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# Economic Losses from the Destruction of Water Supply Systems: An Assessment for Households, the Agricultural Sector, and Industry in Ukraine

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**ABSTRACT**

The article examines the economic losses resulting from the destruction of water supply infrastructure in Ukraine, taking into account the impact on households as well as the agricultural and industrial sectors. It is established that the war has caused significant damage to the natural environment, including ecosystems and water resources, which has led to increasing economic and social risks. It is emphasized that the scale of water infrastructure destruction directly affects the livelihood of the population and the functioning of production processes, underscoring the importance of restoring water supply systems in the context of sustainable development. It is noted that as of September 2025, only 68% of Ukraine's population had access to centralized water supply, while in rural areas this figure amounted to just 26%, resulting in critical inequality in access to water. The study identifies that the low level of access to safe water increases household expenditures on alternative water sources and limits the production capacities of the agricultural and industrial sectors. It is highlighted that military actions have substantially intensified the degradation of water pipelines and engineering facilities, affecting approximately 39.7 thousand km of water supply systems with total economic losses estimated at USD 4.6 billion. The article presents regional disparities in losses that correlate with the intensity of hostilities: the largest damages occurred in Luhansk, Kharkiv, and Zaporizhzhia regions, confirming the need for territorially differentiated investment. It is determined that the modernization of irrigation and drainage systems is a priority of state policy to ensure agricultural productivity and reduce pressure on ecosystems. It is stressed that the combined impact of destruction has caused significant economic losses in households and in the agricultural and industrial sectors, while further exacerbating disparities in access to water resources. The study concludes that an integrated approach to modernizing water supply systems, including infrastructure restoration and the use of modern technologies, is a crucial factor for ensuring socio-economic stability in the post-war recovery period.

**KEYWORDS**

economic losses, water supply, water management infrastructure, destruction, recovery, agricultural sector, industry, households, modernization.

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# Економічні втрати від руйнування систем водопостачання: оцінка для домогосподарств, аграрного сектору та промисловості України

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**СТАТТЯ**

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**АНОТАЦІЯ**

У статті розглянуто економічні втрати від руйнування водопостачальної інфраструктури в Україні з урахуванням впливу на домогосподарства, аграрний та промисловий сектори. Встановлено, що воєнні події спричинили значні руйнування природного середовища, включно з екосистемами та водними ресурсами, що обумовлює зростання економічних і соціальних ризиків. Наголошено, що обсяг руйнувань водної інфраструктури безпосередньо впливає на життєдіяльність населення та функціонування виробничих процесів, підкреслюючи значення відновлення водопостачання у контексті сталого розвитку. Підкреслено, що станом на вересень 2025 року лише 68% населення України мали доступ до централізованого водопостачання, водночас у сільській місцевості цей показник становив лише 26%, що зумовлює критичну нерівність у доступі до води. Визначено, що низький рівень доступу до безпечної води спричиняє зростання витрат домогосподарств на альтернативні джерела води та обмежує виробничі потужності аграрного та промислового секторів. Зауважено, що військові дії значно інтенсифікували деградацію водопровідних мереж та інженерних споруд, охопивши близько 39,7 тис. км водопровідних систем із сумарними економічними втратами у 4,6 млрд дол. США. Висвітлено регіональну диференціацію втрат, що корелює з інтенсивністю бойових дій: найбільші збитки припадають на Луганську, Харківську та Запорізьку області, що підтверджує необхідність територіально диференційованого інвестування. Встановлено, що модернізація зрошувальних і дренажних систем є пріоритетом державної політики для забезпечення продуктивності аграрного виробництва та зниження навантаження на екосистеми. Підкреслено, що комплексний вплив руйнувань спричинив значні економічні втрати у домогосподарствах, аграрному та промисловому секторах, водночас загострили диспропорції у доступі до водних ресурсів. Констатовано, що інтегрований підхід до модернізації систем водопостачання, включно з відновленням інфраструктури та застосуванням сучасних технологій, є визначальним фактором забезпечення соціально-економічної стабільності в умовах поствоєнного відновлення.

**КЛЮЧОВІ СЛОВА**

економічні втрати, водопостачання, водогосподарська інфраструктура, руйнування, відновлення, аграрний сектор, промисловість, домогосподарства, модернізація.

## 1. Introduction

The destruction of water infrastructure in Ukraine as a result of prolonged hostilities poses serious threats to the livelihood of the population and the stability of the agricultural and industrial sectors. At the same time, it negatively affects the environmental sustainability of regions, emphasizing the need for an integrated approach to loss assessment. In this context, a comprehensive analysis of economic losses and the identification of structural weaknesses of water supply systems is important, because the lack of such studies complicates the development of effective recovery strategies. Therefore, the relevance of the topic is due to the need to determine the scale of destruction and restoration priorities to ensure socio-economic stability and sustainable water management.

## 2. Literature Review

The analysis of recent studies and publications shows the relevance of the problem of destruction of water infrastructure and the consequences of hostilities for water resources of Ukraine. In particular, O. Shumilova, K. Tokner, A. Sukhodolova, V. Khilchevsky, L. De Mester, S. Stepanenko, G. Trokhymenko, J. A. Hernandez-Aggero and P. Gleick emphasize the direct impact of the war on water resources and infrastructure [6]. In turn, A. Blakhopolukhna, O. Joa, V. Parakhnenko and N. Lyakhovska focus on the deterioration of the state of drinking water and environmental risks for water supply as a result of hostilities [2]. At the same time, V. Stelmakh, M. Melnychuk and O. Melnyk, I. Tokarchuk reveal significant changes in the hydroecological state of water bodies of Ukraine [18]. I. Hopchak and V. Zhuk analyze the impact of the war on water resources from the point of view of the circular economy [4]. At the same time, G. Khapych, R. Novytskyi, D. Onoprienko, D. Dent and H. Rubik focus on the consequences for water security [7]. In addition, G. Hapich, R. Novytskyi, D. Onoprienko and T. Dubov estimate the losses of ecosystem services from water resources [6].

## 3. Problem Statement

The article is aimed at estimating economic losses from the destruction of water supply systems in Ukraine, taking into account the impact on households, the agricultural sector and industry.

## 4. Methods and Materials

The methodological basis of the study is based on an integrated approach to assessing economic losses caused by the destruction of water supply systems in Ukraine during hostilities. In order to obtain objective and representative results, a set of general scientific, economic, statistical and special methods of analysis was used.

First of all, the structural and logical method was used, which made it possible to systematize information on the state of water infrastructure, to identify the key factors of the impact of armed aggression on water supply networks and to determine the relationship between the level of destruction and changes in the functioning of households, agricultural and industrial sectors.

To quantify losses, economic and statistical methods were used, in particular analysis of dynamics, comparative analysis, interval estimation and extrapolation. The statistical base was formed on the basis of data from the State Statistics Service of Ukraine, the Ministry of Communities and Territories Development, the State Agency for Water Resources, sectoral reports, as well as information from international organizations, including UNICEF, the World Bank and UNECE (physical destruction, cost of restoration) and indirect losses (additional household costs, reduced production productivity, interruptions in logistics processes).

A separate place is occupied by the method of estimating economic losses according to the sectoral approach. For households, the calculation was based on the assessment of the costs of alternative water sources, the increase in the cost of utilities, the increase in morbidity due to the consumption of poor-quality water and the decline in the quality of life. industry, the calculations were carried out taking into account the suspension of production cycles, a decrease in capacity, additional costs for water treatment and restrictions on the functioning of critical enterprises.

The regulatory analysis included the study of current EU standards, recommendations of international organizations on water resources management during conflicts, as well as Ukrainian legislation in the field of water supply. This provided an opportunity to assess the compliance of the national system with the principles of sustainable governance and identify areas for modernization.

Thus, the application of a multi-level methodology combining quantitative and qualitative approaches provided a comprehensive study of the economic consequences of the destruction of water supply systems. Comprehensiveness, interdisciplinarity and the use of various sources made it possible to obtain scientifically based results relevant for the further development of strategies for the restoration and modernization of water infrastructure in Ukraine.

## 5. Results and Discussion

Russian aggression on the territory of Ukraine has caused unprecedented destruction of the natural environment, which manifests itself in significant destruction of ecosystems and large-scale pollution of air, soil, and water resources. According to the State Environmental Inspectorate of Ukraine [10], since the beginning of the full-scale invasion, the amount of damage caused to the environment is UAH 6.01 trillion, in particular, significant losses were caused due to pollution and littering of water resources in the amount of UAH 117.8 billion.

It should be noted that the volume of destruction of water infrastructure directly affects the economic stability of households and enterprises, because water supply is a critical component of the life of the population and production processes. Therefore, the assessment of economic losses in the context of water resources restoration is an important aspect of management decisions in the field of sustainable development and reconstruction of the country.

As of September 2025, only 68% of Ukraine's population had access to centralized water supply, leaving an estimated 1.7 million children without safe access to drinking water. In rural areas, the disproportion is even more critical – only 26% of settlements are provided with centralized water supply compared to 97% of cities [11]. These data confirm the systemic inequality in access to water resources and demonstrate the need for priority intervention in infrastructure restoration.

It is noteworthy that a third of all drinking water samples in Ukraine do not meet national standards. In comparison, EU countries such as Germany report only 0.1% non-compliance, while Austria retains 1.0% [11]. Therefore, the presented indicators allow us to assess the scale of the problem and emphasize the urgent need to modernize water supply systems to achieve compliance with international water safety standards.

It is worth noting that the low level of access to safe water creates preconditions for socio-economic risks, including increased household spending on alternative water sources and limited production capacity of the agricultural and industrial sectors. At the same time, the analysis of the current situation indicates the need for comprehensive investments in the restoration and modernization of water infrastructure, which is of strategic importance for the economic security of the state and for reducing the negative impact on ecosystems.

Hostilities significantly intensified the process of degradation of infrastructure systems that were already in critical condition. According to available data [11], the scale of destruction covers about 39.7 thousand km. km of water supply networks, while the total economic losses of the sector are estimated at USD 4.6 billion. USA. In view of this, the situation in Ukraine demonstrates an unprecedented level of damage, which necessitates a comprehensive analytical rethinking of the mechanisms for the restoration of engineering systems.

It is noteworthy that the regional structure of losses correlates with the spatial dynamics of hostilities. Thus, the Luhansk region suffered potential losses in the amount of about USD 1.6 billion. USA, Kharkiv region – USD 831 million. USA, Zaporizhzhia region – USD 546 million. The Donetsk and Kherson regions are also characterized by critically high rates of infrastructure destruction. In this context, there is a clear relationship between the intensity of military operations and the level of degradation of water supply systems, which confirms the territorial unevenness of economic consequences [11].

It is also significant that the restoration of water infrastructure is a prerequisite for the stabilization of the socio-economic development of the regions. In this case, it is important to take into account the risks of future resource vulnerability, in particular possible water shortages in industrial agglomerations and agricultural clusters. Therefore, the generalization of these provisions shows that

the assessment of resource vulnerability risks requires a detailed analysis of the actual structure of water use in different sectors of the economy. It is the quantitative characteristics of water consumption and waste generation that make it possible to identify the industries with the greatest dependence on the stable functioning of water supply systems and to outline the potential scale of economic losses in case of their destruction. In view of this, it is advisable to refer to the generalized statistical data presented in Table 1.

***Table 1. Water use and waste by type of activity (million cubic meters)***

| Name | Number of reports/ submissions | Total use of natural resources | Use of water for drinking and sanitation | Use for Manufacturing/ Industry | Use for irrigation | General waste |
|---|---|---|---|---|---|---|
| [A] Agriculture, forestry and fisheries | 4326 | 439.019 | 5.033 | 207.3 | 189.99 | 205.503 |
| [B] Mining and quarrying | 380 | 65.341 | 4.831 | 49.758 | 0.003 | 148.952 |
| [T] Household activities | 2 | 0.008 | 0.008 | – | – | – |
| [98] Activities of households as producers of goods and services for their own consumption | 2 | 0.008 | 0.008 | – | – | – |
| [98.1] Activities of households as producers of goods for their own consumption | 1 | 0.008 | 0.008 | – | – | – |
| [98.10] Activities of households as producers of goods for their own consumption | 1 | 0.008 | 0.008 | – | – | – |
| [98.2] Activities of households as producers of services for their own consumption | 1 | – | – | – | – | – |
| [98.20] Activities of households as producers of services for their own consumption | 1 | – | – | – | – | – |

*Source:* Compiled based on [17].

The presented statistical data reflect the volume of water resources use and waste generation in the context of the main types of economic activity of Ukraine. In the reporting structure, the largest number of submissions is provided by the sector of agriculture, forestry and fisheries (4326 reports), which determines its dominance in the general system of accounting for nature management. In view of this, this sector is distinguished by the largest total volumes of natural resources – 439.019 million $m^3$, which indicates a high level of dependence of agricultural production on the availability of water resources.

It is significant that within this sector, the volume of water use for production needs reaches 207.3 million $m^3$, while irrigation accounts for 189.99 million $m^3$, which indicates a significant water intensity of the agricultural sector. At the same time, the need for drinking and sanitary water remains relatively low (5.033 million $m^3$), which is logical given the specialized nature of water use in agriculture. Along the way, it is worth focusing on the fact that significant volumes of waste are generated in this sector – 205.503 million $m^3$, which creates an additional burden on ecosystems and increases the risks of degradation of soil and water resources.

The mining industry, despite a relatively small number of reporting submissions (380), demonstrates a tangible scale of water use, in particular 49.758 million $m^3$ for production needs and 4.831 million $m^3$ for sanitary consumption. The total volume of natural resources used by the industry is 65.341 million $m^3$, while the total waste reaches 148.952 million $m^3$.

In the segment of household activities, represented by separate statistical codes [T], [98], [98.1], [98.10], the minimum use of water is recorded - only 0.008 million $m^3$, and exclusively for drinking and sanitary needs. These indicators are expectedly low given the nature of self-consumption activities. It is noteworthy that in the context of the study of economic losses from the destruction of water supply systems, these categories of households constitute an important benchmark for assessing the minimal but socially significant level of water dependence of the population.

In a broader analytical context, the comparison of the industrial and agricultural sectors demonstrates a significant difference like water use: the agricultural sector is characterized mainly by the consumption of natural water in an unchanged state, while industry causes significantly higher volumes of contaminated waste. The recorded discrepancies in the water use profiles of industries, in particular the different levels of load on natural resources and the volume of formation of polluted effluents, create an important analytical basis for further consideration of infrastructure constraints in the water supply sector. In this sense, it is appropriate to focus on the fact that the vulnerability of water systems is exacerbated by multidirectional sectoral needs, as well as by the critical condition of basic water infrastructure facilities, which determines the ability of the economy to ensure stable and uninterrupted water supply. It is in this context that the analysis of the technical deterioration of drinking water supply systems and its consequences for the functioning of the municipal and industrial sectors is important.

Therefore, the unsatisfactory technical condition of drinking water supply systems leads to a significant increase in operating costs, which in turn leads to an increase in the cost of relevant services. Under such conditions, the activities of water supply and sewerage enterprises become unprofitable, which causes a shortage of working capital and, accordingly, makes it impossible to update fixed assets. It is noteworthy that over the past three decades, the construction and commissioning of new water supply facilities has been practically stopped, while the reconstruction and modernization of existing structures and networks is carried out at an extremely slow pace.

In this context, it is significant that military aggression has significantly exacerbated existing problems, causing large-scale destruction of water infrastructure facilities critical for the functioning of the agricultural sector. Among the most affected elements are irrigation canals, pumping equipment and tank systems, the total damage of which is estimated at USD 740.2 million. The need for recovery over the next decade reaches USD 10.7 billion. USA. Incidentally, it should be noted that within two years, the intensity of destruction in the irrigation and water sectors increased by 95%, which is directly related to the explosion of the Kakhovka hydraulic structure on June 6, 2023 [3].

In the light of these trends, the modernization of drainage and irrigation systems should be considered as a priority area of state policy, because their functioning determines the productivity of agricultural production, as well as the degree of anthropogenic load on natural ecosystems. It is pertinent to note that modernization measures can reduce the volume of pesticides entering water bodies, as well as increase the resilience of Ukrainian landscapes to hydrometeorological risks, in particular floods and droughts, in the context of progressive climate change. At the same time, the continuation of hostilities forms additional barriers to the restoration of infrastructure, increasing uncertainty about the timing and scope of reconstruction. Significantly, the prolonged nature of destruction causes cumulative economic losses that cover household, agricultural and industrial segments, which complicates the formation of long-term water management strategies.

Summarizing the above provisions, it is worth emphasizing that the complex impact of war destruction on important sectors of the economy leads to a significant increase in the need for the restoration of critical infrastructure, particularly in the field of water resources and irrigation. That is why it is appropriate to present the generalized parameters of the necessary investments in Table 2.

According to Table 2, the total financial needs for the reconstruction and restoration of irrigation and water management systems in 2025–2035 will amount to USD 10936.0 million. USA. The given value of the indicator reflects the scale of accumulated losses and the need for comprehensive restoration of infrastructure elements. It is noteworthy that the aggregate needs are structured in two main directions: reconstruction of existing facilities and resumption of service provision, which allows assessing the technical and functional dimension of future investments.

First of all, the reconstruction amounts to USD 4161.0 million. This emphasizes the critical state of the state irrigation infrastructure and related hydraulic structures. The largest share in this category is the modernization and expansion of four important systems: Kakhovka, Severo-Rogachin, Syrohozh and Prinzovskaya, the total need of which reaches USD 1278.3 million. USA. Taking into account the territorial specifics of these massifs, they are characterized by the highest concentration of environmental and economic risks and determine the potential of agricultural production in the southern regions of Ukraine. At the same time, the reconstruction of the state irrigation infrastructure worth USD 2804.3 million. The United States indicates structural aging of systems, a long-term investment deficit and a high level of physical deterioration, which makes it impossible to have a stable water supply during the war and post-war period.

It should be emphasized that in the structure of the same category, the reconstruction of hydraulic structures of the Dnieper reservoirs with a need of USD 78.4 million is separately distinguished. USA. Given the strategic role of the Dnipro cascade in maintaining the country's water balance, these investments ensure the technical sustainability of structures and minimize the risks of systemic accidents that can potentially cause transboundary environmental consequences. Along the way, it should be noted that the restoration of hydrotechnical stability will contribute to the gradual equalization of regional differences in the provision of water resources, which has a significant economic effect for industrial centers and water-dependent agricultural enterprises.

***Table 2. Irrigation and Water Resources: Total Recovery and Reconstruction Needs as of Time (USD million)***

| Category | Activities/investments | Total needs (2025–2035) |
|---|---|---|
| Reconstruction needs | Reconstruction, overhaul and modernization of state irrigation infrastructure | 2804.3 |
| | Reconstruction of hydraulic structures of the protective massifs of the Dnieper reservoirs | 78.4 |
| | Modernization and expansion of irrigation systems in four priority systems: Kakhovka, North Rohachin, Syrohoh and Prinzovska | 1278.3 |
| The needs of resumption of service provision | Restoration and modernization of water infrastructure | 1439.8 |
| | Restoration of the functionality of the state water resources monitoring system | 1.5 |
| | Restoration and construction of centralized water supply to rural settlements using imported water | 93.4 |
| | Restoration of drainage systems | 1100.3 |
| | Flood risk management measures | 642,3 |
| | Water Accumulation Projects | 1500.0 |
| | River revitalization measures | 1562.0 |
| | Technological support / equipment for on-farm irrigation for water user organizations | 327.1 |
| | Solar Energy Alternatives for Pumping Stations | 108.5 |
| **Total** | **–** | **10936.0** |

*Source:* Compiled according to data [20, p. 125]. *Note:* The losses cover 34 months from February 24, 2022 to December 31, 2024; the losses cover a total of 52 months, which includes 34 months from February 24, 2022 to December 31, 2024 and an additional 18 months until June 30, 2026; The needs cover 10 years between 2025 and 2035.

The needs for resumption of the provision of services, which amount to USD 6775.0 million. The United States demonstrates an even wider range of problems related to the degradation of the country's water management potential. The costliest are water accumulation projects (USD 1500.0 million) and river revitalization measures (USD 1562.0 million). The presented directions are systemic in nature, as they provide for the restoration of natural hydrological dynamics, increasing the availability of water and increasing the ecosystem stability of river basins in the context of climate change. The volume of financial needs related to the restoration and modernization of water infrastructure (USD 1439.8 million) and drainage systems (USD 1100.3 million) is also significant. Given the importance of these elements for the efficient operation of irrigation systems, their degradation creates dominant risks of secondary flooding, increased soil mineralization and loss of fertility in the agricultural sector. It is appropriate to emphasize that these investments are decisive for the long-term reconstruction of agricultural potential, especially in regions with an arid climate, where alternatives to artificial moisture are extremely limited.

A notable element is the financing of flood risk management measures, which amounts to USD 642.3 million. USA. In the context of climate change, intensification of extreme hydrometeorological phenomena and destruction of water infrastructure, these measures protect households and industrial enterprises from potential economic losses. It is worth emphasizing that the integration of flood management with other areas of water policy allows for the formation of a more sustainable system of territorial planning, coordinated with the needs of post-war recovery.

In addition, a separate group is made up of investments in technological support for on-farm irrigation (USD 327.1 million) and alternative energy sources for pumping stations (USD 108.5 million). Given the high energy intensity of water lifting processes, the diversification of energy supply helps to reduce the cost of irrigation services and increase the autonomy of systems in critical conditions. In this context, it is advisable to emphasize that the technological re-equipment of the water sector is the basis of its long-term competitiveness. Special attention needs to be paid to the indicator of the restoration of the functionality of the state water resources monitoring system, which is estimated at only USD 1.5

million. USA. Despite its insignificant specific weight, this direction is important, as it provides verification of hydrological data, the formation of accurate forecasts and management decisions based on evidence-based information. Summing up, we note that taking into account the above generalized indicators allow us to move on to a broader analysis of the prerequisites of current imbalances, because it was the basic level of availability of water services that determined the system's resistance to exogenous shocks.

Therefore, the access of the population of Ukraine to wastewater supply and treatment services remained insufficient even before the outbreak of hostilities: the corresponding coverage rates were 70% and 50% of the population, which indicates a significant inequality between urban and rural areas [3]. In this context, the level of water supply and sanitation generally did not meet what was expected for the state, which focuses on harmonizing industry standards with the requirements of the European Union in the field of water policy. At the same time, structural imbalances in access to water services created additional prerequisites for the accumulation of infrastructure risks in the event of any crisis disturbances.

Hostilities have significantly exacerbated these problems, causing interruption or significant degradation of the quality of water supply for millions of citizens [3]. Large-scale destruction of networks, damage to water facilities and prolonged power outages have complicated the functioning of systems for the provision of relevant services throughout the country. It is noteworthy that according to UNICEF-sponsored WASH cluster estimates, in 2024 alone, up to 9.6 million people needed urgent provision of basic water supply and sanitation services, and about 1 million citizens lost access to drinking water as a result of the destruction of the Kakhovka hydroelectric structure [3]. The above data indicate the depth of systemic violations in ensuring water security and confirm the scale of socio-economic losses caused by the destruction of critical infrastructure.

Further analysis confirms that the total losses to the water supply and sanitation sector are estimated at almost USD 4 billion. The total need for reconstruction and recovery for 2024-2033 is USD 11.1 billion. USA [3]. The above data, in turn, demonstrate a high level of capital intensity of the industry and indicate a significant number of deferred investments that needed to be implemented even before the start of the full-scale war. Along the way, it is worth emphasizing that under the condition of the infrastructure is unsatisfactory, even local destruction leads to cumulative economic losses, covering the household, agricultural and industrial segments. Taking into account the outlined systemic risks, further analysis should be supported by quantitative data reflecting the territorial differentiation of economic consequences in the water supply and sanitation sector (Table 3).

***Table 3. Water supply and sanitation: losses, losses and needs by regions (USD million)***

| Area | Damages | Losses | Needs |
|---|---|---|---|
| Nationwide (no specific region) | – | 12150.8 | 2756.3 |
| Zaporizhzhia | 545.8 | 58.6 | 1000.1 |
| Sumy | 19.6 | 0.9 | 34.7 |
| Rivne region | 0.0 | 0.0 | 0.1 |
| Poltava | 14.8 | 0.2 | 25.7 |
| Odesa | 31.3 | 0.4 | 54.4 |
| Mykolaiv | 80.5 | 5.5 | 144.4 |
| Luhansk | 1590.5 | 247.0 | 2990.6 |
| Kyiv | 171.7 | 16.1 | 312.4 |
| Kherson region | 368.7 | 41.7 | 677.6 |
| Kharkiv | 831.2 | 91.7 | 1525.6 |
| Donetsk region | 514.6 | 42.8 | 930.4 |
| Dnipropetrovsk | 104.2 | 2.1 | 181.9 |
| Chernihiv region | 328.8 | 50.8 | 618.0 |
| Cherkasy | 0.6 | 0.1 | 1.1 |
| **Total** | **4602.4** | **12708.7** | **11253.3** |

*Source:* compiled according to data [20, p. 157]. *Note:* The losses cover 34 months from February 24, 2022 to December 31, 2024; the losses cover a total of 52 months, which includes 34 months from February 24, 2022 to December 31, 2024 and an additional 18 months until June 30, 2026; The needs cover 10 years between 2025 and 2035.

The analysis of the data presented in Table 3 indicates a distinct territorial differentiation of economic losses and needs in the field of water supply and sanitation in Ukraine. In general, losses

throughout the country for 34 months of the conflict are estimated at $4.6 billion. USD, while the total losses cover USD 12.7 billion. and the needs for recovery and reconstruction are USD 11.3 billion. USA. It is noteworthy that the largest losses and needs are concentrated in Luhansk (losses – USD 1.59 billion, needs – USD 2.99 billion), Kharkiv (losses – USD 0.83 billion, needs – USD 1.53 billion) and Zaporizhzhia (losses – USD 0.55 billion, needs – USD 1.0 billion) regions. In addition, it should be noted that in some regions (Zakarpattia, Volyn, Vinnytsia, Ternopil, Lviv, Ivano-Frankivsk, Kyiv (city), Kirovohrad, Khmelnytskyi, Chernivtsi) data on damages, losses and needs are absent or not subject to assessment, which emphasizes the lack of empirical data and the need for additional regional research. Therefore, the above state of affairs indicates the importance of integrating information systems for monitoring and assessing infrastructure risks into the national water management policy.

The overall picture indicates an urgent need for priority funding for restoration work in the affected regions. Particularly noteworthy is the fact that critically affected regions account for more than 70% of total recovery needs, which points to the strategic importance of a differentiated approach to investment and reconstruction planning. Emphasizing the above, we note that the restoration of water supply and sanitation in Ukraine requires significant financial resources, as well as an integrated approach to management, i.e. taking into account territorial risks, coordination between central and local authorities and the use of modern technologies to increase the resilience of systems to future crisis impacts. Along the way, this demonstrates that effective water resources management is an important factor in ensuring socio-economic stability and minimizing cumulative losses in the event of repeated emergencies.

## 6. Conclusions

Based on the study, it should be stated that the destruction of water supply and water infrastructure in Ukraine as a result of military aggression has led to a significant increase in economic losses in households, agricultural and industrial sectors, at the same time exacerbating the existing disparities in access to water resources between urban and rural areas. The analysis of the structural characteristics of water use demonstrates the high dependence of the agricultural sector on water resources, and industry – on the stability of water supply and the efficiency of waste management, which confirms the need for priority restoration of critical infrastructure facilities. At the same time, the territorial differentiation of losses and reconstruction needs indicates the concentration of more than 70% of financial resources in the most affected regions, such as Luhansk, Kharkiv and Zaporizhzhia, which determines the strategic importance of differentiated investment and reconstruction planning. Therefore, the results of the study emphasize the relevance of an integrated approach to the modernization of water supply systems, including the restoration of irrigation and drainage networks, the use of modern technologies and increased monitoring, which are decisive for ensuring socio-economic stability and the sustainability of water management in the context of post-war recovery.

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