# Prospects of personnel training for the agricultural sector in the conditions of digitalization

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**Abstract.** The article is devoted to identifying the main problems associated with the lack of young and qualified personnel in the agricultural sector of the economy. This includes financial, household and other problems of the rural areas and population, which reduces the prestige of agricultural jobs for young people, causes reluctance to get education related to agriculture, and after graduation to work in agricultural production. In order to solve these problems, it is necessary to change the system of personnel training, move to a crosscutting continuous agricultural education, form a positive image of a rural worker in children from preschool and school years. One must also improve university and secondary vocational education, and, based on the use of information technology, provide the opportunity for continuous mastering the latest scientific and practical innovative achievements throughout their working life.

## 1 Introduction

The modern agricultural sector of the agro-industrial complex, like the entire economy, is experiencing the rapid development of information technologies, the transition to digitalization, and the use of smart technologies in production. Leading farms actively cooperate with research, consulting and engineering companies. However, at many agricultural enterprises there is still a serious technical and technological lag, which is associated with financial and personnel problems. Therefore, government authorities and heads of agricultural enterprises need to pay serious attention to solving these problems.

## 2 Results and discussion

The studies conducted show that many agricultural educational institutions face significant problems with training personnel for the agro-industrial complex. The problems arise at the stage of student recruitment, since few students apply to do majors related to agriculture. Most young people do not consider jobs in agriculture to be prestigious and choose other areas of study for obtaining a profession.

In particular, in 2020 there were 34.7 thousand students pursuing degrees in *Oil and Gas Business*, 105.5 thousand people majoring in *Construction*. In contrast, the educational program of *Zootechnics* attracted 16.6 thousand students, and only about 1.1 thousand young people studied *Soil Science* (Table 1) [1].

**Table 1.** The number of students in Russia in some areas of education, 2020.

| Areas of education (programs) | Program Code in Russia | Number of students |
|---|---|---|
| Construction | 08.03.01 | 105457 |
| Informatics and Computer Engineering | 09.03.01 | 51017 |
| Applied Informatics | 09.03.03 | 48936 |
| Information Systems and Technologies | 09.03.02 | 45800 |
| Oil and Gas Business | 21.03.01 | 34661 |
| Economics | 38.04.01 | 33357 |
| Soil Science (Bachelor's degree) | 06.03.02 | 874 |
| Soil Science (Master's degree) | 06.04.02 | 272 |
| Zootechnics | 36.03.02 | 16568 |

Moreover, after having graduated from agricultural educational institutions, not all students are ready to work in the field of agriculture. According to the statistics of Novosibirsk State Agrarian University, only

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61–67% of graduates return to work in the village or choose a field of activity related to their profession.

As a result, a difficult situation is developing in Russia's agriculture. Over 40% of agricultural workers do not have special professional education, the number of young people in agricultural production is decreasing, and the proportion of people of pre-retirement and retirement age is growing. In the period from 2017 to 2020, the share of the rural population among workers aged 15–29 decreased by 8.1%, while those aged 55 and over increased by 7.9% (Fig. 1) [2; 3].

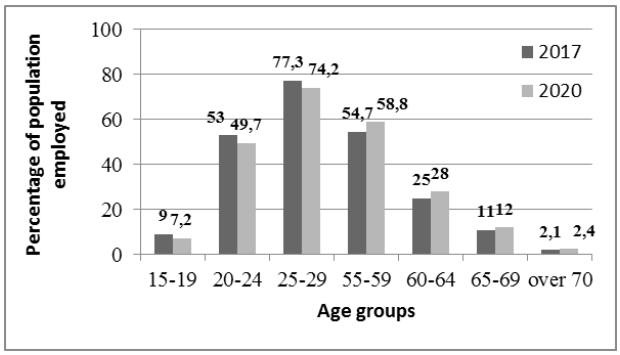


**Fig. 1.** Dynamics of employment of the rural population of Russia by age groups, % of the population of the corresponding age group.

The mass movement of population, including qualified specialists, from rural to urban areas leads to a slump in agricultural production and becomes a threat to the existence of rural settlements. Moreover, in Siberia, the decline in production and depopulation of villages is proceeding faster than in Russia as a whole. While in Russia, the number of rural settlements has decreased by an average of 10%, over the past 10 years, in Siberia this number fell by 16% [4]. The number of cattle over the past 30 years has dropped by an average of 3.2 times in Russia, while in Siberia this decrease is 15% higher. In some regions, the reduction of farm livestock population is even greater. For example, in the Novosibirsk region, the number of cattle fell by 3.7 times in 1990–2020. This situation requires the adoption of certain measures by the state and municipal authorities.

In 2012, the Federal Law "On Education in the Russian Federation" provided for the formation of a system of continuous education in the country. However, this kind of work in the agricultural sector began only in 2022; the Ministry of Science and Higher Education and the Ministry of Agriculture, together with the Innopraktika Foundation [5], carry it out.

In our opinion, in order to develop a crosscutting continuous educational system, it is necessary to involve rural children, starting from preschool age, and systematically continue working with them during school years, creating a positive image of an agricultural worker for them. This approach can be effective as it is in the kindergarten that a child begins to form the most important components of the perception of the world and its initial assessment [6; 7]. Material support for children's educational institutions should be provided at all levels to ensure the accessibility of education to all rural children, since in some regions up to 30% of children aged 3–7 years are not provided with places in preschool educational organizations [8].

In rural schools, efforts to develop children's interest in agricultural occupations should be continued on a constant basis. It is necessary to involve employees of agricultural enterprises, parents engaged in agricultural production, to provide career guidance so as to purposefully prepare schoolchildren for mastering the professions required in agriculture, taking into account the specifics of the regions, lifestyle and type of activity. This is due to the fact that many regions of Russia have their own significant features in the development of agriculture, the culture of the population, the organization of education, etc. For example, school education in the northern regions of Russia has distinct peculiarities [9]. In this connection, a dilemma arises: should schoolchildren study in small groups, preserving their traditional way of life, but to the detriment of the quality of education. Or should they study in boarding schools, where education is better, but there is a danger of children being separated from their usual way of life? In the latter case, they may no longer go back to rural labour in their region. In this case, it is important to find a balance and continue working with children in boarding schools, involving them, in accordance with their age, in rural labour traditional ones for the northern regions. A similar approach should be taken in other regions of the country, given the wide variety of natural and climatic conditions in Russia, the types and methods of agricultural production, the traditions of the rural population and their way of life in rural areas.

An important area of work with schoolchildren should be their focus on the future of innovative and high-tech agriculture, which needs to be developed in the digital economy, and which will require qualified employees. Therefore, in order to succeed in the labour market, it is necessary to receive vocational education. At the same time, teachers of rural schools need to understand that the future belongs to digitalization in all sectors of the economy, and everyone should be prepared for it [10].

The next stage of crosscutting (continuous) approach to the training personnel for the agrarian sector of the economy should include encouraging students to enter professional higher and secondary educational institutions of agricultural specialization. Ways of attracting young people may include increasing scholarships and providing benefits to pay for places in dormitories. In this connection, it is advisable to develop special programs to support students studying in agricultural areas. They should include cost compensation based on co-financing from the budgets of the federal and regional levels with the involvement of different structures of agro-industrial clusters: manufacturing enterprises, financial organizations (Rosselkhozbank, etc.), including insurance

organizations, retail chains and other stakeholders interested in the development of the agro-industrial complex and agriculture as its main component.

Important conditions for receiving increased scholarships throughout the entire period of study should be the progress of students (good and excellent marks) and the obligation to return to the village to work and use competencies in agriculture for a period of at least 3–5 years. This will provide agriculture with young, qualified employees for a certain period of time. For example, in the Novosibirsk region, up to 3,000 young specialists per year can be attracted to rural areas in this way.

The training of students in professional educational institutions should be focused not only on the needs of agricultural production at the currently prevailing technical and technological level, but also on the digitalization of agriculture. Some farms already have technologies based on various precision agriculture software, “smart” technologies, unmanned aerial vehicles, etc. [11, p. 82–98; 12, p. 96].

For example, automated technologies “Smart Land Use”, "Smart Field” take into account the types of land, its location in a particular farm, municipality, etc., analyze the state of the soil, the environment, plants and other parameters. Based on this, digital planning, modeling with the use of geoinformation technologies (GPS, etc.) is carried out. “Smart Garden” system provides for keeping records of data on the areas occupied by fruit and berry crops, analyze the soil condition in these gardens, and monitor the quality of plants, which allows taking the necessary measures to improve the above-mentioned characteristics. The robotic complex “Smart Greenhouse”, created on the basis of digital technologies, provides control of the indoor microclimate, lighting, plant nutrition, energy consumption and other indicators necessary to increase the efficiency of production, growth and development of plants, obtaining high yields. Automated vegetation systems use sensors that automatically measure the properties of the soil, the condition of plants by electrical, electromagnetic, radiometric, laser, acoustic, thermal and other parameters. They are designed to automatically control the mode of lighting, irrigation, ventilation, heating and other processes according to the program built into them.

The technological complex “Smart Farm” is designed for livestock husbandry, provides a reduction in the level of diseases of farm cattle, control of safety, animal productivity and quality of the final product. Automated dairy farm management systems with GPS/GLONASS and RFID (Radio Frequency Identification) technologies help to solve a set of production and management tasks, keep records of livestock and its vaccination, control movement and other indicators, optimize selection work, etc.

The demand for digital technologies will continue growing in the future. According to the Higher School of Economics, the achievements of robotics, the creation of autonomous robotic systems, smart greenhouses and smart farms should become a driver in agriculture [11, p. 83]. Foreign sources also note that by 2021 there were “75 million agricultural devices of the Internet of things in the world, and by 2050 the average farm will generate 4.1 million units of data per day” [13, p. 16]. Therefore, students of agriculture should be ready to work in these conditions and acquire the necessary knowledge and skills.

In addition, the Ministry of Science and Higher Education, the Ministry of Agriculture of Russia, as well as heads of regions and educational institutions should keep in mind that the educational program of IT specialists for the agricultural sector is to cover the specifics of production, product storage, marketing and logistics. This provides the management of enterprises with the necessary information for making effective decisions.

In the educational sphere of agrarian educational institutions, it is necessary to make wider use of the new opportunities brought by information technologies, which allow involving specialists and managers from the agro-industrial complex, manufacturing, research and other organizations of Russia and foreign countries, using online interaction options in the educational process. This will make it possible to establish a close connection of all educational institutions with advanced and innovative enterprises, research organizations, state and municipal authorities, and ensure the acquisition of new knowledge and best practices by both students and agricultural specialists (Fig. 2).

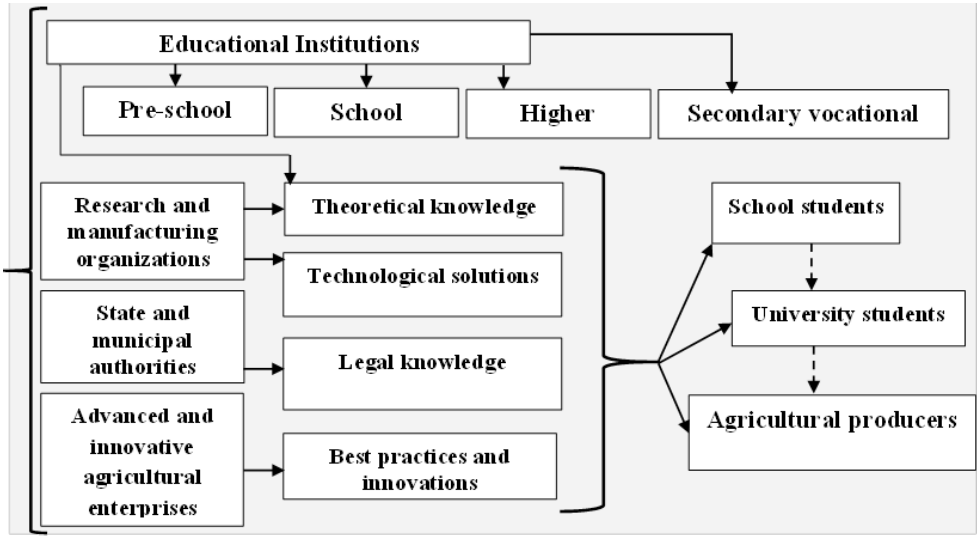


**Fig. 2.** The model of continuous acquisition of new agricultural knowledge and best practices in the context of digitalization.

At the same time, teachers of agricultural educational institutions should understand the importance of using not only traditional full-time teaching methods, but also the opening opportunities for online interaction with students and graduates who need consultation on their future work. Researchers highlight the above-mentioned ideas in relation to various areas of education [14].

The application of up-to-date information technologies is also essential for teaching distance education students in agricultural universities. For example, the process can be organized with the use of the Open Agricultural Education electronic platform developed by Digital Agro LLC. This platform provides students of all agricultural universities in Russia with access to distance learning. The professional knowledge platform participants are currently universities, academies and research organizations that offer hundreds of different educational programs for more than 300,000 students. Using this platform, any student or employee of the agricultural sector can connect to participating organizations, enter their libraries, use literature and learn about scientific developments and other activities of participating organizations. Those who apply through this platform can become both teaching and learning participants in any educational program. Students of all agricultural educational institutions should be encouraged to work with this electronic platform and taught how to use the information available.

In addition, as a number of scientists point out, the use of information technologies and the strategy "Education 4.0" will promote lifelong learning [15; 16; 17]. This means that agricultural specialists who have mastered advanced information technologies will be able to receive data on the latest scientific, technical and other achievements at any time as well as consultations of scientists and teachers of educational institutions they graduated from. It will help them introduce innovations.

Thus, a crosscutting agrarian education is a life-long educational program developed and implemented through all levels of education: from the preschool age of children till the retirement of an agricultural worker. Advanced information technologies will increasingly play a significant role in this process.

## 3 Conclusion

The rapid development of information technologies in the agrarian sector of the economy is a significant trend, and it should be taken into account at all levels: from federal government to on-farm management. At the same time, special attention should be paid to personnel training, since at present there are serious problems in agriculture related to the quantitative and qualitative composition of enterprise employees, the outflow of young people from rural areas.

The studies carried out made it possible to identify the main reasons for the lack of qualified personnel in the rural areas, who are necessary for the development of the latest technologies and the transition of the agrarian economy to an innovative development path.

To deal with the existing problems, it is necessary to switch to continuous education and to its most promising option – cross-cutting agricultural education aimed at building a favourable image of agricultural occupations for children and schoolchildren, starting from an early age. The should be a financial support of students of professional educational institutions, providing opportunities to master modern information technologies that make it possible to introduce innovations into production throughout their working life.

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