

Innovative Agricultural Technologies in Risk Management of Agricultural Producers

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Abstract: The paper deals with investigation of the features of farming industry operation under the conditions of the developing economy of knowledge. A special emphasis is made on the necessity to apply innovative agricultural technologies in agricultural sector. The factors impeding the development of innovative processes in agriculture were distinguished. Reasonability of application of special risk management tools for introduction of technological novelties to production was grounded. The content of the processes for innovation risks control at agricultural enterprises was determined. General and specific risks for agricultural innovations were described. It is suggested to use the target function, which allows development of efficient solutions to the risk situations, arising during implementation of innovative technologies. An assessment criterion for the cumulative risk degree was presented.

Key words: Agriculture • Risk • Management • Innovations • Technologies • Control • Agricultural technologies

INTRODUCTION

It is undisputable that consistent and dynamic development of the modern state is impossible without clear and precise understanding by the society the role and importance of agriculture as the main sphere of social labour and the main source of satisfaction of human needs, despite the fact that agriculture is one of the most risky sectors of national economy. An increased risk level is caused by the fact that agriculture is the field of activity, whose success is affected by various weather and climate conditions, which often could not be controlled by human [1]. Moreover, the farm producers meet such risks as price instability, change in crop capacity and inconsistency of state policy. Significant profits fluctuations from year to year are the results of these risks. At that, despite the products of agricultural sector are mainly the raw materials, standard and characterized by stable commercial demand, related to the constant requirements of other economy branches and constant food requirements of population, the main challenge met by the farm producers is ensuring the break-even activity.

The Main Part: Professional experience indicates that the ability to manage the risks activates the investment-innovation performance, which is immeasurably urgent and important for modern agriculture. This is caused by the fact that in comparison with other economy sectors an innovation lagging is observed in agriculture during the last fifteen years and as a sequence, we can see a decrease in competitiveness of agrarian enterprises, inhibition of high-tech processes development and commercialization as well as reduction in the quality of labour potential [2]. Therefore, to protect management subjects from the risks, improve their competitiveness and perform transition to the innovation development, the appropriate and reliable system of risk managing or risk management is required. Therefore, it becomes evident that the worthy position in the world society can be occupied only by the countries, ensuring their food safety on the basis of rational use of natural resources with consideration of environmental and resource-saving restrictions at fundamental theoretical and practical fitting of agricultural science. Thus, the countries are faced the challenge to find the innovative way for agriculture development,

introduction of innovations and scientific developments into the production process in dialectical unity with the efficient mechanisms of risk management.

Today, the problems of innovation development in agriculture are open to scientific research in various fields of science: economy, ecology, nature management, intellectual property, riskology and etc. Many scientists in different countries of the world deal with development of these problems. The published investigation results give the detailed information about the features of innovation control at agrarian enterprises with different range of goods. The practice of organization of innovation activity presented in scientific publications determines the guidelines for its improved implementation. However, in most mentioned papers the authors pay insufficient attention to the problems of risk minimization at production of agricultural goods by means of improvement of technical and technological logistics and introduction of innovative decisions.

Therefore, the above circumstances prove the urgency and theoretical and practical importance of this research and form the compositional platform and goal for the current publication.

This paper is aimed at consideration of the features of introduction and use of innovative agricultural technologies as well as investigation of qualities and control properties, typical for the given risk technologies accounting the characteristic features of agricultural production.

For the last years, the concept of balanced development (more famous as sustainable development) fortifies its positions and becomes widespread in the agricultural sector as the innovative strategy for long-term development. This concept is the general doctrine of a required balance between satisfaction of modern demands and protection of interests of future generations, including their requirement for safe and healthy environment [3]. Namely this theory of balanced development gave birth to a new type of innovations for agricultural enterprises, which can be called innovative agricultural technologies because of their essence. Among these technologies there are bio-intensive mini-farming, biodynamic farming, technology of efficient microorganisms, low-cost sustainable farming, organic farming, new plant varieties and hybrids, animal breeds, strains, models and modifications of agricultural machinery, technologies, chemical and biological preparations (vaccines), economical developments (documentary procedures, various recommendations, etc.) and many others [4].

However, most business owners do not hasten to introduce innovative agricultural technologies, appealing to the fact that the work on the principles of sustainable development and application of the latest innovations put them at a disadvantage in comparison with competitors. This is firstly caused by the fact that production on the principles of sustainable development oriented to innovative technologies requires new equipment and processes and the customers, in turn, can not pay more for the goods to reimburse expenses of agricultural producer. Secondly, the innovation process in agriculture in comparison with other sectors is characterized by the long terms of innovation development and testing, especially at introduction of selected plant varieties and animal breeds. Therefore, many managers interpret the balanced innovative development as the direction diverging with business-goals and having today an extremely high risk level [5].

But then, investigation of results on innovative technologies adoption in thirty large agricultural corporations in different countries has shown that innovations are unconditional engines of organization and technological development, which will finally compensate all expenses for development and adoption of new technologies. An additional profit is finally generated by production improvement, what allows enterprises increase the output volume, improve working conditions, create new factories, etc. [6]. In the given context the control of innovation risks in agriculture means a complex of practical actions formed on the basis of principles, methods and tools of managerial decisions with consideration of efficiency criteria, what allows a decrease in uncertainty of introduction of innovative agricultural technologies, improvement of implementation efficiency for innovative projects and reduced cost of goal achievement for innovation development.

On the basis of the obtained data, to avoid excessive dramatization and reveal the risks, which can be and should be controlled efficiently, let's free the thesis about the high risk level of innovative agricultural technologies from the excessive fur because it is impossible to control all the risks and identification of the key and regulated ones is the first task of risk management.

Actually, the conditions of agricultural business are complex, but the risks of economic and political character effect the development of all economy sectors. They have been already taken into account in the pay for commercial credits and in other financial tools used for development of parameters of investment projects. Usually, the risks of

production and technical character relate to subjective factors and the authors are unapt to consider that they are stronger in agriculture than in other economy sectors. As it is known, the reaction of agriculture to instability of weather conditions is especially sensitive; therefore, the existence of natural risks does not cause any discussions. However, we can firstly calculate the probability of losses caused by these risks and include them into the fund flow of the investment project. Secondly, the problem of harvest loss because of adverse weather conditions can be solved by means of insurance. Thirdly, dependence of technological efficiency of agricultural production on adverse weather conditions may be reduced with the help of innovative agricultural technologies. Moreover, fluctuations in the supply of their goods, which are the main factors determining the price dynamics these goods, cause certain apprehension of farming producers [7]. It should be noted that variations of purchasing prices for agricultural goods are sufficiently high. This circumstance effects the processes significantly. However, these problems arise for agricultural enterprises mostly in terms of the short-term perspective. According to the analysis of corresponding dynamic series, the periods of slow growth or even reduction of prices for some agricultural goods are replaced by its significant jump-like increase [8].

Thus, we come to the conclusion that introduction and use of innovative agricultural technologies are accompanied by specific risks caused by the uncertainty of market reaction to innovative products and by the risks related to purchasing of new equipment and application of new technologies. The source of such risks may be all stages of agricultural production, starting from purchasing the required production means (seeds, planting stock, fertilizers, agricultural chemicals, etc.) and finishing by the products output and their sale. It seems to be quite justified and well-reasoned that this is these risks that should fall under the action of mechanisms and tools of risk management.

The target function of risk control at innovative technology application is development and implementation of managerial decisions, directed to prevention or efficient solution to the risk situations arisen during implementation of innovative technologies, in other words: restoration of the initial state of innovation process and tendencies to its positive development in the ambient medium with minimally possible losses:

$$\begin{aligned} &\{x_1, x_2, \dots, x_p, \dots, x_n\} \therefore S(t-1) = S(t+1); \\ &\text{if } n \rightarrow \min \\ &F\{x_1, x_2, \dots, x_p, \dots, x_n\} \rightarrow \min \\ &P(S(t)) \rightarrow \min \end{aligned}$$

where $\{x_1, x_2, \dots, x_p, \dots, x_n\}$ - is totality of n actions relative to the solution to the risk situation, when the state of innovation process at time moment t does not correspond to the required (target) value;

$S(t-1); S(t+1)$ are the output [at time moment $(t-1)$] and restored [at time moment $(t+1)$] states of innovation process, respectively;

$F\{x_1, x_2, \dots, x_p, \dots, x_n\}$ is expenditure function for development and implementation of solutions for restoration of innovation process condition $[t-1; t+1]$; $P(S(t))$ indicates losses in the risk situation as deterioration of the state of agrarian enterprises or deceleration of the rates of its positive dynamics because of application of innovative agricultural technologies in comparison with the required (target) value at time moment t .

To implement this target function (by the analogy with the general cycle of management: planning, organization, regulation and control), we can distinguish the main functions of risk management (independently on their specific prevention, origins and consequences): identification and classification of risks; analysis and quantitative assessment of risks, development of risk management activities, monitoring of implementation of decisions or projects and implementation of tactic decisions on risk management.

The estimated parameters of risk on application of innovative agricultural technologies may be presented both in quantitative and qualitative forms. The quantitative approach is based on application of numerical estimates and indices, which can be used for the main mathematical operations. For instance, while estimating the risks at different stages of agricultural production, characterized by introduction of innovative technologies, to determine the total risk degree for every stage, the following formula can be used:

$$M_P^O = \sum_{t=1}^n M_P(t)$$

where M_P^O is total risk degree of the innovative agricultural technology;

$M_p(i)$ is risk degree of the i^{th} stage of agricultural production with implementation of innovative technologies.

CONCLUSION

Therefore, summarizing the results of research it is necessary to note that stable development and competitiveness of agriculture require introduction of the innovative model of sector development and corresponding innovative agricultural technologies. These are the undisputable thesis and target guidelines for any agricultural production. Introduction of novel technologies in the agrarian sphere will improve its performance. Simultaneously, the innovative model of development requires the appropriate mechanisms of risk control, i.e., scientifically grounded, flexible and well-equipped risk management. At that, while planning introduction of innovative agricultural technologies, it is not reasonable to focus the attention on the high risk degree of innovation processes. Risks, sufficiently high for all sectors of Russian economy, are included into the discounting coefficient. And specific risks can be controlled using both the standard and special tools. In this paper we have suggested the target function and generalized criterion of the total risk degree for the innovative agricultural technology, whose application will allow formation of the organization-economical mechanisms for the strategy and tactics of entrepreneurship at introduction of innovations into agricultural productions as well as a choice for the optimal approaches to risk overcoming and management of financial relationships.

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