Stimulation factors of innovation activity as an important condition for the effective development of agriculture

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Abstract. The paper is devoted to the study of urgent problems of innovation activity stimulation on the example of agricultural universities as an important condition for the improvement of the efficiency of the agro-industrial complex and the development of the agricultural industry in general. The ambitious tasks for a significant increase in labor productivity in the agricultural sector, as well as the creation of high-tech jobs are impossible without proper staffing and scientific support. The effective import substitution and maintaining food independence is impossible without the introduction of new technologies, a significant increase in labor productivity in agriculture and the increase in the attractiveness of rural life. These challenges and priorities set the agenda for the formation of requirements for the system of agricultural education and new competencies of youth and teachers. In this regard, the problem of innovative activity of agricultural universities is being updated not only as a source of highly qualified personnel for agriculture, but also as centers for the development of innovations in this area. In paper, it is shown that systemic problems in the field of education are organically linked with the transformations of university science in the second half of the 20th century, when the basic principles and approaches to the organization of scientific research in universities were laid down. It is pointed out that despite numerous attempts to intensify science in agricultural universities, there are a number of constraining factors that affect their potential in the development of innovations in the agricultural sector.

1 Introduction

It is well known that the development of innovations is an important factor in the economic and political independence of the state. In modern conditions, the agricultural sector of economy is of strategic importance for the provision of food independence and sustainable development of society. The exceptional social significance of agriculture is confirmed by current events and indeed by the whole history, when, in any crisis, the demand for agricultural products grows first of all. The effective import substitution and maintaining food independence is impossible without the introduction of new technologies, a significant increase in labor productivity in agriculture and the increase in the attractiveness of rural life. These challenges and priorities set the agenda for the formation of requirements for the system of agricultural education and new competencies of youth and teachers.

Continuous deepening and updating of knowledge and improvement of professional competence are becoming the most important areas for the formation of personnel in the agro-industrial complex. A modern agrarian specialist is a person with broad general and specialized knowledge, able to quickly respond to changes in machinery and production technologies. He needs basic knowledge, analytical thinking, information literacy, socio-psychological competence and intellectual culture.

Science-intensive technologies and active innovative activity are the initial driving force of the entire economic life of the republic. The predominant increase in agricultural production and the accelerated development of the agro-industrial complex are ensured through the reproduction of new knowledge and the implementation of scientific and technological achievements.

At the same time, it is necessary to understand that modern society is at the stage of development of the post-industrial economy, i.e. requiring the increase in the processability and science intensity of all industries, including the agro-industrial complex (focusing on advanced development in terms of precision farming, production robotization, genetic engineering, genomic technologies, digitalization, artificial intelligence, etc.).

Entering a new stage of the scientific and technological revolution implies a significant transformation in agriculture, including a focus on the so-called precision farming, robotization of production, the introduction of genetic engineering achievements and

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a high level of digitalization of all industries [1].

2 Materials and methods

The purpose of this paper is to determine systemic problems of agricultural education that reduce the effectiveness of the development and implementation of innovations in the agricultural sector of economy. The research is based on the modernization approach, which allows considering the role of agricultural science in innovation processes in the context of transformational changes in Russian society through the prism of modernization. Policy in this area largely determines the scale and speed of innovation, the ability of economy and society to perceive the achievements of science and innovation. In order to achieve this purpose, various research methods were used, the main of which was the analysis of regulatory documents: the Decrees of the Government of the Russian Federation and regions, various state programs for the development of the agricultural sector, as well as reports of scientific and educational organizations. This method allows comparing plans, ways to implement them, as well as correlate the planned indicators with real figures and facts.

3 Results and discussion

One of the acute problems in the implementation of the innovative path of development of the Russian agro-industrial complex is the reduction in the human resources potential of agricultural science, which is expressed, first of all, in the decrease in the number of researchers, as well as the aging of scientific personnel. Thus, according to the data for 2020, the proportion of scientists under the age of 40 is about 40%, and about 30% are scientists over 60 years old. The total number of researchers in the field of agricultural sciences for 2015-2018 decreased by almost 25%, and in the total number of researchers in 2018 it was only 2.8% [2].

According to the report of the Russian Science Foundation (RSF) 2020, in the total volume of projects supported by the Foundation according to the priorities of the Strategy for Scientific and Technological Development of Russia, highly productive agriculture and aquaculture accounted for only 6.3% [3]. In the distribution of applications by branches of knowledge, agricultural sciences accounted for only 2.9% [3]. Among the supported projects, agricultural projects accounted for 3% [3]. According to our calculations (there is no official data from the RSF report for 2021 yet), the share of supported research in the field of agriculture has decreased by at least 1%. It is necessary to note that in the most supported priority area of research - advanced digital technologies, which accounts for 36.3% of all projects supported by the Fund according to the priorities of the Strategy of Scientific and Technological Development of Russia, agricultural research is not presented at all. That is, in fact, the digitalization of agriculture, which is one of the priorities of the state agrarian policy, is not represented by scientific research [3]. There is a significant gap between the needs of the agricultural sector of economy and the real possibilities of modern agricultural science. At the same time, one of the key problems of the agricultural sector remains low labor productivity, which is largely due to the slow introduction of innovations and advanced technologies in this sector of economy. It is necessary to note that this problem is recognized at the state level. Thus, for example, according to the State Program "Development of agriculture and regulation of agricultural products, raw materials and food markets in the Republic of Tatarstan for 2013-2025" by 2025, labor productivity in agriculture should increase by 1.8 times compared to 2013 and by 20215, 4944 units of highly productive jobs should be provided [4]. It is shown that the possibility of the realization of these goals is closely related to the staffing of the agro-industrial complex [5].

The difficult situation in the development of agrarian science is also shown by the low level of the contribution of Russian scientists to the total volume of publications indexed in Scopus and Web of Science. Thus, at the beginning of 2022, Russia ranked the 27th position in terms of the number of scientific publications in the field of agricultural sciences according to Web of Science. It is also indicative that the financing of the plan for the development of science and scientific research in the Republic of Tatarstan for 2014–2025 was completed only for 74% in 2020 [6].

In fact, the problem of the intensification of scientific research and improvement of the organizational forms of science development is not fundamentally new. Russian science faced the same problems in the second half of the 20th century. Thus, already in the decisions of the 20th Congress of the CPSU, it was indicated that higher education should radically improve research work, concentrate scientific forces on the solution of the most urgent scientific and technical problems and ensure the introduction of the achievements of science and technology into national economy. To solve this problem, a set of measures was developed, which also included, structural adjustments in universities. Thus, two types of laboratories were to be opened in higher educational institutions: industry-specific, financed from the economic activities of a university itself, and fundamental research laboratories, the financing of which was directly carried out from the budget [7, p. 218-226]. The relevant ministries and departments received permission to allocate funds to university laboratories in order to provide them with equipment, materials and instruments. The laboratories created at the expense of budget financing were on the balance of a university, but they could only work on topics agreed with the relevant ministries and departments.

The fundamental research laboratories were opened at the departments. Their work was attended mainly by the teaching staff, but they could also have their full-time scientific, engineering and technical staff and service personnel not related to the work of the departments. Although the activities of fundamental research laboratories were financed from the state budget, within the limits of approved plans and estimates, they had operational independence.

Industry laboratories were created at universities to solve applied problems primarily at the expense of

industrial enterprises and worked under contracts concluded for research work with ministries and departments in close cooperation with enterprises and industry research institutes.

The creation of industry laboratories was preferred in cases where there were no research institutes in the region, or design and technology and design organizations of the industry, but there were universities that had personnel capable of solving certain applied problems [8, p. 116].

Fundamental research laboratories of universities were called upon to conduct theoretical and experimental research in the field of problem areas approved for them, provide assistance to the relevant departments and organizations in design development, participate in pilot tests of new models of machines, equipment, instruments, products, materials and technological processes developed in laboratories, as well as in their implementation in production. By 1965, 41 research and 20 branch laboratories were formed at 19 universities of the RSFSR [9, p. 190]. The problem with this transformation was that the reform increased the number of bureaucratic procedures. For example, a university that had industry-specific or fundamental research laboratories had to coordinate the plans for the work of these laboratories with the Ministry of Higher Education or another ministry in a department of which a university was located. The ministries, in turn, had to coordinate the work plans of the universities' laboratories with the State Engineering Committee of the USSR, the State Construction Committee of the USSR and the State Economic Commission. Such a multi-stage structure of approvals resulted in the increase in the number of various plans, justifications, etc., but did not result in the real innovative activity of universities [10, p. 77–78]. For comparison, this problem remains relevant today. Thus, for example, agrarian universities in Russia, on the one hand, are subordinate to the Ministry of Agriculture of the Russian Federation, and on the other hand, they are obliged to comply with the general educational standards of the Ministry of Science and Higher Education of the Russian Federation. Accordingly, on the one hand, this is a double reporting, and on the other hand, agricultural universities, being departmental, do not have the opportunity to use tools to support research activities that can be used by universities directly subordinate to the Ministry of Science and Higher Education. Namely, for example, agricultural universities, can not form scientific and educational centers, since this is not provided for by the budget of the Ministry of Agriculture.

It is also fair to say that in the summer 2019 it was widely announced that within the framework of the national project “Science and Universities”, 14 agricultural research and educational centers would be created in Russia [11]. However, in this case, we are talking not only about supporting agricultural universities. In addition, information on how this initiative was eventually implemented could not be found. Agrarian universities in order to work in the system of scientific and educational centers are forced to cooperate with other universities subordinate to the Ministry of Science and Higher Education. On the other hand, an agricultural university can not deviate from the requirements of the Ministry of Science and Higher Education, for example, in order to extend practice at agricultural enterprises. All this creates significant difficulties, deprives universities of independence and flexibility and also diverts significant resources to perform purely administrative work in order to create all kinds of plans, roadmaps, monitoring and other reporting [12].

This situation is aggravated by the fact that the main scientific foundations, the purpose of which is to support promising scientific research in various fields, indicate in the requirements of the competitive documentation a number of requirements that are not directly related to science. Thus, the RSF, the main Foundation through which scientific research is financed, in the application documents (clause 2.17 of the Competitive documentation for fundamental scientific research and exploratory scientific research by small separate scientific groups) asks to indicate the experience of educational activities over the past 5 years (information about the management of graduate students, adjuncts, interns, residents, development and implementation of new educational courses in Russian and foreign universities) [13]. Taking into account that a project manager during the implementation of the project must be in labor relations with the organization through which the funding is provided (clause 2.16), all scientists who work in non-core universities for their qualification are almost automatically cut off from financial support. For example, a chemist or mathematician under such conditions will not be able to receive a research grant while working in an agricultural university, since, at a minimum, he will not have the necessary experience in educational activities, since in a non-core university he can not manage postgraduate students, etc. It is problematic in such a situation to attract specialists-scientists.

At the same time, it is important to understand that the training of a high-quality specialist is a complex multifactorial process. A modern specialist must have good knowledge in various fields of science, as well as have developed analytical thinking, which is formed not only and not so much by narrow professional disciplines, but by disciplines that are non-core for a given university, for example, mathematics, philosophy, etc. However, teachers and scientists in such a situation tend to affiliate with universities specialized in their field of study, since this increases the chances of to get grant funding, while departmental universities continue to experience difficulties in attracting high-quality specialists.

If we turn again to the experience of the USSR, we can state that the multi-level system of the management of the research work of universities and the division of laboratories into research and industry ones did not give a systemic positive result. In the work of fundamental research laboratories, formalism often prevailed, expressed in the substitution of major scientific tasks for one-time assignments, which led to the dispersion of forces, concentration on narrow subjects and work without a long-term perspective. On the other hand, industry laboratories were sometimes limited to the

solution of utilitarian and narrow tasks performed in order to obtain funds from a customer for the purchase of equipment. To improve the efficiency of university science, the Central Committee of the CPSU and the Council of Ministers of the USSR on February 20, 1964 adopted a resolution "On the further development of research work in higher educational institutions" [14, p. 450], according to which university science should be included in national plans for the development of science and technology, which increased the importance of university research work. The resolution stipulated that during the development of plans for scientific research and introduction of the achievements of science and technology into national economy, universities should take a direct part in the solution of promising scientific and technical problems. A network of university research institutes also developed. The Research Institute of Nuclear Physics of Moscow State University, the Research Institute of Mathematics and Mechanics of Kazan University, the Research Institute of Physics of Leningrad University, etc. became well-known scientific institutions in the country. In total, in higher educational institutions of the USSR, by the end of 1977, there were 58 research institutes, more than 540 problematic and 770 industrial laboratories [15, p. 158].

In the 1970s the measures were taken to establish a real connection between the beginning of university research and their completion, followed by the use of research results in social production [13, p. 80–81]. To this end, from 1971-1972 all types of higher education institutions of the USSR, research and development sectors (RDS) began to be created. At the same time, two types of RDS were most widely used – centralized and decentralized.

The centralized RDS of the university had its own accounting department, personnel and supply services, a planning and financial department, etc. The presence of these services allowed collecting in a timely manner the information necessary to make decisions on the advisability of concluding certain economic contracts for research by the scientific divisions of the university in order to monitor performing R&D more carefully.

The decentralized RDS was the coordinating and controlling body in the conduct of research work at the university. Its services (accounting, personnel, etc.) were merged with the corresponding services of the university. This form of RDS prevailed in universities with a small amount of research work.

The above-mentioned measures on the improvement of the organization of university science contributed to strengthening its connection with practice and created more opportunities for the solution of topical theoretical and, mainly, scientific, technical, and applied problems.

However, in most universities, not everything was so good. It was precisely this circumstance that caused the adoption of the next resolution of the Central Committee of the CPSU and the Council of Ministers of the USSR "On the further development of higher education, improving the quality of training" on July 12, 1979. The main thing that the Resolution drew attention to was the discrepancy in the learning process with the realities of production and the latest achievements. In this regard, it was proposed to improve the professional training of university graduates through the involvement of academicians and leading scientists in teaching, improvement of scientific and technical information and the promotion of advanced national and foreign production experience among students, provision of the predominant development of full-time postgraduate studies, etc.

It is necessary to emphasize that the party and state leadership of the country in the late 1970s no longer had any extraordinary opportunities to increase the role of the department. Therefore, in the mentioned resolution of the Central Committee of the CPSU and the Council of Ministers of the USSR, the increase in the role of the department was conceived primarily by assisting young teachers in mastering pedagogical skills and implementing measures to improve the moral and material incentives for pedagogical work. However, these attitudes could no longer significantly enhance the role of the department. First, it remained unclear what the assistance to young teachers in the improvement of their pedagogical skills should consist of and who and how should provide this assistance. Secondly, the measures of personal stimulation (gratitude, Certificate of Honor, Board of Honor) were outmoded. Thirdly, financial incentives for university teachers in the conditions of economic stagnation, total shortages were just a wish.

The state did not have the opportunity to radically improve the material and technical situation of most departments. For decades, there was a lack of premises, equipment, instruments and reagents in departments. Therefore, the resolution stated that ministries and departments should participate in the intensification of the material base of universities by the provision of educational institutions with the opportunity to use the premises and equipment of relevant enterprises and organizations, creating on their basis, the branches of specialized departments if necessary.

However, not all of 883 universities in the country were able to use the provisions of this resolution. The main reason was that most organizations and enterprises were not in hurry and more often they were not going to give universities the opportunity to organize branches of departments on their premises, since it was easier for them to turn to applied research and development centers to develop important scientific and technical problems for them it was easier for them to apply to applied research institutes in their industry.

In addition, scientific work in universities did not develop rapidly enough due to the fact that the teaching staff had almost no time for scientific studies. Teaching, methodological and educational work were in the first place in their activities. According to an individual plan, a university teacher was assigned from 1 to 4 hours a day for scientific work. The situation was aggravated by the established practice of financing scientific work in higher education: if the USSR Academy of Sciences received 8 out of every 10 rubles from the state budget and only 2 earned itself under economic contracts, then the university from the 8 rubles it earned itself had the right to spend only about 40 kopecks for the development of its material and technical base, its own experimental and research production [16, p. 349].

The state order for scientific research was considered as a measure that would increase the effectiveness of scientific research in universities in the late 1980s. In 1988, it amounted to 7 million rubles and according to the calculations of the USSR State Committee for Public Education its implementation allowed increasing the volume of research in higher education by 1995 to 1 billion rubles. However, the universities themselves were not ready for a serious restructuring of the entire mechanism that had developed over decades. In the system of higher education during the years of Soviet power there was a practice when a plan for recruiting students and graduating specialists was initiated by state. In this case the state regulated everything that was possible: the ratio of students and teachers, staffing, workload, etc. The race of assembly line for the training and graduation of specialists not only did not contribute to progress, but also led to the depreciation of higher education itself. This trend continues to a large extent to this day. The problem of formalism, the pursuit of quantitative indicators instead of qualitative ones, has not been eliminated either at the level of university reporting or at the level of research.

It is well known that if in order to receive funding in the form of grant support, it is necessary, at least, to fulfill a number of quantitative requirements for publications, the age of performers etc. In the form of a report, quantitative indicators are the main ones (the number of articles published in various citation bases). Then scientists are forced by any means to try to increase the number of publications. Usually this comes at the expense of quality. The result of this approach is the impossibility of a qualitative assessment of the projects themselves. Thus, with such numerous and rather high requirements for project managers, the RSF in March 2022 was forced to publish an appeal from the RSF expert councils on the quality of reporting materials. This appeal pointed out that often reports on supported projects are essentially formal replies that do not contain specific and verifiable results, characterized by lexical mistakes, as well as excessive brevity. It is shown that the reports contain an erroneous indication of the quartile of the journal or incorrect information about the indexing of the journal in which the work is published, duplication of publications, including in different languages, etc. [17].

At the same time, important documents have already been adopted. They determine the relevance of this area of work, taking into account global challenges [18, 19, 20]. A unified global economic, legal and information system is being purposefully formed. The intensification of global competition covers not only the traditional markets for goods, capital, technology and labor, but also the systems of national governance, innovation support and human development. If we formulate the main challenges of a global nature, then they include:

- The transition of the world economy to a new technological order “Industrialization 4.0” and digital economy.
- The acceleration of technological development of the world economy. The real competitors of Russia are not only the leading countries in the field of innovation, but also many developing countries, the CIS countries.
- The intensification of global competition for the factors that determine the competitiveness of innovation systems, primarily for a highly skilled workforce and smart money (the investments that attract new knowledge, technologies and competencies to projects), education and a sharp increase in the mobility of these factors.
- Challenges faced not only by Russia, but also by humanity in general, which determine the priority areas of scientific and technological development of the Russian Federation - climate change, the problem of ecology and sustainable development, population aging and health challenges, food security on a global context.

According to the Strategy for Scientific and Technological Development of the Russian Federation, the following areas should be determined as priorities:

1. Food security, understood as the need to ensure food security and food independence of Russia, the competitiveness of domestic products in the world food markets and the reduction of technological risks in the agro-industrial complex.
2. Rational agriculture and aquaculture, environmental protection, safe food in the sense of transition to a highly productive and environmentally friendly agriculture and aquaculture, development and implementation of systems for the rational use of chemical and biological protection of agricultural plants and animals, storage and efficient processing of agricultural products, creation of safe and high-quality, including functional, food products.
3. Effective interaction between man, nature and technology, providing the possibility of an effective response of Russian society to great challenges, taking into account the interaction of man and nature, man and technology, social institutions at the present stage of global development, including the application of the methods of humanities and social sciences.

The national development goals of the Russian Federation, indicated in the Decree of the President of the Russian Federation of July 21, 2020 are of particular importance for the development of the goals and objectives of the development program of Kazan State Agrarian University. First of all, we are talking about the opportunity for self-realization and development of talents, where the positions that universities should achieve by 2030 are clearly defined:

– the formation of an effective system for the identification, support and development of abilities and talents in children and youth, based on the principles of justice, universality and aimed at self-determination and professional orientation of all students;
– the provision of the presence of the Russian Federation among the ten leading countries in the world in terms of research and development, including through the creation of an effective system of higher education;
– the creation of conditions for the formation of a harmoniously developed and socially responsible personality based on the spiritual and moral values of

the peoples of the Russian Federation, historical and national cultural traditions.

During the formation of the priorities for the development of the University, the Strategic Initiatives formulated in the Decree of the Government of the Russian Federation dated October 6, 2021 No. 2816-r "List of initiatives for the socio-economic development of the Russian Federation until 2030": Circular Economy and Agricultural Science – a step in the future development of the agro-industrial complex were taken into account.

4 Conclusion

There is an urgent need to learn from the past experience. Following the path of the division of universities, increasing reporting and giving priority to quantitative indicators, it is hard to speak of a systemic restructuring of universities for innovation processes. The introduction of innovative mechanisms, including the digitalization of education, should also not occur at the expense of a sharp increase in extracurricular workload on teachers. The reforms in this area require a reasonable approach and a qualitative analysis of possible problems and risks. The positive moment is that there is a clear understanding that universities, where scientific work is not conducted or poorly organized, are not able to train high-quality specialists corresponding to the current level of development of science, technology and production organization.

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