Tyumen region", Decree of the Government of the Tyumen Region dated 12/30/2014 No. 699-p "On approval of the state program of the Tyumen region "Development of the agro-industrial complex" for 2013-2025, Resolution of the Government of the Tyumen Region dated 05/23/2019 No. 151-p "On approval of the regulations on the procedures for providing state support for the creation of a system of support for farmers and the development of rural cooperation in the Tyumen Region", as well as the Regulation on the procedure for granting grants to Agrostatap for the implementation of projects for the creation and (or) development of farms, developed by the Department of Agriculture of the Tyumen Region. According to the regulatory framework, a farmer can purchase with grant funds (from 3 to 4 million rubles) planting material for laying perennial plantings, including vineyards and strawberries [7, 8].

Solving the problem of farmers engaged in irrigation and fertilization of fruit crops, we propose the introduction of a plant for applying water-soluble fertilizers into the production process in the summer, when weather conditions are not predictable and many farmers do not have access to water sources.

In our opinion, an important technological solution for watering and fertilizing fruit plants in the conditions of risky agriculture in the south of the Tyumen region is the use of this device for applying water-soluble fertilizers and at the same time watering fruit crops by collecting rainwater.

The project is an installation with a volume of 1.2 square meters, the installation will simplify watering and fertilization at agricultural facilities focused on perennial fruit crops. This will allow, firstly, to apply metered water-soluble fertilizers, and secondly, to create certain moisture reserves by collecting rainwater.

The installation will be installed in the immediate vicinity of fruit crops, then the nutrients previously added to the water will be able to affect the plant by supplying them with pipes.

In the installation, there will also be a compartment for adding water-soluble fertilizers. This installation can be used with other geotechnical solutions, such as automatic irrigation systems. The installation consists of a tank (its size is 1.2 cubic meters) with a centrifuge for storing water and stirring fertilizers, and it also uses a water meter with a float to determine the water level in the tank, a pump, hoses, pegs for drip intra-soil irrigation. The purchase of components can be carried out on marketplaces, in regional chain stores "Krepezh", "Mikhalych", and the assembly of the installation itself is carried out on the customer's territory [9].
Undoubtedly, the potential results of the successful implementation of the project are expected to increase the yield of fruit crops, as well as increase the efficiency of fertilizer use.

Potential consumer segments, at the same time, are farmers, agricultural enterprises engaged in the cultivation of fruit crops, therefore, the type of interaction between the subjects will be the B2B business model (business for business).

The business model is presented in the table, within which the problem is highlighted, ways to solve it and the main channels for the implementation of this installation are identified.

Table 2. The main parameters of the business model

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Solution options</th>
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<tbody>
<tr>
<td>Problem</td>
<td>- Watering of fruit crops;</td>
</tr>
<tr>
<td></td>
<td>- Optimization of the moisture content of fruit</td>
</tr>
<tr>
<td></td>
<td>crops;</td>
</tr>
<tr>
<td></td>
<td>- Fertilization of fruit crops.</td>
</tr>
<tr>
<td>Decision</td>
<td>- Development of a design solution;</td>
</tr>
<tr>
<td></td>
<td>- Purchase of components;</td>
</tr>
<tr>
<td></td>
<td>- Design solution-assembly.</td>
</tr>
<tr>
<td>Implementation</td>
<td>- Direct sales (to small forms of sole proprietors,</td>
</tr>
<tr>
<td>channels</td>
<td>farms, cooperatives; agricultural enterprises);</td>
</tr>
<tr>
<td></td>
<td>- Electronic trading platforms.</td>
</tr>
</tbody>
</table>

In the process of studying the competitive environment, no direct, similar offers have been identified in the region, however, in the context of this business model, competitors may be similar systems such as:

1. Drip irrigation system;
2. Installation for the preparation of fertilizers;
3. Smart-grow;
4. Mobile unit for applying liquid fertilizers (stuurman);
5. Water collection system;
6. Rain receiver.

I would like to emphasize the main competitive advantages of this technical solution, so, the main competitive advantage of this installation is its versatility, which consists in simultaneous watering and fertilization of soils. A detailed analysis of competitors' offers showed separate technological operations aimed only at watering or fertilizing.

Thus, the value proposition of this device is focused on such parameters as maintaining an optimal balance of soil moisture, timely application of the necessary soil fertilizer, as well as increasing the yield of fruit crops of farmers, agricultural enterprises operating in this market segment.

To verify external assessments, the opinion of farmers in the Tyumen region was studied by conducting a questionnaire. According to the conducted research, which involved 15 farm owners, the relevance of this installation was revealed, which allows timely watering and irrigation of fruit crops in the conditions of risky farming of farms in the Tyumen region. Almost all the survey participants confirmed the potential for business growth and scaling, especially in conditions of constantly changing technologies and requirements, taking into account natural and climatic conditions, moisture deficiency, in some areas of the south of the Tyumen region. Therefore, it is very important to collect rainwater as an additional source of moisture for many gardeners and personal subsidiary farms, taking into account the technical and cost characteristics of the product.

According to Yandex statistics, there were 930 requests for the topic "Installation for the application of water-soluble fertilizers and irrigation of fruit crops" per month, which also confirms the interest and relevance of this proposal. Gardeners of the Tyumen region
showed particular interest in this technical solution to the problem of irrigation and soil fertilization.

To determine the economic parameters of the feasibility of this decision, we calculated and analyzed a financial model, the results of which are presented in Table 3. An increase in the number of buyers and conversions will certainly have a positive impact on the growth of revenues from the sale of this installation. At the same time, revenues will amount to 28528,800 rubles, the amount of necessary expenses for components will amount to 25371328 rubles, the amount of profit received in the first year will amount to 3157472 rubles, while investments in this installation will pay off in four months.

Table 3. Results of the financial model

<table>
<thead>
<tr>
<th>Indicators</th>
<th>The amount of rubles</th>
</tr>
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<tbody>
<tr>
<td>Income, rub.</td>
<td>28528800</td>
</tr>
<tr>
<td>Expenses, rub.</td>
<td>25371328</td>
</tr>
<tr>
<td>Profit, rub.</td>
<td>3157472</td>
</tr>
<tr>
<td>Profitability, %</td>
<td>12.44</td>
</tr>
<tr>
<td>Unit cost, rub.</td>
<td>26 237</td>
</tr>
<tr>
<td>The payback period of investments</td>
<td>0,4</td>
</tr>
</tbody>
</table>

According to the results of the calculation of the financial model, the following results were obtained, the total income received during the implementation of this installation will amount to 285288800 rubles, current annual expenses will amount to 25371328 rubles, when determining the financial result, the profit will amount to 3157472 rubles, investments will pay off for 4 months, and the profitability will be 12.44%. Thus, the relatively low cost of this installation will allow you to quickly achieve cost recovery and enable farmers to moisturize and fertilize their fruit trees.

The investment climate in the Tyumen region is characterized by a fairly high level of investment opportunities for various industries and business entities, therefore, obtaining investments for the production of this installation can be carried out in various directions [10, 11, 12].

In the region, there is support from local authorities and programs for the development of agricultural production, as well as innovation centers and technology parks to receive financing for their projects, where you can also get advice on launching your production. Another option for obtaining financing is crowdfunding, which allows you to attract interest in the product and get financing for the idea [13, 14]. Government grants for the development of new technologies, which is a fairly popular option among farmers in the Tyumen region. Partner investments provide an opportunity to attract additional resources, and the knowledge and experience of another company can be useful for successful business scaling.

4 Conclusion

Thus, the proposed installation allows farmers and private farms engaged in growing fruit crops in the Tyumen region, in a zone of risky farming, to promptly moisten the soil under fruit crops, provide fruit crops with the necessary nutrients, which will significantly increase their yield and, accordingly, economic efficiency about farmers. For the effective operation of agricultural enterprises, in addition to the action of on-farm factors, it is necessary to create conditions for certain support, in the Tyumen region, agricultural
producers can count on various forms of support, including the implementation of innovative and technological solutions.

Acknowledgements

I would like to express my gratitude to the farmers of the Tyumen region for conducting the survey, who confirmed the relevance of the release and introduction of a device for applying water-soluble fertilizers into the production process. Special thanks to the heads of enterprises of the Agricultural Firm "KRiMM" - Gennady Ryazanov, Openovskoye LLC - Oleg Viktorovich Koshev, Zapsibkhleb-Iset LLC - Viktor Viktorovich Gontarovsky, Sibir LLC - Sergey Vladimirovich Ivashchenko, who shared their own experience in using digital solutions and their results obtained on the basis of their enterprises.

References