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ASSESSMENT OF STRATEGIC DIRECTIONS FOR THE IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP IN THE FIELD OF SECURITY DEVELOPMENT OF THE AGRICULTURAL SECTOR

ABSTRACT

The article analyzes the features of choosing the optimal strategic direction for increasing the effectiveness of public-private partnership mechanisms in the field of security development of the agricultural sector in the context of modern challenges and threats. The study covers two main strategic directions (D1 and D2), which are considered from the perspective of potential benefits, costs, opportunities and risks. The basis of the methodological toolkit is the BOCR method, which makes it possible to assess not only the benefits and costs but also the risks and prospects for the development of selected strategic solutions. In the process of applying the BOCR approach, evaluation criteria were formed for each element (B - benefits, O - opportunities, C - costs, R - risks) and pairwise comparisons were conducted, which made it possible to determine the weight of each criterion. In parallel, the consistency of expert assessments was calculated by calculating the consistency ratio, which confirmed the relevance and reliability of the results obtained. According to the results of the assessment procedures, it was established that the direction of forming a mechanism for in-depth technological cooperation and accelerating digital transformation (D2) has a higher global priority despite the higher level of risks and higher costs. This is due to the fact that the D2 strategy, in addition to expanding innovative opportunities, contributes to the creation of favourable conditions for the implementation of advanced technologies, and infrastructure development and attracting more investors to projects in the agricultural sector. In parallel, D2 meets the needs of security development in the war and post-war periods, proposing the creation of comprehensive mechanisms for cooperation and accelerating adaptation to global challenges.

Keywords: public-private partnership, agricultural sector, security development, digital transformation, BOCR method, strategic choice, risks, innovations

JEL Classification: Q10, Q18, O31, H57

INTRODUCTION

In modern economies, the agricultural sector plays one of the leading roles, as it is responsible for food security, the stability of the domestic market and export opportunities. The development of this sector directly depends on the effective interaction between the state and private business, which is fueled by various mechanisms of public-private partnership. In recent years, under the influence of global challenges and various security threats, the need to find strategic directions that can ensure not only economic growth but also the stability and security of the industry as a whole has become particularly important. In this context, it is important to understand which directions of development will be the most effective, both in terms of economic indicators and taking into account possible risks and costs, in particular in wartime conditions. According to modern theories of economic growth, the combination of private sector resources (investments, innovative technologies, experience) with the regulatory functions of the state allows achieving optimal results. In the field of agricultural production, increasing

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the efficiency of public-private partnerships is a key tool for accelerating innovation, introducing modern technologies, and improving infrastructure.

For this process to be effective and safe, it is worth considering a wide range of factors — from economic feasibility to social and environmental consequences. Among these factors, the issue of preparing the industry for Industry 5.0, which involves the use of high technologies and artificial intelligence as a driving force for progress, is becoming increasingly important. The current stage of development of the agricultural sector is characterized by increased global competition and increased requirements for the quality and safety of food products. In addition, the instability of the geopolitical situation and the risks associated with military conflicts increase the role of security in shaping public policy and private business strategies. That is why technological innovations that can increase productivity and simultaneously ensure the economic and physical security of food supply are gaining increasing importance.

Public-private partnerships in the agricultural sector essentially involve pooling resources, competencies, and risks between the state and private companies to implement projects aimed at developing agricultural infrastructure, increasing food security, and overall modernization of agricultural production. The main advantages of such partnerships can be summarized as follows:

1. Access to capital and technology. The private sector provides investments and advanced solutions that contribute to the modernization of production processes, reduce losses, and increase yields.
2. Risk sharing. The state, as a rule, assumes part of the market or regulatory risks, while the private partner is responsible for the effective implementation of the project and managing operational risks.
3. Infrastructure improvement. Joint projects allow the creation or modernization of warehouses, logistics chains, irrigation systems, and other facilities important for agricultural production.
4. Ensuring food security. Joint initiatives can be aimed at increasing production volumes, building reserves, and increasing the competitiveness of domestic products in global markets.

The introduction of monitoring systems, automation of production processes, drones and unmanned aerial vehicles significantly expands the possibilities of doing business but also creates the need to develop appropriate infrastructure and regulatory mechanisms. Against this background, there is an urgent need to choose adequate strategic directions for the development of public-private partnership mechanisms that would promote effective interaction between all stakeholders. Multi-criteria analysis methods serve as a promising tool for evaluating various scenarios, among which the BOCR method is distinguished by the ability to comprehensively take into account the benefits, opportunities, costs and risks of each strategy. This approach makes it possible to form a quantitative assessment and make economically sound decisions in conditions of uncertainty and complex interrelationships between factors. This is especially important in areas where the stakes are high, and errors in choice can lead to significant financial and socio-economic losses.

Thus, the relevance of our research is due to the need to develop a systematic approach to choosing the optimal strategic direction for increasing the effectiveness of public-private partnerships in the agricultural sector, taking into account security challenges and the need for digital transformation. The article provides a comparative analysis of two possible directions (D1 and D2) using the BOCR method. The results allow us not only to identify which of the directions will be the most effective but also to demonstrate a quantitative comparison mechanism that can be applied in different industries and scales. The results of the study allow us to identify potential priorities for further state and corporate decisions and form a scientifically sound basis for the development of relevant development programs.

LITERATURE REVIEW

In the context of studying the strategic directions of implementing public-private partnerships in the field of security development of the agricultural sector, it is advisable to refer to scientific works that systematize approaches to assessing the effectiveness of public-private partnerships and identify critical success factors in various industries.

Liu et al. (2015) emphasize the importance of taking into account the life cycle of projects within public-private partnerships and the formation of critical success factors that should ensure the safety and reliability of infrastructure facilities. Although their study mainly concerns general infrastructure projects, the criteria for the viability of public-private partnerships identified by the authors can be transferred to the agricultural sector. In particular, the issues of attracting investors, cost control, and risk sharing are basic for any investment environment, including the agricultural one.

In the article Khmel, V., & Zhao, S. (2016) focus on financing road infrastructure through public-private partnership mechanisms, highlighting current challenges and potential benefits for the state and private investors. According to the results of the study, the decisive factor for success is the correctly chosen model of risk distribution between project participants and effective planning of costs and implementation deadlines. Orshanska, M. I. (2019). In the context of Ukraine, Orshanska, M. I. (2019) draws attention to the attraction of foreign direct investment in infrastructure development precisely through public-private partnerships. The work emphasizes that the level of investment attractiveness of the country directly depends on the regulatory framework and the stability of macroeconomic indicators.

Lasa, Y. M., Takim, R., & Ahmad, N. (2018) highlight an integrated partnership model when private companies not only invest funds but also participate in the management and operation of facilities. An important point is the differentiated risk-sharing system, which depends on the industry specifics and the level of participation of each partner. This experience allows us to understand how countries with a similar level of development can model their own mechanisms to increase investment attractiveness. Shuliuk, B. (2021) examines the corporate aspects of financing public-private partnership projects, focusing on assessing financial opportunities and risks for private partners. The proposed approaches to analyzing investment flows, capital formation, and efficiency modelling indicate that the criteria for success are not only the size of the profit but also the long-term sustainability of projects.

The methodological principles for assessing the effectiveness of public-private partnership projects are highlighted in the work of Kuznyetsova, Klipkova and Maslov (2022). They propose a system of indicators that takes into account socio-economic and financial-economic aspects, as well as models the impact of variables related to the legal environment. Such a multifactorial approach can be useful for assessing agricultural projects, especially when it comes to ensuring food security and supporting innovative development.

The work of Jakaitis et al. (2011) explores the prospects for using public-private partnerships for the development of urban areas. Although agricultural areas differ in their specifics, a number of approaches to territorial planning and balanced use of resources have common features. In particular, one can single out the issue of coordinating the economic interests of local authorities and private businesses, which similarly arises in the agricultural sector in the form of the distribution of rights, obligations and risks between state bodies and agricultural enterprises.

Similarities and differences in approaches to public-private partnerships between Ukraine and the European Union countries are highlighted by Podolyan and Ivashchenko (2021). Their comparative analysis demonstrates that EU policy is aimed at improving the regulatory environment and developing high-quality infrastructure. The Ukrainian context, on the other hand, still requires strengthening the legal framework and increasing the level of transparency, which is also relevant for the secure development of the agricultural sector. It is these aspects that determine the long-term attractiveness of public-private partnerships for external and domestic investors. A significant contribution to the understanding of procurement procedures and preparation of public-private partnership projects was made by Zhang, Leiringer and Winch (2023). The authors consider the issue of developing the necessary capabilities from the perspective of project owners, emphasizing the importance of acquiring managerial competencies and knowledge about the optimal distribution of roles between the state and private participants. For the agricultural sector, where there are many small farms, the problem of forming joint cooperative structures and building competencies in the field of technological innovation acquires additional complexity.

The issues of developing a public-private partnership system in the face of modern challenges are highlighted in the work of Kruglov (2021). The researcher emphasizes that the instability of the economic environment requires new incentive mechanisms, including fiscal and administrative ones, as well as further digitalization of public-private partnership processes. The author emphasizes that without the introduction of a comprehensive state policy aimed at reducing corruption risks and enhancing competitiveness, the effectiveness of the partnership may be significantly limited.

The study by Cepparulo, Eusepi and Giuriato (2020) analyzed financial instruments and macroeconomic factors that affect the distribution of risks in public-private partnerships in the EU. For the agricultural sector, where sustainability of financing is crucial, the conclusions of these authors signal the need for careful assessment of debt burden, budget constraints and tax incentives. Given that agricultural production is susceptible to natural and climatic risks, adequate financing of insurance mechanisms becomes one of the prerequisites for sustainable development.

In summary, the available literature confirms the importance of a comprehensive approach to the assessment of public-private partnership projects, which should take into account not only the economic interests of the parties but also the specifics of the sectoral environment, the legal framework, as well as macroeconomic conditions. Given the priority of the security aspect in the agricultural sector, the use of multi-criteria methods and a long-term perspective become mandatory elements in the process of strategic choice.

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AIMS AND OBJECTIVES

The purpose of the article is to propose an approach to evaluating and selecting, based on its results, the most optimal strategic direction for implementing public-private partnership mechanisms in the field of agricultural sector development.

METHODS

The methodological basis of the study was the BOCR method, which enables a systematic comparison of strategic alternatives taking into account their benefits (B), opportunities (O), costs (C) and risks (R). This method is based on a hierarchical decomposition approach, where each alternative is evaluated according to specific criteria, and the relative weights of these criteria are also taken into account. This combination of qualitative and quantitative assessment allows for a more holistic view of the potential consequences of each development direction. The use of the BOCR method helps to avoid a narrow focus only on economic benefits or, conversely, only on risks, while in the context of the secure development of the agricultural sector, it is important to find a balanced solution. Before starting the analysis, four hierarchies of criteria were formed: benefits, opportunities, costs and risks, each of which included three sub-criteria. For the hierarchy of advantages (B), criteria were selected that reflect the level of compliance of the strategic direction with the priorities of the security development of the agricultural sector, the goals of sustainable development and intellectual potential. For the hierarchy of opportunities (O), the criteria of novelty of the strategic direction, socio-economic effect and prospects were singled out. The hierarchy of costs (C) considered financial and material, technical and motivational costs, and for risks (R) information, resource and personnel aspects were taken into account. At the next stage, a pairwise comparison of criteria was carried out within each hierarchy, which made it possible to establish relative weights for advantages, opportunities, costs and risks. After that, a direct comparison of strategic alternatives (D1 and D2) was carried out in terms of each of the subcriteria in all four hierarchies. For this, the rule of geometric means was used, where each row of the comparison matrix was reduced to a single coefficient. In this way, it was possible to clearly record which of the alternatives prevails on a particular subcriterion, and how significant this advantage is. An important element of the application of the BOCR method is the verification of the consistency index, which indicates the level of systematicity and consistency of the expert assessments made. According to the theory of paired comparison methods, if the index slightly deviates from the norm, there may be a need to reconsider the assessments, adjust the formulations of the criteria, or check the correctness of the initial data. In our study, the consistency ratio did not exceed 0.1 for all groups of criteria, which is acceptable and confirms a sufficient level of reliability of the results obtained. Thanks to this, we could be confident in the validity of the identified priorities and the ranking of alternatives. As a result, for each of the two strategies (D1 and D2), an integral indicator U_i was calculated, which takes into account the final weights of advantages, opportunities, costs, and risks. The results obtained became the basis for drawing conclusions about which of the development directions should be considered as a priority in terms of economic feasibility and ensuring security interests in the industry. Thus, the applied methodology is a comprehensive approach that allows you to assess the multidimensional picture and, relying on analytics, make more informed decisions. It is worth emphasizing that the BOCR method allows you to adapt the list of criteria to the specifics of a particular sector, which makes it a universal tool for strategic planning in conditions of uncertainty and multiple risks.

RESULTS

1. Activity of agricultural sector enterprises regarding public-private partnership

Until the beginning of 2022, the decrease in the number of enterprises participating in public-private partnerships was mainly influenced by legislative-bureaucratic, economic and institutional factors (State Statistics Service of Ukraine, 2025). After the start of the full-scale war in 2022, there is currently little available statistical data on the situation in the agricultural sector, but it can be assumed that the risks have increased even more, and therefore, full-fledged statistics on public-private partnership projects will be the subject of further research in the post-war period (Figure 1).

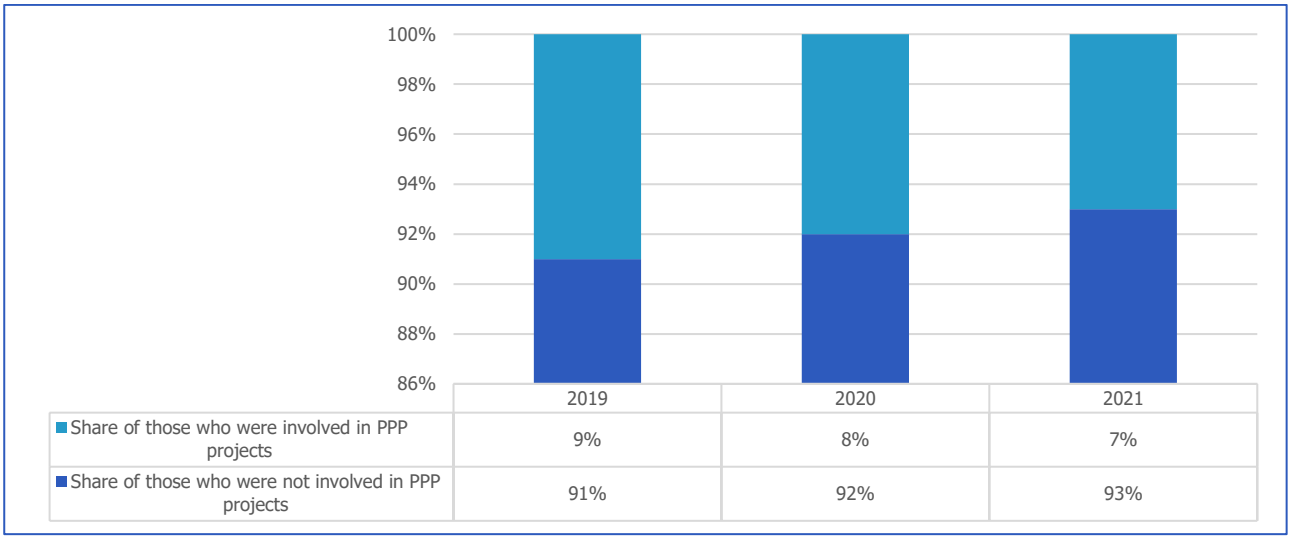

Figure 1. Share of agricultural sector enterprises involved in public-private partnerships, %.

Existing cases where state obligations were not fulfilled on time or partially, form a cautious attitude on the part of business. This especially applies to mechanisms for investment reimbursement and profit distribution, if state programs are financed unstable. Many agricultural producers do not have sufficient information or professional advice on the possibilities of public-private partnerships. The lack of examples of successful implementation or systematic explanatory work by the authorities only increases uncertainty.

2. Basic conditions for conducting an assessment

The digital transformation of public-private partnership mechanisms in the field of security development of the agricultural sector requires a number of measures, the decision on which must be justified and economically feasible. This perspective prompted us to form a methodological approach to assessing options for strategic directions for increasing the effectiveness of public-private partnership mechanisms in the field of security development of the agricultural sector, which allows us to apply the BOCR method.

We will choose two strategies for assessment:

- D1. The direction of forming innovation-oriented financing mechanisms and tax support. This includes the actual transformation and modernization of the entire regulatory and legal field and the creation of such languages that will make it possible to create such security conditions under which it will be possible to attract more investors to new projects. In essence, to form a security environment of incentives for businesses to invest in risky projects, as well as simplifying access to state grants and loans specially designed for the needs of the development of the agricultural sector.
- D2. The direction of forming a mechanism for in-depth technological cooperation and accelerating digital transformation. This can be achieved through the development of joint innovation centres, various "incubators" and test laboratories between the state and the private sector, which in turn will enable the development of new standards for the development of the agricultural sector and even prepare for a smooth safe transition to Industry 5.0. At the same time, in wartime conditions, namely, the continuity of critically important processes related to research and development and the development of new technologies, acquires particular importance as such.

To begin with, let us describe the criteria for the chosen methodology in the context of our goal, namely: choosing the optimal strategic directions for increasing the effectiveness of public-private partnership mechanisms in the field of agro-cultural sector development. Therefore, the hierarchy of advantages (B) will consist of the following criteria in the context of our work (Figure 2):

1. The strategic direction corresponds to the priority areas of ensuring the security development of the agricultural sector.
2. The strategic direction corresponds to the goals of sustainable development.
3. Provision of intellectual potential in the conditions of the development of the agricultural sector.

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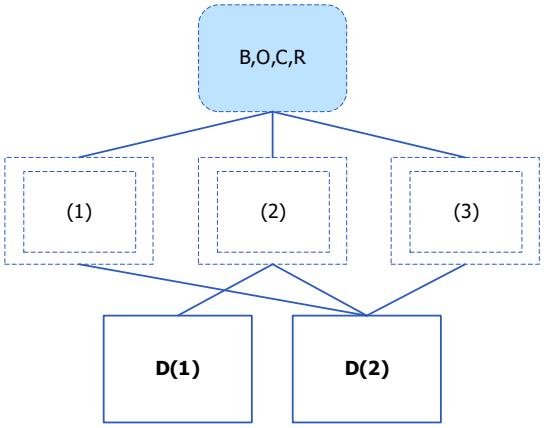

Figure 2. Interrelation of assessment criteria according to the BOCR method.

The hierarchy of opportunities (O) will consist of the following criteria in the context of our task in the article:

1. The degree of novelty of the strategic direction.
2. The degree of novelty of the socio-economic effect of the strategic direction.
3. The level of prospectivity of the strategic direction.

The hierarchy of costs (C) will consist of the following criteria in the context of our article:

1. Financial and material costs for the implementation of the strategic direction.
2. Technical and engineering costs for the implementation of the strategic direction.
3. Motivational costs for the implementation of the strategic direction.

The cost hierarchy (R) will consist of the following criteria:

1. Information risks of data and information disclosure.
2. Resource risks of insufficient provision.
3. Personnel risks in the form of insufficient personnel qualifications for the implementation of the strategy.

3. Results of comparison of BOCR criteria

To begin with, it is necessary to make a comparison in which the key element will be the value of "n", that is, the total number of all cases at one of the levels (1):

$$\frac{n(n-1)}{2}. \quad (1)$$

At the same time, three full-fledged processes of comparing BOCR criteria will be carried out, which will give us the corresponding matrix, which we will present in tabular form (Table 1).

Table 1. Results of comparing BOCR criteria.

Criterions	Matrix
B (1-3)	$\begin{bmatrix} 1 & 1/9 & 1/6 \\ 9 & 1 & 1 \\ 6 & 1/3 & 1/7 \end{bmatrix}$
O (1-3)	$\begin{bmatrix} 1 & 2 & 1/7 \\ 1/2 & 1 & 1/9 \\ 7 & 9 & 1 \end{bmatrix}$
C (1-3)	$\begin{bmatrix} 1 & 1/3 & 2 \\ 3 & 1 & 3 \\ 1/2 & 1/3 & 1 \end{bmatrix}$
R (1-3)	$\begin{bmatrix} 1 & 3 & 1/7 \\ 1/3 & 1 & 1/5 \\ 7 & 5 & 1 \end{bmatrix}$

Each criterion is compared with itself, which is indicated in the matrix by the value "1" on the diagonal. This means that each criterion is considered equivalent to itself, which is logical and mathematically correct when applying this methodology.

4. Results of comparison by all criteria of each element of BOCR of the proposed strategic directions

Furthermore, it will be compared with respect to all criteria (B, O, C, R) which of the proposed strategic directions above (D) is better for each. Since our proposed hierarchy above (Figure 1) has only a strategy, then equality (1) changes to the following (2):

$$3 * \frac{n(n-1)}{2} \quad (2)$$

It should be noted that the number "3" indicates the number of criteria for each component of the BOCR.

Since each element of BOCR has three criteria. So, as a result, we will have a comparison of each strategic direction of increasing the effectiveness of public-private partnership mechanisms in the field of security development of the agricultural sector by three criteria of each element of BOCR (Table 2).

Table 2. Comparison results for each element B, O, C, R proposed strategic directions.

Criterions	Matrix
B (1-3)	D D1 D2 D1 1 1/3 D2 3 1
O (1-3)	D D1 D2 D1 1 1/7 D2 7 1
C (1-3)	D D1 D2 D1 1 1/5 D2 5 1
R (1-3)	D D1 D2 D1 1 3 D2 1/3 1

In total, we kept 12 matrices, three for each element of BOCR, which we will denote as $M=m_{ij}(m*m)$. Next, the relative importance of all objects should be calculated using the geometric mean of each of the rows of the matrix, according to the corresponding equality (3):

$$w_i=\frac{ui}{\sum_{i=1}^{m} ui} \quad (3)$$

It is used to transform the unnormalized weights w_i into a standard scale where the sum of all u_i equals 1. This normalized weight u_i indicates how important criterion i (or option i) is compared to the others within the same comparison set.

At the same time, ui is determined by the following equality (4):

$$u_i= \sqrt[m]{\prod_{j=1}^{m} mij}. \quad (4)$$

This formula computes the "geometric mean" of each row i in a comparison matrix. If you have a row i in a matrix with elements m_{ij}, the geometric mean is calculated by multiplying all the elements in that row together and then taking the m-th root (where mmm is the number of elements in that row).

In order to obtain a vector of relative importance (which, in turn, is a way to provide a more objective and systematic approach to assessing and choosing strategic directions of development, especially in today's complex and dynamic conditions), it is necessary to multiply the data obtained from Table 1 by the data obtained for w_i. The data from Table 3, in this case, will be denoted as MB, MO, MC, MR respectively. In this case, the result of the value: $M*w_i/w_i$ will give us the value λ_{max} used to calculate the consistency index, which is an indicator of how consistently the elements of the matrix were evaluated.

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Table 3. Results of comparisons across all BOCR criteria of the proposed strategic.

B	
w_i	**$M*w_i$**
$\begin{pmatrix}0.1\\0.65\\0.25\end{pmatrix}$	$\begin{pmatrix}0.2\\0.2\\0.6\end{pmatrix}$
λmax	3.1
Consistency Index	0.03
Consistency Ratio	0.05
O	
w_i	**$M*w_i$**
$\begin{pmatrix}0.15\\0.1\\0.75\end{pmatrix}$	$\begin{pmatrix}0.46\\1.2\\2.4\end{pmatrix}$
λ_{max}	3
Consistency Index	0.04
Consistency Ratio	0.06
C	
w_i	**$M*w_i$**
$\begin{pmatrix}0.3\\0.61\\0.1\end{pmatrix}$	$\begin{pmatrix}0.9\\0.7\\0.25\end{pmatrix}$
λmax	3
Consistency Index	0.04
Consistency Ratio	0.08
R	
w_i	**$M*w_i$**
$\begin{pmatrix}0.15\\0.1\\0.75\end{pmatrix}$	$\begin{pmatrix}0.4\\0.3\\0.3\end{pmatrix}$
λ_{max}	3.1
Consistency Index	0.04
Consistency Ratio	0.06

It is important to remember that the consistency ratio, which is based on the reference value according to the methodology and depends on the number of objects, in our case, there were 3 of them, i.e., the reference value was 0.58, should be below 10% according to all BOCR criteria. That is, we are within the normal range.

It is important to remember that the relative weight for each B1-B3, O1-O3, C1-C3, R1-R3 of the implemented strategic directions can be a maximum of one and is needed to determine U_j, which allows us to establish the level of global priority of a particular strategic direction for increasing the effectiveness of public-private partnership mechanisms in the field of security development of the agricultural sector according to the following equality (5):

$$U_j=\sum_{i=1}^{n} wi * uij \quad (5)$$

Where, w_i its basically w_B, w_O, w_C, w_R are the normalized weights (found using formulas similar to (3) and (4)) that indicate how significant each of these four categories is overall. It calculates a single integrated indicator Uj for each strategic direction j. The higher Uj is, the more favourable that strategy tends to be because it reflects that the Benefits and Opportunities outweigh the Costs and Risks, once all are weighted properly.

The results of calculations and calculations are listed in Table 4.

Table 4. Results of BOCR assessment for choosing the optimal strategic direction.

BOCR	R1	R2
B		
B1	$\begin{pmatrix}0.25\\0.12\\0.2\end{pmatrix}$	$\begin{pmatrix}0.75\\0.88\\0.8\end{pmatrix}$
B2		
B3		
U	0.15	0.85
O		
O1	$\begin{pmatrix}0.12\\0.2\\0.1\end{pmatrix}$	$\begin{pmatrix}0.88\\0.9\\0.9\end{pmatrix}$
O2		
O3		
U	0.1	0.9
C		
C1	$\begin{pmatrix}0.25\\0.2\\0.3\end{pmatrix}$	$\begin{pmatrix}0.75\\0.8\\0.7\end{pmatrix}$
C2		
C3		
U	0.25	0.75
R		
R1	$\begin{pmatrix}0.2\\0.15\\0.1\end{pmatrix}$	$\begin{pmatrix}0.8\\0.85\\0.9\end{pmatrix}$
R2		
R3		
U	0.15	0.85

We interpret the results as follows: the proposed strategic direction D(1), which involves the formation of innovation-oriented financing mechanisms and tax support, is less costly than D(2). That is, a lower value for the criterion "C" is better. At the same time, the proposed strategic direction D(2), which consists of forming a mechanism for in-depth technological cooperation and accelerating digital transformation, is an order of magnitude riskier than the same D(1), but it also provides many more advantages and opportunities. Therefore, despite the riskiness and cost, we believe that in today's conditions, the optimal implementation of D(2), which consists of forming a mechanism for in-depth technological cooperation and accelerating digital transformation, will be.

DISCUSSION

Our calculations and analysis of two strategic directions (D1 and D2) for increasing the effectiveness of public-private partnership mechanisms in the agricultural sector gain additional weight in light of existing research focusing on risk management, alignment of interests, and ensuring sustainable development.

According to Kushneruk and Alekseienko (2020), the alignment of economic interests of the state and private capital in public-private partnership projects is a key factor in success. Our results demonstrate that the direction of in-depth technological cooperation (D2), although it requires higher costs and entails increased risks, provides significant innovation advantages. This is consistent with the author's conclusions regarding the search for a compromise between benefits and risks, where state authorities should provide appropriate conditions for attracting private investment.

Comparing our findings with the study by Hrytsenko et al. (2021) on risk management in public-private partnership projects confirms the importance of methodical analysis and clear risk allocation between participants. According to the BOCR method, high-risk and cost indicators (especially for D2) are compensated by greater benefits and opportunities. This illustrates the thesis that a careful partnership structure aimed at minimizing critical threats can provide higher payback and strategic gain in the future.

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Tian et al. (2023) study shows that a proper "relational" model of public-private partnership management contributes to increased sustainability and stability of projects. Our results, which show the advantage of D2 despite its riskiness, resonate with the idea that partnerships should include flexible coordination mechanisms, as well as incentivize participants to jointly manage risks and costs.

Shkurenko (2021) presents a somewhat different perspective, considering public-private partnerships as an instrument for the transition to a circular economy. Within the agribusiness sector, this concept may mean the introduction of environmentally friendly technologies, which is particularly relevant for D2, as active digitalization allows for better control of resource consumption and minimizes the environmental footprint. Such a "green" dimension of the partnership strengthens long-term competitiveness and security.

Jayasena et al. (2023) emphasize the potential of public-private partnerships in building "smart" infrastructure. Our vision of D2 as a strategy for a digital breakthrough in the agribusiness sector is consistent with the idea of "smart infrastructure", where technological solutions not only increase efficiency but also form a new model of market relations and interaction with the state. However, as in the case of Hong Kong, access to finance and competent personnel remains a key obstacle.

Akomea-Frimpong et al. (2023) emphasize global challenges, in particular the COVID-19 pandemic. Their conclusions about the need for flexible responses of partners to crisis situations echo our recommendations to use digital and innovative solutions (D2). After all, they allow for faster adaptation and minimizing losses in conditions of significant uncertainty.

The previously mentioned methodological component of assessing public-private partnerships, proposed by Kuznetsova and Maslov (2021), emphasizes the importance of forming clear organizational and economic mechanisms for such cooperation. Our results indicate that the implementation of the mechanism of in-depth technological cooperation should be based on appropriate organizational structures and motivational levers. A balanced system of incentives can mitigate risks and optimize costs.

Finally, it is worth mentioning the work of Megawati et al. (2024), which emphasizes the role of "green" government initiatives in ensuring sustainable development and improving the quality of public services. In the case of the agricultural sector, these initiatives are particularly relevant, since the industry affects both food security and the environment. Our recommendation to focus on promising innovative technologies in the D2 strategy (in particular, precision agriculture, reduced crop losses, and deep processing) is consistent with the logic of environmentally-oriented management.

Thus, a comparison with existing research reveals consistency and confirms the feasibility of the priority of the D2 direction (deep technological cooperation and digitalization). Despite the risks and costs, this vector corresponds to the global trends of "green" and "smart" development, allows for effective coordination of the interests of different participants and potentially increases the level of food security through the introduction of innovations.

CONCLUSIONS

Based on the conducted research, which was based on the application of the BOCR method, it can be argued that the considered strategic directions (D1 and D2) have different effects on the effectiveness of public-private partnerships in the field of security development of the agricultural sector. D1, namely the formation of innovation-oriented financing mechanisms and tax support, turned out to be less risky and less costly, which may be attractive to conservative investors and allow you to start implementing projects faster. However, this approach may limit the overall scale and innovation potential, since it focuses more on improving current mechanisms than on a radical technological breakthrough. In contrast, strategy D2, associated with the formation of a mechanism for in-depth technological cooperation and accelerating digital transformation, has higher risk and cost indicators, but at the same time offers more benefits and opportunities. This is due to the fact that deep digitalization and technological innovations require significant resource investments, infrastructure development, development of necessary personnel competencies and additional security measures. However, if successfully implemented, this strategy can significantly increase the competitiveness of the agricultural sector, open up new opportunities for exports, attract investors and create innovative jobs. Calculations made using the BOCR method showed that the D2 strategy ultimately receives a higher integrated indicator of benefits and opportunities, which exceeds the negative impact of costs and risks. Thus, the overall priority index (U) is more attractive for D2, especially if we consider it from the perspective of its long-term impact on the security development and innovative activity of the industry. This indicates the feasibility of choosing D2 as the main vector of public-private partnership to prepare for the transition to a new technological order and integration into global food supply chains.

However, it should be emphasized that the success of the implementation of the D2 direction cannot be guaranteed without properly addressing the problems of staffing, financial sustainability of projects and the creation of an appropriate

regulatory framework that would stimulate the development and implementation of high technologies. A comprehensive approach is needed, where the state takes on the role of coordinator and guarantor of investment security, while private companies bring innovative potential and operational flexibility. Only under the condition of such synergy can we expect stable development of the industry and achievement of ambitious goals for the implementation of modern technological solutions.

Thus, the results of our study can serve as a guideline for both state bodies and private investors in the agricultural sector. The use of the BOCR method demonstrated the possibility of obtaining a structured assessment of two promising, but different in terms of complexity and risk, strategic directions. The final choice, according to the results obtained, leans towards the D2 strategy, which takes into account global trends in digitalization and innovative development. At the same time, before implementing D2, it is worth analyzing and mitigating the high risks and costs by developing a balanced public-private partnership model that will meet both security priorities and the requirements of efficiency and effectiveness in the medium and long term.

Regarding future research, it should be noted that it can be based on our findings. For example, because D2 prioritizes deep technological cooperation and digital transformation, a pressing research need is to define the digital platforms, data-sharing protocols, and cybersecurity safeguards required. Investigations can focus on building robust frameworks that facilitate data-driven decisions and at the same time ensure data privacy and system resilience.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ОЦІНЮВАННЯ СТРАТЕГІЧНИХ НАПРЯМІВ РЕАЛІЗАЦІЇ ДЕРЖАВНО-ПРИВАТНОГО ПАРТНЕРСТВА В ЦАРИНІ БЕЗПЕКОВОГО РОЗВИТКУ АГРОПРОМИСЛОВОГО СЕКТОРА

У статті проаналізовано особливості вибору оптимального стратегічного напряму підвищення ефективності механізмів державно-приватного партнерства в царині безпекового розвитку агропромислового сектора в умовах сучасних викликів і загроз. Дослідження охоплює два основні стратегічні напрями (D1 та D2), які розглянуті з позицій потенційних переваг, витрат, можливостей і ризиків. Основою методичного інструментарію є метод BOCR, що дає можливість оцінити не лише переваги та витрати, а й ризики та перспективи розвитку обраних стратегічних рішень. У процесі застосування підходу BOCR було сформовано критерії оцінювання для кожного елемента (B – переваги, O – можливості, C – витрати, R – ризики) та проведено парні порівняння, які дали змогу визначити вагу кожного критерію. Паралельно було розраховано узгодженість експертних оцінок шляхом обчислення відношення узгодженості, що підтвердило релевантність і достовірність отриманих результатів. За підсумками оціночних процедур було встановлено, що напрям формування механізму поглибленої технологічної кооперації та прискорення цифровізаційної трансформації (D2) має вищий глобальний пріоритет попри вищий рівень ризиків і більші витрати. Це зумовлено тим, що стратегія D2, окрім розширення інноваційних можливостей, сприяє створенню сприятливих умов для впровадження передових технологій, розвитку інфраструктури та залучення більшої кількості інвесторів до проєктів агропромислового сектора. Паралельно D2 відповідає потребам безпекового розвитку у воєнний та післявоєнний періоди, пропонуючи створення комплексних механізмів співпраці й прискорення адаптації до глобальних викликів.

Ключові слова: державно-приватне партнерство, агропромисловий сектор, безпековий розвиток, цифрова трансформація, метод BOCR, стратегічний вибір, ризики, інновації

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