

Ways to automate and digitalize agriculture by building temporary research centers

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Abstract. This article is devoted to the ways of automation and digitalization of agriculture through the construction of temporary research centers. The study reveals the problems associated with population growth and their increased demand for agricultural products, which can be solved by automation; organization of applied scientific research, the problems of which will be solved in temporarily built SRC. Automation of agriculture is the use and implementation of automated systems that can partially or completely remove workers from the daily key tasks of checking, adjusting, and inspecting produce during production. This article concludes with the main advantages in building research centers, which will have a positive impact on the agro-industrial complex and increase the number of scientific personnel in the agricultural industry.

1 Introduction

Agriculture is one of the oldest and leading industries, the demand for which is growing over time. New technologies are being automated to increase the efficiency of the agro-industrial complex, and temporary research centers are being built to explore new methods of production. The construction of such facilities is conditioned by several factors:

- easy installation, cost-effective and energy-efficient;
- increasing the number of scientific projects aimed at developing new technologies;
- involvement of students in research activities.

There are fewer requirements for temporary buildings than for permanent ones, namely: simplified system of documentation, which does not require obtaining a construction permit and expertise, the erected structures are not tied to a specific site, at the end of the works the structures can be easily dismantled, in case of need they can be erected again. So under temporary SIC the foundations are not required deep, on this basis temporary buildings have advantages over permanent ones.

2 Relevance

At this point in time, the world's population is continuously increasing. According to the forecast [1] in 30 years the population will increase by 12% (Figure. 1), and the need for food

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will be 1.7 times more than it is produced now. To prevent a possible shortage of agricultural products it is necessary to automate the agro-industrial complex.

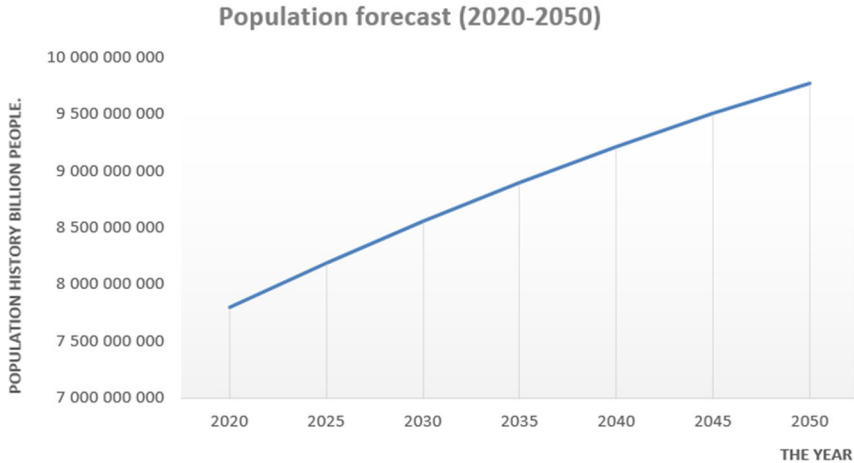


Fig. 1. Possible population projection based on country meters data.

The relevance of the construction of temporary R&D centers lies in the possibility to increase the efficiency of production, reduce costs, find and expand markets. It should be noted that important factors in the construction of temporary research centers are reliability, cost-effectiveness, mobility, and reduction of energy costs. One of the opportunities to achieve the most profitable construction process is the use of modular buildings, which consist of a metal frame and sandwich panel envelopes, and it is also possible to consider tent-type buildings.

3 Objectives

The purpose of this article is to examine the effectiveness of building temporary research centers to increase automation and digitalization of agriculture.

4 Tasks

In accordance with the stipulated subject of the article, the following tasks are highlighted:

- collecting information about the functional purpose of temporary research centers;
- analysis of the impact of temporary research centers on agricultural performance;
- analysis of the structural features of the construction of temporary research centers.

5 Problem solving

Agriculture is one of the sectors to be digitally transformed, but so far it has lagged behind other areas of the economy in terms of digitalization. According to the report "Digital Economy Indicators 2022. [2], the internal costs of Russian organizations for the creation, distribution and use of digital technologies and related products and services in agriculture in 2020 were 6.3 billion rubles (0.34 %), and in 2021, 8.4 billion rubles (0.29 %) compared to other sectors of the economy (Figure 2), which is a low indicator.

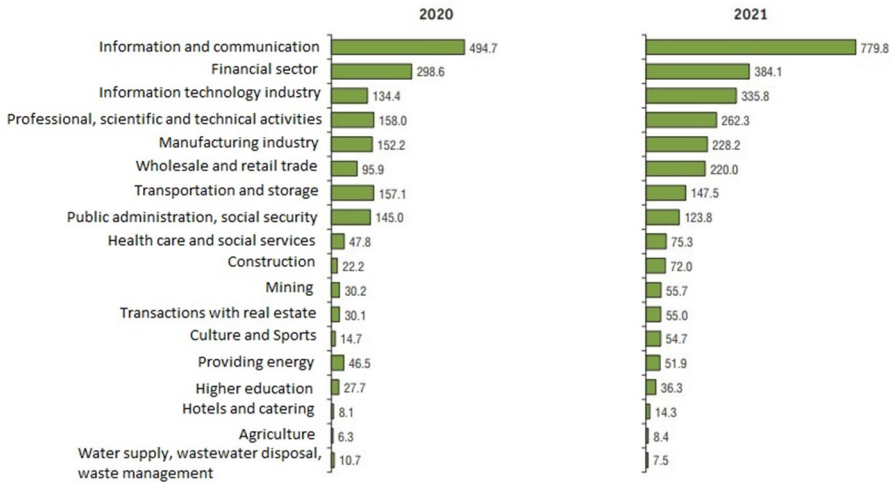


Fig. 2. Internal costs of organizations for the creation, distribution and use of digital technologies and related products and services by type of economic activity (billions of rubles).

According to the innovation index [3], Russia ranks 46th in the world, and the degree of digitalization of agriculture is 15th in the world and is three times behind Germany and France and four times behind the United States. Such a significant lag in the development of the digital economy from the world leaders is explained by gaps in the regulatory framework of the digital economy and an insufficiently favorable environment for business and innovation and, consequently, the low use of digital technology by business structures (Figure 3).

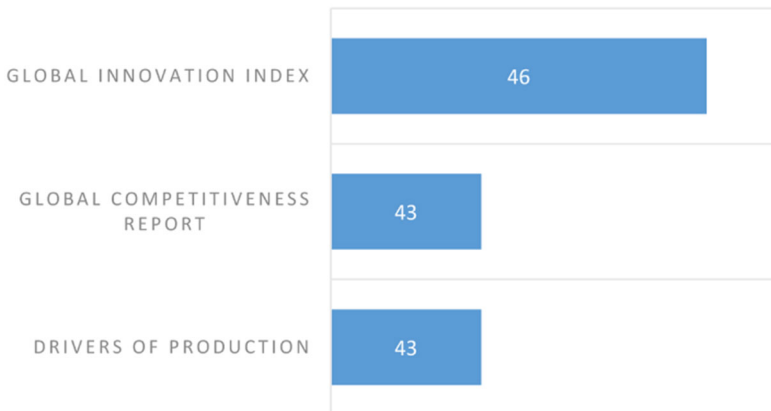


Fig. 3. Russia's place in the international economic development rating.

Thus, Russia has great potential for the introduction of digital technologies in agriculture, which will achieve significant results and improve the position in the global market.

Temporary research centers are a closed laboratory space with equipment and samples that will ensure the introduction of advanced information technologies in agriculture. Their functionality is aimed at creating high-tech solutions in the field of automation of the agricultural complex, increasing productivity, risk planning and forecasting, creating new types of fertilizers, plant varieties and seeds.

The main functional purposes of temporary research centers are:

- collecting information for research activities;

- prediction and analysis of the test specimen;
- transferring data to the server storage.

Temporary research centers are equipped with advanced technology to obtain remote information from the research site using sensors and drones. The results will be used to improve agricultural production. Using the power of digital technology, farmers and agricultural professionals will be able to make sound decisions that will lead to increased productivity and sustainability in the industry.

Analyzing the impact of temporary research centers on agriculture, we can highlight the challenges that will be addressed:

- increasing the quantity and quality of the crop;
- capital investment minimization;
- reducing labor intensity and increasing agricultural productivity;
- reducing reliance on human factors in agriculture and yield variation.

As temporary research centers, it is advisable to use facilities such as quickly erected modular buildings and tents.

A modular building is a prefabricated building made up of repeating sections called modules [9]. Modularity involves the construction of sections away from the building site. Assembling prefabricated sections is completed on site (Figure 4).



Fig. 4. Quickly erecting modular building.

The main advantages of quickly erected modular buildings include:

- shortening the construction period by up to 80%;
- environmental friendliness and sustainability;
- fire safety - III degree of fire resistance;
- reduction of energy costs;
- a great variety of architectural and planning solutions;
- mobility of modular buildings;
- cleanliness and low noise level during construction.

A tent hangar (Figure 5) is a fast construction of a collapsible type consisting of a light metal frame covered with PVC-tents in two or more layers. Such constructive solution allows to minimize the cost of the building and increase the speed of its construction. Quickly erected hangars have a lot of advantages which make them so popular nowadays. Their advantages include:

- high speed of construction - the structures are erected in a very short time;

- low cost - it is influenced by the use of modern construction technology and small consumption of materials required for the construction of the hangar;
- versatility - erection of the building is possible at any time of the year, weather conditions are of no importance;
- mobility - owing to small weight of ready hangar it is quickly mounted and can be installed practically on any ground;
- versatility - a modern prefabricated hangar, if necessary, can be quickly re-profiled into a spacious storage facility.



Fig. 5. Quickly erected tent hangar.

Diesel power plants and generators can be used as a source of power at these facilities. The main advantages of such power sources are:

- the possibility of stabilizing the generated voltage. If necessary, it is possible to choose a model with a built-in motor speed regulator. With its use, the device automatically adapts the voltage in case of voltage jumps to the requirements of consumers;
- high efficiency. It can reach 50% when using a system of intercooling and turbocharging;
- high service life;
- possibility of operation in a wide temperature range;
- low operating costs.

The required power of the diesel generator can be calculated using the formula (1):

$$S = P / \cos\varphi \quad (1)$$

where P is the total power of the consumer, W;

$\cos\varphi$ is the cosine of the angle between current and voltage.

This formula is used to determine the active power of electrical consumers. Active consumers include light bulbs, heaters and other electrical appliances. A certain power reserve should be taken into account, as this will reduce the load on the installation, reduce fuel consumption and increase the life of the power unit.

6 Results

As a result of the study of the tasks, it was found that for research centers a modular or tent type of building is a profitable solution. These types of temporary buildings:

- are quickly erected;
- accommodates equipment for necessary research

- can be dismantled and used in new projects.

With these advantages, research centers will increase automation, reduce manual labor and increase agricultural productivity. Producers and professionals in the field will be able to make rational decisions that will lead to a more sustainable industry.

7 Conclusion

Having analyzed the method of automation and digitalization of agriculture through the construction of temporary research centers, we can talk about the sufficient effectiveness of their application. As a result of the research, the functional purposes of SRCs were described. It was found that they increase the efficiency of work and increase the productivity of agriculture. Using structures such as tent hangars and modular buildings, it is possible to significantly reduce their construction period and achieve a reduction in energy costs. Using the possibilities of digital technology and automating the processes of agricultural production, the state will be able to ensure food security of the population

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