Study of the Impact of the Volume of Investments in Agrarian Projects on the Risk of Their Value

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Abstract

The work presents analysis of use of the project-oriented management in agrarian field. The expediency of the research on the impact of the volume of investments in agrarian projects on the risk of their value and development of the approach to implementation of the mentioned managerial process are substantiated in the article. The authors suggest an approach to investigation of the impact of the volume of investments in agrarian projects on the risk of their value. It is based on the model, which secures system consideration of the subject and market risks of the changeable project environment. It also concerns peculiarities of formation of the products of agrarian projects by different scenarios of their implementation. The impact of the scenarios of agrarian project implementation on their value is considered in the research. The suggested approach provides accurate results of assessment of the risk of profit, made by investors with consideration of its minimum value. Basing on the proposed approach and set project environment (Brody district, Lviv region), the authors have conducted investigation on the impact of the volume of investments in the projects of winter rape production on the risk of their value. The got forecasts of profits for the investors of the projects of winter rape production confirm that planning of profits, made by investors, should be done within 420…610 $/ha. It will secure the risk of earning less than the expected level. It is substantiated that the risk to make less profit, made by investors of the agrarian projects, significantly depends on the scenario of their product formation. For the set project environment, it is reasonable to use the scenario, which expects application of fertilizers, use of protection agents and technical resources at the level of advanced technologies. The further research needs developing applied software for assessing the risk of the value for the investors of agrarian projects depending on the set changeable project environment, volume of investments and scenario of implementation.

Keywords 1

Management, value, risk, agrarian projects, approach, investments

1. Introduction

Nowadays, the project-oriented management of the enterprise operation in different branches is widely applied. It refers to the agrarian projects, which include projects of crop production. The mentioned projects have their peculiarities, which significantly influence the approved managerial decisions during their life cycle [1-4].

Coordination of the volume of investments in the projects and risks of the value for their investors is an important and inter-dependent managerial process, which is performed at the stage of initiation. It significantly influences the agrarian project value. Scientists greatly concern those processes in

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different kinds of projects. They outline peculiarities of the domain and the project activity, as well as specificities of the project environment [5, 6, 14, 16]. However, the impact of the volume of investments in agrarian projects on the risk of their value has not been studied by the men of science. Without such investigations, project managers make gut suggestions, often resulting in false managerial decisions. It is also necessary to consider the specific changeable project environment.

2. Analysis of published data and problem setting

Nowadays, there are numerous scientific publications, devoted to solution of the managerial problems as well as development and improvement of the instruments of agrarian project management [7-9, 17, 21, 23]. The majority of the works considers peculiarities of the domain and are popular among the project managers.

There are also some studies of the resources, risk, value and their impact on the project budget [10-13]. The performed investigations describe both peculiarities of different domains and particularities of the project management in them. Considering agrarian projects, those processes are studied in some publications [5, 10, 18-20], which are devoted to the corresponding managerial processes and peculiarities of their performance in the agrarian projects. Nevertheless, the researches on the impact of the volume of investments in agrarian projects on the risk of their value do not substantiate the general approach and specificities of those processes performance.

Unfortunately, the current approaches to the management of resources, risk, value and their impact on the budget neglect many components of the changeable project environment, which is specific for the production projects in agrarian sphere [4, 8, 15, 22-40]. In particular, the subject and market risk, which is consistent and caused by the changeable environment, is not considered. That risk makes a significant impact on the value of agrarian projects, which depends on the scenarios of their product formation, as well as on their budget.

Therefore, it is necessary to study the impact of the volume of investments in agrarian projects on the risk of their value that consistently considers the subject and market risk of the changeable project environment, as well as value of the project investors, which depends on the scenarios of their product formation. It is the scientific and applied issue of the day.

3. Goal and tasks of the research

The goal of the research is to develop an approach and use it to evaluate the impact of the volume of investments in agrarian projects on the risk of investors value for the set project environment.

To reach the goal, the following tasks should be solved:

to suggest an approach to investigation of the impact of the volume of investments in agrarian projects on the risk of their value that consistently considers the subject and market risk of the changeable project environment, peculiarities of formation of the project products by different scenarios, as well as their impact on the investors value;

- to study the impact of the volume of investments in agrarian projects on the risk of their value basing on the proposed approach and set project environment.

4. The approach to investigation of the impact of the volume of investments in agrarian projects on the risk of their value

To study the impact of the volume of investments in agrarian projects on the risk of their value, it is proposed to use the known model, which is represented in the work [9]. That model expects that the variable amount of funds (uf) received from production of agrarian products is distributed according to the normal distribution law. Moreover, the variable amount of costs (cf) spent for implementation of the projects of agrarian production is also distributed according to the normal law. It is known [11], that combination of the normal distribution laws provides the opportunity to get a variable amount of profit (pr), made by the project investors. It will be similarly distributed according to the normal

distribution law. Moreover, mathematical expectation of the amount of profit (pr), made by investors of the projects, is calculated by the formula:

$$\mathrm{M}(pr) = \mathrm{M}(uf) - \mathrm{M}(cf), \quad (1)$$

There is a correlation relation between the values of the amount of funds (uf), received from production of agrarian products, and amount of costs (cf), spent for implementation of the corresponding projects [18]. However, the mean square deviation of the amount of profit (pr), made by investors of the projects, is calculated by the formula:

$$\sigma(pr) = \sqrt{\sigma^2(uf) + \sigma^2(cf) - 2r \cdot \sigma(uf) \cdot \sigma(cf)}, \quad (2)$$

where r – the correlation factor between the amount of funds (uf), received from production of agricultural products, and the amount of costs (cf), spent for implementation of the corresponding projects.

The density of distribution of the changeable amount of profit (pr), made by investors of agrarian projects, is calculated by the formula:

$$f(q) = \frac{1}{\sigma(q)\sqrt{2\pi}} \cdot \exp\left[-\frac{[p-\mathrm{M}(q)]^2}{2\sigma^2(q)}\right], \quad (3)$$

The main index of assessment of the risk of the amount of profit (pr), made by investors of agrarian projects, is the probability that the mentioned profit will be higher than the set value pr_1:

$$R\left(pr_1 < pr < \infty\right) = \frac{1}{\sigma(pr)\sqrt{2\pi}} \int_{pr_1}^{\infty} \exp\left[-\frac{[pr-\mathrm{M}(pr)]^2}{2\sigma^2(pr)}\right] dpr, \quad (4)$$

$$R\left(pr_1 < pr < \infty\right) = \phi_0\left(\frac{\infty-\mathrm{M}(pr)}{\sigma(pr)}\right) - \phi_0\left(\frac{pr_1-\mathrm{M}(pr)}{\sigma(pr)}\right), \quad (5)$$

where ϕ_0 – Laplace distribution.

The agricultural production projects, which fulfill the following conditions, are considered reasonable:

$$pr_1 \geq 0. \quad (6)$$

The projects of agricultural production are considered not loss-making if they are characterized by:

$$pr_1 = 0. \quad (7)$$

The loss-making projects of agricultural production satisfy the condition:

$$pr_1 < 0. \quad (8)$$

While initiating the projects of agricultural production, it is necessary to make decisions on the volume of investments in the mentioned projects. However, they concern such index of their value as profit , made by investors (pr), risks of possible losses $R(lo)$ under different scenarios of implementation of the agricultural production projects, each having its amount of costs (cf) for the mentioned projects implementation.

Assessment of the probability of the set amount of profit, made by investors (pr) of the projects of agricultural production under different scenarios of the amount of costs (cf), spent for implementation of the mentioned projects, is performed on the base of the proposed model of assessment for the risk of investments in production projects [19]. It provides the opportunity to justify the law of distribution of the random value of profit, made by investors (functions $F(pr)$ and density $f(pr)$ of distribution) of the agrarian projects and its statistical characteristic under different expected average values of costs (cf), spent for implementation of the mentioned projects.

5. Results of the research on the impact of the volume of investments in agrarian projects on their value

The research on the impact of the volume of investments in agrarian projects on the indices of their value is conducted on the example of the projects of winter rape production for the conditions of the project environment of Brody district in Lviv region. Yield of some crops is one of the resultant

indices of the value of obtained products of agrarian projects. It is confirmed (Fig. 1) that the average values of yield (U_p) of winter rape has a close correlation relation with the amount of expected average values of costs (cf), spent for implementation of the mentioned projects that is described by the correlation equation for the set project environment

$$U_p = 0{,}274 \cdot cf + 0{,}679 . \quad (9)$$

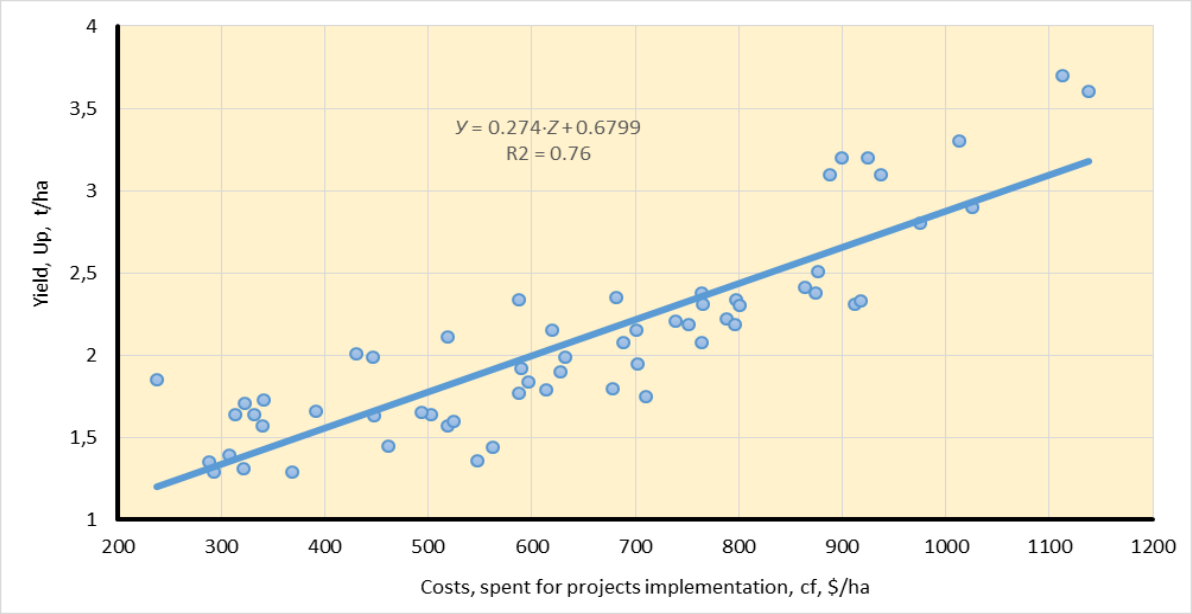

Figure 1: Dependence of the yield (U_p, t/ha) of winter rape on the costs, spent on implementation of the projects of its production (cf, $/ha)

Considering the fact (Table 1) that probability of the random value of yield (U_p) is distributed according to the normal law, one can assume [17] that mathematical expectation of the yield $M(U_p)$ is equal to the average value of the yield $(\bar{U}_p)$ (Fig. 2).

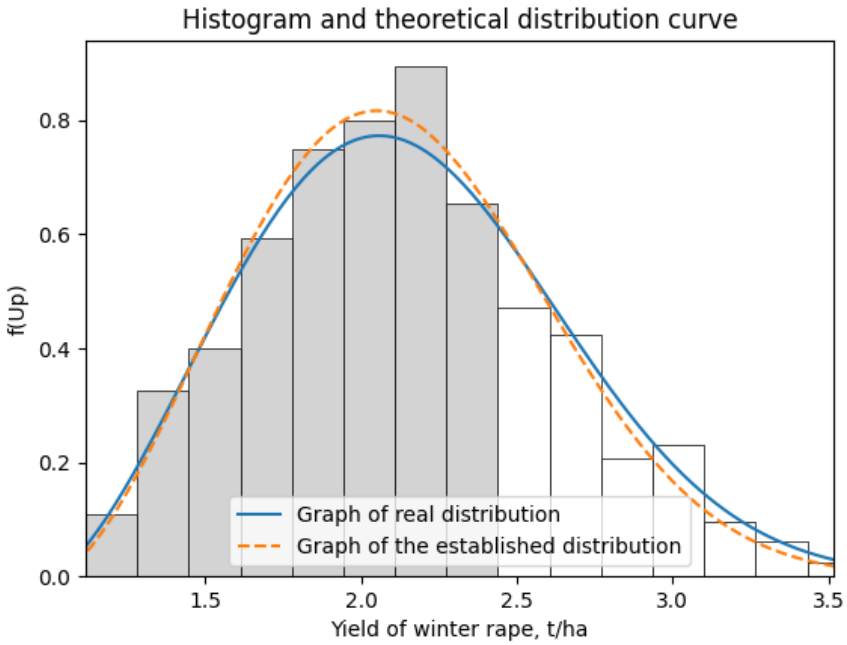

Figure 2: Histogram and theoretical distribution curve for winter rape, t/ha

Table 1
Characteristics of distribution of the yield of winter rape for conditions of Lviv region, t/ha*

Kind of raw material crop	Statistical characteristics of distributions, t/ha			
	$M(U_p)$	$\sigma(U_p)$	U_{pmin}	U_{pmax}
Rape	2.443	4.98	1.3	3.7

*Statistical data on the characteristics of distribution of the yield Y_{ki} of winter rape for the conditions of Lviv region

Similarly, mathematical expectation of the costs $M(cf)$, spent for implementation of the mentioned projects according to the normal law of distribution of the random value of the index of costs, is equal to the average value (cf). In that case, basing on the property of the mathematical expectation of a linear function, which states that mathematical expectation of the linear function of the random value is equal to that linear function from the mathematical expectation of the random value [19], and the equation (9) has the following form:

$$M(U_p) = 0{,}274 \cdot M(cf) + 0{,}679. \quad (10)$$

Assuming that the tendencies of formation of the sale price for winter rape (cp) will be actual in the future, distribution of the probability of the random value of the amount of funds (cp), received from winter rape production, will be described according to the normal law with the following statistical characteristics (Fig. 3), particularly mathematical expectation - $M(sp) = 501\$ / m$; mean square deviation $\sigma(sp) = 19{,}75\$/m$, variation factor $v(sp) = 0.039$.

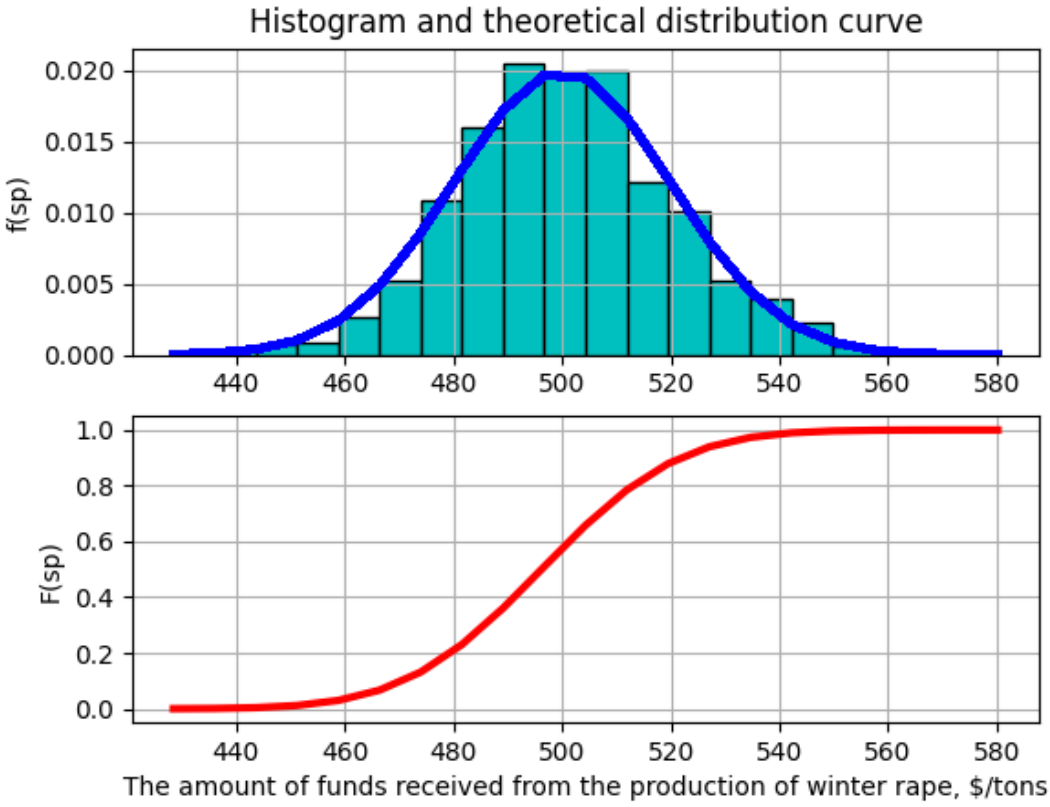

Figure 3: Density and the function of distribution of the amount of funds (sp), received from winter rape production, $/t

To assess the parameters (statistical characteristics) of distribution of the probability of the random value of costs (cf), spent for implementation of the projects of winter rape production for different fields or different farms, the variation factor $\nu(cf)=0.324$ is taken. It is obtained due to conducted experimental researches.

Assessment of the risks of winter rape production projects is performed to confirm the suggestions. The work describes three scenarios of their implementation:

The first (scenario I) – mathematical expectation of the spent costs $M_I(cf)=250$ \$/ha that satisfies the project content, which suggests application of chemical fertilizers and use of the minimum amount of protection agents (production is based on the natural soil fertility).

The second (scenario II) – mathematical expectation of the spent costs $M_{II}(cf)=750$ \$/ha that satisfies the content of the projects of winter rape production in 2019-2020 in the Western regions of Ukraine.

The third (scenario III) – mathematical expectation of the spent costs $M_{III}(cf)=1250$ \$/ha that satisfies the project content, which suggests application of fertilizers, use of protection agents and technical resources at the level of advanced technologies.

Referring to the above-described model, the authors have determined the amount of funds (uf), received from the production of agricultural products, amount of costs (cf), spent for the corresponding projects implementation, amount of funds (cp), received form winter rape production, profit (pr), made by investors of the projects of winter rape production for the identified scenarios of implementation of the projects of winter rape production.

Basing on the expected figures of the statistical characteristics of forecasted random indices of value under different scenarios of implementation of the projects of winter rape production and considering that fact that probabilities of the random value of profit, made by investors (pr) of the projects of winter rape production, are distributed according to the normal law for the concerned scenarios of the project implementation, the equation of the function and density of distribution of the probability of profit, made by investors, is obtained:

$$f_I(pr)=0.005\cdot exp\left[-\frac{(pr-421,5)^2}{13057,28}\right], \tag{11}$$

$$F_I(pr)=0.005\cdot\int_{-\infty}^{\infty} exp\left[-\frac{(pr-421,5)^2}{13057,28}\right]dpr, \tag{12}$$

$$f_{II}(pr)=0.003\cdot exp\left[-\frac{(pr-508)^2}{33057.28}\right], \tag{13}$$

$$F_{II}(pr)=0.003\cdot\int_{-\infty}^{\infty} exp\left[-\frac{(pr-508)^2}{33057.28}\right]dpr, \tag{14}$$

$$f_{III}(pr)=0.002\cdot exp\left[-\frac{(pr-615)^2}{94264,82}\right], \tag{15}$$

$$F_{III}(pr)=0.002\cdot\int_{-\infty}^{\infty} exp\left[-\frac{(pr-615)^2}{94264,82}\right]dpr, \tag{16}$$

The graph of the density and distribution function (integral curve) of the expected probability of profit, made by investors of the projects of winter rape production under different scenarios of their implementation, is presented by the Fig. 4.

The analysis of obtained results on the established figures of the statistical characteristics of forecasted random indices of value, as well as resultant tendencies of change of the density and distributed function of profit, made by investors of the projects of winter rape production under different scenarios of their implementation (Fig. 4), is demonstrated in the Table 2.

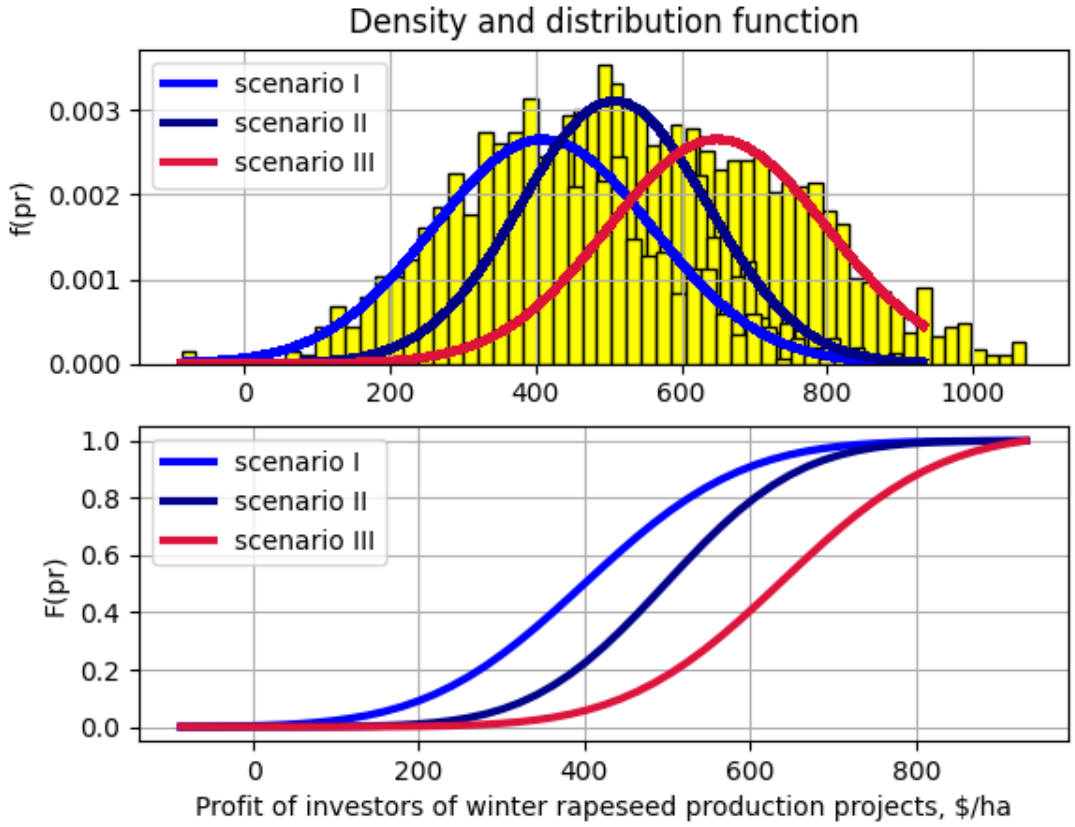

Figure 4: Density and distribution function of the profit, made by investors of the projects of winter rape production under different scenarios of their implementation

Table 2

Expected minimum values of the profit, made by investors of the projects of winter rape production under different scenarios of their implementation and set probability of profit-making, $/ha

Project scenario	Average amount of costs (cf), spent for the project implementation, $/ha	Set probability of profit, made by investors of the projects				
		0.997	0.977	0.84	0.5	0.15
I	250	175	262.5	337.5	425	500
II	687	25	187.5	350	512.5	675
III	1250	-37.5	187.5	400	612.5	837.5
	Risk level	0	0.023	0.16	0.5	0.9

The obtained results of the forecast of the minimum value of profit, made by investors of the projects of winter rape production under different scenarios of their implementation and set probability of making the profit 0.997 (Table 2), confirm that under the third scenario, possible losses will be at the level of 37.5 $/ha. Moreover, with the high accuracy of calculations (probability of the set event 0.840), the value of profit will be above 400 $/ha. Permitting lower accuracy (probability of the set event 0.15), one can confirm that the minimum value of the profit, made by investors under the third scenario of project implementation, will be above 837.5 $/ha.

Referring to the forecast on the profit, made by investors of the projects of winter rate production, the conclusion is that it is highly (0.840) probable that the minimum value of the profit under the concerned scenarios of project implementation will be the highest in case spending costs for the project implementation in the amount of $cf = 1250$ $/ha.

If the probability of obtaining value for stakeholders (profit, made by investors of the projects), which is less than the expected one, is taken as the criterion (degree) of risk R(pr), then the values of the corresponding risk can be assessed by the expression:

$$R(pr) = 1 - P(pr). \quad (17)$$

For practical goals one can use the empiric scale of the risk levels (risk probabilities):

Area I – $R(pr)$ = 0…0,2 – minimum risk;

Area II – $R(pr)$ = 0,2…0,5 – tolerable risk;

Area III – $R(pr)$ = 0,5…0,8 – high risk;

Area IV – $R(pr)$ = 0,8…1,0 – critical risk.

Basing on the performed calculations on the forecast of the minimum expected value of profit (pr), made by investors of the projects (Table 2), one can evaluate the dependence between the minimum profit and level of risk of its making under different scenarios of their implementation (amount of costs (cf) spent for the project implementation, $/ha). For the set project environment, that dependence is graphically represented (Fig. 5).

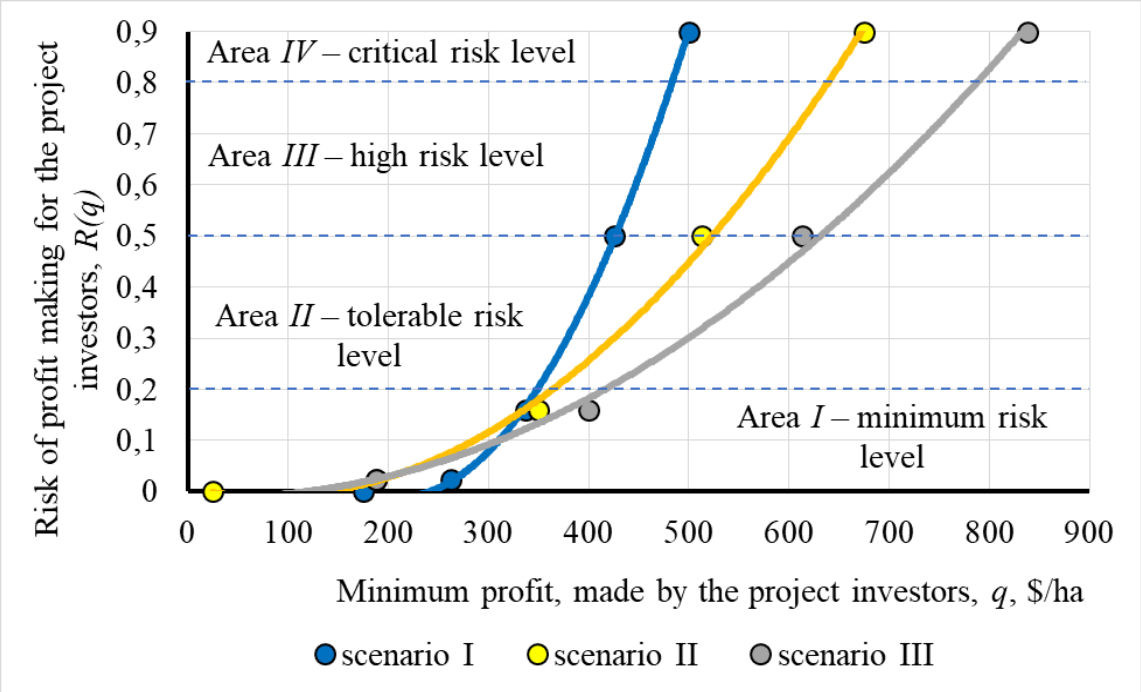

Figure 5: Dependence of the level of risk R(pr) of profit making by investors on its minimum expected value (pr) under the set scenario of implementation of the winter rape production projects

The obtained dependencies of the level of risk of profit-making by investors on the minimum expectation of its value under the set scenario of the projects implementation are described by the equations:

Scenario I

$$R(pr) = 1 \cdot 10^{-5} \cdot pr_I^2 - 0{,}0045 \cdot pr_I + 0{,}454,\ r = 0{,}98, \quad (18)$$

Scenario II

$$R(pr) = 3 \cdot 10^{-6} \cdot pr_{II}^2 - 0{,}0004 \cdot pr_{II} + 0{,}006,\ r = 0{,}98, \quad (19)$$

Scenario III

$$R(pr) = 1 \cdot 10^{-6} \cdot pr_{III}^2 - 9 \cdot 10^{-5} \cdot pr_{III} - 0{,}0095,\ r = 0{,}98. \quad (20)$$

The resultant dependencies of the level of risk of profit-making by investors on its minimum expected value (pr) under the set scenario of implementation of the projects of biofuel raw material production (Fig. 4) at the tolerable risk level (Area II – $R(pr)$ = 0,2…0,5), the minimum profit, made by investors under the first scenario of the project implementation, will be within

$pr_I = 350...420$ \$/ha, under the second scenario - $pr_{II} = 370...515$ \$/ha, and under the third scenario - $pr_{III} = 430...620$ \$/ha.

The further research needs development of the applied software for the quantitative assessment of the value of investors of agrarian projects depending on the set project environment, volume of investments and scenario of implementation.

6. Conclusions

1. The proposed approach to investigation of the impact of the volume of investments in agrarian projects on the risk of their value is based on the model, which secures system consideration of the subject and market risks of the changeable project environment, peculiarities of formation of their project products under different scenarios, as well as their impact on the value of investors that provides accurate results of assessment of the risk of profit, made by investors with consideration of its minimum set value.

2. Basing on the suggested approach, the investigation is performed on the impact of the volume of investments in the projects of winter rape production on the risk of their value, basing on the proposed approach and set project environment (Brody district, Lviv region). Referring to the obtained results on the expected profit, made by investors of the projects of winter rape production, one can plan the profit for investors within 420…610 \$/ha that will secure not less than the tolerable risk of profit-making, which significantly depends on the scenario of the project product formation. For the set project environment, it is reasonable to use the scenario, which involves application of fertilizers, use of protection agents and technical resources at the level of advanced technologies.

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