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## An Interim Assessment of the War-Induced Damages and Losses in Ukraine's Agriculture

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### Abstract

The full-scale Russian invasion of Ukraine has inflicted massive damages and losses on Ukrainian agriculture and terminated or even reversed the growth of the last twenty years. This article makes an interim assessment of the financial consequences of the war-related damages and losses in Ukrainian agriculture. The assessment is performed based on data from regular monitoring by the Kyiv School of Economics. The estimated damages to physical assets caused by Russia's invasion have been found to total \$10.3 billion, while economic losses have reached almost \$70 billion. With an estimated 16 million hectares being at risk of landmine contamination, the estimated cost of demining Ukraine's agricultural lands ranges from \$12.8 to \$26.6 billion. The reconstruction and recovery needs of the agricultural sector beyond this demining are in turn estimated at \$56.3 billion.

### Introduction

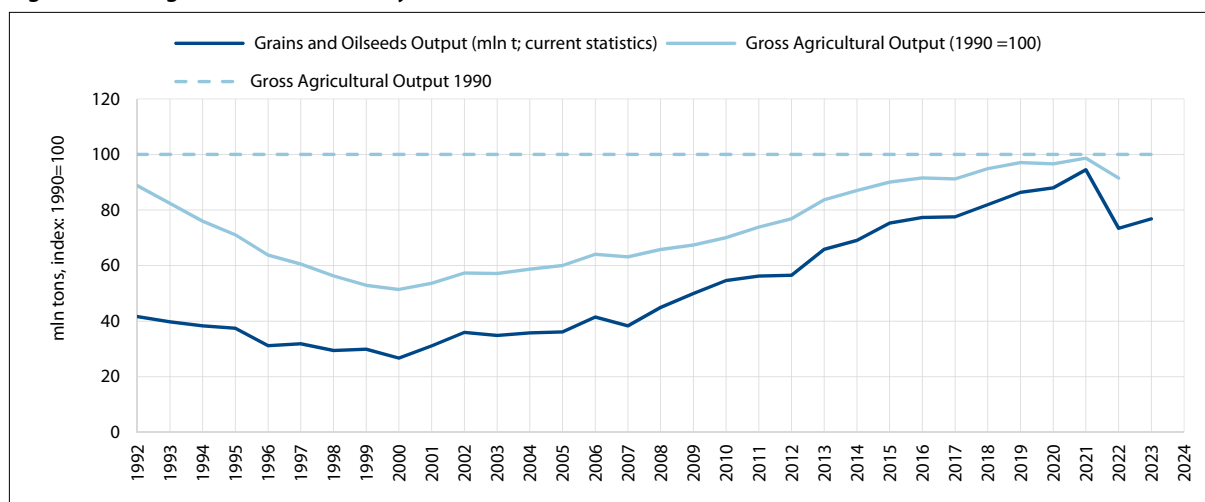
Over the two decades preceding Russia's full-scale invasion, Ukraine had become an increasingly important global supplier of grains and vegetable oil (Figure 1). On average, it accounted for 10% of global wheat exports, 16% of global maize exports, and 50% of global sunflower oil exports over the 2018–20 period. Ukraine's agriculture is mainly crop-based and is also a key sector of the national economy. In 2020, the entire agri-food sector (i.e., primary agriculture and upstream/downstream sectors) amounted to roughly 20% of Ukrainian GDP, and 45% of Ukraine's exports. Abundance of black soils (one of the most fertile types of soils for agricultural production)—almost one-third of the total world stock of black soils is located in Ukraine—favorable climate conditions, landscape characteristics that allow for large-scale farming, suitable geographical location including access to the Black Sea, and investments in farming and in broader export supply infrastructure have paved the way for the substantial agricultural productivity increase observed in Figure 1. Nevertheless, crop yields still fell short of their full potential; so closing the agricultural productivity gap could make an even larger contribution to Ukraine's national economy and to global food supplies.

Russia reversed this trend by invading Ukraine in February 2022, and the price of this ongoing war is already immense. Ukraine's GDP plummeted by nearly 30% in 2022, and the most recent estimate of total war damages to Ukraine amounts to \$155 billion, nearly equal to its 2022 GDP. More than 10 million Ukrainians have left their homes, including 6.4 million refugees recorded across Europe. Russia's war has caused massive damage and losses also to Ukrainian agriculture, which has halted and reversed the positive trends and contributions of the previous decades mentioned above.

This paper presents the results of these war-induced damages and losses in Ukrainian agriculture based on an ongoing monitoring of the impact of the Russian invasion on Ukraine's economy. The estimated damages to physical assets from Russia's invasion at the time of publication total \$10.3 billion, while economic losses (i.e. foregone revenue and/or increased production costs) have mounted to almost \$70 billion. We also single out damages to agricultural land due to mining, as this is not included in agricultural damages figures. The current estimated cost of demining agricultural lands ranges from \$12.8 to \$26.6 billion. In addition, we separately present our estimates of the financial consequences of the Kakhkovka dam disaster on Ukrainian agriculture, which has so far caused \$1.18 billion in damages and losses to the sector. These findings are crucial for understanding the current state of Ukrainian agriculture and the scale of current reconstruction, as well as the level of recovery needed to set it back on a sustainable development path.

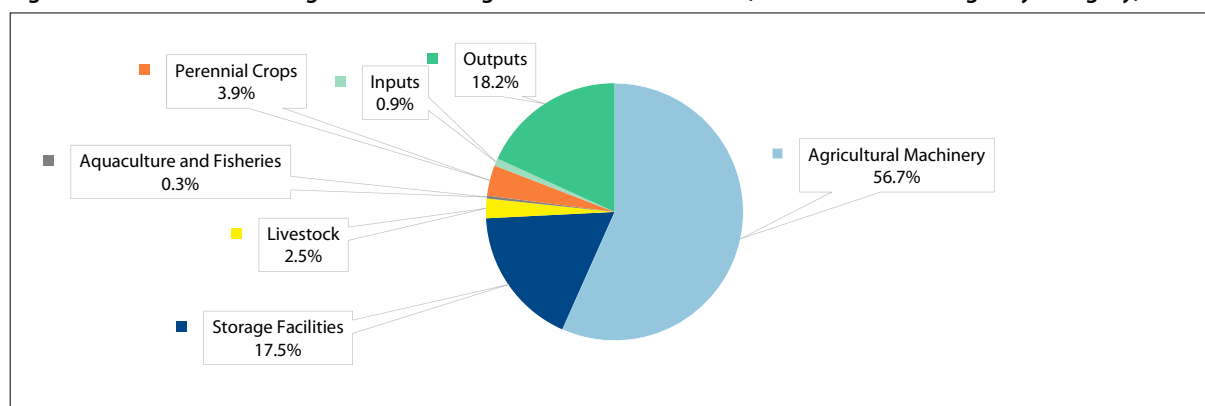
### One-Third of Ukraine's Agricultural Sector Has Already Been Destroyed

Agricultural damages are estimated by the Center for Food and Land Use Research at the Kyiv School of Economics (hereinafter "KSE Agrocenter") based on secondary data collected from various sources on the value of completely destroyed or stolen physical assets or capital, as well as physical assets partially damaged but still suitable for reconstruction. The details on calculation of damages and losses (covered in a separate section below), data and exact methodology is available on the webpage of the [Kyiv School of Economics](#).

**Figure 1: Agricultural Productivity Growth in Ukraine**

Source: Own presentation using Ukrstat data. Time series through 2021 are presented as three-year moving averages to smooth out short-run fluctuations.

The damages are broken down into the following groups: agricultural machinery and equipment, storage facilities, livestock, bees, fisheries, aquaculture, key perennial crops, and stolen or lost inputs and outputs, with the structure of damages presented in Figure 2. As of December 2023, almost two years after the full-scale invasion, the cumulative damages suffered by Ukrainian agriculture are estimated at \$10.3 billion, or more than a third of all capital stock accumulated in Ukrainian agriculture before 2022. The damages have been heaviest in the Ukrainian oblasts in the east and south that have seen the most fighting.

**Figure 2: War-Induced Agricultural Damages as of December 2023 (Breakdown of Damages by Category)**

Source: KSE Agrocenter. Note: lost inputs reflect damaged and stolen fuel and fertilizers, while lost outputs reflect damaged and stolen grain and oilseeds.

The largest category of damages is agricultural machinery, constituting almost 57% of all damages, or \$5.8 billion; damages to tractors leads the way in terms of subcategories, with up to \$1.6 billion lost. Overall, more than 21% of all available stock of agricultural machinery and equipment in Ukraine is completely or partially damaged.

The second-largest damaged category of assets is grain and oilseeds stocks. This category faced not only physical destruction, but also systematic theft by Russia, a topic widely covered in leading global media outlets. The estimated damages attributed to the destruction and theft of stored products amount to \$1.9 billion at the time of publication, involving an estimated 4 million metric tons of grain and oilseeds.

The third-largest damaged category of assets is storage facilities, which account for 17.5% of all damages, or \$1.8 billion. According to the assessment, out of Ukraine's initial storage capacity of 75 million tons prior to the invasion, nearly 11.3 million tons of storage capacity has been completely destroyed, and a further 3.3 million tons partially damaged. The impact on storage capacity becomes even more pronounced when considering that some facilities, though physically intact, are situated in occupied territories and are thus inaccessible to Ukrainian agricultural producers.

## Farmland Damages and Demining

The above-mentioned agricultural war damages do not cover the damages to farmland caused by mines and various other sources of damage and pollution from military use, battles, etc. Ukraine is now faced with an immense challenge in this respect, as an estimated 16 million hectares are being at risk of mine contamination, which is more than a quarter of the country's total area. Out of these 16 million hectares, about 11.2 million hectares is farmland. To put this in perspective: this figure is comparable to the entire stock of all farmlands in Germany and poses an immense challenge.

A huge and sustained effort is needed to demine these lands in order to once again enable their safe cultivation. The total cost of farmland demining in Ukraine is currently estimated in the range of \$12.8–26.6 billion. The process of demining consists of three steps:

The first step is a non-technical inspection in which the demining operators collect information on the territories at risk: whether there were any battles, any troops stationed in the area, or any reports on mine-related incidents. Based on interviews with demining companies in Ukraine, 84% of land is returned to regular service after a non-technical inspection, while the remaining 16% (or 1.8 million hectares of the 11.2 million hectares of farmland at risk of contamination) needs further examination. Non-technical inspection not only allows for the rapid return of the majority of land back to safe operation, but it is also inexpensive, i.e., on average about \$8 per hectare.

In the second stage, the minority of farmlands not cleared in a first non-technical inspection are technically inspected. At this stage, deminers either manually carefully check the area with metal detectors and other equipment, or utilize demining machines. The main point of the technical inspection is to identify the location of mines and other unexploded ordnance. At the moment, about 1.8 million hectares must be technically inspected at the cost of about \$3,000 per hectare. Allowing for determining which areas need actual demining and which do not, approximately 70% of technically inspected areas are returned to safe operation after technical inspection, while approximately 30% are found to require actual demining.

The actual demining comes last. An estimated 500,000 hectares of Ukrainian agricultural land requires actual demining at an estimated average cost of \$25,600 per hectare.

## Note on the Kakhovka Dam Disaster

On June 6, 2023, Russia destroyed the Kakhovka Dam, unleashing havoc in Southern Ukraine. The agricultural sector was among the hardest hit by this man-made disaster. The combined direct damages and long-term losses for primary agriculture are estimated at \$1.18 billion (with losses amounting to \$1.15 billion and direct damages accounting for \$25.7 million, respectively).

The majority of direct damages were suffered by the fisheries sector, with an estimated \$24.5 million based on calculations from the Ministry of Agrarian Policy and Food (MAPF), reflecting the value of fish killed directly following the incident; the rest of the direct damages were caused by damaged crops and drowned livestock. The losses, by contrast, are projected over the next five years, reflecting the anticipated time frame for rebuilding the Kakhovka Dam and its associated infrastructure; the largest portion of these losses (\$909 million) arise from the disruption of irrigation to highly drought-prone farmlands in Southern Ukraine (about 262,000 hectares in total). The remaining long-term losses include those incurred by the fisheries sector (\$242.3 million), livestock losses (\$1.9 million), and the expenses related to land recultivation (\$0.5 million).

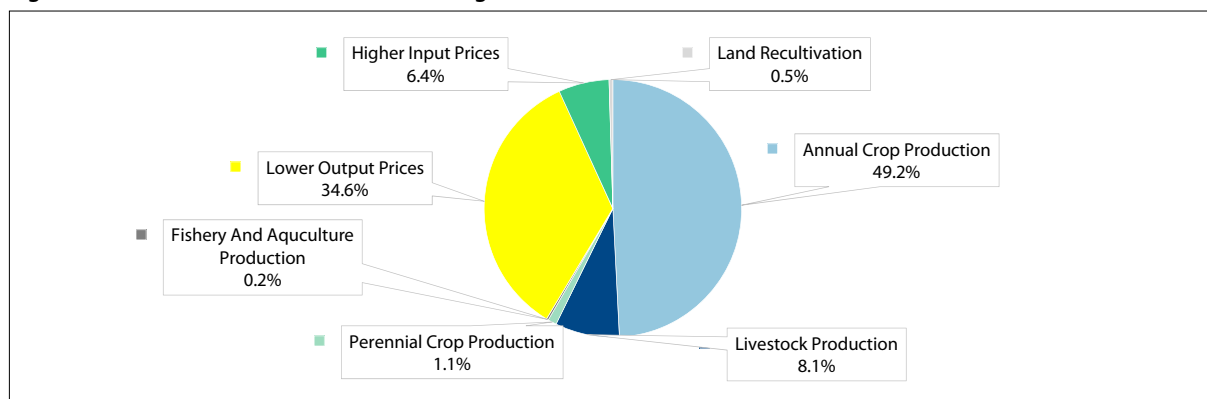
## Total Agricultural Losses Now Exceed Pre-War Annual Agricultural GDP

According to our assessment, Ukraine's total agricultural losses are estimated at \$69.8 billion; for orientation, this figure far exceeds entire Ukraine's agricultural GDP for 2021. In contrast to direct damages, agricultural losses are calculated based on the estimated foregone revenue due to lower production, decreases in prices, and increases in production costs resulting from the full-scale invasion.

The breakdown of losses by category is presented in Figure 3. The largest category of losses, constituting 49.2% of the overall total (or \$34.3 billion), is attributed to lower crop production. For annual crop production, which comprises the majority of this category of losses, this decrease in production is estimated not only for the years 2022 and 2023, but also include further losses extending into 2024 due to decreases in sowing areas. Losses due to lower livestock, aquaculture and fisheries production amounted to \$5.6 billion through December 2023.

The second-largest category of losses is export disruptions. Prior to the full-scale Russian invasion, over 90% of all agricultural products were exported from Ukraine via maritime routes (i.e., via the Black Sea). However, following the invasion, maritime exports were halted, forcing Ukrainian agricultural companies to re-route their exports through land corridors and the Danube river ports. This resulted in increased logistics costs and created bottlenecks in agrifood exports, which in turn suppressed domestic prices (Figure 4). Despite partial recovery of maritime exports

**Figure 3: Structure of the War-Induced Agricultural Losses in Ukraine as of December 2023**



Source: Own Calculations by the KSE Agrocenter Team.

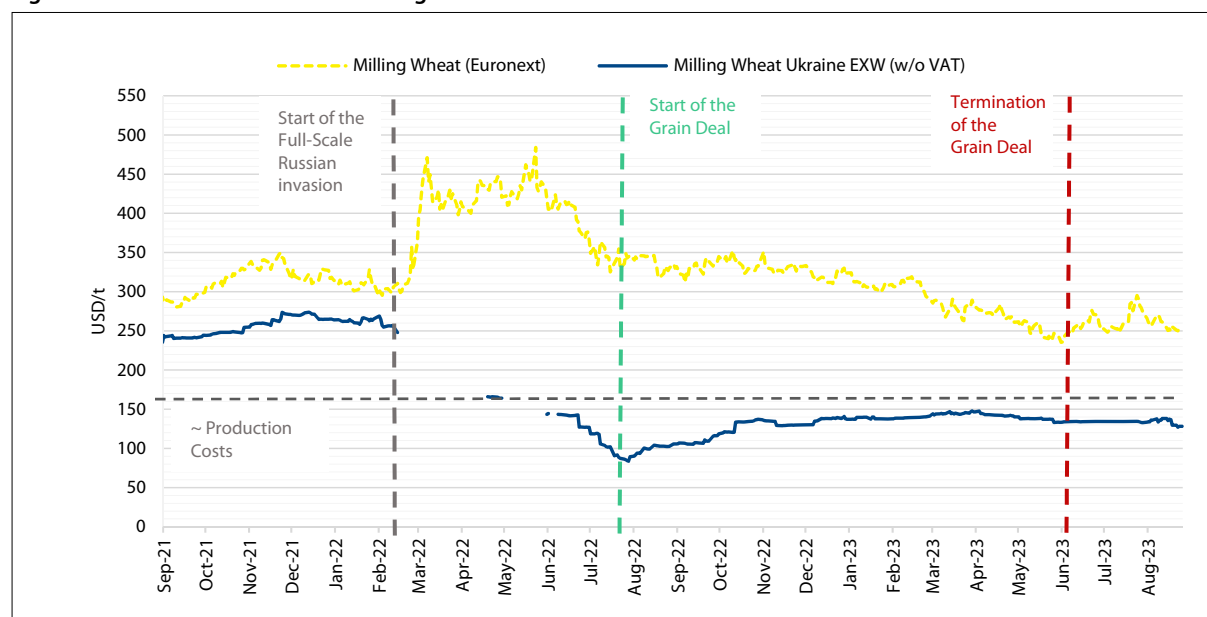
through the Black Sea Grain Initiative after August 2022, Russia still ensured exports remained insecure via delayed vessel inspections that failed to significantly lower logistics costs and to improve domestic prices; the Initiative was ultimately abandoned by Russia in July 2023.

Since then, with the help of active naval operations, Ukraine has finally become able to once again facilitate sea exports, hereby substantially increased its export capacity; the gap between domestic and world prices has, however, remained well above pre-invasion level, indicating that the invasion’s effect on domestic prices persists. We have thus estimated losses due to export disruptions for grain stocks from the 2021 harvest and the entire 2022 harvest, using the average price difference between pre-war and post-war prices and weighted by monthly export volumes. We also assume that the 2023 harvest will also be sold at depressed domestic prices.

Another challenge faced by Ukrainian producers has been the rise in production costs. We have estimated the increase in prices for two crucial inputs: fuel and fertilizers. Assuming no changes in production technology, Ukrainian producers are projected to incur an additional \$844 million in additional costs due to the post-invasion surge in fertilizer and fuel prices.

Recultivation of damaged farmland is another challenge, a concern separate from the demining mentioned in the previous section. Approximately 835,000 hectares need recultivation, which would require an additional \$184 million in financing.

**Figure 4: The War’s Effect on Milling Wheat Prices in Ukraine**



Source: Own presentation using Ukragroconsult data. Production costs data was received by informal discussion with medium and large-scale farmers in Ukraine.

## Agricultural Reconstruction and Recovery Needs

For the Needs Assessment, the methodology was taken from the Post-Disaster Needs Assessment Guidelines developed by the Global Facility for Disaster Reduction and Recovery, World Bank Group, European Union, and United Nations, as well as discussions with the Ministry of Agricultural Policy and Food of Ukraine, Ministry of Finance of Ukraine, international development projects, and other stakeholders.

**Table 1: Breakdown of Recovery and Reconstruction Needs (own estimations)**

Category	Component	Total in Millions of USD
<b>Reconstruction Needs</b>	<b>(a) Support for Reconstruction</b>	<b>9,402</b>
	Storage facilities	2,163
	Farm equipment and machinery	6,415
	Perennial crops	477
	Livestock, fisheries, and aquaculture	346
<b>Recovery Needs</b>	<b>(b) Support for Short-Term Recovery of Agricultural Production</b>	<b>6,122</b>
	Interest rate compensation for agricultural loans	3,370
	Agricultural loan guarantees via a Partial credit guarantee fund for agriculture	631
	Grants and inputs for agricultural production by small farms (per hectare and per livestock unit)	1,071
	Recultivation of damaged farmlands	1,050
	<b>(c) Support for Longer-Term Recovery of Ukrainian Agriculture</b>	<b>35,513</b>
	Investment grants for promoting climate-smart technologies for arable crops	15,000
	Investment grants for investing in horticulture (orchards and greenhouses)	2,513
	Investment grants for livestock development	9,000
	Investment grants for integrated food-energy systems, including biogas development	8,000
	Investment grants for fisheries and aquaculture	1,000
	<b>(d) Support for agricultural public institutions, including restructuring and compliance measures to accelerate EU accession</b>	<b>5,020</b>
	<b>TOTAL</b>	<b>56,057</b>

The total required funding is estimated at \$56.1 billion over the course of the next 10 years (Table 1). We have categorized these needs into two primary groups:

The **Reconstruction Needs** category is designed to address the compensation for and reconstruction of damaged physical assets. The costs for the reconstruction process are estimated with the 'build back better' principle in mind, which includes a 20% premium for certain damage categories.

The **Recovery Needs** category is focused on supporting production recovery efforts with the goal of returning to pre-invasion production levels. This category encompasses three distinct subcategories: 1) **Immediate Production Recovery** actions that need to be taken urgently to safeguard Ukrainian agriculture; 2) **Longer-Term Recovery of Agriculture** includes steps required to shape the future of Ukrainian agriculture; 3) **Support for Agricultural Public Institutions** aims at strengthening and supporting key agricultural public institutions due to higher workload resulting from the war, as well as addressing the rising capacity demands of public institutions due to Ukraine's plans of EU accession.

Overall, these needs extend over the course of the next years and might at first glance not seem extraordinarily high. However, as the war still rages and its resolution in the near future appears unlikely, the toll of the war will continue to mount. Moreover, the recovery and reconstruction needs presented above come on top of the regular fixed and working capital financing demand from agricultural producers that historically (excluding the high-price period of 2021–2023), according to the UKRSTAT data, has been around \$25 billion per year. That means that despite the substantial and continuing support from donors to help Ukraine to mobilize the necessary funds for recovery and reconstruction, Ukraine will need to facilitate crowding in private sector investments that are essential not just for the reconstruction, but also for the long-term development of the sector. From the government's perspective, it is important for Ukraine to leverage scarce public/donor resources and undertake necessary reforms (or, as is often the case,

avoid actively harmful decisions) that would improve the investment climate in the country, reduce specific agricultural risks, and facilitate crowding in private investments that would further spur development and growth.

#### *About the Authors*

*Oleg Nivievskyi* is Associate Professor and Dean of Graduate Economics Studies at the Kyiv School of Economics and is an Honorary Research Fellow at the School of Economics of the University of Queensland (Australia). He has more than 18 years of international experience in applied research of agri-food products, factor markets and value chains, rural development, and transportation economics. His research interests also include spatial economics, econometrics, efficiency and productivity analysis.

*Roman Neyter* is a researcher in agricultural and land policy at the Kyiv School of Economics and a PhD student at Wageningen University (Netherlands) in the 'Agricultural Economics and Rural Policy Group.' His research areas include the land market in Ukraine, assessment of the development potential of local communities, and assessment of the damage, losses and needs for reconstruction and recovery of Ukrainian agriculture.

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