

Ways to increase the efficiency of automation in agriculture

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Abstract. The article presents the results of the theoretical analysis of automation in agriculture. Conceptual issues and problems of automation are considered. The article analyzes the significance and effectiveness of automated systems in agriculture. Agricultural automation relies on rich industry experience. The main feature of agricultural production is an inseparable link of technology with biological objects (animals, plants) marked by the continuity and the cyclical nature of production, the impossibility of increasing output by accelerating production. Under these conditions, automation should be reliable, since it cannot be interrupted and intensified.

1 Introduction

Automation of agriculture helps reduce the need for manual labor, while increasing labor productivity, the volume of agricultural production, and improving quality of agricultural products [10]. This involves the use of new production technologies, which include machines, mechanisms, and computers, automatic systems that facilitate and improve the working conditions of employees.

Over the past decades, the automation of agriculture has turned into an independent branch of science and technology, covering the theory, principles of construction and methods of using automated control systems operating with minimal or no human participation.

At the current stage of development of the agricultural industry, there is an inextricable connection of technology with biological objects [5]. The state of soils, the plant environment, animals, and the continuity of production processes are taken into account.

The automation of all agricultural processes has been referred to the development strategies of the largest agro-industrial and engineering companies in the world [4]. To improve the agricultural productivity, to ensure a stable result of innovations and to increase the competitiveness of local and global enterprises, huge amounts of information and advanced data management systems are required.

Consider conditions of the automation system presented in figure 1.

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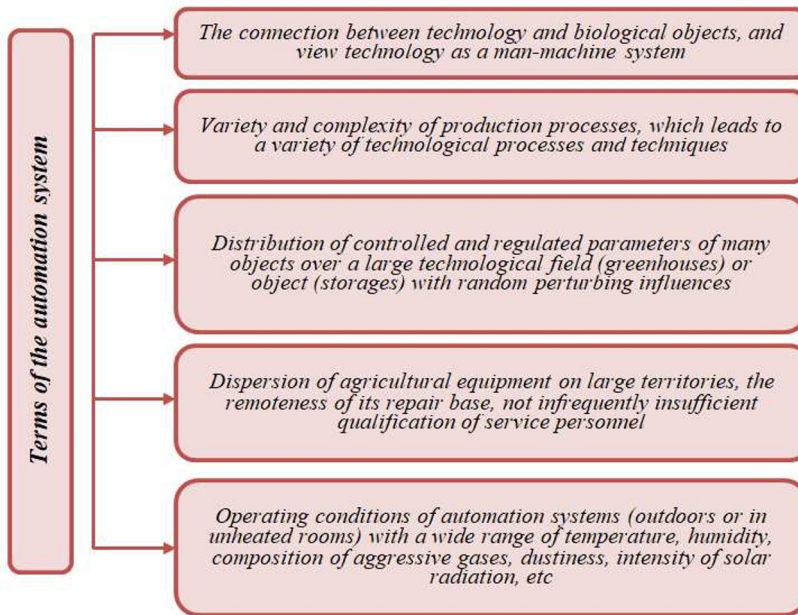


Fig. 1. Terms of the automation system in agriculture.

The production processes in agriculture are complex objects of management marked by a large number of controlled and manageable parameters and numerous disturbances that affect the efficiency of these processes [12]

2 Materials and methods

The article deals with analytical and theoretical aspects of the automation in agriculture. Opportunities and positive aspects of the agricultural automation are analyzed. Statistical data is provided.

To achieve the goals and objectives of automation, it is necessary to ensure [2;6]:

- Continuous improvement of agricultural technological processes, their transfer from discontinuous to continuous ones with combined or independent traffic.
- Scientific generalization of world experience in the agricultural automation.
- Establishment of an optimal scope and order of automation of technological processes.
 - Identification of standard solutions and their analogues for the purpose of reasonable use of serial automation equipment. continuous improvement of automation methods and control algorithms.
 - Determination of static and dynamic characteristics of agricultural automation objects. mathematical description of control objects (modeling).
 - Establishment of functional dependencies between the controlled parameters of agricultural products and physical properties (electrical, optical, acoustic, thermal, mechanical, etc.) in order to apply measuring transducers in agriculture.
 - Development of new agricultural machines taking into account automation requirements.
 - Improvement of methods for optimal design and calculation of automation equipment taking into account the expansion of their functional tasks and improvement of their hardware and operational reliability [3; 16].

3 Results

One of the trends in the development of modern Russian agriculture is the automation of production processes, which can improve the efficiency of enterprises [1; 7]. The automation of agricultural processes is based on complex mechanization and electrification of technological operations, which makes it possible to partially or even completely exclude human participation, replacing it with technical means of control and monitoring. Reducing the share of manual labor has a beneficial effect on the productivity of the enterprise.

Figure 2 presents reasons for the automation of agriculture.

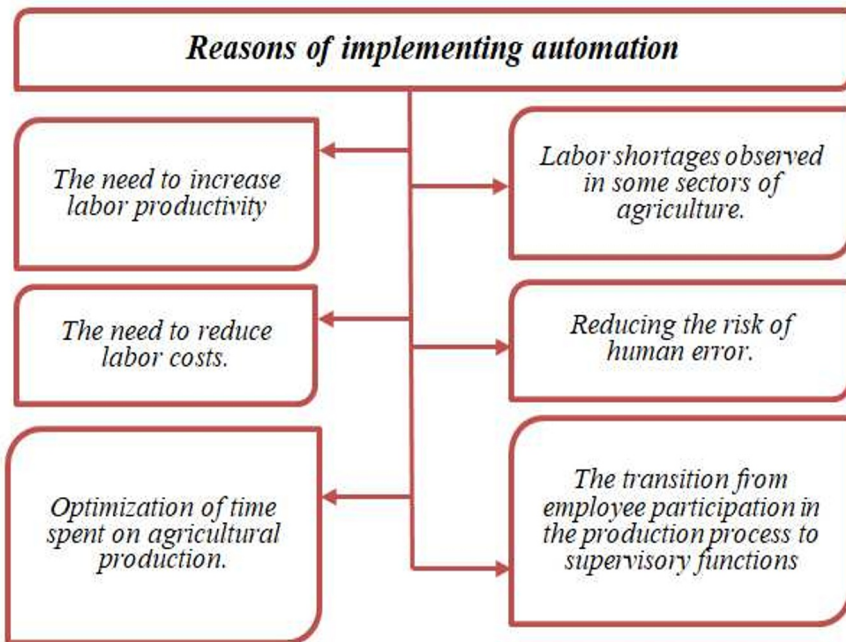


Fig. 2. Reasons for implementing automation in agriculture

Figure 2 shows that the automation of the agricultural industry can improve the productivity and quality of finished products, the efficiency of resource use, and the competitiveness of agricultural enterprises. The issue of labor shortage can be solved by reducing the need for heavy physical work and improving environmental sustainability [16].

Thus, the automation of agriculture includes the following positions:

- Development of an individual automation option.
- Selection and installation of equipment.
- Installation and setup of software.
- Personnel training.
- Technical support [17].

Figure 3 presents the statistical data on the need for the automation of agricultural enterprises

Figure 3 shows that the level of mechanization affects the production process, and with the automation of enterprises the volume of production increases [15].

Consider positive aspects of the automation in the agricultural industry (Figure 4).

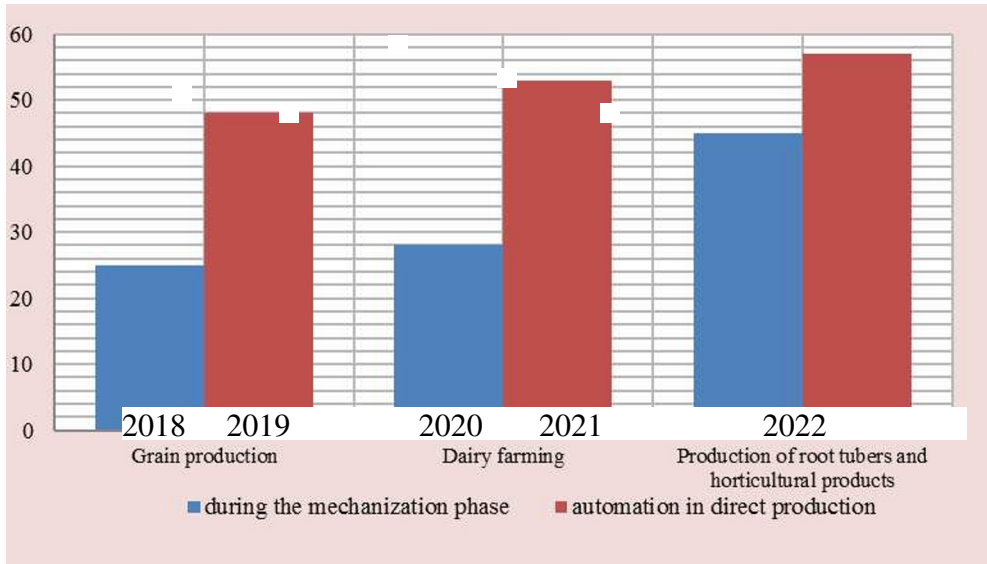


Fig. 3. Agricultural mechanization losses

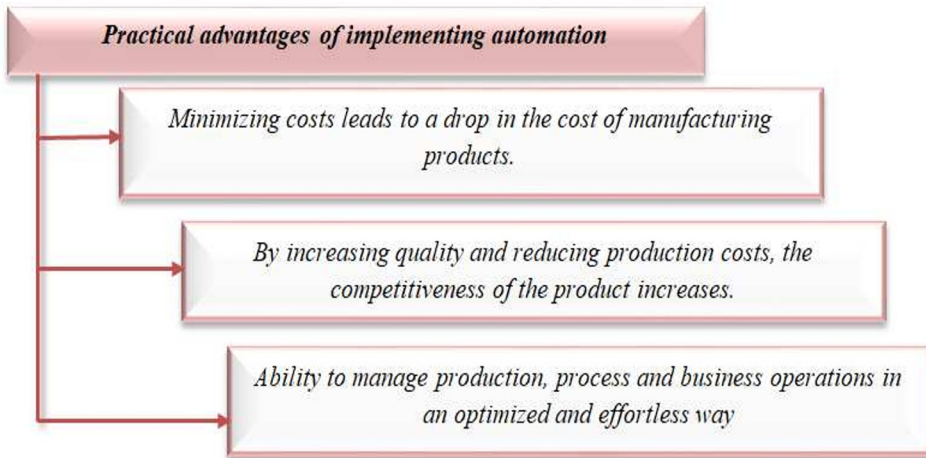


Fig. 4. Practical aspects of implementing automation

The analysis of the positive aspects showed that while minimizing costs, the company can improve the quality of products, reduce prices, and improve labor productivity within a few years [8].

Currently, automated systems, equipment, robots, and surveillance systems are used in the Russian Federation

4 Discussion

Technological progress driven by the processes of innovation has been a key factor in the social and economic transformation, improving labor productivity and well-being of people [14]. This applies to agri-food systems as much as to other sectors of the economy.

Considering the automation of agriculture, we can identify advantages of the automation processes presented in Figure 5.

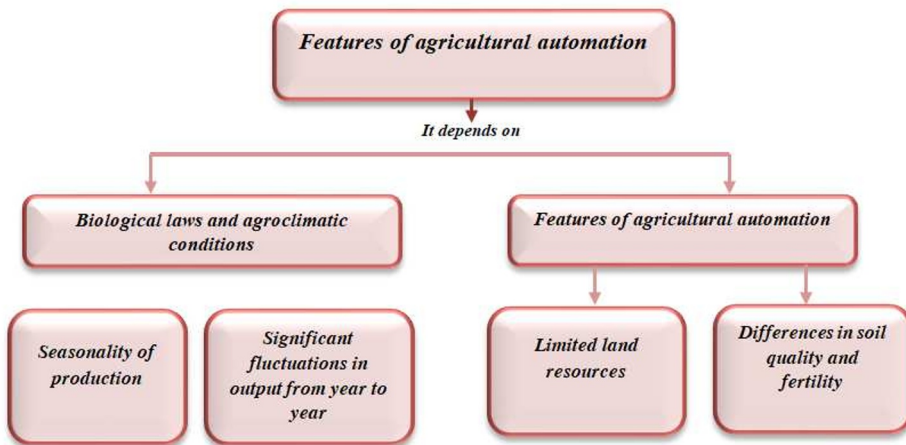


Figure 5. Features of agricultural automation [9].

Due to the above features and a number of other reasons, the methods of automation and requirements for automated systems used in agriculture differ significantly from the industrial ones [13]. The working conditions of automation equipment in agriculture are difficult, and the probability of malfunctions is much higher than in other sectors of the national economy. Under these conditions, the automated systems should be reliable, and the means of automation should be diverse, cheap, simple in design and reliable in operation [11-12]. When developing automation devices for agricultural installations, they should be calculated for a wide range of changes in the environmental parameters. This will make it possible to produce highly reliable means, since the most effective measure to improve the reliability of automation devices is the selection of elements with a low probability of failures and various ways to improve the design reliability.

5 Conclusion

Currently, in order to provide the world population with food, it is necessary to increase the volume of production of nutritious products and tackle problems such as limited availability of agricultural land, unsustainable use of natural resources, shocks and stresses, and climate change. Therefore, the agricultural industry should cope with the challenge of sustainably increasing productivity. There is a growing need to implement new technological solutions that can improve the productivity and sustainability of all agricultural sectors: crop production, livestock, fisheries, aquaculture, and forestry. It is necessary to improve the productivity of agri-food systems at all levels of production.

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