

# 1 **Assessing Ukrainian agriculture in wartime: consequences, policy responses and** 2 **prospects**

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8

## 9 **Abstract**

10 The war in Ukraine has caused significant damage to the country's agricultural sector and poses a threat  
11 to global food security. However, the impact of the war on agricultural policy remains uncertain. To  
12 provide a thorough understanding of the challenges facing Ukraine's agricultural sector, we  
13 systematically review statistical data, legislative and regulatory measures, and relevant literature. Our  
14 analysis focuses on the period of war from 24 February 2022 to the end of 2023. We identify the main  
15 issues arising from the conflict and the agricultural policy responses. In addition, we outline potential  
16 trajectories for the development of Ukraine's agricultural sector in the post-war period. This study  
17 represents the first attempt to analyse Ukraine's agricultural policy during the war and envisages future  
18 post-war development through a comprehensive assessment of the agricultural challenges and policy  
19 frameworks during the war.

20 **Keywords:** Ukrainian agriculture, Russian invasion of Ukraine, Economic Implications, Agricultural  
21 policy, Wartime.

22

## 23 **1. Introduction**

24 The Russian invasion of Ukraine began on 24 February 2022, triggering a rapid deterioration in the  
25 country's economy. The war disrupted Ukraine's agricultural and food production, leading to disruptions  
26 in trade with other countries. Its global impact was felt through increased fuel and food prices, which  
27 affected the entire global economy.

28 Previous literature has analysed the impact of the war on global agriculture and food security, e.g. by  
29 (Abay et al., 2023), (He et al., 2023), (Chepeliev et al., 2023). Some earlier studies have focused on  
30 Ukraine's agricultural sector, highlighting its role as an agricultural exporter (Banse, 2022), (Rexhaj et  
31 al., 2023), (Shubravska & Prokopenko, 2022). Several comprehensive studies provide insights into

32 wartime agriculture (KSE Agrocentre, 2022a, 2022b), (Dibrova et al., 2023), (Klymenko & Nehrey, 2024).  
33 However, there remains a lack of analysis of the Ukrainian agricultural sector and its challenges, as well  
34 as a lack of studies on policy adjustments during the war and the sector's post-war prospects.  
35 Our study aims to fill these gaps by providing a comprehensive assessment of the multiple impacts of  
36 the Russian invasion on Ukraine's agricultural sector. Focusing on the first two years of the war, we  
37 examine the scale, scope and dynamics of the invasion, while assessing the government's responses  
38 to mitigate its effects. The structure of the paper includes an overview of pre-war Ukrainian agriculture,  
39 a detailed examination of the agricultural impact of the war on global markets and food security, an  
40 assessment of wartime agricultural policies, and a comprehensive discussion of the findings with  
41 implications for policy and research.

42

## 43 **2. Methodology**

44 Our aim is to provide an in-depth assessment of Ukrainian agriculture in the context of the Russian-  
45 Ukrainian war, and to examine Ukraine's agricultural policy responses. Focusing on the war timeframe  
46 from 24 February 2022 to the end of 2023, our analysis aims to delve into the first two years, potentially  
47 setting the stage for future studies covering subsequent war phases and the post-war period.

48 Our methodology consists of three key steps. First, we conducted a comprehensive review of statistical  
49 data from the Ukrainian State Statistical Service, the Food and Agriculture Organization, and other  
50 relevant sources. Second, we reviewed Ukrainian agricultural policy, examining legislative and  
51 regulatory acts of the Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine and the Ministry  
52 of Agrarian Policy and Food of Ukraine. Third, an extensive literature review was carried out by  
53 systematically reviewing research papers, Ukrainian government reports and publications by the FAO,  
54 the World Bank and the United Nations.

55 These methodological steps enabled a comprehensive understanding of Ukrainian agriculture from 24  
56 February 2022 to December 2023. This included an analysis of the sector's challenges, the responses  
57 of farmers and the government, and an assessment of the sector's potential. Such a comprehensive  
58 assessment serves as a basis for deriving key insights for agricultural policy formulation and potential  
59 growth trajectories within the sector for the post-war period.

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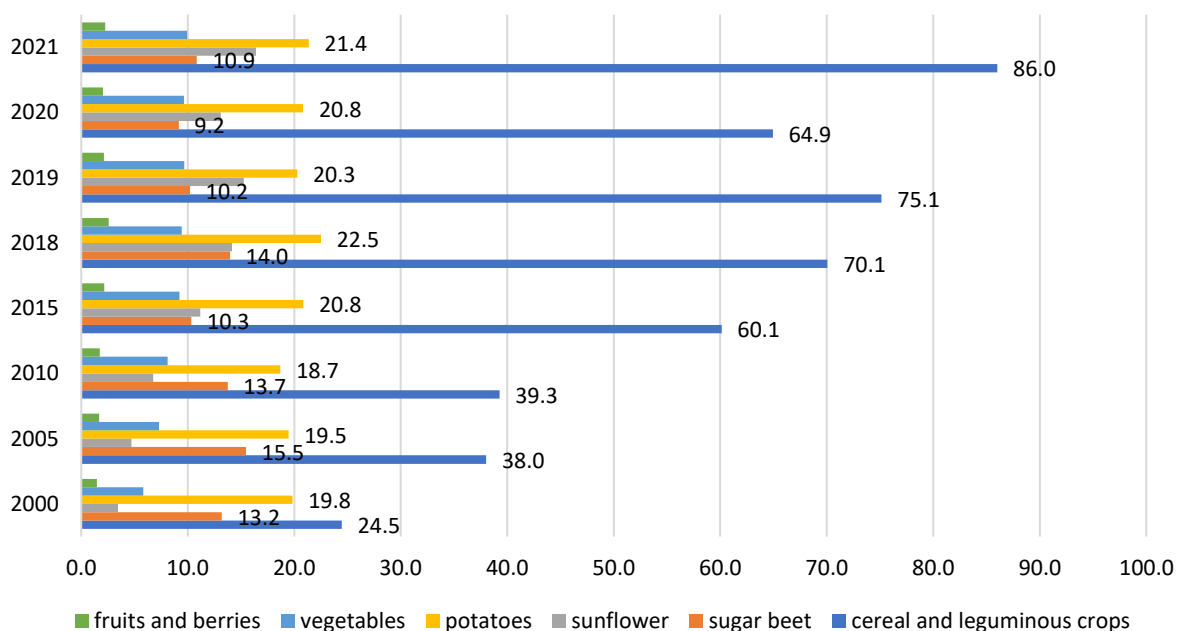
## 61 **3. Results**

### 62 **3.1. Ukrainian agriculture before the war**

63 Before the war, Ukrainian agriculture played a central role in the country's economy, making a  
 64 substantial contribution of 10% to GDP and accounting for 41% of total exports. The sector employed  
 65 more than 6 million people.

66 The structure of Ukrainian agriculture was twofold. On the one hand, 4 million households cultivated  
 67 20.8 million hectares of land and produced 55% of the gross output. On the other hand, more than  
 68 39,000 agricultural enterprises were active in Ukrainian agriculture, cultivating 20.4 million hectares of  
 69 land and producing 45% of the gross output (State Statistic Service of Ukraine, 2022b). Among the  
 70 agricultural holdings, the largest share of land (24.58%) was cultivated by agricultural enterprises of  
 71 between 1000 and 5000 hectares. Large agricultural holdings were a feature of the Ukrainian agricultural  
 72 sector. In 2021 they cultivated 12.77% (5 273 845 ha) of the Ukrainian agricultural area. The largest  
 73 agricultural holdings in Ukraine before the war were Kernel (514,000 ha of land bank), UkrLandFarming  
 74 (500,000 ha of land bank) and MHP (362,000 ha of land bank).

75 Ukrainian agriculture focused on crop production, which accounted for 81.4% of its output, while animal  
 76 production accounted for the remaining 18.6% (State Statistic Service of Ukraine, 2022a). Ukrainian  
 77 agricultural enterprises mainly specialised in the production of export-oriented crops, including cereals,  
 78 pulses, sugar beet, and sunflowers. At the same time, households focused their efforts on growing  
 79 vegetables, fruit, and other agricultural products to meet the needs of the domestic market. The  
 80 dynamics of the production of the most important agricultural products is shown in Figure 1.



81

82

Fig. 1. Production of agricultural products in 2021, million tons.

83 Notably, Ukrainian agriculture had achieved complete self-sufficiency in meeting the population's food  
84 needs, while enabling significant exports of agricultural commodities such as sunflower oil, wheat, barley  
85 and corn. Ukraine was the world's largest exporter of sunflower oil, accounting for 53.28% of total  
86 exports in 2021. Ukrainian agriculture also accounted for 11.48% of world exports of corn, 11.54% of  
87 barley, 8.42% of wheat and 9.58% of rapeseed (State Statistic Service of Ukraine, 2022b).

88

### 89 **3.2. Dynamics of the Russian invasion: impact on the Ukrainian agricultural sector**

90 Russia's invasion of Ukraine, which began on 24 February 2022, has created significant challenges for  
91 Ukrainian agriculture. In the initial phase, which lasted from 24 February to 31 March 2022, Russia  
92 occupied 25% of Ukraine's territory, including parts of the Zaporizhzhya, Kyiv, Zhytomyr, Luhansk,  
93 Sumy, Kharkiv, Chernihiv and Donetsk regions. This led to the large-scale destruction of production  
94 facilities, and infrastructure and logistical disruptions in agriculture. During this period, the agricultural  
95 sector experienced feed shortages, farm closures and damage to transport networks. The occupation  
96 and blockade of ports led to a halt in exports. Migration and mobilisation of labour created shortages,  
97 while a lack of working capital and problems with VAT refunds added to the financial pressures. Logistics  
98 have undergone significant changes: routes have changed, and costs have risen.

99 Active defensive actions took place between April 2022 and August 2022, resulting in the liberation of  
100 key regions, including Kyiv, Chernihiv, and Sumy regions. Fighting shifted mainly to eastern Ukraine.  
101 However, these operations were accompanied by challenges for agriculture, including problems with  
102 sowing, disrupted logistics, and a lack of resources and labour. A new challenge was the restoration of  
103 land that had been deoccupied. At this stage, initiatives such as the Solidarity Lanes Action Plan, which  
104 aims to create alternative logistics routes through rail, road and inland waterways (May 2022), and the  
105 Grain Initiative (July 2022), which aims to stimulate the export of Ukrainian agricultural products through  
106 Black Sea ports, were launched. In August, the State Agrarian Register, an automated digital system  
107 created by the Ministry of Agrarian Policy to obtain and distribute all types of support to Ukrainian farmers  
108 efficiently and transparently, was launched.

109 Between September 2022 and December 2022, the agricultural sector faced challenges related to  
110 damage to energy infrastructure and difficulties associated with rising input prices. Land mining also  
111 hampered the harvesting and planting of winter crops.

112 January-April 2023 saw prolonged battles for Bakhmut, Vuhledar and other settlements, accompanied  
113 by Russian strikes on energy facilities, causing prolonged power outages. During this period, farmers

114 from neighbouring European countries began blocking agricultural supplies, as well as interruptions in  
115 the Grain Initiative. There was a significant reduction in sowing areas due to the occupation and mining  
116 of the territories. The constant shortage of resources, export restrictions and logistical complications  
117 created a very difficult environment for the Ukrainian agricultural sector.

118 In the ensuing period, from May to August 2023, the Ukrainian Armed Forces launched a counter-  
119 offensive. In June 2023, the destruction of the Kakhovka Dam had a detrimental impact on vital irrigation  
120 systems that are critical to agricultural productivity. It is important to note that the Grain Initiative, a key  
121 source of export support, was not extended beyond 17 July 2023, creating new challenges and  
122 necessitating adaptation measures within the agricultural community. The arrival of new crops, coupled  
123 with insufficient storage capacity, added to the complexity of the situation and highlighted the need for  
124 innovative solutions.

125 Between September 2023 and December 2023, the agricultural sector endured ongoing hostilities.  
126 Ukrainian farmers responded by increasingly using an alternative corridor to export agricultural products,  
127 using Danube ports and land transport routes. However, the situation was exacerbated by the active  
128 shelling and destruction of port infrastructure in Odesa and the Danube ports by Russian troops. These  
129 challenges were compounded by bans on agricultural imports from neighboring European countries and  
130 the blockade of transit routes for Ukrainian grain, adding to the multifaceted difficulties faced by the  
131 agricultural sector.

132

### 133 **3.3. Effects and adaptations of war on Ukrainian agriculture**

134 The war led to changes in Ukraine's agricultural policy, with almost all traditional support programs  
135 suspended in 2022. The Cabinet of Ministers of Ukraine (CMU) redirected \$136 million from the 2022  
136 state budget, originally earmarked for agricultural support, to security and defence. Nevertheless,  
137 measures were introduced to support agricultural production during the war, including streamlined  
138 bureaucratic procedures, allowing the use of agricultural machinery without registration, simplified seed  
139 imports, a zero-excise tax rate, a reduction in the value-added tax (VAT) on fuel from 20% to 7% for all  
140 uses, and temporary financial support in the form of subsidies. agricultural producers were granted VAT  
141 exemptions on goods destroyed in the war and those used for national defence. Phytosanitary export  
142 requirements and the state registration process for pesticides and agrochemicals were relaxed. The list  
143 of agrochemicals that could be imported, produced, traded and used without registration was expanded.

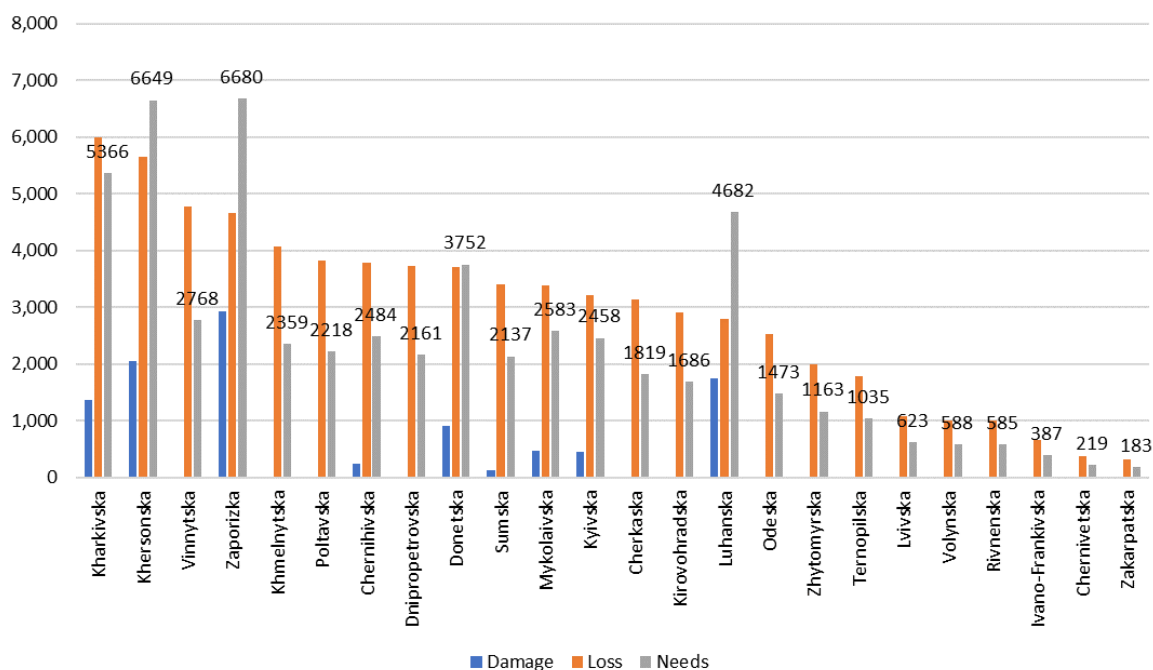
144 Under martial law, new rules on state veterinary and sanitary control were introduced, allowing the  
145 import of EU-registered feed additives for livestock production.

146 In 2022, Ukraine ratified an agreement with the United Kingdom to eliminate import duties and tariff  
147 quotas. As part of the Ukraine-Canada Free Trade Agreement (FTA), Canada eliminated import tariffs  
148 and restrictions on Ukrainian products for the year. In 2022, the European Council temporarily  
149 suspended customs and anti-dumping duties on certain Ukrainian products for one year.

150 International aid to Ukraine's agriculture, which exceeded USD 8.7 billion as of April 2023 (OECD, 2023),  
151 focused on direct damage through demining, seed supply, and equipment repair. EU assistance offered  
152 \$96 per hectare and \$318.5 per cow for small producers. The FAO Rapid Response provided \$115.4  
153 million and the US AGRI initiative contributed \$100 million. A temporary grain storage initiative provided  
154 35,000 bins with a capacity of 7 million tonnes. FAO, USAID and Japan provided seed and fertiliser  
155 assistance. The FAO grant program targeted small-scale producers, and joint efforts supported farmers  
156 during the planting season.

157 As of 24 February 2023, damage and losses to Ukrainian agriculture are estimated at US\$40.2 billion,  
158 with losses accounting for 78% of the total (Himmelfarb, 2023). The war has caused US\$8.72 billion in  
159 total damage (30% of pre-war agricultural capital), with total losses reaching US\$31.50 billion.

160 According to the World Bank, as of the end of 2023, total damage in the agriculture sector amounts to  
161 US\$10.3 billion, while losses amount to US\$69.8 billion, including the destruction of the Kakhovka Dam  
162 (World Bank, 2024). Damage includes partial or complete destruction of storage facilities, fisheries,  
163 aquaculture, perennial crops and forced grazing. In addition, it includes the destruction and theft of  
164 machinery, equipment, as well as production resources and products. Among these, damage to  
165 machinery and equipment accounts for the largest share of total losses at 57%, followed by stolen inputs  
166 and products (18%) and damaged storage facilities (18%). Damage, losses and needs by region (in  
167 USD millions) are presented in Figure 2. The regions most affected were Luhansk, Zaporizhzhya,  
168 Kharkiv, Kherson and Donetsk.



169  
 170 Fig. 2. Regional impact assessment: agricultural damage, losses, and recovery needs (USD millions) -  
 171 February 2023 (World Bank, 2024).

172  
 173 The total loss of Ukrainian arable land (both abandoned and seized by Russia) by 2023 is estimated at  
 174 over 6 million hectares, or 18% of Ukraine's total arable land in 2021 (Mkrtchian & Müller, 2024). The  
 175 impacts of mining on the agricultural sector include crop losses, financial burdens associated with the  
 176 repair or purchase of machinery, risks to worker safety, environmental degradation with soil and water  
 177 contamination, increased vulnerability to invasive species, and a potential decline in investment due to  
 178 unstable regional conditions.

179 The destruction of the Kakhovka Dam on 6 June 2023 caused extensive chaos in southern Ukraine.  
 180 Estimated total damage and losses to primary agriculture amount to \$1.18 billion, with fisheries bearing  
 181 the most significant impact at \$24.5 million (UN Ukraine, 2023). Additional losses include damaged  
 182 crops, drowned livestock, and costs of land reclamation. The destruction of the dam has particularly  
 183 affected intermittent irrigation for drought-prone agricultural land, with losses estimated at \$909 million  
 184 over the next five years.

185 To raise finance, farmers have been able to use financial instruments and strategies such as the 5-7-  
 186 9% scheme and government portfolio guarantees from banks, as well as guarantees from the EBRD  
 187 and IFC. In addition, farmers have used government grant schemes, eRobota grants and funding from  
 188 global institutions and agencies. Non-bank financial institutions, such as leasing, finance and factoring

189 companies and credit unions, played a key role in attracting finance. It should be noted, however, that  
 190 such programs have not been available to all farmers and have not been available in all regions.  
 191 According to a survey conducted by the FAO in 2022, 44% of respondents acknowledged a catastrophic  
 192 increase in production costs, and 25% reported reducing or stopping production activities due to the  
 193 war. In the first year of the war, about 90% of crop producers and 60% of livestock producers  
 194 experienced a significant or steep decline in income (FAO, 2023). In particular, certain enterprises,  
 195 especially those located in frontline regions, ceased operations, contributing to a 7% bankruptcy rate  
 196 among agricultural enterprises, despite government initiatives ostensibly aimed at supporting the  
 197 agricultural sector throughout the conflict.

198 In 2022, the total capitalisation of Ukrainian agricultural holdings was EUR 66,363 million, marking a  
 199 significant decrease of EUR 46,009 million (41.0%) compared to the previous year, 2021, which  
 200 recorded a total capitalisation of EUR 112,372.5 million (UkrAgroConsult, 2023). Furthermore, the fourth  
 201 quarter of 2023 observed a decline in the total capitalisation of prominent Ukrainian agricultural holdings,  
 202 including MHP, Kernel, Agroton, Astarta-Kyiv, Agrodzhenerien, Milkiland, IMC, KSG Agro, Ovostar  
 203 Union, Ukrproduct and Agroleague (UkrAgroConsult, 2024). According to stock exchange data and  
 204 calculations by UkrAgroConsult, the total capitalisation for this period amounted to €10,088.6 million,  
 205 which is a decrease of €1953.3 million (15.3%) compared to the same quarter in 2022 (€12,761.9  
 206 million).

207 In the face of the challenges of war, Ukrainian farmers showed a high degree of resilience. They  
 208 continued to produce agricultural products, even in the occupied territories and "wounded" fields. In  
 209 2022, there was a significant decline in harvests of crops traditionally grown in Ukraine (Table 1). This  
 210 decrease in harvest in 2022 is caused by two main factors. The first is a reduction in harvested area due  
 211 to various reasons such as occupation, damage, mining, and inability to work. The second is a reduction  
 212 in yields due to non-compliance with production technology. For example, due to the forced migration  
 213 of large numbers of people, rising input prices, and low liquidity of agricultural producers, fertilisers and  
 214 pesticides were reduced. In 2023, there was a slight increase in crop production compared to 2022, but  
 215 the agricultural sector did not return to pre-war levels.

216

217 Table 1. Dynamics of areas, yields, and harvests of major crops (MAPF, 2023).

	Area, million ha			Yield, centner/ha			Harvested, million tonnes		
	2021	2022	2023	2021	2022	2023	2021	2022	2023
Wheat	7.1	5.0	4.7	45.3	40.5	47.9	32.2	20.2	22.5

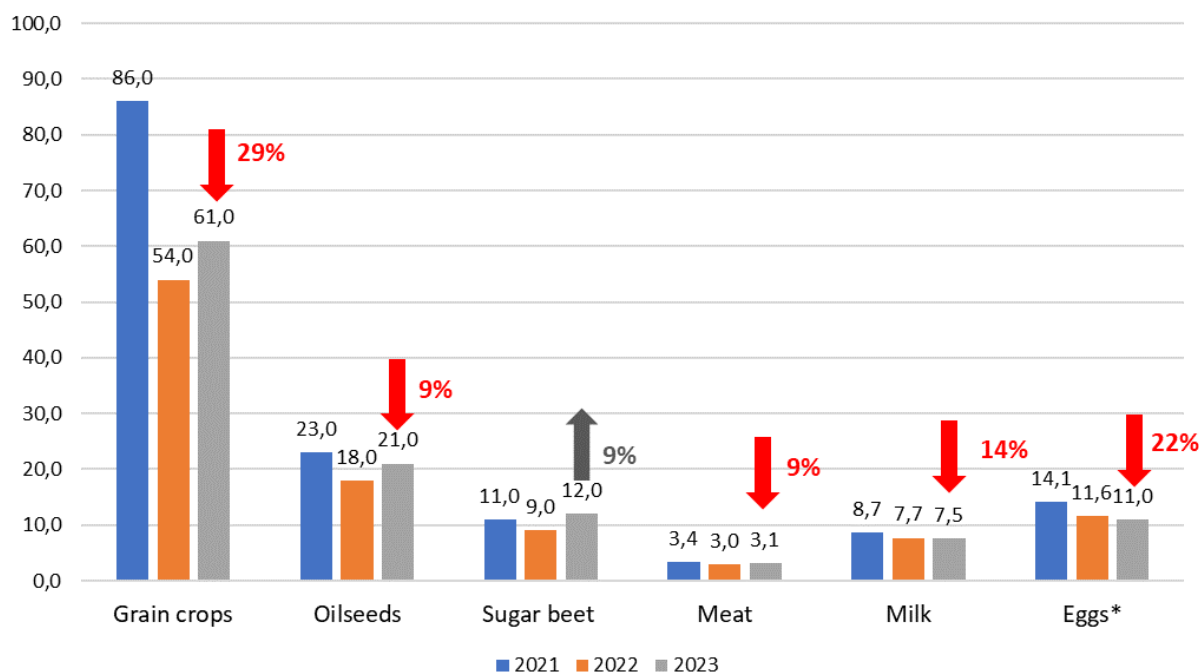


Barley	2.5	1.7	1.5	38.2	34.7	39.3	9.4	5.8	5.9
Peas	0.2	0.1	0.2	23.6	22.8	25.9	0.6	0.3	0.4
Corn for grain	5.5	3.6	3.6	76.8	65.7	78.1	42.1	23.5	28.2
Buckwheat	0.1	0.1	0.1	11.5	13.7	14.8	0.1	0.2	0.2
Millet	0.1	0.0	0.1	23.5	22.8	22.8	0.2	0.1	0.2
Sunflower	6.6	4.8	5.0	24.6	21.7	23.9	16.4	10.5	12.0
Soya	1.3	1.5	1.8	26.4	24.3	26.5	3.5	3.7	4.8
Rapeseed	1.0	1.1	1.4	29.3	28.6	28.7	2.9	3.2	4.5
Sugar beet	0.2	0.2	0.2	479.1	501.0	477.0	10.9	9.0	0.9

218

219 Agricultural production fell sharply during the war (fig.3), with cereals down by 29%, oilseeds by 9%,  
 220 and sugar beet by a modest 9%. There were further declines in meat production (9%), milk (14%) and  
 221 eggs (22%).

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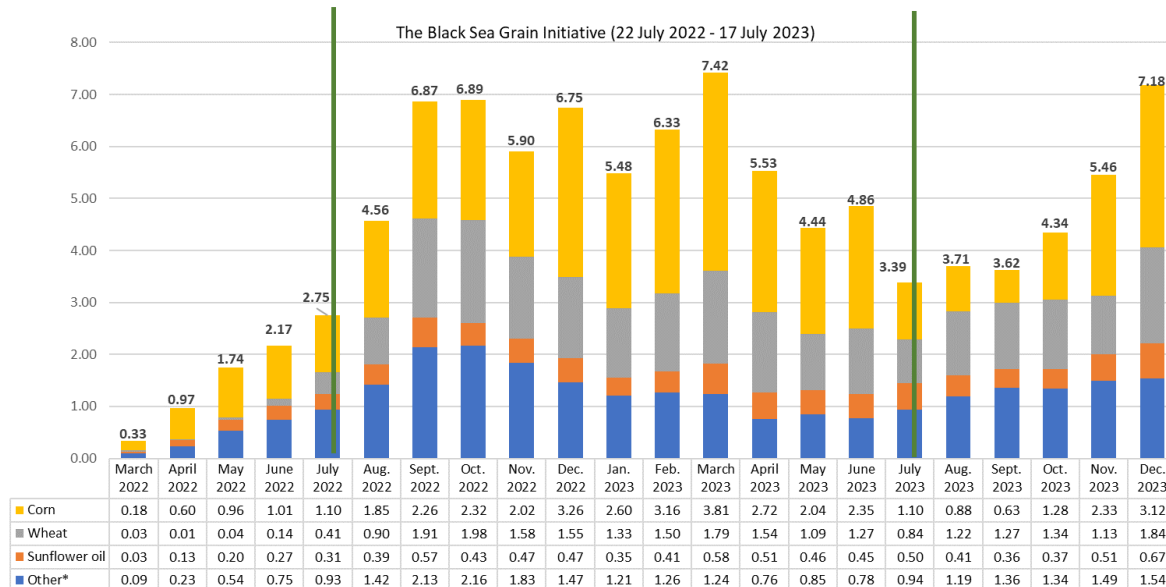
223

224 \* billion pcs

225 Fig. 3. Dynamics of agricultural production in Ukraine, million tonnes (UCAB, 2024).

226

227 The trajectory of agricultural exports during the war showed significant fluctuations across different  
 228 commodities, particularly influenced by the impact of the Grain Initiative from July 2022 to July 2023.  
 229 Following the expiration of the agreement, Ukrainian farmers shifted their operations to the Danube  
 230 ports, resulting in a significant increase in exports to 7 million tonnes by December 2023. Despite the  
 231 challenges, physical exports of agricultural products increased in 2023 (Fig. 4).



\* oil-cake, rapeseed, soybeans, barley, sunflower seeds, sunflower seeds

233

234

235 Fig. 4. Ukraine's agricultural exports during wartime (2022-2023), million tons (Ukrainian Grain  
236 Association, 2024).

237

238 On the other hand, export revenues amounted to USD 21.9 billion in 2023, a decrease of 8% compared  
239 to 2022, mainly due to lower prices compared to the previous year, which was characterised by the  
240 unprecedented global food prices in 2022. The export levels observed in 2022-2023 proved insufficient  
241 to cover the entire harvest period, thus increasing the risk of significant carryover stocks, particularly in  
242 the cereals sector. This financial predicament for Ukrainian farmers was exacerbated by depressed local  
243 market prices and the financial burden associated with export logistics. As a result, it became imperative  
244 to systematically explore all available options to increase export volumes and ensure that the entire  
245 harvest was fully exported before the start of the next season.

246

247 **4. Discussion**

248 The ongoing war in Ukraine has exposed critical challenges in its agricultural sector. Resource scarcity  
249 emerged as a major issue, putting pressure on key inputs and overall productivity. Disruptions to  
250 logistics and supply chains, including blockaded Black Sea ports and compromised storage facilities,  
251 hampered seamless movement and responsiveness to market demands. Market dynamics underwent  
252 a significant shift, shaping both the domestic and international landscape and requiring the formulation  
253 of innovative strategies. Labour shortages posed a significant challenge to the workforce, forcing them

254 to navigate through unprecedented circumstances. The mining and contamination of land by explosives  
255 introduced environmental complexities that affected vital resources and livelihoods within the sector.  
256 From a financial perspective, the crisis has caused significant damage, amounting to \$69.8 billion.  
257 Despite the prevailing uncertainty, the war has highlighted the resilience, unity and ingenuity of Ukraine's  
258 agricultural sector. This underscores its remarkable resilience and ability to persevere and adapt in the  
259 face of difficult circumstances.

260 In the short term, several critical measures need urgent attention, including ensuring resource  
261 availability, improving logistics efficiency and expanding access to global markets.

262 The drivers of post-war growth include the following key elements:

- 263 - Human capital. This involves attracting and recruiting new workers by creating favourable  
264 conditions for their involvement in agriculture. In addition, the promotion of agricultural education  
265 and scientific endeavour are crucial aspects.
- 266 - Strengthening small and medium-sized enterprises (SMEs). SMEs play a key role in ensuring  
267 Ukraine's food security, supporting regional supply chains, promoting rural development and  
268 preserving biodiversity.
- 269 - Agricultural integration with the European Union. Given Ukraine's candidacy for EU  
270 membership, there are significant opportunities to expand trade relations and enhance  
271 economic cooperation.
- 272 - Prioritising environmental and sustainable development. Ukraine's agricultural sector has  
273 considerable potential for the establishment of organic farms and the production of organic  
274 products. Prioritising proactive adaptation to climate change is essential.
- 275 - Support research, innovation and technological development. Digitalisation is emerging as a  
276 critical factor in the sector's growth trajectory. Leveraging Ukraine's well-developed IT sector  
277 can facilitate collaboration between the IT industry and agriculture, fostering innovation and  
278 technological advancement.

279

## 280 **5. Conclusion**

281 The war in Ukraine has caused significant agricultural losses, posing a threat to global food security.  
282 Our study, covering the period from 24 February 2022 to the end of 2023, examines these losses as a  
283 result of the Russian invasion. Key challenges resulting from the war include resource shortages,  
284 logistical disruptions due to blockades, destruction of grain reserves, land contamination and local

285 market downturns. In an effort to bolster the agricultural sector, the government implemented several  
286 measures, Special state programs were introduced, offering low-cost loans, support for processing  
287 companies, horticulture development, and greenhouse construction. The government facilitated  
288 alternative logistics networks for exports by obstructing ports, and tax exemptions were enacted,  
289 resulting in changes in land payment for state and municipal ownership during martial law. Aid from  
290 international organisations, partner-country governments and the private sector has largely focused on  
291 direct damage to Ukraine's agricultural sector and land resources, estimated at more than USD 10.3  
292 billion as of December 2023, by demining farmlands, providing seeds, and investing in the construction  
293 and repair of production facilities.

294 Immediate action is needed to ensure the availability of resources, improve the efficiency of logistics  
295 and expand access to global markets.

296 Post-war government priorities should shift towards human capital, smallholder empowerment, global  
297 market integration, sustainable practices and technological advancement, which will require supportive  
298 policies.

299 Our study provides a basic understanding of the impact of the war on Ukrainian agriculture, response  
300 strategies and post-conflict development. Further research should track subsequent phases of the war,  
301 new challenges and policy changes for a comprehensive understanding and effective policy formulation.  
302 Rebuilding Ukraine's agricultural sector in the context of economic change and potential EU integration  
303 requires sound policies based on evidence of technical capacity, human and financial resources and  
304 technological progress.

305

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