



THE ROLE OF TECHNICAL SERVICES IN MANAGEMENT OF INNOVATION ACTIVITIES AT UKRAINIAN AGRICULTURAL ENTERPRISES

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Abstract: The ways of introducing innovations into production were found as a result of conducted research on innovative activity at agricultural enterprises in the Ukraine. By means of the developed schemes, the stages of selecting an innovative product were shown and the need to transform the decision-making system in agricultural production was justified. In order to improve the information flow system, it was found that the innovative activity of agricultural enterprises is influenced by the presence of innovation media and innovation-active staffing support of production. The low level of innovation activity of agricultural enterprises is due to the low level of scientific support of agricultural production in Ukraine. It was found that the head of engineering and technical services plays a significant role in introducing innovations. He is directly involved both in the selecting an innovative product and introducing it to production. Thus, in order to improve the innovative climate in the agricultural sector of the country's economy, it is necessary to create direct links between innovators and producers, and also to pay increased attention to training appropriate personnel.

Keywords: technological innovations, technical management, agroengineering

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Introduction

The rapid development of scientific and technological progress requires the reorientation of enterprise development strategy to introduce innovations in order to provide its competitiveness. Analysis conducted on the basic elements of innovative activity in Ukrainian agrarian enterprises over the last ten years indicates a low level for most of them. Thus only about 20% of Ukrainian enterprises performed one or

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another type of innovation activity. At the same time, most innovations refer to the acquisition of new technological equipment (Kyzenko, Hrebeshkova 2018, pp. 155-162; Kalinichenko, Havrysh, Hruban 2018, pp. 199-217). Moreover, the most innovatively active is the processing industry.

Innovation potential is the main factor of influence in innovation activity. It may be considered that the majority of agricultural enterprises have set out on the path of introducing innovative decisions. This is connected with the expansion of economic activities. In such a way, most of the successful enterprises that specialized in the producing raw materials, added processing production to their activities in order to gain more profits. For a single agro-industrial complex enterprise, innovation activity is the introduction of a new type of production. Nevertheless, introducing such innovations in most cases is dictated not by the desire to introduce new technologies, but due to the imbalance of profit to the type of production. Processing and commercial structures draw on a significant part of the profit that the producer of agricultural raw materials does not want to lose. This is confirmed by statistics data (*Scientific and Innovative Activity in Ukraine...* 2018). The modernization and acquisition of fixed assets of production has the largest share of innovations in Ukraine. In relation to that, innovative activity depends on the size of the enterprise. Introducing innovations is inherent in large enterprises with a high level of innovation potential. Agricultural holdings and large agricultural associations belong to such enterprises. The complete production cycle from the production of raw materials to obtaining the final consumer product is organized at such enterprises. Consequently, there is a concentration of the potential needed for innovation activity. Small and medium-sized agro-industrial complex enterprises are characterized by a low level of innovation potential, which is due to both the lack of investment capital and the lack of appropriate personnel. In fact, such enterprises do not act as innovators due to such reasons: the long duration of scientific research in the field of selection, and the need to have systemic fundamental knowledge in the fields of biology, chemistry and engineering (Dzhaman 2016, pp. 27-36). At the same time, significant investments are needed in order to create an innovative product. Considering the abovementioned, it can be concluded that the constraining factors of the innovation process are the general economic results of economic activity and the lack of staffing support. Each of these factors is connected not so much with the internal properties of production systems as with external influences. That is, in the vast majority, the structures that are separate from the manufacturer are responsible for creating innovations in agricultural production. Research institutes or stations, higher educational institutions, private scientific and commercial enterprises, and large plants that produce technological equipment belong to such structures (Bajdur 2018, pp. 18-26). The production facilities of enterprises may be used as the testing grounds for inventions and the approbation of proposed innovations. It becomes obvious that the process of introducing innovations reveals the concept of innovation activity at agricultural enterprises, and the scale of introducing innovative products defines the level of innovation activity.

In such a way the innovative development of small and medium-sized enterprises passes into the plane of creating progressive forms of promoting innovative ideas to

be implemented, as well as its financial and staffing support. Regional advisory services, clusters according to the types of scientific and production activities, as well as technological parks are created in order to improve the conditions of innovative development. Such innovations provide the opportunity for wider dissemination of information on the achievements of scientific and technological progress (Brzozowska, Bubel, Kalinichenko 2015, pp. 175-186). However, in most cases their functioning does not affect the growth of innovation activity, but only helps the adaptation or commercial promotion of a certain product or service to an agricultural producer. Interestingly, such a product does not always contain innovative ideas. The weak stimulation of introducing new technologies by the state does not increase the innovation activity of agro-industrial complex small and medium-sized enterprises either.

Literature review

In order to define the tasks of the technical services manager more accurately while performing innovation activity by an enterprise, it is necessary to analyze the spheres of the possible introduction of innovations in agricultural production. Consequently, most scientists (Yankovskaya 2010, pp. 1-3; Vinichenko 2012, pp. 44-48; Donec 2013, pp. 92-97) identify six innovation directions to which, in addition to social and economic, belong biological, chemical, technological and technical. During analysis of the types of innovation activity by each of the directions, it was established that decision-making on introducing innovations in technical and technological directions is not possible without participation of the technical services manager of the enterprise (Riaz et al. 2014; Yao et al. 2014, pp. 101-108; Sidorov, Babenko, Bondarenko 2017, pp. 70-76).

Technological and technical innovations are closely linked (Almukhambetova et al. 2017, pp. 1-24). All the technologies of agricultural crop cultivation are based on the use of one or another type of equipment. In some cases, it is the mechanical and automation equipment that provides the significant share of innovations in the selected technology (Sorvino 2017).

Decision-making connected with the organization of production, which contains elements of innovations, can be considered by two possible scenarios. In the first case, there is a complete change of the production system. There is no transformation of the scheme of decision-making (Kalinichenko, Havrysh, Perebyynis 2016, pp. 150-158). The integral components of the constructed system are the stages of analysis of the resource base and its optimization, as well as functioning and effectiveness forecasting (Babenko 2017, pp. 115-121). They justify the composition, structure and management system of production processes. Only certain conditions and limitations are added to it. They regulate the necessary level of skills and knowledge, as well as elements of stimulation and motivation. The effectiveness of innovation activity is determined by comparing the obtained overall results of production with previous data. Interestingly, gaining profit from innovations happens due to introducing an innovative product, rather than improving the technical and technological system of agricultural production (Jabłoński 2018,

pp. 141-149; Kalinichenko et al. 2016, pp. 387-400). Such complete replacement of production technologies is not possible in agricultural enterprises with a wide range of crops. This fact is based on the diversity and variety of technological methods and means of production at the cultivation of certain crops. Enterprises that specialize in the cultivation of monocultures are almost absent.

Research aim

The goal of the study was to determine the conditions for creating an innovation favorable climate in agricultural enterprises in the Ukraine. Articulation of the innovative product concept in the agrarian sector enables step-by-step decision-making on introducing innovations at the level of engineering and technical services. The role of the managers of these services is to identify the main factors that influence the effectiveness of technical innovations in the enterprise.

Main research material

The decision-making scheme in the activities of the head of the engineering and technical service at an agrarian enterprise can look different if we partially replace some elements in the production with an innovative option. Parts of the fixed or current assets of production act as an innovative product. The technology of primary soil treatment, the choice of the fertilizer system, plant protection, assortment of certified seeds, separate aggregates for performing certain operations, equipment for the postharvest treatment of crops and others are subjects for the introduction of innovations. In this case, the subsystems of the production system or its individual elements are subjects for innovation. In order to determine the role of technical service personnel in innovation activities, it is necessary to consider the process of introducing innovations into agricultural production.

In any of the above described scenarios, the implementation of innovation activity in agricultural production happens in two stages. The first stage is the choice of the innovative product, the second is its direct introduction into production. The result of the first stage is the decision to introduce innovations, the result of the second stage is the adoption of decisions on constructing and operating a production system taking into account innovations.

The initial phase in selecting the innovative product is to establish the goal of innovation activity (*Figure 1*). As a rule, the goal is either to generate additional profit or reduce production costs. Additional profit is generated by a gain in the gross yield of crop production, while lowering production costs is connected with innovations which reduce the use of a certain resource of the enterprise. It is not possible to consider goals that are aimed at producing a new product without expanding the production capacity towards the processing industry. Since the expansion of production specialization requires the construction of completely new production systems, this problem should be solved separately.

To determine the innovative product that is planned to be introduced, the technical services manager is directly involved in the analysis of the technologies existing at the enterprise and the innovation proposals in the market (Loconto, Poisot, Santacoloma 2016). The desired goals should also be taken into account during the analysis. Analysis of the object of innovations establishes a connection of all the components and specifies the place of innovations in existing technologies. The task is to implement the results of the analysis. The essence of the task is to choose from the alternatives which correspond to the desired goal. The alternatives are formed in accordance with the features of the innovations, the availability of information, the place of origin and complexity of implementation.

It is necessary to choose the best one from the obtained set of alternatives taking into account the resource base of the enterprise and extrinsic stimuli. The state policy in the field of innovation, the availability of financial initiatives from investors, banks, funds, and the human resources of the territory where the enterprise operates may act as the extrinsic stimuli (Klochach, Klochan 2018, pp. 99-105; Ulanchuk et al. 2018, pp. 68-83). To make a reasonable choice of the innovative product, the technical services manager must create a certain number of forecast models. They can be based on calculation methods using mathematical apparatus or on personal conclusions. Sometimes it is a combination of mentioned above mechanisms of justification. The justification criterion is the achievement of the desired goal taking into account all the conditions and opportunities.

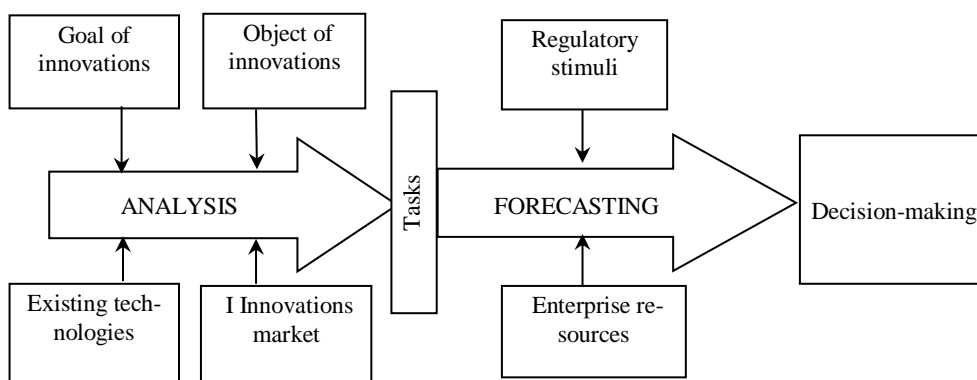


Figure 1. Making a decision to choose an innovative product

Source: Authors' own compilation

The result of considering the possible scenarios is the management of decision-making on introducing a certain innovative product.

The crop production system should be developed taking into account the innovations that are planned for implementation (Figure 2). In fact, the innovative product is integrated into the existing technological process. The innovation process becomes a part of the technological process with a significant change in the functions of the head of technical services. Analysis of the necessary basis for introducing

innovations occurs along with analysis of the production resources, conditions and restrictions, risks and management actions.

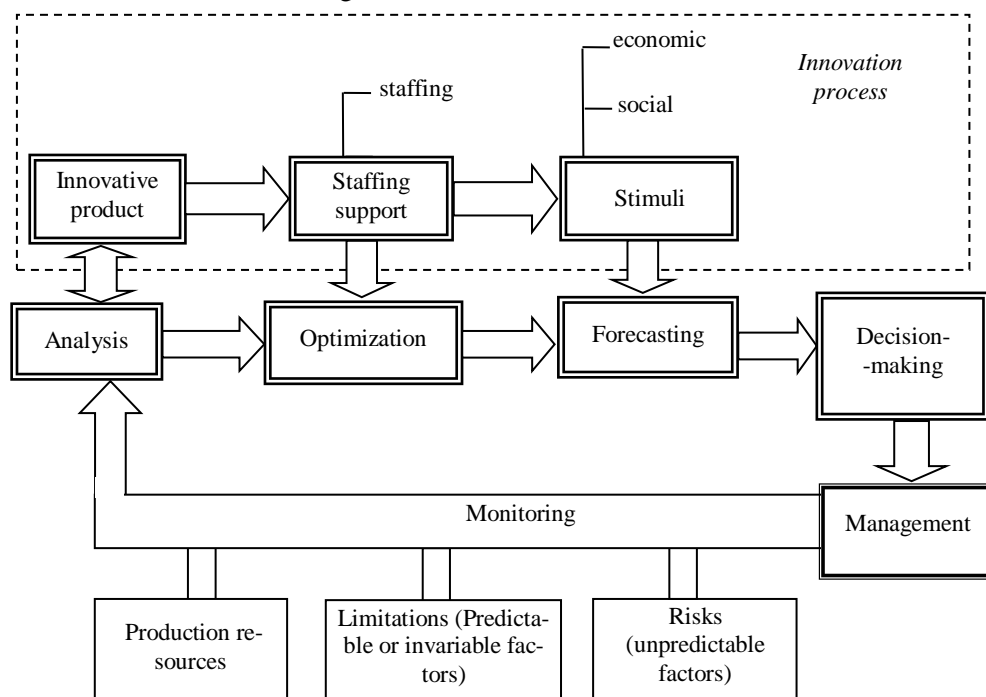


Figure 2. Decision-making for production based on innovation

Source: Authors' own compilation

The function of optimizing fixed or current assets is supplemented by the undeniable condition of introducing the innovative product. Staffing support sets certain demands for the labour force and in most cases it requires personnel training or the selection of new cadres.

The results of optimization and support with the addition of internal motivating factors should be taken into account in the process of forecasting the production system effectiveness. These factors include wage increases, bonus payments, and also improvements in working conditions. These factors should be provided by the chosen innovative product.

In fact, the superstructure of the system at all levels of supporting and conducting the technological process of the new product should be reproduced at the enterprise. Furthermore, achieving the goal set for innovation activity is the key factor in decision-making justifications (Kalinichenko, Havrysh 2019, pp. 68-83). Thus, it can be stated that technical services personnel are directly involved in selecting the innovative product and in its implementation. It should be noted that the technical service in modern conditions of agricultural production plays a significant role in forming its effectiveness.

Significant changes also occur in the system of information streams (Figure 3). Before performing the innovation activity of agricultural production, the part of the decision-making information system containing data on running the technological process is closed. When performing the innovation activities, it is necessary to maintain a constant connection with innovation media. As was mentioned earlier, they include scientific and technical institutions, higher education institutions, scientific and commercial enterprises, as well as machinery and equipment production plants. It is also advisable to visit exhibitions, seminars, conferences, and trade fairs. Establishing a constant flow of information on the latest products and technologies is a long-term process that requires a certain labour force and sets the requirements for personnel qualifications. Hence, there is the need for constant contact with institutions and organizations that provide educational services. They include advisory services, educational institutions and commercial entities. Some innovation media create their own training centers for more active promotion of their products or technologies.

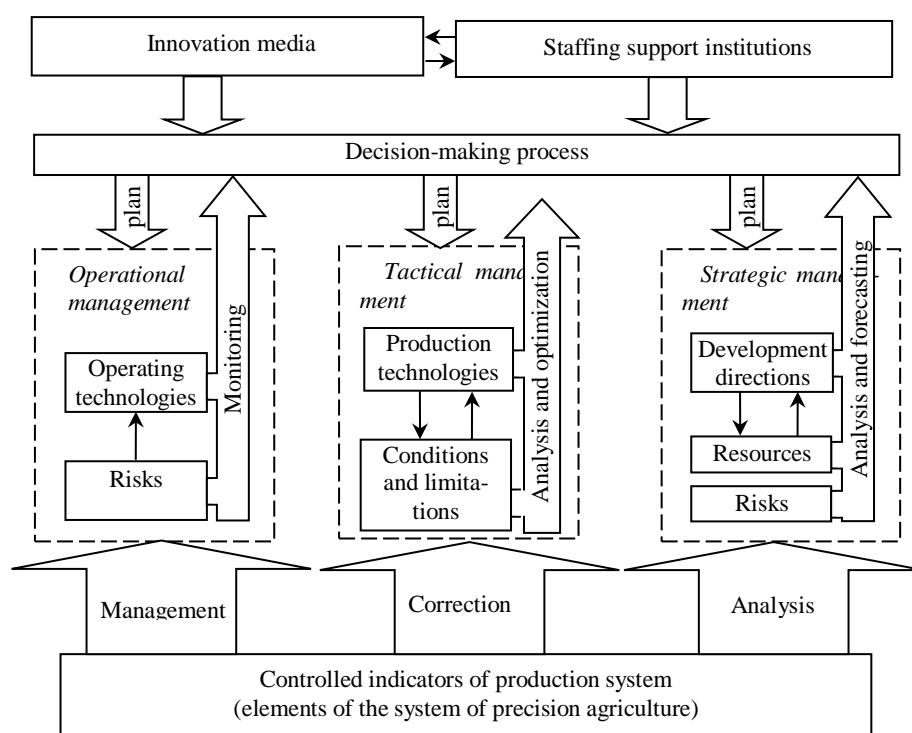


Figure 3. System of information streams in agricultural enterprise with innovations

Source: Authors' own compilation

It can be noted that educational institutions are both the innovation media and staffing support institutions. This combination creates prerequisites for the shortest path of innovation for the producer.

Information technologies can be not only a tool for collecting, processing and accumulating information. They can also be an innovative product by themselves. In this case, they have a certain influence on running the technological process, forming the technologies and justifying the directions of development. Depending on the goals of implementing information systems, they can be used in the management of operational technologies, to adjust and supplement the results of optimizing the use of fixed or current assets of production, as well as in analysis of production system functioning efficiency.

Precision agriculture systems may serve as a prime example of such systems. The combination of hardware components with software makes it possible to monitor and control technological processes in crop production. Moreover, their implementation imposes special requirements on the operation of technical services of the enterprise. In most agricultural enterprises of Ukraine partial introduction of precision agriculture system elements is observed. It is usually hardware innovations which are focused on improving the working characteristics of performing the operational technologies. The use of GPS navigation, means of automatic support of parallel driving, machines for controlled introduction of the technological material provide optimal use of both the fixed and current assets of production and, correspondingly, they reduce the use of certain resources (seeds, fuel, mineral fertilizers, etc.).

Thus, it can be stated that the system of information streams significantly changes when conducting innovation activity at an enterprise. At the same time, the information systems can act as an innovative product.

It becomes obvious that an increase in innovation activity requires the establishment of an innovation favorable climate at the enterprise. It largely depends on the innovation potential of the personnel. The increase in potential is provided by establishing close links between the enterprise and the media of innovations and institutions of staffing support.

Confirmation of the low level of innovation activity can be found in state statistics data of the Ukraine. A quantitative measure of agroengineering innovative products in the Ukraine can be the number of patents for an invention or utility model.

Analysis of the number of granted patents for inventions (*Figure 4*) showed that educational institutions occupy the leading positions in comparison with other scientific, research and commercial institutions and organizations. Over the years of the researched period, the number of patents received by employees of educational institutions is almost two times higher than in other institutions and organizations. Thus, it can be stated that there is a concentration of innovations in the education sector. Patents for inventions in agriculture are almost absent. One patent per year was obtained only in 2013 and 2017 (*Scientific and Innovative Activity in Ukraine... 2018*).

This indicates that in the agriculture sector, research work in the areas which are subject to invention patenting, did not have sufficient innovative results. To a large extent, this is due to the completely different mechanism of property rights protection of crop varieties. The general trend towards a decrease in the number of patents obtained for inventions over the past four years should also be noted.

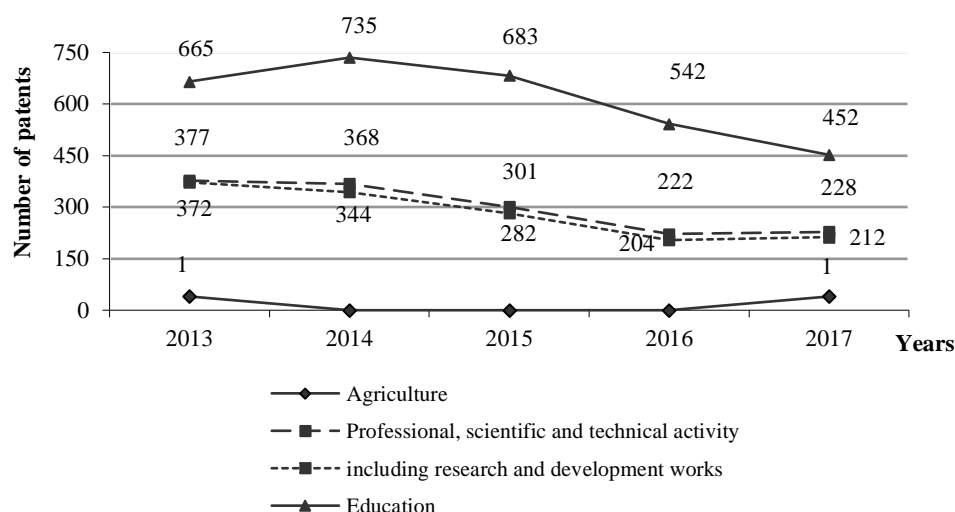


Figure 4. Dynamics of invention patents by type of economic activity

Source: (Scientific and Innovative Activity in Ukraine... 2018)

The number of granted useful model patents clearly characterizes the level of innovations in the technical direction. Most of them belong to mechanical and automation equipment.

In agriculture the situation of granting useful model patents is not better than in patents for inventions. Although the industry received several units of innovative products each year, their number is incomparably smaller than the total number (Figure 5). Once again, educational institutions are significantly ahead of other scientific institutions by the number of received useful model patents. The trend of change in the number of patents till 2016 was the same for both educational institutions and other institutions (Scientific and Innovative Activity in Ukraine... 2018).

In 2017 there was a decrease in the number of patents in scientific institutions, while in educational institutions it continued to grow. Nonetheless, despite the concentration of innovative solutions in educational institutions, the vast majority of innovations have nothing to do with agricultural production. It becomes obvious that the main carriers of innovations in agriculture are machinery and equipment manufacturing plants. Mainly, innovations come in to being as the result of works on breeding, chemical-biological and organizational and economic research. Furthermore, the innovative product in most cases is of foreign origin. This fact is confirmed by the data on the number of researchers.

The dynamics of change in the number of researchers that are involved in scientific studies has a slight tendency to decrease (Figure 6). At the same time, a slight increase in the number of researchers in the technical sciences was observed over the past two years, but its number is less than in 2013. The trend of changes in the number for researchers in the agriculture sector corresponds to the changes in technical sciences. Nevertheless, it can be noted that in five years there had not been

any fundamental change in the number of employees that were involved in the processes of creating innovative products (*Scientific and Innovative Activity in Ukraine... 2018*).

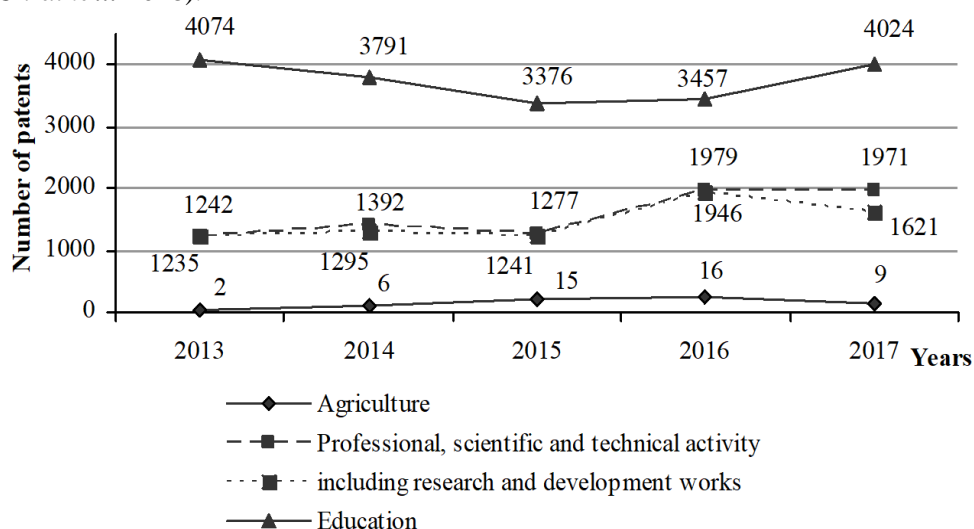


Figure 5. Dynamics of useful model patents by types of economic activity

Source: (*Scientific and Innovative Activity in Ukraine... 2018*)

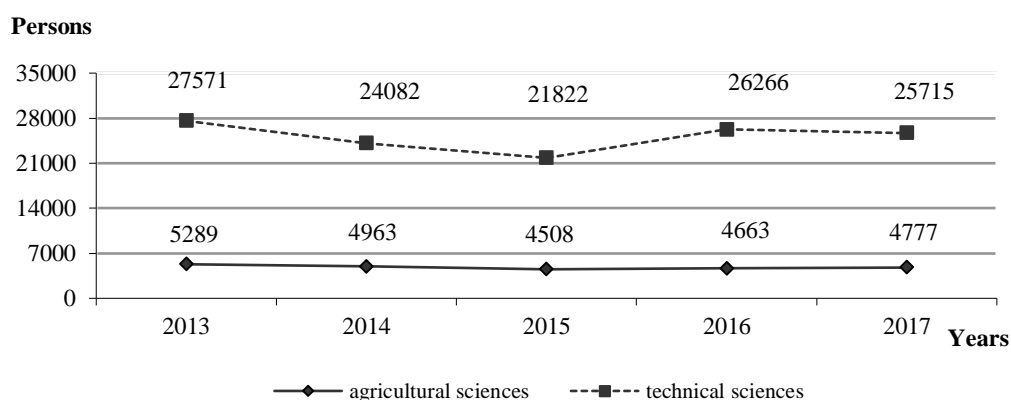


Figure 6. Number of researchers in science sectors

Source: (*Scientific and Innovative Activity in Ukraine... 2018*)

According to the comparison of information on the granting of patents with the number of scientists, it can be concluded that the number of researchers in the field of agricultural science does not affect the number of obtained patents. In other words, most researchers do not perform research work connected with technical support of agricultural production processes.

In this case, reorientation of the functions of educational institutions in the direction of staffing support of agricultural producer innovation activity should be done. In addition creating conditions for training innovatively active personnel becomes the main task of innovation media in this direction.

It should be noted that according to the government statistics agencies, the total number of employees involved in performing research works in Ukraine is at a lower level in comparison with most European countries. Thus, Ukraine can be compared with such countries as Poland, Romania and Bulgaria and per 1,000 involved people, it would be 7, 5, 10, 5 and 10, correspondingly. In comparison with other countries this indicator is much worse. On average, according to the data in 2015, it is 20 performers in the European Union.

Conclusions

As a result, it can be said that technical service personnel play significant role in forming the agricultural producer's level of innovation activity. They are directly involved in both the decision-making processes: choosing an innovative product and organizing the production systems functioning with innovations. Innovative activity imposes a number of demands on the level of qualification of technical service personnel. Establishing close relationships between innovation media, staffing support institutions and producers is an undeniable condition for increasing the innovation potential of an agricultural enterprise.

In conditions of a concentration of technical and technological agricultural innovations in agricultural machinery manufacturers, educational institutions should act as innovation media. Their main function becomes the training of personnel with high innovation potential. What is more, innovation media or stimulating authorities should create the best conditions for presenting, familiarizing and studying their proposals.

On the other hand, training professional human resources will not fully solve the problem of the engineering and technological service quality functioning in agrarian enterprises. Unfortunately, theory and practice in the Ukraine are not closely connected. Most of the theoretical developments which were registered in the form of patents are not implemented in practice. Therefore, we need to direct our further research to overcome this gap. Cooperation between education, science and industry can improve the efficiency of agricultural enterprises in the Ukraine.

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ROLA USŁUG TECHNICZNYCH W ZARZĄDZANIU DZIAŁALNOŚCIĄ INNOWACYJNĄ W UKRAIŃSKICH PRZEDSIĘBIORSTWACH ROLNYCH

Streszczenie: W artykule przedstawiono istniejące podejścia do wdrażania innowacji w procesach produkcyjnych w przedsiębiorstwach rolnych na Ukrainie. Za pomocą opracowanych schematów wyświetlono etapy wyboru innowacyjnego produktu i uzasadniono potrzebę przekształcenia systemu podejmowania decyzji w rolnictwie ukraińskim. W celu poprawy systemu obiegu informacji stwierdzono, że na działalność innowacyjną przedsiębiorstw rolnych wpływa obecność nośników innowacji oraz aktywne wsparcie kadrowe. Niski poziom aktywności innowacyjnej przedsiębiorstw rolnych wynika z niewielkiego wsparcia naukowego procesów produkcyjnych na Ukrainie. Stwierdzono, że kierownik działu usług technicznych odgrywa znaczącą rolę we wprowadzaniu innowacji, jest on bezpośrednio zaangażowany zarówno w dobór innowacyjnego produktu, jak i jego wprowadzenie do produkcji. Dla poprawy innowacyjnego klimatu w sektorze rolnym gospodarki kraju konieczne jest stworzenie bezpośrednich więzi pomiędzy nosicielami innowacji i producentami oraz zwrócenie większej uwagi na szkolenie odpowiedniego personelu.

Słowa kluczowe: innowacje technologiczne, zarządzanie techniczne, agroinżynieria