УДК 332

В. Бабенко
Доктор экономических наук, профессор кафедры международной электронной коммерции
и гостиничного и ресторанного бизнеса, Харьковский национальный университет им. В. Н. Каразина,
vitalinababenko@karazin.ua, ORCID: http://orcid.org/0000-0002-4816-4579

ИССЛЕДОВАНИЕ ОЦЕНКИ РИСКА В СФЕРЕ АГРОПРОМЫШЛЕННОСТИ

В данной статье были рассмотрены теоретические и практические вопросы оценки влияния рисков, связанных с природно-климатическими условиями и погодной неопределенностью, на производство сельскохозяйственной продукции. Методы и модели оценки рисков были изучены на примере сельскохозяйственного производства.

Ключевые слова: оценка рисков, риски сельскохозяйственного производства, производство высокого риска, статистический метод, интегральный показатель.

Библиогр.: 10 назв.

V. Babenko
Doctor of Economics, Professor of International E-commerce and Hotel&Restaurant Business Department,
V. N. Karazin Kharkiv National University, e-mail: vitalinababenko@karazin.ua
ORCID: http://orcid.org/0000-0002-4816-4579

RESEARCH OF A RISK ASSESSMENT IN THE SPHERE OF AGROINDUSTRY

In this article were considered theoretical and practical issues of assessing the impact of risks connected with natural, climatic conditions and weather uncertainty on the production of agricultural products

The methods and models of risk assessment were studied using the example of agricultural production.

Key words: risk assessment, agricultural production`s risks, high-risk production, statistical method, integral indicator.

Ref.: 10 titles.

Formulation of the problem. The transformations that happened in the process of agrarian reform and economic freedom, given to the agrarian formations, brought to the market of agricultural products, apart from large and medium-sized companies, many small commodity producers, which are deeply exposed to unfavorable climatic conditions and weather uncertainty, that often lead to significant losses of production and property, direct losses that increase the probability of bankruptcy in comparison with enterprises of other economic sectors. This indicates that the level of natural risks in agricultural production is much higher than in other industries.

In this regard, there is a need to assess the impact of negative natural, climatic and weather factors on the magnitude of damage in order to provide preventive and repressive measures to minimize it, as well as assess the level of weather risks in forecasting the overall production of agricultural industry.

Analysis of recent research and publications. The works of Vitlinsky V.V., Granaturova V.M., Kardash V.A., Lomakina T.P., Zagotova V.A., Nakonechny S.G., Ustenko O.L., Utkina E.A., Khokhlova N.V., Chepurko V.V., Chupis A.V. [1—5] are devoted to the problems of estimating the agrarian risks and improving the management mechanism for them.

However, the issues of estimating the impact of natural, climatic and weather conditions on the results of agricultural production were not studied enough in their works.

An object of the work. The purpose of this article is to study methods and models of assessing the impact of natural risks (natural and climatic conditions, weather uncertainty) on the final results of agricultural production.

Statement of the main material. Agricultural production all over the world has always been and still concerns to the high-risk production. In Ukraine, due to the transformation into a market economy and a constant change of the economic environment, the risk of the shortfall of the expected result increases and it is often a common practice, that enterprises are not even able to return funds spent on the production, suffering direct losses. This is especially evident in the agrarian sphere.

Socio-economic changes happening in the process of implementing agrarian reform, providing enterprises with economic freedom, significantly increased the risk level of agricultural production. And in connection with its dependence on natural and climatic conditions and weather fluctuations, the risk level of this industry is much higher than in other sectors of the economy.

Nevertheless, in scientific researches devoted to the risk category, a very little attention is paid to agricultural production and very often the concept of "agrarian risks" is not used in a typical risk classification. Only some authors strip them from the general classification of risks and give a description of their specific characteristics [3; 6; 7].

By its characteristics, agrarian risks should be referred to the risk category, which poses threat of causing damage to agricultural formation, in consequence of the disruption of the normal course of the production process.

The main characteristics of agricultural risk are its branch belonging and object identification of its orientation — the process of agricultural production.

Whereas for industrial sectors the most serious malfunctions of the production process are connected with a failure of machinery and equipment, the peculiarity of the manifestation of agrarian risks lies in the fact of their changes in the processes of organogenesis (growth and development of plants) in a plant growing, which lead to a serious damage and loss of agricultural plants and, as a result, to the shortage of crops, diseases and death of animals in animal breeding.

Natural climatic conditions and weather fluctuations leading to the loss of production are the main sources of risks of agricultural output.

At the same time, their negative impact is manifested in all agricultural crops, although to different extents. This special factor limits the possibility of reducing the level of risk due to diversification of the main production. Therefore, it is necessary to find the affinity of the relationship and the influence degree of climatic conditions and weather fluctuations on the results of cultivation of various crops (reduction or loss of crops) in order to spread the possibilities of minimizing damage in case of agrarian risk’s realization of natural character.

Considering the wane in a crop growing as the damage or bruise of seeds and, as a result, as the shortage or deficiency of the crop, it should be taken into account that the fact of detecting the crop`s decline (for example, of winter crops) lags behind the fact of crop`s damage sometimes more than to 6—8 months, and the fact of the loss of the future crop (zero yield capacity) is established immediately after the detection of fact of the crop`s loss or harvest failure.

Beyond that, the crop`s loss occurs much more rare than their damage. Therefore, it is extremely important to distinguish two categories of damage, for the delimitation of possible measures to minimize the consequences of damage and loss of crops:

a) from a decrease in yield capacity, as a result of crop`s damage;

b) from the total loss of agricultural crops in the entire area of seeds.

Concurrently, the dangers that cause these damages must be differentiated.

The reduction of yield capacity, as a rule, occurs in adverse natural and climatic and weather conditions, which do not belong to the category of natural disasters.

This phenomenon very often depends on a combination of some deviations from the norm in quality factors, intensity and duration of precipitation, sudden temperature fluctuations in the winter-spring period, the number of sunny days and similar phenomena in the period of vegetation and wintering of agricultural crops.

At the same time, droughts, storms, hurricanes, floods, severe frosts and etc. in most cases have as a consequence a complete loss of agricultural crops throughout the crop`s area. The differentiation of natural phenomena with a glance to their influence on the future crop exists in agricultural agrometeorology, but its criteria are not still adapted for using in natural risk management [6].

In this direction, additional scientific researchers at the intersectorial level are needed much. In consequence of these studies, it is possible to set up differential scales of meteorological changes which could be considered not only as forms of assessments of natural and climatic and weather conditions, but also as danger risks which cause a certain type of damage (bruise or total loss of seeds of agricultural plants) for the next using in the natural risks' management and for estimating their level in forecasting the output volumes of agricultural production.

Taking into account that the natural risks' management of agricultural units is carried out in conditions of insufficient information about the possible future consequences of taken decisions, it is very likely that many aspects of these decisions may be unsatisfactory.

Therefore, after gathering all the necessary information about the existing natural risks of the agrarian formation, there comes such a stage of analysis as a risk assessment, which is aimed to determine its quantitative characteristics: the probability of adverse event`s occurrence and the possible amount of loss.

The most spread methods of quantitative analysis today are methods of multidimensional statistical of data processing.

The statistical method is used in those cases when the agricultural enterprise has a significant volume of analytical and statistical information on the necessary elements of the analyzed system for n periods of time. The degree of a risk is presented by the probability of the occurrence of losses (probability of a risk realization), as well as it is presented by the amount of possible damage from it and is expressed in terms of the standard deviation from the expected values.

The essence of the statistical method is based on the probability theory of the distribution of random values. That is why, for the calculation of the degree of a certain type of risk, it is necessary to know the law of its distribution, i.e. information on the following: a) under what conditions it can be realized, b) how its realization will be reflected in the activities of the business unit.

The mathematical expectation of this reflection is determined from the formula:

$$\bar{X} = \sum_{i=1}^{n} X_i P_i \, ;$$

where X_i is the value of a random variable;

P_i a probability of appearance of a random variable;

n is the total number of events.

But the mathematical expectation is not yet a complete characteristic of a random variable, so it is advisable to use a dispersion that is determined from the formula:

$$\sigma^2 = \sum_{i=1}^{n} (X_i - \bar{X})^2 P_i \ .$$

The variable with the help of which the distance (deflection) of the possible values of random variables from its average value can be estimated is called the mean-square departure:

$$\sigma = \sqrt{\sigma^2} = \sqrt{\sum_{i=1}^{n} (Xi - \bar{X})^2 P_i}$$

The value of the mean-square departure does not give a possibility to compare the risk of directed activity and specific situations by the signs, which are expressed in different units of measurement. The risk theory solves this contradiction by introducing a coefficient of variation. It is presented by the ratio of the mean-square departure to the arithmetical average and shows the degree of deflection of the obtained values:

$$V = \sigma / \bar{X} \cdot 100\%$$

The higher the ratio, the greater the variability is: up to 10% — weak variability; 10—25% moderate; over 25% — high variability. But agricultural statistics, which could give a representation of the quantitative parameters of the loss of seeds, excluded this category from the its study area [3].

The method of analyzing the costs and benefits is based on the fact that in the process of agricultural formation, the costs for each specific direction, as well as for individual elements, have a different risk degree, the definition of which is oriented towards the identification of potential risk areas.

The condition for each of the cost elements is divided into risk areas representing the zone of common losses, within the boundaries of which the specific losses do not exceed the limit value of the established level of risk: the area of absolute stability; area of normal stability; area of unstable state; area of critical state; area of recessionary state.

The advantage of this method lies in the fact that knowing the cost item, which has the maximum risk, it is possible to find ways of its reduction. The disadvantage of this method (the statistical method has the similar one) is presented by the occurrence that the enterprise does not analyze the origins of the risk, but takes the risk as an integral value and, in such way, its multi-components are ignored.

The experimental method of risk assessment is used in case of the absence of statistical data which are necessary for the risk estimation with the help of using statistical or other formalized methods.

One of the most important components of this method is the formulation of inquiry forms containing a list of points that allow us to estimate the degree of risk and, consequently, to achieve the goal. The drawbacks of the method lie in the lack of assurance of the validity of derived estimates, as well as in difficulties of conducting a survey of experts and processing the data.

The following stages are typical for the analytical method`s application:

– preparation for analytical processing of information;

– comparison of the dependence diagrams of the selected resultant indicators on the size of the initial parameters for the emphasizing the main indicators that have the greatest impact on this type of enterprise activity;

– determination of critical values of key parameters;

– analysis of possible ways of efficiency increase and stability of the enterprise performance, and therefore, analysis of ways of the reduction of the risk degree, which is determined by one of the above mentioned methods. The advantage of the method is that it combines both the possibility of a factor analysis of parameters that affect risk, and the identification of possible ways to reduce its degree by influencing them [7].

To increase the effectiveness of management decisions taken in conditions of natural risk and weather uncertainty, it is very important to use scientifically based economic and mathematical methods and models. Therefore, to solve a wider range of economic problems, along with methods of mathematical programming in which extrema of functions are determined, V.V. Chepurko and M.D. Chepurko [8] consider studying and using of so-called optimal minimax and maximin solutions to be an expedient variant of work.

With account of this fact, these scientists propose the usage of the applicable theory of games, which is represented by a comparatively new section of the optimization approach, which will help us to solve decision-making problems in conditions of natural risk and weather uncertainty.

Economic and mathematical modeling based on a linear programming deserves attention.

Down to recent times, most authors in models of this type devoted to the optimization of individual industries or the structure of agricultural production, considering a variety of factors, at the same time, did not pay enough attention to the influence of one of the main factors of agricultural production — natural and climatic conditions and weather fluctuations.

The authors, who took into account this important factor and all its components, used the simplex method of linear programming to solve problems [1; 8].

Unfortunately, in our opinion, it is necessary to specify the list of natural factors that affect the fluctuation of agricultural crops. In the course of the research, we identified seven factors: the amount of precipitation during the vegetation period, the sum of the active temperatures, the climate scores (or the hydrothermal coefficient), the land bonuses (scores), the absolute minimum of temperatures, the absolute maximum of temperatures; the duration of the frost-free period.

Each of these given factors individually, characterizing some of the planes of variation, does not fully disclose the degree of impact on crop yield fluctuations. That is why we consider that more in-depth study of the influence of all factors in conjunction is needed. In our opinion, this influence is reflected in the best way by the integral index calculated as the geometric mean of seven values [8]:

$$K_u = \sqrt[7]{K_1 \cdot K_2 \cdot K_3 \cdot K_4 \cdot K_5 \cdot K_6 \cdot K_7}\ ,$$

where K_1 is the coefficient of a relative mean linear deviation of the dynamic yield series,

K_2 is the coefficient of variability,

K_3 is the minimum deviation from the trend,

K_4 is the relative average deviation from the calculated simplex yield trend,

K_5 is the coefficient characterizing the type of instability of the dynamic yield series,

K_6 is the coefficient of average negative variability,

K_7 is the coefficient of the average maximum negative variability of the dynamic yield series.

Moreover, such a relationship between the behavior of each of the factors and the fluctuation of yield capacity should be determined separately for each crop or a group of crops, because the listed factors in certain years can affect the crops downwards while others may, on the contrary, increase them.

Conclusions. Effective risk assessment includes, first of all, the prevision and forecasting of possible difficulties and planning of activities aimed at preventing and minimizing adverse consequences, but not created for the delaying response to adverse events.

When analyzing or predicting the loss and damage of agricultural crops, such sources of danger should be distinguished: a) natural and climatic disasters; b) usual unfavorable natural conditions caused by a combination of separate deviations of meteorological indicators from their normal values — because these groups of danger have fundamental differences upon indications of occurrence frequency.

For problem solving of a wide range of economic problems, along with determinate models of mathematical programming, it is advisable to study and use the tasks of stochastic programming which deal with probabilistic values (tasks of *M*, *D*, *P*-type).

On top of that, it makes sense to use the methods of game theory, which allow to consider "games with nature", logical-and-probabilistic neural network models taking into account risks, including natural ones.

References

1. *Гранатуров, В. М.* Экономический риск: сущность, методы измерения, пути снижения : учеб. пособие / В. М. Гранатуров. — М. : Дело и сервис, 1999. — 112 с.

2. *Бабенко, В. А.* Теоретические аспекты и методические подходы к оценке влияния природных рисков на производство сельскохозяйственной продукции / В. А. Бабенко // Зб. наук. праць Тавр. Держ. агротехнол. ун-ту (економічні науки). — 2010. — № 3 (11). — С. 62—69.

3. *Ломакиева, Т. П.* Риск сельскохозяйственного производства в системе риск-менеджмент / Т.П. Ломакиева // Управление риском. — 2002. — №1. — С. 54—58.

4. *Babenko, V.* The task of minimax adaptive management of innovative processes at an enterprise with risk assessment / V. Babenko, E. Alisejko, Z. Kochuyeva // Innovative technologies and scientific solutions for industries. — 2017. — No. 1 (1). — P. 6—13.

5. *Хохлов, Н. В.* Управление риском : учеб. пособие для ВУЗов / Н.В. Хохлов. — М. : ЮНИТИ-ДАНА, 2001. — 239 с.

6. *Заготов, В. А.* Теоретико-методические аспекты управления аграрным риском / В.А. Заготов // Вісник ХНАУ, сер. «Економіка АПК і природокористування». — 2007. — № 5. — С. 156—160.

7. *Кардаш, В. А.* Экономика оптимального погодного риска в АПК (теория и методы) / В.А. Кардаш. — М. : Агропромиздат, 1989. — 162 с.

8. *Babenko, V.* Research into the process of multi-level management of enterprise production activities with taking risks into consideration / V. Babenko, N. Chebanova, N. Ryzhikova, S. Rudenko, N. Birchenko // Eastern-European Journal of Enterprise Technologies. — 2018. — Vol 1, No 3 (91). — P. 4—13. DOI: 10.15587/1729-4061.2018.123461.

9. *Наконечний, С. І.* Оптимізація виробництва в умовах погодної невизначності / С. І. Наконечний, С. С. Савіна // Економіка АПК. — 1998. — № 3. — С. 1—24.

10. *Чепурко, В. В.* Математическое моделирование природно-климатической составляющей риска аграрного производства / В. В. Чепурко, М. Д. Чепурко // Наук. праці Півден. філіалу Крим. агротехнол. ун-ту НАУ, сер. Економічні науки. — 2007. — Вип. 103. — С. 19—26.