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MECHANISMS OF PUBLIC-PRIVATE PARTNERSHIP IN FINANCING THE DEMINING OF THE TERRITORIES OF UKRAINE

Summary

The mechanisms of public-private partnership (PPP) in financing humanitarian demining of the territories of Ukraine and their impact on ensuring population safety and post-war recovery of the state have been examined. The current state of the problem of mined areas, the scale of humanitarian and economic risks, and the necessity of attracting private investments, international assistance, and public resources for effective land clearance have been analyzed. It has been established that public-private partnership serves as an effective instrument for implementing socially significant projects, allowing the combination of financial, managerial, and technological resources of the state and the private sector. It has been revealed that international experience in applying result-based financing models, blended finance mechanisms, and social impact bonds significantly enhances the effectiveness of humanitarian demining in high-risk zones. The role of modern technologies including robotic systems, unmanned aerial vehicles, and artificial intelligence in improving the accuracy, speed, and safety of demining operations has been analyzed. The necessity of systematic training of qualified personnel capable of working in complex conditions, in compliance with international safety standards and cooperation procedures between public and private entities, has been substantiated. The legal foundations for applying public-private partnerships in Ukraine have been established, ensuring procedural transparency and enabling the involvement of private and international resources. The effectiveness of PPP models in the demining sector such as BOT (Build-Operate-Transfer), concession agreements, and outcome-based PPPs has been demonstrated, as they facilitate investment attraction, stimulate innovation, and enhance quality control. The key role of international organizations including UNMAS, GICHD, and UNDP in coordinating actions, providing technical assistance, and guaranteeing part of the financial risks has been identified. The implementation of monitoring and performance evaluation systems, including geographic information systems (GIS), big data analytics, and transparent reporting, ensures resource accountability, objective analysis, and timely

identification of problem areas. The role of financial incentives including tax benefits, government guarantees, and result-oriented financing in creating conditions for active private sector participation in high-risk humanitarian demining projects has been disclosed. It has been summarized that the synergy of public, private, and international resources ensures a safe, economically efficient, and transparent process of territorial recovery, enhances the country's investment attractiveness, and contributes to the stabilization of the socio-economic situation. It has been substantiated that improving the mechanisms of public-private partnership in the field of humanitarian demining is a strategically important direction of Ukraine's post-war recovery, aimed at strengthening territorial security, attracting investment, developing technologies, and enhancing the international image of the state as a reliable partner in security and development.

Introduction

The problem of landmine contamination in Ukraine represents one of the most acute challenges of the current stage of state-building and post-war recovery. The large-scale mining of land as a result of hostilities poses a long-term threat to the lives and health of the population, hinders the effective use of natural and industrial resources, and significantly complicates the processes of rebuilding the national economy. Mined territories lose their economic value, causing substantial financial losses to the state, businesses, and local communities.

The process of humanitarian demining requires enormous financial, material, technical, and human resources. According to expert assessments, state funding alone is insufficient to ensure the scale and systematic nature of such operations. Therefore, there is an objective need to attract private capital, international technical assistance, and investment mechanisms, which can be effectively implemented through instruments of PPP.

Public-private partnership is an effective form of cooperation between the state and the business sector, aimed at implementing socially significant projects by combining financial resources, managerial competencies, and technological capabilities of both parties. The use of PPP mechanisms in the field of land demining makes it possible not only to optimize the financing structure but also to enhance the efficiency of resource utilization, ensure project management transparency, and promote the introduction of innovative approaches in the fields of security and recovery.

The relevance of this research topic is determined by the need to develop effective financial and organizational instruments capable of ensuring sustainable and long-term financing of humanitarian demining processes. Under current conditions, this issue is not only a matter of security but also an essential prerequisite for restoring economic activity, attracting investments, and increasing the socio-economic stability of the state.

The purpose of the study is to substantiate the theoretical foundations and develop practical recommendations for the application of public-private partnership mechanisms in financing the demining of the territories of Ukraine.

Chapter 1. Theoretical framework of public-private partnership in the context of demining operations in Ukraine

In recent years, the development of PPP in Ukraine has gained new significance due to the urgent need for economic recovery following the large-scale destruction caused by military aggression. Since 2022, Ukrainian scholars have primarily focused on identifying effective financial mechanisms for attracting private capital to socially important projects, which is directly relevant to the issue of financing demining activities.

Among recent studies, the works of Y. Yevtushenko, R. Lomonos, and R. Bessarab deserve attention, as they focus on the financial aspects of PPP development in Ukraine [34]. The authors examine the peculiarities of forming and distributing financial flows between partners, managing risks, and ensuring project investment attractiveness. In the context of demining, these provisions are significant because they help identify which models of financial interaction between the state and the private sector can ensure sustainable funding for humanitarian initiatives.

The studies by L. Kostyrko, R. Kostyrko, and L. Zaitseva explore PPP as an instrument for financial support in the energy sector [12]. Although their analysis focuses on energy, the authors propose universal approaches to managing financial risks, structuring agreements, and ensuring transparency in partner interactions, which can be adapted to the demining sphere. A valuable contribution has been made by S. Kulikova and O. Zakharchenko, who systematized financing strategies for infrastructure projects within PPP frameworks [15]. The researchers emphasize the importance of blended financing sources combining public funds, private investments, and international assistance. This approach is particularly relevant to demining projects, which require substantial financial resources and have long payback periods.

The scientific works of H. Azarenkova reveal the essence of the PPP mechanism, its principles, implementation stages, and key success factors [3]. The author highlights the need to improve project management efficiency and enhance the legal framework for PPPs. These aspects are especially important for developing regulatory foundations to involve private entities in financing demining activities. In his studies, S. Makukh identifies key problems in the development of PPPs in Ukraine, including the lack of effective financial guarantees for private partners, unclear risk allocation, and imperfect mechanisms of state support [17]. These deficiencies are critical for potential demining projects, where the risk level is particularly high and financial returns are often indirect.

An important contribution to understanding the specific conditions of today is made by A. Ryzhkova, who analyzes the prospects for PPP development under martial law [31]. The scholar identifies priority sectors of the economy where PPPs can be most effective and emphasizes the role of the state in creating incentives for business participation. These insights are highly applicable to humanitarian demining, which requires the combination of security and economic solutions.

Particular attention should be given to the work of V. Umantsiv devoted to the analysis of humanitarian demining in Ukraine. The authors study the scale of the problem, the structure of funding, and the role of international donors in supporting

demining initiatives [33]. Although the study does not directly address PPP mechanisms, its findings can serve as a foundation for substantiating the need to involve the private sector in financing these processes.

Summarizing the results of the analysis, it should be noted that most Ukrainian scholars consider public-private partnership a promising instrument for financing infrastructure restoration, developing strategic industries, and implementing socially significant projects. At the same time, the application of PPP mechanisms in the field of humanitarian demining remains insufficiently explored. This creates a scientific niche for further research aimed at developing effective financial and organizational partnership models capable of ensuring sustainable development and territorial security in Ukraine.

International studies demonstrate that public-private partnership is an effective instrument for mobilizing private resources to implement socially significant projects, especially under conditions of limited public funding and high risk. Most authors emphasize that successful PPP implementation requires legal certainty, an effective management system, clear risk allocation, and transparent control mechanisms. These factors foster trust between public and private partners and ensure the financial stability of projects. The key studies of foreign scholars regarding the formation of PPP mechanisms in financing the demining of Ukraine's territories are presented in Table 1.

Analysis of foreign scientific sources indicates that PPP, combined with innovative financial instruments and international guarantees, can provide effective and stable financing for humanitarian demining programs. However, the success of such models largely depends on legal certainty, transparency of procedures, a clear monitoring system, and the presence of political will.

Foreign researchers pay particular attention to the use of innovative financial instruments in the context of socially important programs, including humanitarian demining. Models such as blended finance, impact bonds, and outcome-based public-private partnerships allow for the combination of public and donor funds with private investments, simultaneously reducing risks for the private sector and increasing project management efficiency. Payments to private partners are usually made upon the achievement of specific, measurable outcomes, facilitating better coordination of the interests of the state, businesses, and international donors.

Studies show that international organizations such as UNDP, UNMAS, and GICHD play a key role in creating conditions for private sector participation in humanitarian demining. They provide technical support, quality standards, monitoring systems, and assume part of the financial risks, making projects more attractive to private investors and enabling the implementation of technological innovations such as unmanned systems, robotic complexes, and specialized mine-detection equipment [9]. At the same time, foreign scholars emphasize that the application of PPP in high-risk sectors has limitations, including high transaction costs, complexity in monitoring work quality, the need for complex legal contracts, and dependence on political stability. In the case of demining, additional risk factors include operational instability and challenges in evaluating the economic efficiency of cleared territories.

Table 1

Views of foreign scholars on public-private partnership in financing the demining of the territories of Ukraine

№	Researchers	Research Focus
1.	Regan M.	Research conducted by the scholar demonstrates that the PPP mechanism can be an effective instrument for financing humanitarian demining in Ukraine. The author proposes two main approaches: Sustainability-Linked Bonds (SLB) and Outcome-Based Public-Private Partnerships (OB-PPP). Both approaches involve attracting private capital, with SLBs providing investors with returns based on the achievement of specific environmental and social targets, while OB-PPPs are oriented toward concrete results in demining and infrastructure restoration.
2.	Batjargal T.	The scholar examines financial models of public-private partnership (PPP) as a means of minimizing risks for private investors. According to the researcher, the key elements of successful partnership include the use of outcome-based contracts, where funding is provided only upon the achievement of specific objectives. This approach ensures a balance between the interests of the state, the private sector, and donors, while simultaneously enhancing the efficiency of resource utilization.
3.	Marana P.	Researchers have developed the concept of blended finance for humanitarian demining. They note that blended finance enables the combination of donor grants, public funds, and private investments, thereby reducing financial risk for the private sector. The use of instruments such as Outcome-Based Public-Private Partnerships (OB-PPP) and Sustainability-Linked Bonds (SLB) encourages investors to participate in projects with high social impact but low commercial returns.
4.	Azarian M.	An important aspect of private sector engagement, according to scholars, is the role of international organizations in providing guarantees and standardizing processes. Researchers emphasize that UNMAS, GICHD, and UNDP act as intermediaries and assume part of the financial risks, making demining projects more attractive to private partners. They also highlight the importance of technical expertise and the implementation of modern technologies in the demining process.

Source: compiled by the authors using sources [2; 4; 18; 28]

Overall, the analysis of international research demonstrates that PPP, in combination with international guarantees and modern financial mechanisms, can provide sustainable financial support for humanitarian demining programs. Nevertheless, the effectiveness of these models largely depends on the existence of transparent legal conditions, a clear risk allocation system, and long-term contracts that ensure mutual obligations of the state, private sector, and donors.

As indicated by the analysis of both domestic and foreign studies, PPP represents an organizational and legal form of interaction between the state and private entities aimed at implementing socially significant projects that require substantial financial, technological, and managerial resources. In scientific research, PPP is defined as a long-term cooperation based on the shared allocation of duties, risks, and financial outcomes between the state and private partners. The primary objective of such collaboration is to attract additional resources and enhance the efficiency of managing social, infrastructural, or security-related projects.

Analysis of current domestic scientific sources shows that the concept of “mechanisms of public-private partnership in financing the demining of Ukraine’s territories” has not yet received a distinct theoretical definition or systematic coverage in scholarly publications. Despite numerous studies on PPP, humanitarian demining financing, and post-war territorial recovery, no contemporary Ukrainian scholars, among others have applied this term as an independent scientific concept in works published since 2022.

The analysis of scientific publications indicates that there are related studies covering PPP mechanisms in general, including their legal, economic, and organizational aspects; financial instruments for the restoration of territories affected by military actions such as blended finance, outcome-based financing, and international donor participation; and technological and managerial aspects of humanitarian demining, including robotic complexes, unmanned systems, personnel training, and project evaluation. However, no research integrates these areas into a single concept systematically describing PPP mechanisms specifically for financing the demining of Ukraine’s territories. The absence of such a term in scientific discourse creates a gap in the theoretical framework and highlights the need for further research to develop a conceptual foundation. Thus, it can be concluded that the concept of “mechanisms of public-private partnership in financing the demining of Ukraine’s territories” has not yet been established in domestic scientific literature, creating a perspective for further scholarly exploration and the formation of a comprehensive theoretical framework integrating economic, legal, and technological aspects of humanitarian demining project management through PPP [34].

In Ukraine, the development of PPP is regulated by a set of normative legal acts that define the legal basis, interaction mechanisms, duties, and responsibilities of the state and private partners. The primary purpose of legal regulation is to ensure transparency, predictability, and efficiency in the implementation of projects involving private capital.

Key legislative acts include the Law of Ukraine “On Public-Private Partnership” № 1085-IX of 2020 [16], which establishes general principles and forms of PPP, defines contract procedures, risk allocation mechanisms, and ways to control the fulfillment of obligations. The law stipulates that PPP can be implemented through concessions, joint ventures, build-operate contracts, and outcome-based agreements. It provides the legal grounds for interaction among the state, local governments, and private businesses in projects of strategic or social significance. Additionally, the Law of Ukraine “On Public-Private Partnership” plays an important role in reforming mechanisms for attracting private investment for infrastructure development and post-war territorial recovery, contributing to an improved investment climate, enhanced transparency, and effective implementation of PPP projects. The successful realization of this law depends on the effective implementation of its mechanisms and procedures, as well as proper oversight of compliance.

Cabinet of Ministers resolutions play a crucial role in ensuring legal conditions for PPP, detailing project implementation mechanisms and regulating financial and organizational aspects of state-private sector cooperation. For example, the Resolution of the Cabinet of Ministers of Ukraine “On Approval of the Procedure for

Allocating Funds for the Preparation of PPP Projects and the Fulfillment of Long-Term Obligations under PPP regarding State-Owned Facilities" № 222 of 14.03.2023 [29] sets general requirements for project preparation, selection procedures, implementation stages, and efficiency assessment criteria. The Order of the Ministry of Economy of Ukraine №. 1067 of 14.12.2021 "On Approval of the Methodology for Analyzing the Effectiveness of PPP Implementation" [22] defines mechanisms for analyzing results, financial and social indicators, facilitating evaluation of resource utilization efficiency.

In the context of humanitarian demining, these normative legal acts can be adapted to ensure effective financing and program implementation. The application of effectiveness assessment procedures allows monitoring of land clearance results, while the use of state guarantees promotes the involvement of private companies and international donors. Combining national legislation with international standards and recommendations, e.g., from UNDP, UNMAS, and GICHD, enhances procedural transparency, ensures safety, and facilitates effective risk management inherent to high-risk projects. Legal and regulatory support for PPP in Ukraine thus creates the framework for attracting private capital, defining risk allocation mechanisms, and controlling obligation fulfillment, ensuring compliance with international standards particularly relevant for humanitarian demining, where transparency, long-term efficiency, and territorial safety are critical.

Forms of PPP differ according to the private partner's level of involvement, financial contribution, and project responsibility. Among the most common forms are BOT, concessions, and outcome-based PPP (see Fig. 1).

The choice of PPP form depends on project objectives, the level of private investment, acceptable risk to the state, and the need to ensure financial attractiveness for the private partner. For humanitarian demining projects, a combination of BOT, concessions, and OB-PPP is most appropriate, allowing effective mobilization of private resources, quality control of operations, and promotion of innovative technologies. In the post-war recovery period, Ukraine will face the challenge of ensuring safe access to territories affected by armed conflict, necessitating a large-scale and efficient demining process.

This process is characterized by high financial, technological, and managerial requirements that significantly exceed the state budget. International experience demonstrates that applying PPP mechanisms in demining is an effective tool for mobilizing additional resources, optimizing risk management, and increasing the overall efficiency of humanitarian programs. Analysis of practices in other countries shows that key success factors for PPP include a transparent legal framework, clear allocation of responsibilities between the state and private partners, and the participation of international donor and technical organizations.

For example, in Cambodia, government agencies collaborate with private companies and international foundations within the framework of humanitarian demining programs, allowing for an optimal combination of state resources and foreign aid. This approach not only increases the volume of financing but also enhances the efficiency of operations through the implementation of quality control and safety standards.

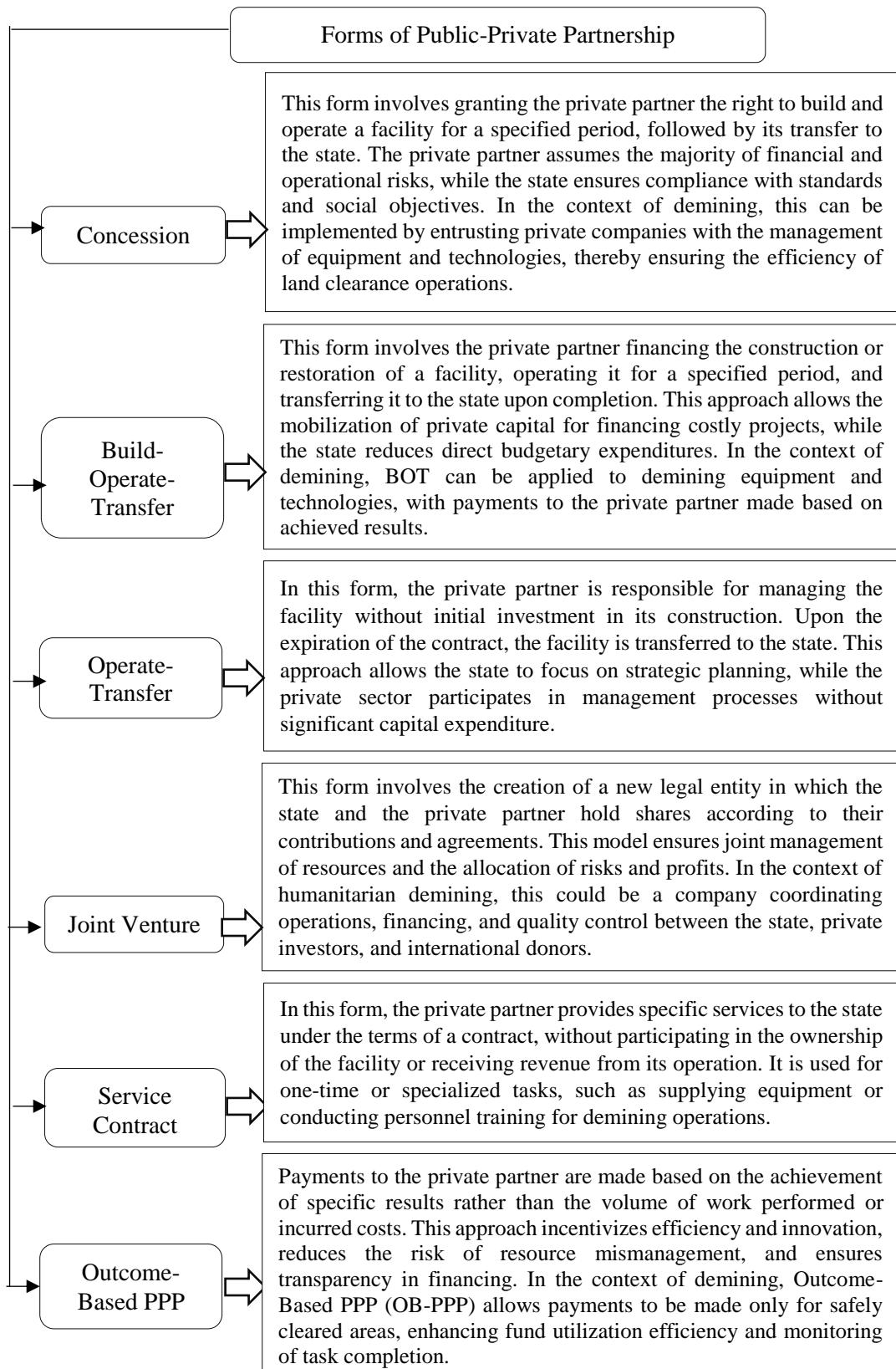


Figure 1. Forms of public-private partnership in the process of demining operations

Source: compiled by the authors

In Colombia, a national demining strategy has been established, which actively involves the private sector and donors through outcome-based financing models. Private companies are compensated only upon achieving specific results, such as clearing designated areas or restoring infrastructure. This approach improves accountability and operational efficiency while reducing financial risks for both the state and private partners.

Afghanistan demonstrates another approach to public-private partnership, where most demining programs are implemented with the participation of international organizations, such as HALO Trust, acting as coordinators and guaranteeing part of the private partners' risks. This enables the attraction of foreign investments and ensures the standardization of operations, thereby improving safety and project quality. Similar models are applied in Yemen, where the government initiative "Masam" combines state resources, international aid, and private companies to implement humanitarian demining programs under challenging operational conditions.

International experience also highlights the importance of employing modern technologies to enhance the safety and efficiency of demining. The use of robotic complexes, unmanned aerial vehicles, and artificial intelligence systems allows for rapid identification of hazardous areas, optimization of operational routes, and reduction of personnel risks. In Colombia and Cambodia, these technologies have significantly shortened project timelines and improved the accuracy of contaminated area assessments.

Overall, international experience demonstrates that public-private partnership in humanitarian demining is an effective tool for mobilizing resources, improving operational quality, and ensuring safety. Its adaptation in the Ukrainian context can facilitate a systematic and secure process of territorial restoration in areas affected by armed conflict, contributing to socio-economic stabilization and sustainable national development.

Chapter 2. Financial instruments of the public-private partnership mechanism in the demining of Ukrainian territories

Financial components are one of the key elements of the effective functioning of public-private partnership mechanisms in the field of humanitarian demining. In conditions of high risk, limited state funding, and long project implementation periods, ensuring a stable financial flow becomes a critical requirement for achieving strategic objectives. The primary goal of the financial components of public-private partnerships is to create a balanced system of interaction between the state, private partners, and international donors, enabling efficient mobilization and utilization of resources for the demining of territories affected by armed conflict.

With the onset of Russia's full-scale invasion of Ukraine in 2022, the country experienced widespread contamination by landmines and unexploded ordnance (UXO). According to the State Emergency Service of Ukraine, as of August 2025, approximately 25% of the country's territory, or around 139,000 km², is potentially contaminated with mines and explosive devices [26]. Analytical data from the Institute of International Political Studies indicate that the area of Ukraine requiring

humanitarian demining exceeds the size of England (130,000 km²). This places Ukraine among the most heavily mined countries in the world, posing a significant threat to the life and health of civilians residing in hazardous areas. It is estimated that over 6 million people are at direct or potential risk of explosive device-related injuries [11].

Agricultural areas in Kharkiv, Sumy, and Zaporizhzhia regions have been particularly affected, where active mine contamination significantly complicates agricultural activities and regional economic recovery. According to the State Emergency Service of Ukraine, since the beginning of the military aggression, 359 civilians have been killed, including 18 children, and nearly 1,000 injured, confirming the high social danger of contaminated areas [26]. The explosive devices most commonly encountered in these territories include large anti-tank and anti-personnel mines containing 5–10 kg of explosives, as well as ordnance dropped from unmanned aerial vehicles. Their detonation under heavy machinery or civilian transport renders the demining process complex and hazardous, especially for sappers and local populations.

According to the Action Plan for the Demining of Agricultural Lands approved in March 2023, 470,000 hectares of agricultural land were identified as potentially contaminated and prioritized for clearance. In 2023, 274,000 hectares were surveyed and cleared where necessary, with 208,000 hectares returned to agricultural use. As of August 2025, Ukraine continues active efforts to clear agricultural lands of explosive devices. According to the Ministry of Economy, Environment, and Agriculture of Ukraine, nearly 6,000 hectares of liberated lands were cleared in August 2025.

According to the Committee on Agrarian Policy and the Resolution of the Cabinet of Ministers of Ukraine “On Approving the Procedure for Using Funds Allocated in the State Budget for Compensation of Humanitarian Demining Costs of Agricultural Lands” dated March 12, 2024, № 284 [30], which defines the mechanism for utilizing state budget funds under the program “Compensation of Humanitarian Demining Costs of Agricultural Lands” aimed at restoring agricultural production on demined plots, this mechanism also accelerates the land clearance process. From the program's inception to the end of July 2025, 76 contracts were signed for clearing 14,308.9 hectares of agricultural land, totaling UAH 853.1 million [20].

Starting October 13, 2025, the program was expanded to include households. Owners of land plots subject to humanitarian demining are eligible to submit applications for inclusion in compensation programs through the State Agrarian Register. In cases where electronic submission is not feasible, applicants may submit documents in person or electronically using a digital signature. Paper applications are sent to the respective local executive authorities or local self-government bodies at the location of the land plot or to the official email address designated by these bodies.

Upon receiving an application, executive authorities and local self-government bodies verify the accuracy of the submitted information within three working days. If the information is inaccurate or proof of land ownership is absent, the application is rejected. Upon approval, the landowner is included in the list of agricultural producers entitled to receive compensation. This list, along with electronic copies of

applications, is sent monthly by the fifth day to the Humanitarian Demining Center, which then conducts a full verification of the applicant and the land plot.

The Humanitarian Demining Center reserves the right to reject an application in the following cases:

1. Provision of information by the Mine Action Center regarding the impossibility of clearing the land plot due to an unstable security situation.
2. Lack of data from the Mine Action Center regarding the presence or potential contamination of the plot with explosive devices (ED).
3. Non-compliance of land characteristics or ownership with the conditions specified in the relevant procedure.

After approval of the application and opening of an escrow account by the applicant, the Humanitarian Demining Center signs an agreement and announces a demining services procurement auction.

Gradual territory clearance has already yielded some results. Compared to the end of 2022, the area of potentially mined land has decreased by over 20%, now totaling approximately 137,000 km², mostly agricultural land [11]. However, clearance rates remain insufficient, indicating the need for intensified efforts. Demining operations are carried out by the State Emergency Service of Ukraine, the National Police, the Ministry of Defense, and non-governmental mine action operators. Currently, 112 certified operators, including 8 foreign ones, are active in Ukraine, along with over 9,000 specialists, 278 units of specialized demining and earth-moving equipment, and more than 13,000 metal detectors [21]. According to the Accounting Chamber of Ukraine, from 2022 to July 2025, only 7,750 hectares of agricultural land were cleared, representing only 0.08% of contaminated lands. At the current rate, full clearance of agricultural lands in Ukraine could take over 80 years [22]. These data highlight the necessity of strengthening efforts in humanitarian demining, including mobilizing additional resources, improving compensation programs, and actively cooperating with international partners.

Financial and material support from international partners plays a key role in accelerating the demining process. In 2025, contributions to the accounts of the Ukraine Demining Capability Coalition (DMCC) reached €93 million, and €700 million is expected by 2034 for the procurement of specialized equipment. Additionally, Canada allocated approximately USD 11.7 million to support humanitarian demining [8].

An important direction for improving operational efficiency is the introduction of innovative technologies. The Ministry of Defense of Ukraine is considering the creation of a modern testing ground for new solutions, including artificial intelligence applications, which will increase the accuracy of demining operations and reduce risks to personnel. According to the Ministry of Environmental Protection and Natural Resources of Ukraine, clearing priority areas, including protected zones, will require approximately 10 years and around USD 38 billion. Complete clearance of the country, given the scale of contamination and complexity of territories, may take centuries, highlighting the need for a systematic and multi-level approach to humanitarian demining management.

Information from the Ministry of Economy of Ukraine regarding financial needs for clearing priority areas allows assessment of the problem's magnitude and identification of key directions of state policy in security and humanitarian recovery. According to official data, approximately USD 38 billion is required to clear priority lands, confirming estimates from the Ministry of Environmental Protection and Natural Resources of Ukraine. This indicates massive economic costs associated with security risks and the restoration of territories affected by military actions. Full clearance of Ukraine from mines and explosive devices is expected to be a decades-long process, emphasizing both the humanitarian and economic dimensions of the problem.

Based on these figures, several key conclusions can be drawn. First, the volume of financial resources significantly exceeds the domestic capacity of the Ukrainian state budget, especially considering the current war-affected economic conditions. This necessitates mobilization of international assistance, donor grants, loans from international financial institutions, and the use of public-private partnership mechanisms. Second, the prolonged duration of land clearance indicates that the demining strategy must be comprehensive and multi-level. A phased approach is required, beginning with priority agricultural and populated areas and gradually extending to less urgent sites. Such an approach will optimize the use of limited resources and minimize socio-economic losses.

Economic analysis of demining costs and efficiency is particularly important. The estimated USD 38 billion includes not only direct expenses for demining operations and equipment procurement, but also associated costs for personnel training, worker safety, disposal of explosive devices, and infrastructure restoration. From a financial perspective, there is potential to reduce costs through the application of modern demining technologies, such as unmanned systems, robotic complexes, and remote mine detection methods. The use of such technologies can significantly reduce risks to personnel and accelerate the land clearance process.

An essential component of the analysis is also the social and economic impact of demining. The return of land to agricultural use, restoration of infrastructure, and safe habitation in affected areas contribute to economic stabilization, business development, and improvement of social welfare. In this context, demining funding should not be viewed solely as an expenditure, but as an investment in the long-term development and security of the country.

Information provided by the Ministry of Economy highlights the scale of the demining problem, the high level of financial requirements, and the lengthy nature of the process. To ensure effective resource utilization, state funds must be combined with international assistance, the private sector should be engaged, innovative technologies introduced, and a comprehensive system of planning and monitoring applied. Such an approach will not only ensure citizen safety but also facilitate economic recovery and stability in areas affected by armed conflict.

Analysis of existing statistics and resource capacity indicates that Ukraine requires not only substantial financial and technical resources but also active coordination between state authorities and international partners. Integration of modern technologies, training of highly qualified personnel, strategic planning, and financial

support from donors remain key factors capable of ensuring effective and safe land clearance. Given limited state resources and the need for rapid recovery, Ukraine must implement effective mechanisms for demining financing. One such mechanism is PPP, which allows the involvement of the private sector and international donors in funding and implementing demining programs. However, for PPPs to function effectively, an appropriate legal, organizational, and financial framework must be developed [19].

In this context, it is crucial to analyze the financial components of the public-private partnership mechanism, including sources of financing, mechanisms for private sector engagement, the role of international donors, and the efficiency of fund utilization. This analysis will identify the advantages and disadvantages of existing approaches and allow the development of recommendations for improving the financial component of public-private partnerships in the demining of Ukrainian territories. The main financial instruments of PPPs in the demining sector are illustrated in Figure 2.

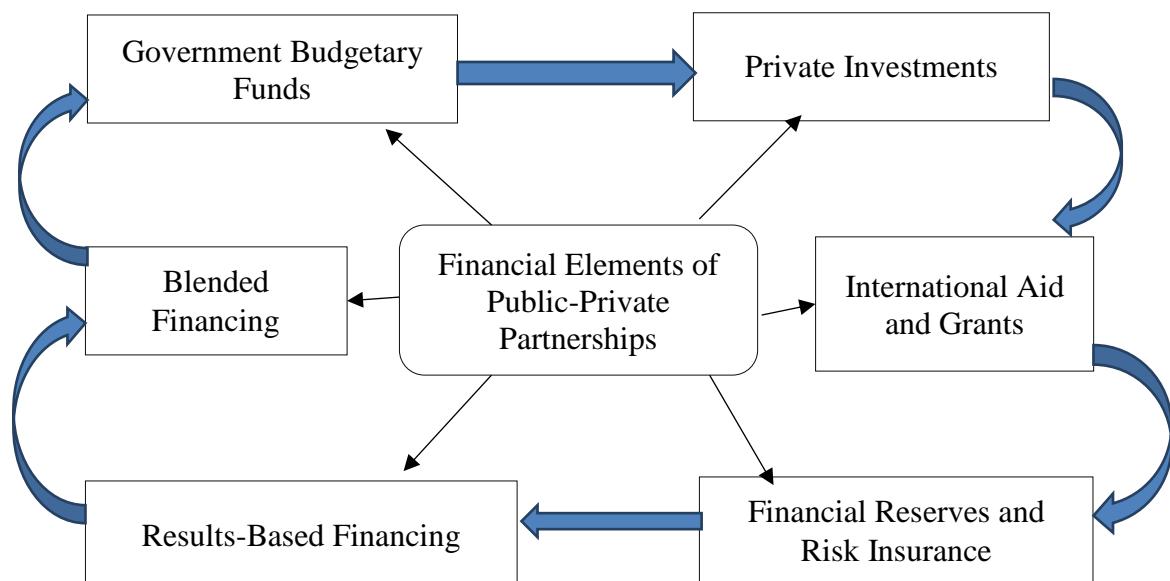


Figure 2. Financial instruments of public-private partnership in the field of demining

Source: compiled by the authors

It is important to examine each of the financial instruments PPPs in the field of demining:

1. State budget funds, which are provided by the government acting as the initiator of demining projects and ensuring a basic level of financing through relevant state programs and special funds. Budgetary resources are intended to cover core operational expenses, personnel training, procurement of equipment, and organization of monitoring and control over project implementation. Successful financial participation by the state establishes a foundation for attracting private capital and international assistance, enhancing trust in the project.

The state acts as the initiator of demining projects and provides baseline funding through dedicated state programs and special funds. In 2024, pursuant to the Cabinet of Ministers of Ukraine Order “On the transfer of funds from the account for financing humanitarian demining activities, opened for the Ministry of Economy at the National Bank” dated April 23, 2024, No. 343-r, funds amounting to UAH 98 million were allocated to finance humanitarian demining activities [23]. These funds were distributed through the Ministry of Economy of Ukraine to the State Emergency Service of Ukraine, the Ministry of Internal Affairs of Ukraine, and the Administration of the State Special Transport Service of the Ministry of Defense of Ukraine to implement humanitarian demining measures.

2. Private investments from the private sector, which involve participation by companies investing financial and technological resources in demining projects. Private investment in demining can take several forms. First, direct capital contributions to establish or modernize enterprises specializing in mine action, which enhances production capacity and facilitates the adoption of advanced technologies. Second, investments in the procurement of specialized equipment, such as metal detectors, robotic complexes, and demining vehicles, which increase operational efficiency and reduce personnel risk. Third, private companies may provide consulting, engineering, and training services, ensuring proper operational planning, personnel preparation, and compliance with international safety standards.

The effectiveness of private investment depends largely on the presence of incentives and guarantees. Government financial incentives, such as tax breaks, subsidies, and compensation mechanisms, reduce financial risks for investors and increase the attractiveness of participation in high-risk projects. Simultaneously, state guarantees for investment returns or partial cost coverage in case of unforeseen circumstances foster business trust in state programs. Clear regulation of contract terms, including transparent risk-sharing mechanisms and defined responsibilities for participants, is essential for attracting capital and forming a stable partnership between the state and private companies [7].

Analytical data indicate a gradual increase in private investment in mine action in Ukraine. Some international mine action operators working in the country receive funding in the form of direct investments or grants from private foundations and companies. According to the Humanitarian Demining Center, by 2025, approximately 20% of demining equipment and some services are provided by private entities, demonstrating the potential of the private sector to ensure sustainable financing. The effectiveness of such investments largely depends on integration with state programs and coordination with international donors, allowing for maximum synergy of resources and technology.

Private investments play a critical role in the development of the humanitarian demining system in Ukraine. Their effectiveness requires a combination of financial incentives, state guarantees, and transparent contractual mechanisms. In the long term, private sector participation will accelerate land clearance and create sustainable financing models capable of adapting to high-risk environments while ensuring population safety [17].

3. International aid and grants, provided by organizations such as UNDP, UNMAS, GICHD, UNOPS, and others. These resources can be allocated as grants, technical assistance, risk insurance, or partial cost coverage. International funding helps to offset limitations of the state budget and provides conditions for attracting private sector participation by reducing financial risk.

Since the start of the full-scale war, Ukraine has received substantial support from international partners. In the first half of 2025, the state budget received USD 22 billion in external financing, including contributions from G7 countries and the EU through the ERA mechanism. These funds were directed to various needs, including humanitarian assistance, infrastructure reconstruction, and demining. Overall, since the beginning of the full-scale war, international partners have provided Ukraine with approximately USD 73.7 billion in direct budget support. International partners actively support demining activities. By 2034, participants of the Demining Coalition will provide Ukraine with EUR 700 million for demining equipment procurement. Canada, in particular, will allocate CAD 15 million (approximately USD 11.7 million) to demining efforts. In 2025, contributions to the Demining Capacity Coalition of Ukraine (DMCC) accounts reached EUR 93 million [8].

4. Blended finance, applied to enhance the resilience and effectiveness of demining projects, combines state funds, private investments, and donor grants. The blended finance mechanism allows optimal distribution of financial risks among project participants. State and donor funds can be used to provide concessional loans, partial loss guarantees to private investors, or grants covering part of the costs. This approach enables private investors, who might otherwise be deterred by high-risk conditions, to actively participate in financing, thereby increasing the overall resilience and efficiency of demining projects.

International experience demonstrates the effectiveness of applying blended finance models in high-risk sectors. For instance, in 2024, the European Union allocated approximately €1.5 billion to support high-risk investments in Ukraine through blended finance mechanisms, which included demining projects. Similarly, the IFC-Netherlands program targeting the MENA region attracted \$22 million in private investments for projects with significant socio-economic impact, where purely commercial investor motivation was insufficient. These examples confirm that integrating state and donor resources with private funds creates conditions for financial stability and long-term project implementation in high-risk environments.

In Ukraine, the application of blended finance in the field of demining includes several key components. First, it involves combining state funds, private investments, and donor grants to reduce risks and ensure project sustainability. Second, establishing effective partnerships between government agencies, international organizations, and private companies is crucial, as it enhances coordination and monitoring of project execution. Third, the use of modern demining technologies, including unmanned systems, robotics, and specialized equipment, contributes to increased operational efficiency and reduced personnel risk [9].

Despite the effectiveness of blended finance, there are certain challenges limiting its application in demining projects. These include a high level of operational risk associated with the unstable security situation in areas requiring clearance, as well as

legal uncertainty regarding the conditions of private partner participation. In addition, the limited number of private investors willing to engage in high-risk projects necessitates the creation of additional incentives, guarantees, and transparent contractual conditions.

The prospects for the development of blended finance in Ukraine are linked to strengthening partnerships, implementing innovative technologies, and improving the regulatory and legal framework. Engaging international donors and financial institutions in such projects ensures both technical support and partial mitigation of financial risks. The adoption of modern technologies increases operational efficiency, while a transparent project management system strengthens investor confidence and ensures the long-term sustainability of projects.

It can be concluded that blended finance is an effective instrument for mobilizing private and international resources for demining projects in Ukraine. Its application allows for risk reduction for investors, more efficient use of resources, and ensures the long-term sustainability of projects. At the same time, the success of such mechanisms largely depends on the establishment of a reliable legal framework, an effective management system, transparent contractual conditions, and active participation of international partners.

5. Outcome-Based Financing (OBF) – this instrument involves payment only upon the achievement of specific, measurable results, such as cleared land or the volume of work performed to ensure public safety. The essence of this approach lies in the fact that project funding is disbursed exclusively after predetermined, clearly defined, and measurable outcomes are achieved. In the context of demining activities, such results may include: a specified area cleared of explosive ordnance, the volume of work conducted to secure public safety, the number of personnel trained, or the implementation of quality control systems for project execution.

The application of Outcome-Based Financing in demining establishes an effective mechanism to incentivize the private sector and international donors toward maximum efficiency. In a traditional budgetary model, the risks of uneven or inefficient use of funds largely fall on the state or donors, reducing the attractiveness of project participation for private investors. Outcome-based financing addresses this issue by linking payment to the achievement of clearly defined goals, thereby reducing the likelihood of misallocation of funds and encouraging optimal planning and execution of operations.

International experience demonstrates the high effectiveness of outcome-based financing in sectors where traditional funding mechanisms fail to ensure adequate control over resource use and achievement of results. For example, in humanitarian demining programs in Afghanistan and Somalia, the introduction of outcome-based contracts allowed for precise determination of work scope, quality assessment, and financial transparency, which enhanced donor confidence and encouraged active participation of private companies in projects [3].

In the Ukrainian context, the application of OBF entails contracts between state agencies or international donor organizations and private demining operators, where financing is directly tied to the achievement of specific results. This approach balances the interests of three stakeholders: the state receives a guarantee of achieving

strategically important outcomes, private partners have clear and measurable performance criteria, and donors gain assurance of the effective use of their resources.

Analytical data indicate that the use of outcome-based financing increases project efficiency by 15–25% compared to traditional budgetary financing schemes. In the case of demining, where high-risk areas contain a significant density of explosive devices, this instrument allows for prioritization of resources, reduction of losses, and improved productivity of demining teams. The implementation of OBF also promotes the adoption of innovative technologies and modern operational methods. For instance, payment may be tied to the use of unmanned systems, robotic complexes, or automated methods for monitoring cleared areas. This provides an additional incentive for private companies to invest in advanced equipment and personnel training, which directly enhances operational safety and reduces the time required for land clearance.

In Ukraine, where mined areas extend across tens of thousands of hectares and funding is limited, the outcome-based approach enables the most efficient utilization of state and international resources. It ensures control over project results, enhances transparency and accountability, and simultaneously motivates the private sector to participate in high-risk and socially significant projects.

Thus, outcome-based financing serves as a key instrument for optimizing resources in humanitarian demining, combining economic efficiency with social responsibility. Its application ensures the achievement of the state's strategic goals, enhances private partner motivation, and strengthens international donor confidence, which is critically important for the stable and safe recovery of mined territories in Ukraine.

6. Establishment of Financial Reserves and Risk Insurance – given the high-risk nature of demining operations, it is necessary to create dedicated financial reserves and implement risk insurance mechanisms for private partners and personnel. Activities related to the detection and neutralization of explosive ordnance are inherently high-risk, as they involve potential human casualties, equipment damage, and losses of material resources. Consequently, to mitigate the economic consequences of unforeseen events, both the state and private partners must establish specialized financial reserves.

In the context of public-private partnerships, financial reserves act as a “buffer” to cover additional expenses in the event of unexpected circumstances, such as explosions in areas with a high density of mines, equipment damage, or project delays due to adverse weather or logistical constraints. According to international practice, such reserves are formed in the form of insurance funds, guarantee accounts, or special budgetary allocations, ensuring timely responses to force majeure events.

Risk insurance in humanitarian demining projects serves as an additional mechanism for protecting the financial interests of all participants. This includes personnel injury insurance, equipment and machinery insurance, and liability insurance for third parties. The implementation of such mechanisms increases the willingness of private sector participants to engage in high-risk projects, as it reduces potential financial losses and provides protection against unforeseen events. International experience indicates that in countries where comprehensive mechanisms of financial reserves and risk insurance are applied, the efficiency of

demining operations is significantly enhanced. For instance, in Colombia and Lebanon, government agencies and donor funds establish insurance pools for private operators, enabling rapid responses to incidents and avoiding delays in demining operations. This approach fosters trust among the state, international donors, and private partners [12].

In Ukraine, establishing financial reserves and implementing risk insurance is particularly relevant, given the scale of mined territories and the intensity of hostilities from 2022 to 2025. State programs should allocate funds to create insurance pools and reserve funds, ensuring continuity of operations even in the event of accidents or unforeseen circumstances. Simultaneously, private operators can enter into commercial insurance contracts covering personnel and equipment risks, while international donors may provide partial insurance guarantees to incentivize investment.

Integrating mechanisms for financial reserves and risk insurance within public-private partnerships ensures operational stability and continuity of demining activities, strengthens the financial resilience of project participants, and minimizes potential economic losses. Moreover, this approach creates favorable conditions for attracting private capital and international support, thereby enhancing the efficiency of project implementation under extremely complex and hazardous conditions.

In summary, the types of financing considered within the framework of public-private partnerships in demining in Ukraine demonstrate a comprehensive and interconnected nature of financial mechanisms that ensure sustainable project development and enhance operational efficiency. State budgetary funds serve as the foundation for organizing demining activities, providing basic financing for operations, personnel training, and equipment procurement. Timely and sufficient government funding establishes the conditions for attracting private capital and international donor resources, building trust in projects and increasing their resilience in a high-risk environment.

Private investments and international assistance are critically important for expanding financial capacity and introducing modern technologies in demining. The use of blended finance models and outcome-based financing mechanisms enables effective risk distribution, incentivizes the achievement of specific results, and improves the economic efficiency of projects. At the same time, the establishment of financial reserves and risk insurance ensures stability and continuity of operations, reduces potential losses, and facilitates the involvement of new partners. A comprehensive combination of these financial mechanisms, supported by a clear legal framework and coordinated efforts among the state, private sector, and international donors, lays the foundation for the long-term and safe restoration of mined territories in Ukraine.

Chapter 3. Prospects for applying public-private partnership mechanisms in financing the demining of Ukrainian territories

For Ukraine, the adaptation of international experience in public-private partnerships (PPPs) within the field of humanitarian demining involves several key directions:

1. Establishing a Legal and Regulatory Framework Defining the Rights and Responsibilities of the State, Private Partners, and International Donor.

One of the primary directions for improving PPP mechanisms in demining is the creation of a clear and comprehensive legal framework. The existence of legally regulated rules ensures clarity of rights and obligations for all participants, increases trust between state authorities, private partners, and international donors, and reduces the risks associated with legal uncertainty, which often hinders the attraction of private investments in high-risk projects.

The legal framework should regulate key aspects of cooperation: defining the functions and responsibilities of the state, including planning, oversight, and the provision of guarantees; the obligations of private partners regarding the execution of demining operations, compliance with safety standards, and efficient resource utilization; as well as the role of international donors and organizations providing financial support, technical assistance, and guarantees for partial risk coverage. Such regulatory clarity allows for the precise delineation of responsibilities and reduces potential conflicts of interest.

International experience shows that successful PPP programs in humanitarian demining are always based on legally established mechanisms. For example, in Colombia and Cambodia, the creation of relevant legal acts provided legal guarantees for private companies, enabling the effective attraction of investments and the implementation of long-term demining projects. In the absence of clear legal frameworks, transaction costs increase, oversight of project implementation becomes more difficult, and the risk of abuse rises, reducing the attractiveness of projects for investors.

For Ukraine, establishing a legal foundation involves not only passing legislation on public-private partnerships in humanitarian demining but also developing subordinate regulatory acts detailing the procedures for project preparation, implementation, and oversight. Additionally, it is advisable to introduce mechanisms for contract standardization, the definition of clear performance evaluation criteria, and transparent procedures for financial control [9].

Creating a legal framework is a fundamental step toward ensuring the effectiveness and stability of PPPs in demining. It fosters long-term collaboration among the state, private sector, and international donors, enhances the investment attractiveness of projects, and ensures the safety and efficiency of humanitarian demining operations in Ukraine.

2. Implementation of Outcome-Based Financing Models and Hybrid Mechanisms Combining Public, Private, and Donor Resources.

International experience in PPPs for humanitarian demining demonstrates a variety of financial models that effectively attract private investment and international assistance. One commonly applied approach is Outcome-Based Financing (OBF). In this model, the private partner is remunerated only after achieving predetermined results, such as clearing a specific area of mines or restoring safe access to critical infrastructure. This mechanism has been successfully applied in Colombia, where government agencies and international donors signed contracts with private

companies focused on specific socio-economic outcomes, enhancing partner accountability and the efficient use of resources.

Another effective approach is blended finance, which combines public funds, donor grants, and private investments. In Cambodia and Afghanistan, the use of this model enabled the stable financing of long-term humanitarian demining programs while reducing financial risk for the private sector. For example, in Cambodia, donor grants partially covered initial costs for staff training and equipment procurement, while private investors funded technological demining complexes.

Social or Impact Bonds have also found application in international practice. These bonds involve investors financing project implementation, with repayment by the state or international donors contingent on the achievement of specified social outcomes. In Yemen and several African countries, such bonds were used to attract private capital to demining projects where commercial profitability was low but social significance was extremely high [34].

An important element of international experience is also joint financing by public and private enterprises, where the state creates infrastructural conditions and guarantees part of the risks, while the private sector provides technologies and expert support. In Afghanistan and Cambodia, this model allowed the integration of local expertise with the technological potential of private companies, resulting in high operational productivity.

International experience indicates that the success of PPPs in demining largely depends on the involvement of organizations such as UNMAS, GICHD, and UNDP, which act as guarantors for partial risk coverage, oversee the quality of operations, and provide technical assistance. They also contribute to process standardization and coordination among different participants, increasing trust between the state and the private sector.

The application of such financial mechanisms allows not only for resource mobilization but also for ensuring the long-term sustainability of programs, which is critical in the context of demining, where project timelines may span years and investor risks remain high. For Ukraine, the adaptation of these PPP models allows for the combination of public funds, private investments, and international assistance, the creation of transparent and effective risk-sharing mechanisms, and the deployment of modern technologies to enhance operational safety. The implementation of these models will ensure systematic and efficient financing of humanitarian demining programs, support the restoration of affected territories, and protect the population from the threat of mines and unexploded ordnance.

3. Integration of Modern Demining Technologies and Training of Qualified Personnel for High-Risk Operations.

In conditions of high risk and operational complexity, traditional demining methods often prove insufficiently effective, increasing the likelihood of accidents and slowing down the pace of territory restoration. Modern technological solutions enhance the precision of mine and explosive device detection, reduce operational time, and minimize risks to personnel.

International practice demonstrates the use of robotic complexes, unmanned aerial vehicles (drones), autonomous sensor systems, and artificial intelligence-based

software capable of analyzing large datasets on contaminated areas and predicting hazard levels. For example, in Cambodia and Colombia, the implementation of robotic systems significantly reduced the time required to clear land and improved the accuracy of residual mine assessment. Using such technologies within a PPP framework allows private partners to invest in innovative solutions, while the state provides legal support and partial funding for their implementation.

Equally important is the training of qualified personnel capable of operating in high-risk environments. Effective training includes both technical competence in working with modern devices and robotic systems, as well as knowledge of international safety standards, legal norms, and procedures for coordination between state authorities, private companies, and international donors. International experience shows that successful PPP implementation is impossible without systematic preparation of local specialists capable of participating in long-term humanitarian demining projects.

For Ukraine, integrating modern technologies and training personnel involves establishing training centers and professional development programs in partnership with international organizations, private companies, and research institutions. This approach not only increases demining efficiency but also creates a professional workforce capable of supporting large-scale projects in high-risk conditions. Therefore, integrating modern technologies and systematic personnel training is a critical component for effective PPP implementation in demining, ensuring safety, precision, and speed, enhancing private-sector investment appeal, and promoting the sustainable development of humanitarian demining programs in Ukraine.

4. Ensuring Active Participation of International Organizations as Guarantors, Coordinators, and Technical Advisors.

International experience demonstrates that involving such organizations significantly reduces financial and operational risks, enhances transparency, and ensures compliance with international safety standards. International structures such as UNMAS, GICHD, UNDP, and other donor agencies perform several key functions. First, they provide guarantees for part of the financial risks, increasing private-sector interest in long-term humanitarian demining projects. Second, international organizations act as coordinators, ensuring interaction between government institutions, private partners, and donor structures. This coordination helps avoid duplication of efforts, optimizes resource utilization, and accelerates project implementation.

Furthermore, international organizations provide technical advisory functions, offering expert support in implementing modern technologies, risk assessment, and compliance with international safety standards. This is especially relevant for Ukraine, where the scale of contamination is significant and local specialists require additional training and support in using advanced demining technologies.

Integrating international organizations into the PPP process builds trust among participants, ensures procedural transparency, and increases the investment attractiveness of projects. They can act as intermediaries in contract negotiations, monitor project execution, and provide financial guarantees for the private sector. International experience shows that such approaches allow projects to be

implemented in complex operational environments, including zones with high risk to personnel and infrastructure.

For Ukraine, the active involvement of international organizations is strategically important as it enables the integration of state resources, private investments, and international assistance within a unified project management system for humanitarian demining. This contributes to increased efficiency in resource utilization, ensures compliance with high safety standards, and allows large-scale projects to be implemented within shorter timeframes. Therefore, engaging international organizations as guarantors, coordinators, and technical advisors is an indispensable component of effective PPP implementation in humanitarian demining. It ensures a comprehensive approach to project management, enhances safety and operational efficiency, and lays the foundation for the stable and sustainable restoration of Ukrainian territories.

5. Implementation of a Monitoring and Evaluation System for Demining Projects.

Establishing an effective monitoring and evaluation (M&E) system for demining projects ensures process transparency, increases accountability of all participants, and facilitates the timely identification of problem areas in program implementation. Effective monitoring allows not only tracking work progress but also evaluating the achievement of strategic objectives, the efficiency of financial resource use, and compliance with international safety standards.

The monitoring system should include comprehensive performance indicators covering both quantitative and qualitative aspects. Quantitative indicators may include the area of cleared land, the number of detected and neutralized mines, project timelines, and resource consumption. Qualitative indicators include adherence to international safety standards, personnel training levels, use of modern technologies, and compliance with transparent financing procedures. This comprehensive approach provides a complete picture of project effectiveness and forms the basis for strategic management [6].

International experience demonstrates the high effectiveness of monitoring systems in humanitarian demining. For example, in Cambodia and Colombia, specialized information platforms track demining processes in real time, generate analytical reports, and forecast risks. Such systems ensure an objective assessment of results, independent of individual project participants, enabling international donors and government agencies to make informed decisions regarding further funding.

For Ukraine, implementing an M&E system involves integrating digital technologies such as geographic information systems (GIS), contaminated area databases, big data analysis tools, and risk assessment software. This allows timely collection of operational data, assessment of resource efficiency, and projection of project completion timelines. Digitalization also enhances transparency, which is critical for attracting international donors and private partners.

Special attention should be given to evaluating the efficiency of financial resources, including analyzing the ratio of invested funds to project outcomes, identifying key sources of savings, and detecting areas of inefficient resource use. This improves the effectiveness of state and private financing, optimizes fund allocation, and ensures achievement of target indicators within established timelines.

In addition to technical aspects, the monitoring and evaluation system should include an institutional component, specifying responsible authorities, reporting procedures, and mechanisms for interaction among government agencies, private partners, and international donors. In international practice, centralized management systems coordinate large demining projects, avoiding duplication of efforts and ensuring efficient use of financial and technological resources.

The implementation of monitoring and evaluation systems is a prerequisite for the sustainable development of PPPs in humanitarian demining. It ensures control over operations, increases transparency and accountability, allows early detection of issues, optimizes the use of financial and technological resources, builds trust among the state, private sector, and international donors, stimulates investment, and contributes to achieving strategic humanitarian demining objectives in Ukraine [12].

6. Development of Financial Incentives to Attract the Private Sector to Mine Clearance in Ukraine.

In conditions characterized by high operational and security risks, long payback periods, and substantial capital investments, private companies often avoid participation in demining projects without appropriate guarantees and incentives. Financial mechanisms can mitigate these risks, motivating investors to engage actively and facilitating the faster restoration of affected territories. Key financial incentives include tax relief and preferential treatment for companies involved in humanitarian demining. These may encompass exemptions from certain profit taxes, tax credits for the acquisition of specialized equipment, as well as tax incentives for investments in personnel training and technological innovations. Tax incentives reduce private partners' costs, enhance their profitability, and provide an additional economic stimulus for investing in high-risk projects.

Another important mechanism is government guarantees regarding the return of investments or partial compensation of expenses. In international practice, particularly in Afghanistan and African countries, such guarantees have facilitated the engagement of private companies in demining projects under conditions of high uncertainty. Guarantees may include partial compensation for losses in the event of force majeure, provision of risk insurance, and coverage of costs for technological upgrades. For Ukraine, implementing these instruments is particularly relevant given the high level of risk in humanitarian demining due to ongoing military operations and the extensive scale of contaminated territories [14].

An additional mechanism to incentivize the private sector is Outcome-Based Financing (OBF), whereby payment for project participation is made only upon achieving specific, measurable results. For example, a private company may receive remuneration for each hectare of cleared territory or for completing a designated set of safe mine clearance operations. This approach enables more effective coordination of interests among the state, the private sector, and international donors, while also promoting increased productivity and cost optimization.

Equally significant is the blended finance model, which combines public funds, donor grants, and private investments. International experience indicates that the application of such mechanisms reduces the financial burden on private partners, enhances the reliability and stability of funding, and ensures the sustainable

development of projects. In countries with long-term experience in humanitarian demining, this model facilitates the involvement of high-tech companies in projects that generate social rather than commercial returns.

Beyond financial incentives, it is essential to ensure legal guarantees for private partners, including clearly defined responsibilities, dispute resolution mechanisms, and risk insurance. Such guarantees increase trust in the state, reduce uncertainty, and encourage private sector participation in complex and long-term humanitarian demining projects.

The analysis and systematization of the main directions for improving public-private partnership mechanisms in humanitarian demining indicate that the effective functioning of such partnerships requires a comprehensive approach. This approach integrates legal certainty, technological modernization, active involvement of international organizations, continuous monitoring, and private sector incentives. Establishing a clear legal framework defines the rights and obligations of all participants, reduces conflicts of interest, and promotes process transparency. The integration of modern technologies and the training of qualified personnel enhances operational safety and allows effective project implementation even in high-risk areas, while the participation of international organizations provides coordination, technical expertise, and partial financial risk guarantees [13].

The implementation of a system for monitoring and evaluating project effectiveness allows for the timely identification of problems, assessment of strategic goal achievement, and optimization of resource utilization. The development of financial incentives including tax benefits, government guarantees, and outcome-based financing promotes active private sector participation and attracts additional investments. In summary, the comprehensive implementation of these measures creates the conditions for the sustainable development of humanitarian demining programs, increases the efficiency of financial and technological resource use, ensures the safety of personnel and the population, and contributes to the restoration of territories affected by military actions.

Conclusions

Based on the study of PPP mechanisms in financing the demining of Ukraine's territories, the following conclusions can be drawn:

1. The issue of mined territories in Ukraine represents one of the key challenges in the current stage of state-building and post-war recovery. Extensive landmining poses a threat to civilian life, hinders effective resource utilization, and significantly complicates the country's economic recovery. Humanitarian demining requires substantial financial, material, technical, and human resources, which exceed the capacities of exclusively state funding. This underscores the necessity of attracting private capital, international assistance, and utilizing public-private partnership mechanisms. PPP serves as an effective tool for implementing socially significant projects, combining the financial resources, managerial competencies, and technological capabilities of both the state and the private sector. In the demining sphere, PPP can enhance financing efficiency, project management transparency, and the introduction of innovative approaches.

2. Domestic and international research confirms that the successful application of PPP in high-risk areas, such as humanitarian demining, requires legal certainty, a clear risk allocation system, transparent control mechanisms, and long-term contracts. International experience, particularly from Cambodia, Colombia, Afghanistan, and Yemen, demonstrates the effectiveness of outcome-based financing models, blended finance mechanisms, and technology integration (robotic systems, unmanned aerial vehicles, artificial intelligence) in enhancing safety, accuracy, and efficiency of demining operations. Ukraine's legislative and regulatory framework, including the Law of Ukraine "On Public-Private Partnership" and the draft Law "On Public-Private Partnership," as well as relevant Cabinet of Ministers resolutions and Ministry of Economy orders, provides the legal basis for implementing PPP in humanitarian demining, ensuring transparency, control mechanisms, and the possibility of involving private and international resources.

3. The most effective approach for implementing humanitarian demining projects is a combination of PPP forms, particularly BOT schemes, concessions, and outcome-based PPPs, which allow for efficient mobilization of private investments, stimulation of innovation, and quality control of operations. The use of PPP in Ukraine's demining sector can ensure a systematic, safe, and economically efficient process of territorial restoration, enhance the state's investment attractiveness, and contribute to stabilizing the socio-economic situation.

4. The analysis of financial mechanisms for PPP in humanitarian demining in Ukraine indicates that effective implementation is only possible through the systematic combination of state, private, and international funding. The contemporary model for restoring mined lands in Ukraine is characterized by a multifaceted approach, which includes budgetary financing, private investments, blended finance mechanisms, outcome-based instruments, as well as the establishment of insurance and reserve funds to minimize risks. This multi-layered structure ensures not only financial stability but also long-term sustainability of projects, enhances transparency, accountability, and operational efficiency.

5. In the context of post-war economic recovery in Ukraine, PPP becomes a key instrument for mobilizing resources and introducing advanced technologies into demining processes. Statistical data indicate that since 2022, the funding volume for humanitarian demining has been increasing, while collaboration with international partners such as UNDP, the World Bank, and the European Commission ensures both financial assistance and technical expertise. At the same time, a prerequisite for the successful development of partnership projects is the existence of effective regulatory frameworks that guarantee procedural transparency, protect private investors' interests, and coordinate the actions of all participants. Therefore, the establishment of a modern financial architecture in humanitarian demining contributes not only to territorial safety but also to economic revival, development of the agricultural sector, and enhancement of Ukraine's investment attractiveness in the post-war transformation period.

6. A comprehensive analysis of ways to improve PPP mechanisms in humanitarian demining in Ukraine allows for the conclusion that the synergy of state, private, and international resources is essential for effective, safe, and economically justified

clearance of territories from explosive hazards. The successful implementation of PPP in this field requires a systematic approach based on legal certainty, financial sustainability, technological modernization, and transparency in management processes.

7. The creation of a legal and regulatory framework is a fundamental condition for the functioning of effective PPP mechanisms. Legislative establishment of the roles and responsibilities of the state, private partners, and international donors lays the groundwork for long-term cooperation, reduces legal uncertainty risks, and facilitates investment in high-risk humanitarian projects. Equally significant is the implementation of modern financial models, including outcome-based financing, blended finance, and social bonds, which optimize resource use, mitigate the risk of misallocation, and enhance accountability among all participants. Technological modernization of demining, through the use of robotic systems, drones, sensor technologies, and artificial intelligence, enables the minimization of personnel risks and increases operational efficiency. Simultaneously, training qualified specialists remains a critical aspect of program implementation, ensuring compliance with international safety standards and providing sustainable human capital for the sector.

8. The involvement of international organizations, particularly UNMAS, GICHD, and UNDP, plays a key role in ensuring transparency, coordinating actions, providing technical assistance, and guaranteeing part of the financial risks. Their participation builds trust among stakeholders, improves management quality, and enhances project implementation effectiveness. An integral structural element is also a system for monitoring and evaluating effectiveness, which ensures objective analytics, resource control, and timely identification of problematic aspects during program execution.

9. Financial incentives, including tax benefits, government guarantees, and compensation mechanisms, create conditions for activating private sector participation in humanitarian demining. The combination of such incentives with effective monitoring and a regulatory framework establishes a balanced ecosystem for cooperation among the state, business, and international donors.

In conclusion, improving PPP mechanisms in humanitarian demining should become one of the key directions in Ukraine's post-war recovery. It will contribute not only to enhanced territorial safety but also to creating new opportunities for economic development, restoring agricultural potential, attracting investments, and strengthening the country's international image as a responsible and reliable partner in the fields of security and development.

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