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NEW APPROACH TO RISK ASSESSMENT OF CERTAIN AGRICULTURAL PRODUCTS

Purpose. *The main purpose of the research is to substantiate a new approach to assessing the risk of production and sales of certain types of the agricultural products.*

Methodology / approach. *The abstract-and-logical method (systematization of publications on risk assessment of the risk level); the economic and statistical one (determination of root-mean-square deviation (δ), the coefficient of variation (v), and the coefficient of residual variation); the marginal analysis (determination of the break-even level of production of certain types of the products) have been used.*

Results. *The methodological approach that allows determining the risk level of certain types of the products has been developed and it has been proposed to determine not only with the help of the break-even point, but also to supplement the following indicators – determining the reserve of safety and the reserve of financial strength. It is proved that similar obtained assessments of the certain product type production risk level using the analysis of variation indices can be reached by examining the break-even point indices, financial safety margin and the margin of safety. Research results show that unlike variation indices, the break-even point index, the financial safety margin index and the margin of safety index show the maximum amount of possible net income reduction.*

Originality / scientific novelty. *The methodical approach to the assessment of the risk level of agricultural production at the given level of profitability, which is based on the comparison of the levels of production intensity of certain types of the products, that ensures their break-even point, has been substantiated.*

Practical value. *The application of the proposed methodological approach allows the managers to determine how much to reduce the amount of the net income or the level of production intensity, but not to fall into the zone of loss.*

Key words: *agriculture, profit, margin analysis, risks, break-even point.*

Introduction and review of literature. The entrepreneurial risks are an integral part of any business. First of all, the skilled assessment methods of their level are required to efficiently manage industrial and financial risks in the area of agricultural business.

The analysis of literature in the field of agricultural risk (Barry, 1984; Gomez-Limon et al., 2003; Hardaker et al., 2004; Nitsenko and Rudenko, 2017; Harwood et al., 1999; Johnson, 2008) shows that it is difficult to evaluate and manage risks in agriculture. Agricultural enterprises have to cope with large numbers of uncertainties. Most authors, among whom Baquet, Hambleton and Jose (1997), Cather (2010), Dimitrakopoulos, Kavussanos and Spyrou (2010) expected there are five distinct risk factors in agriculture: production risk, marketing risk, credit risk, personal risk, and

environmental risk. Whereas Hardaker et al. (2004) expands this list with business risks. Thus, each of these risks plays a role in the decision-making process of the owner, and therefore it is extremely important to properly assess and neutralize the risks in agriculture.

Relevance of problematic issues of identification substantiation of the system of minimization and neutralization of risks by business entities individual crops in crop production is confirmed by close attention domestic scientists to identify threats and potential opportunities for sustainable development (Isik and Khanna, 2003; Bilan et al., 2017; Just, 2003; Kravchenko et al., 2020). Some authors (Knight, 2002; Su et al., 2011; Cather, 2010) argue that the level of economic risk may differ among farm types due to differences in the continuity of production and the frequency of related market operations for each type, inherent price instability, the impact of government programs, differences in production variability and other related factors. Production risk in agriculture can also be traced among farmers seeking to increase their income through strategies for cultivating crops with greater risk and high returns (Hardaker et al., 2004; Nitsenko et al., 2017).

Adams (2008) introduced a generalized definition of the economic category risk, which is investigated by the inexhaustible uncertainty of the relationship between the reality of the economic system and the possibility of its transformation in some future reality. In the scientific works he develops quantitative identification, valuation and hedging tools economic risks of agro-industrial enterprises.

The main issues of the economic risk assessment theory and practice are stated in the works of such scientists as Dubrova (2006), Nitsenko et al. (2019), Kleiner (2007), Lapusta and Sharshukova (2008), Khristianovskiy and Lakhtionova (2007) and etc.

The scientists such as Blank (2005), Picus (2010), Nitsenko et al. (2018), Pisarevskiy and Steshenko (2008), Kirieieva et al. (2019), Klimenko and Dubrova (2005) and others paid great attention to the issue of the methodological tools in the risk level assessment. However, in spite of a large number of papers dealing with the study of risks, the level of prior studies of the risk assessment problem regarding a certain product type or a specific industry is not satisfactory and requires further research.

The purpose of the article. The main purpose of the research is to substantiate a new approach to assessing the risk of production and sales of certain types of the agricultural products.

Methodology and research methods. The abstract-and-logical method (systematization of publications on risk assessment of the risk level); the economic and statistical one (determination of root-mean-square deviation (δ), the coefficient of variation (v), and the coefficient of residual variation); the marginal analysis (determination of the break-even level of production of certain types of the products) have been used.

Results and discussion. The quantitative risk rating system includes absolute and relative values (Dubrova, 2006; Ostapenko et al., 2020; Ma, 2020; Sakhno et al., 2019). The risk can be determined in absolute terms by the possible risk cost in

material (physical) or value (monetary) terms.

There is the following system of risk measurement absolute values: absolute risk cost value (absolute level of losses), mathematical expectation, variance, semi-variance (half variance), seven-squared error and standard deviation (Tarasova, 2011).

The standard deviation shows how much on average the specific values of the feature deviate from their mean value. The standard deviation shows what variations the studied value has in the average for each strategy due to uncertainty and conflict of conditions. The standard deviation-based risk assessment approach is considered as a classical one. Moreover, the greater the value shall be, the greater the degree of risk shall be that is associated with a particular strategy, that is, the risk value.

The scientist Pikus (2010) holds the same opinion by stating that one of the most common classification methods of quantitative risk rating is statistical. The main tools in the statistical method are as follows: the average expected value of a random variable (X aver); variance (δ_2); standard deviation (δ); variation factor (v); probability distribution of the studied random variable (Dao and Peduzzi, 2004).

The academician Blank (2005) distinguishes economic and statistical methods as a basis for financial risk level assessment. Within this method, the following relative and absolute indices can be calculated:

a) level of financial risk. It is characterized by the general assessment algorithm for this level set forth by the following formula:

$$RR = RP \cdot AL, \quad (1)$$

where *RR* – level of certain financial risk;

RP – probability of occurrence of the given financial risk (it is expressed as one of the measurement factors of this probability (variation factor, beta coefficient, etc.);

AL – amount of possible financial losses in realization of this risk in terms of value.

b) variance – characterizes the ratio between the degree of fluctuation in the expected revenue due to the studied financial transaction and its average value. The variance is calculated using the formula:

$$\delta^2 = \sum_{i=1}^{n} (R_i - \bar{R})^2 P_i, \quad (2)$$

where δ^2– variance;

R_i – certain value of the possible expected revenue variation for a given financial transaction;

$\bar{R}$ – average expected revenue for a given financial transaction;

P_i – possible frequency (probability) of gaining particular expected revenue variations for a financial transaction;

n – number of observations.

c) average (standard) deviation – as variance determines the degree of fluctuation of individual financial risk and it is calculated using the formula:

$$\delta = \sqrt{\sum_{i=1}^{n} (R_i - \bar{R})^2 P_i} \quad , \quad (3)$$

d) coefficient of variation – makes it possible to determine the risk level if the indices of the average expected revenue due to the financial transactions differ from each other. The index is calculated using the formula:

$$CV = \frac{\delta}{\bar{R}}, \quad (4)$$

where *CV* – coefficient of variation;

δ – average (standard) deviation;

$\bar{R}$ – average expected revenue value for a given financial operation.

e) beta coefficient (or beta) – commonly used to assess the investment risks in certain securities; makes it possible to assess the ratio between the individual or portfolio systematic financial risk and the level of financial market risk as a whole. This index is calculated using the formula:

$$\beta = \frac{K\delta_i}{\delta_m}, \quad (5)$$

where β – beta coefficient;

K – correlation degree between the profitability level of an individual type of securities (or according to their portfolio) and the average profitability level of a given group of stock instruments on the market as a whole;

δ_i – average (standard) profitability deviation due to an individual type of securities (or according to their portfolio as a whole);

δ_m – average (standard) profitability deviation on the stock market as a whole.

The most common statistical risk level assessment method is the use of variation indices, in particular the coefficient of variation and the related standard deviation of the studied value.

The total assessment of production risk level and sales of certain products based on the used coefficient of variation comes out of the very essence of this index. The higher the value of the coefficient of variation is, the greater the fluctuations of the studied economic index are due to the influence of a set of objective and subjective factors, and consequently the greater the production and certain product marketing risk is. And conversely, a low coefficient of variation value or even its zero value should indicate a low risk level or no risk at all.

Pisarevskiy and Steshenko (2008) holds the same point of view stating that the greater the spread of values in the variation index is, the riskier the project is. The scientist has established the following qualitative assessment of different coefficients of variation: up to 10 % – weak fluctuations; from 10 % to 25 % – moderate fluctuations; more than 25% – high fluctuations. Therefore, the starting point is that the higher the variation is, the higher the risk level is.

The practical use of the coefficient of variation to assess the production and certain agricultural products marketing risk requires to solve the preliminary issue regarding the criteria choice or their system which variation is subject to be studied. Moreover, it is required to be aware of the fact that different indices will reveal different variation levels which will require to determine the criterion that will be used to determine the certain product type production risk level.

As the main purpose of any business is to get the profit under the Economic Code of Ukraine, it is quite natural to adopt this index. First of all, its variation will characterize how risky this or that product type is. However, the following factor should be kept in mind that the earned profit amount due to the production and sales of a certain type of agricultural product is practically and functionally related to the planting acreage of the respective crop in vegetation or livestock inventory which in their turn represent the result of appropriate management decisions. When studying the profit variation level and certain product type marketing it is reasonable to level up the impact of this factor and to formulate the economic series based on the weighted indices: in particular, the amount of profit per planting acreage unit of a certain crop or a forage acre requirement.

The variation index in agricultural yields and animal productivity is important in conjunction with the profitability index of certain agricultural products. However, the mentioned natural indices characterize the technological production efficiency of certain product types and are subordinate or factorial in regard to the profitability indices formation and variation.

Yield and profit variation indices due to the sales of basic agricultural products in the Kharkiv region within the period from 2010 to 2017 will be determined using the Table 1.

Table 1

Yield and profit variation indices based on sales of main types of agricultural products in agricultural enterprises of Kharkiv region within the period from 2010 to 2017

Agricultural product types	*Average yield (productivity)	Average profit (+), loss (-), UAH/ha (UAH/capita)	Standard yield (productivity) deviation, dt/ha	Coefficient of yield (productivity) variation, %	Standard profit deviation UAH/ha (UAH/capita)	Coefficient of profit variation, %
Winter wheat	38.2	1476.44	9.1	23.8	1174.9	79.6
Barley	25.92	478.66	5.5	21.4	480.0	100.3
Corn for grain	48.4	1330.0	11.9	24.6	1978.0	148.7
Sunflower	25.8	4697.9	3.6	13.8	3334.3	71.0
Cattle growth for meat	471.9	-1789.7	28.4	6.0	670.9	-37.5
Milk	5613.7	3260.5	813.1	14.5	1705.0	52.3
Pig growth for meat	409.8	-34.8	65.6	16.0	373.8	-1074.8

Note. *****Agricultural yield – dt/ha, cattle or pig growth for meat – capita/day; milk – kg.
Source: made by the author based on enterprise statistical reporting.

The data in Table 1 show that the coefficient of agricultural yield and livestock productivity variation range from 6.0 % in cattle increase for meat to 24.6 % in corn for grain in Kharkiv region over the researched period. The sunflower has the lowest index of the coefficient of variation among the crop production.

When interpreting the obtained data of agricultural yield and livestock productivity variation, it requires to take into account the fact that there was an increase in agricultural yields and livestock productivity over the researched period due to the introduced new technologies and other innovations, which on the one hand should be considered as a positive action, though on the other hand it should be kept in mind that any increase in economic indices causes an increase in the variation index determined in a traditional way that as if should indicate an increased certain product type risk level. It is quite obvious that these differences are subject to be resolved.

When the coefficients of profit variation due to sales of main agricultural products (Table 1) are put under analysis it is necessary to pay attention to some fundamental points. Firstly, the coefficient index of profit variation significantly exceeds the coefficients of agricultural yield and livestock productivity variation. It is due to the fact that certain crops and livestock productivity variation is only one of the factors for income fluctuations, and moreover, they depend on a large set of other factors. Secondly, the attention is paid to the fact that the coefficient data of profit variation in certain products (barley, corn for grain, pig increase for meat) exceeds 100 %. It can occur only if the researched dynamic series had one or more negative observations. Alternatively stated, some years faced losses for the indicated types of products. For example, barley production was unprofitable in 2010 and 2013, corn in grain faced losses in 2013. Thirdly, the attention is paid to the negative index of the coefficient of cattle increase for meat and pig increase for meat profit variation. It is due to the fact that the beef production has been unprofitable from year to year, and the pork production was unprofitable from 2010 to 2012, as a result the average financial result index used to calculate the coefficient of variation is consequently negative. Fourthly, the nominal factors dynamics in production profitability of certain types of agricultural products is characterized by even faster growth within the researched period in comparison with the agricultural yield and livestock productivity indices that have much more significantly increased the coefficients of variation data.

The study of the financial results dynamic range based on sales has proved that the profit growth rate based on sales of sunflower is 833.44 UAH ha, of winter wheat is 318.32 UAH/ha, the cattle increase for meat is 231.02 UAH/capita.

Instead, the researched dynamic yield (productivity) range indicates a lower yield (productivity) growth rate as compared to the increase in profit (loss). As a result, the winter wheat productivity growth rate is 1.42 dt/ha, of sunflower is 1.37 dt/ha, of cattle for meat is 11.4 dt/capita.

Therefore, the indices growth rates selected to characterize their production risk levels are quite significant causing a significant misrepresentation of the findings.

To eliminate the detected defect, the residual variation coefficient which levels out the trend influence of the researched index and shows how the researched index level deviates from the trend line is proposed to be used for the statistical characteristics of certain agricultural product type production risk levels. To establish the trend, a linear graph of the dependence of yield and income on time has been

constructed and a linear function has been obtained.

The indices of residual yield and profit variation based on sales of main agricultural products in Kharkiv region within the period from 2010 to 2017 will be determined using the Table 2.

Table 2

Residual yield and profit variation indices based on sales of main agricultural product types in agricultural enterprises of Kharkiv region within the period from 2010 to 2017

Agricultural product types	*Average yield (productivity)	Average profit, UAH/ha (UAH/capita)	Standard yield (productivity) deviation, dt/ha	Coefficient of residual yield (productivity) variation, %	Standard profit deviation UAH/ha (UAH/capita)	Coefficient of residual profit variation, %
Winter wheat	38.2	1476.4	5.7	15.0	400.8	27.1
Barley	25.92	478.7	3.9	14.9	322.1	67.3
Corn for grain	48.4	1330.0	8.8	18.1	1367.2	102.8
Sunflower	25.8	4697.9	2.4	9.4	2259.1	48.1
Cattle growth for meat	471.9	-1789.7	16.9	3.6	238.1	-13.3
Milk	5613.7	3260.5	187.1	3.3	929.8	28.5
Pig growth for meat	409.8	-34.8	35.0	8.5	245.3	-705.1

Note. *****Agricultural yield – dt/ha, cattle or pig growth for meat – capita/day; milk – kg.
Source: made by the author based on enterprise statistical reporting.

Having analyzed the data in the Table 2 it's possible to conclude that the variation indices have decreased significantly once the trends in agricultural yields, livestock productivity and analyzed product types production profitability have been leveled out. In absolute terms, the lowest index of residual variation coefficient was reached due to the financial result dynamics based on sales of cattle for meat. But it does not mean that this industry is the least risky. On the contrary, it is almost guaranteed that beef production is going to be unprofitable judging upon the established patterns. It prevents this industry from achieving the main business objective (that is to get the profit), and therefore it leads to a permanent decline in this industry.

The lowest index of the residual variation coefficient has winter wheat with 27.1 % and sunflower with 48.1 % among other listed crop products. This is one of the main reasons why the production volumes and these crops acreage keep increasing each and every year. Milk production in agricultural enterprises of Kharkiv region with 28.5 % gives even lower index of the residual profit variation coefficient. Though, milk production in the agricultural enterprises of the region tends to be cut down unlike winter wheat and sunflower, if milk production reached 2236254 dt per capita of 36.0 thousand livestock in 2014, then the production got cut

down to 2138828 dt per capita of 34.8 thousand livestock by 2016. It is caused by a number of circumstances. Firstly, milk production profitability is much lower than sunflower production. Secondly, dairy farming requires a high capital-output ratio (it requires lots of investments to start profitable milk production). Thirdly, the production cycle lasts longer in dairy farming requires than in most crop industries.

It is required to state their main disadvantages when summarizing the approbation of the methodological approach to the assessment of certain agricultural product type production and marketing risk level based on the variation indices of profit-and-loss indices. Firstly, the reporting data over an expanded time-being are required to be used to calculate variation indices of economic indices. What's the factor that can change the formation of efficient indices significantly? For example, the implemented state regulation of agricultural markets through commodity and financial interventions can significantly affect certain product type profitability variation. Secondly, the calculated index of the coefficient of variation, including the residual one, characterizes the average deviation level of the researched index from its average value or the trend line, but does not answer the question whether the certain product type production will keep being profitable if all the risk events occur that happened within the analyzed period. Thirdly, the coefficients of variation do not answer the question regarding the possible drop in production volumes, lower sales prices or an increase in the cost of a product that will lead to the breaking (overcoming) of a break-even point.

Margin analysis can help to find answers to these questions to a certain extent. It makes it possible to determine the ratio between product price, production (sales) volume and unit cost (Pronko et al., 2020). It is possible to determine the break-even margin using margin analysis, that is, to determine such the production and sales volume with which the company will receive neither profit nor loss, and the break-even level will be zero. Moreover, margin analysis makes it possible to determine a number of other indices, in particular, the financial safety margin, the reliability margin which are of crucial importance in taking managerial decisions whether it's worth developing the production of this or that product type.

Therefore, the idea emerged to use indices that are calculated within the margin analysis to characterize certain product type risk level. The first stage is characterized by a suggestion that the least risky products are the ones with the lowest break-even point. And in our opinion, this approach has the right to be used when comparing different agricultural product type risk levels, as it is problematic to apply the break-even volume index as far as this production volume is stated in different range units.

The possible use of both the average annual data for several previous periods and for the last year that is the most approximate to the planned (projected, future) period may be considered as the advantage of using margin analysis indices to characterize the certain agricultural product type risk level.

The margin analysis method, unlike others, makes it possible to determine a number of indices that are of crucial importance in managerial decision-making process. The determined margin of safety makes it possible to analyze how much the

sales can be cut down while avoiding production losses. The determined cash breakeven point shows the amount of sales that is required to cover expenses. The assessed options of managerial decisions lead to the best possible profit-oriented choice.

Determining the break-even point by the method of the equations is carried out by the formula:

$$Q_{\text{break-even}} = \frac{FC}{MI} = \frac{FC}{P-VC}, \quad (6)$$

where $Q_{\text{break-even}}$ – break-even volume of production (sales), cwt;

FC – fixed costs for the entire volume of production, UAH;

MI – marginal income per unit of the product, UAH;

P – sales price of a unit of the product, UAH;

VC – variable costs per unit of the product, UAH.

The break-even point in monetary terms is determined by the following formula:

$$BP = \frac{FC}{MIC}, \quad (7)$$

where *BP* – break-even point, UAH;

MIC – marginal income coefficient.

Another hypothesis in the undertaken research was the attempt to use the financial safety margin index to characterize the production risk level and marketing of certain agricultural product types. The financial safety margin is found out as the difference between the actual amount of income based on sales of a certain product type and its estimated value which provides a break-even financial result. Despite the fact that the financial safety margin for any product type is determined in currency units, these indices cannot still be compared. There are two reasons for it. Firstly, it is reasonable to calculate the financial safety margin per 1 ha of acreage and as for livestock production it's required to calculate per capita to assess the crop production and sales risk level. Secondly, different branches of agricultural production vary significantly in their possibility to intensify the production process, as a result the amounts of revenue can differ dramatically that can be obtained per one hectare of different planted crops or per livestock capita. For example, the average cost of winter wheat sowing per 1 ha was 9812.9 UAH/ha, and the revenue from sales was 14364.3 UAH/ha per 1 ha are, the sunflower production cost reached 12213.6 UAH/ha while the revenue was 20024.3 UAH/ha.

On the basis thereof, the financial safety margin calculated per hectare of particular crop acreage or capita of a particular livestock can only be used to compare the same product type production and marketing risk level in different farms or regions.

Relative indices are often used in economic science and practice when it is impossible to compare absolute or cost indices. In particular, the margin of safety represents such a relative index in the margin analysis, it is measured in percentage.

The margin of safety (assurance) is defined in percentage and characterizes the number of percentages that an enterprise can withstand if the sales volume is cut down before it reaches a break-even point. The margin of safety is calculated using

the formula:

$$MS = \frac{V - Tb}{V} * 100\% = \frac{SA}{V} * 100\%, \quad (8)$$

where *MS* – margin of safety, %;

V – achieved volume of sales;

Tb – volume of sales that provides a break-even level of production;

SA – safety area (possible cut down in the volume of sales which will ensure a break-even level).

Let's consider break-even indices, the financial safety margin and the safety area using the main product types produced by agricultural enterprises in Kharkiv region in 2010–2017.

Table 3

Financial safety margin and margin of safety determined with regard to main product types in agricultural enterprises of Kharkiv region from 2010 to 2017

Product type	Break-even point of production volume (per 1 ha/1 capita, dt)	Production costs that ensure the break-even point (per 1 ha/1 capita, UAH)	Financial safety margin, UAH	Margin of safety, %
Winter wheat	14.9	3109.3	4183.9	61.1
Barley	14.7	2548.7	963.4	43.4
Corn for grain	19.7	3605.9	3725.8	59.3
Sunflower	4.9	2421.8	9752.5	80.9
Milk	9.0	3478.9	16718.8	84.0
Pig growth for meat	1.8	3659.5	-849.8	-

Source: made by the author based on enterprise statistical reporting.

First of all, the attention is paid to the fact that there is no financial safety margin and reliability and margin of safety in the pig production for meat. It is caused by the fact that the production of this type of products was unprofitable within the researched period, and therefore the riskiest. It fully corresponds to the draw conclusions based on the study of coefficients of variation and residual variation.

The sunflower (80.9 %) has the highest index of margin of safety among the crop production and the milk (84.0 %) has it among the livestock production. Therefore, these products in agricultural enterprises of Kharkiv region are the least risky for production. This conclusion also completely coincides with the conclusion obtained due to the analyzed variation indices.

The lowest margin of safety and, accordingly, the highest risk level among crop production were detected in the production of barley and corn for grain.

The researched break-even levels of livestock production make it possible to draw the following conclusions: the production of cattle growth for meat was unprofitable throughout the researched period, variable unit costs were higher than the selling price as a result it is impossible to determine the break-even point.

Consequently, the margin of safety indices as well as the variation indices can be used to characterize and compare the different product type production risk level. Though, unlike the variation index, the break-even point indices, the financial safety

margin indices and the margin of safety are more informative for financial and operational management. As a result, the financial safety margin shows the maximum amount of possible net income reduction to financial managers, but without getting into the production loss area. Using the break-even point indices and the margin of safety indices operational managers can come to a conclusion regarding a possible cut down in the production intensification level of a certain product type which will not cause to get into the loss area.

Conclusions. The variation indices are among the statistical assessment methods of the production risk level and marketing of certain agricultural product types. The approved coefficient of variation to assess the main product type production risk level in agricultural enterprises of Kharkiv region showed that it is deficient due to the fact that its index depends on the growth trends of economic indices among other factors. And the higher the growth rate is, the higher the variation rate is. The residual variation coefficient of economic indices has no defect of this kind it levels out the trends influence towards their growth. Therewith, the variation index is little informative for financial and operational management.

The course of research made it possible to prove that similar obtained assessments of the certain product type production risk level using the analysis of variation indices can be reached by examining the break-even point indices, financial safety margin and the margin of safety.

Unlike variation indices, the break-even point index, the financial safety margin index and the margin of safety index show the maximum amount of possible net income reduction or the intensified production level cut down to financial managers but without getting into the loss area.

It is reasonable to concentrate the further studies on a large appraisal of break-even point indices, financial safety margin indices and margin of safety indices to assess the production risk level of different agricultural product types produced by different manufacturers and to justify the acceptable risk levels.

References

1. Adams, K. F. (2008), Risk perceptio and Bayesian analysis of international contruction contract risks: The case of payment delays in a developing economy. *International Journal of Project Management*, vol. 26, is. 2, pp. 31–38. https://doi.org/10.1016/j.ijproman.2007.05.007.

2. Baquet, A., Hambleton, R. and Jose, D. (1997), Introduction to risk management,1st ed., USDA Risk Management Agency, Washington, USA.

3. Barry, P. J. ed. (1984), Risk Management in Agriculture, Iowa State University Press, Iowa, USA.

4. Bilan, Yu. V., Nitsenko, V. S. and Samoilyk, Iu. V. (2017), Conceptual modeling of agri-food market development under economy's globalization. *Scientific bulletin of Polissia*, vol. 3, no. 11, part 1, pp. 54–61. https://doi.org/10.25140/2410-9576-2017-1-3(11)-54-61.

5. Blank, I. A. (2005), Financial risk management, Nika-Centre, Kyiv, Ukraine.

6. Cather, D. A. (2010), A gentle introduction to risk aversion and utility theory.

Risk Management and Insurance Review, vol. 13, is. 1, pp. 127–145. https://doi.org/10.1111/j.1540-6296.2009.01173.x.

7. Dao, H. and Peduzzi, P. (2004), Global evaluation of human risk and vulnerability to natural hazards. *Enviro-info*, vol. 1, pp. 435–446.

8. Dimitrakopoulos, D., Kavussanos, G. M. and Spyrou, S. I. (2010), Value at risk models for volatile emerging markets equity portfolios. *The Quarterly Review of Economics and Finance*, vol. 50, is. 4, pp. 515–526. https://doi.org/10.1016/j.qref.2010.06.006.

9. Dubrova, O. S. (2002), Modern view on risk management as an important compound of business management system. *Stratehiia ekonomichnoho rozvytku Ukrainy*, vol. 1(8), pp. 446–453.

10. Gomez-Limon, J., Arriaza, M. L., Riesgo, L. (2003), An MCDM analysis of agricultural risk aversion. *European Journal of Operational Research*, vol. 15, pp. 569–585.

11. Hardaker, J. B., Huirne, R. B. M, Anderson, J. R. and Lien, G. (2004), *Coping with risk in agriculture*, 2nd ed., CABI Publishing, Wallingford, USA.

12. Harwood, J., Heifner, R. H., Coble, K., Perry, J. and Somwaru, A. (1999), Managing risk in farming: concepts, research, and analysis. Agricultural Economic Report No. 774, U.S. Department of Agriculture, Washington, USA.

13. Isik, M. and Khanna, M. (2003), Stochastic technology, risk preferences, and adoption of site-specific technologies. *American Journal of Agricultural Economics*, vol. 85, is. 2, pp. 305–317. https://doi.org/10.1111/1467-8276.00121.

14. Johnson, T. C. (2008), Volume, liquidity, and liquidity risk. *Journal of Finance Economics*, vol. 87, is. 2, pp. 388–417. https://doi.org/10.1016/j.jfineco.2007.03.006.

15. Just, R. E. (2003), Risk research in agricultural economics: opportunities and challenges for next twenty-five years. *Agricultural Systems*, vol. 75, no. 2–3, pp. 123–159. https://doi.org/10.1016/S0308-521X(02)00063-X.

16. Khristianovskiy, A. T. and Lakhtionova, L. A. (2007), *Finansovyi analiz subiektiv hospodariuvannia* [Financial analysis of business entities], KNEU, Kyiv, Ukraine.

17. Kirieieva, E. A., Pryshliak, N. V., Shamanska, O. I., Salkova, I. Yu. and Kucher A. V. (2019), Strategic priorities and financial support of Ukrainian agricultural sector development. *International Journal of Ecological Economics & Statistics*, vol. 40, no. 2, pp. 25–37.

18. Kleiner, G. B., Tambovtsev, V. L. and Kachalov, P. M., (1997), Enterprises in an unstable economic environment: risks, strategies, security, Publishing House «Economics» Ltd., Moscow, Russia.

19. Klimenko, S. M. and Dubrova, O. S. (2005), *Obgruntuvannia hospodarskykh rishen ta otsinka ryzykiv* [Substantiation of business decisions and risk assessment], KNEU, Kyiv, Ukraine.

20. Knight, F. H. (2002), Risk. Uncertainty and Profit, 4 th ed., Mifflin Publishers, Houghton, UK.

21. Kravchenko, O., Kucher, A., Hełdak, M., Kucher, L. and Wysmułek, J. (2020), Socio-economic transformations in Ukraine towards the sustainable development of agriculture. *Sustainability*, vol. 12, no. 13, 5441. https://doi.org/10.3390/su12135441.

22. Lapusta, M. and Sharshukova, L. (2008), Risks in entrepreneurial activity, Infra-M, Moscow, Russia.

23. Ma, B. (2020), Value shaping of ecological man: external standard and internal idea. *Future Human Image*, vol. 13, pp. 57–65. https://doi.org/10.29202/fhi/13/6.

24. Nitsenko, V., Mardani, A., Kuksa, I. and Sudarkina, L. (2018), Additional opportunities of systematization the marketing research for resource conservation practice. *Management Theory and Studies for Rural Business and Infrastructure Development*, vol. 40, no. 3, pp. 361–368. https://doi.org/10.15544/mts.2018.34.

25. Nitsenko, V., Mardani, A., Streimikis, J., Ishchenko, M., Chaikovsky, M., Stoyanova-Koval, S. and Arutiunian, R. (2019), Automatic information system of risk assessment for agricultural enterprises of Ukraine. *Montenegrin Journal of Economics*, vol. 15, no. 2, pp. 139–152. https://doi.org/10.14254/1800-5845/2019.15-2.11.

26. Nitsenko, V., Mukoviz, V. and Sharapa, O. (2017), Accounting of transaction expenses of economic entities. *Scientific Bulletin of Polissia*, vol. 4, is. 12, part 2, pp. 71–78. https://doi.org/10.25140/2410-9576-2017-2-4(12)-71-78.

27. Nitsenko, V. S. and Rudenko, S. V. (2017), Risk management at the enterprises of agro-food sector. *Actual problems of innovative economy*, vol. 3, pp. 12–21.

28. Ostapenko, R., Herasymenko, Y., Nitsenko, V., Koliadenko, S., Balezentis, T. and Streimikiene, D. (2020), Analysis of production and sales of organic products in Ukrainian agricultural enterprises. *Sustainability*, vol. 12(8), 3416. https://doi.org/10.3390/su12083416.

29. Pikus, R. V. (2010), *Upravlinnia finansovymy ryzykamy* [Financial risk management], Znannia, Kyiv, Ukraine.

30. Pisarevskiy, I. M. and Steshenko, O. D. (2008), *Upravlinnia ryzykamy* [Risk management], KhNUMG, Kharkiv, Ukraine.

31. Pronko, L., Furman, I., Kucher, A. and Gontaruk, Y. (2020), Formation of a state support program for agricultural producers in Ukraine considering world experience. *European Journal of Sustainable Development*, vol. 9, no. 1, pp. 364–379. https://doi.org/10.14207/ejsd.2020.v9n1p364.

32. Sakhno, A., Polishchuk, N., Salkova, I. and Kucher, A. (2019), Impact of credit and investment resources on the productivity of agricultural sector. *European Journal of Sustainable Development*, vol. 8, no. 2, pp. 335–345. https://doi.org/10.14207/ejsd.2019.v8n2p335.

33. Su, X., Zhao, Z., Zhang, H., Li, Z. and Deng, Y. (2011), An integrative assessment of risk in agriculture system. *Journal of Computational Information Systems*, vol. 7, pp. 9–16.

34. Tarasova, K. I. (2013), Methodological principles of quantitative risk assessment. Scientific notes of Ostroh Academy National University. Series «Economics», no. 23, pp. 367–372.

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