Questions and Answers
Ukraine's Crop Storage Infrastructure: Post-Invasion Damage Assessment

September 15, 2022

1. What is the assessment's main findings?

Approximately 1 in 6 (15.73%) of Ukraine's crop storage facilities - silos, elevators, grain bins, and warehouses for keeping grains and seeds such as wheat, barley, and sunflower seeds - have been destroyed, damaged, or controlled by Russia and its aligned forces since the start of the 24 February invasion. Of the 344 sites imaged by satellites for the assessment, the Yale School of Public Health's Humanitarian Research Lab (HRL) found 75 of those facilities show visible damage from conflict since the start of Russia's full-scale invasion.

2. How much crop storage in tonnes has Ukraine likely lost because of the war?

Ukraine had at least 58 million metric tonnes[1] of storage available before the war. It has lost at least 8.41 million tonnes because of the invasion, or 14.57% of its pre-war certified grain storage capacity. At least three million tonnes of storage has been damaged since February of 2022 and six million tonnes or more of storage (including nearly one million tonnes of damaged storage) were in Russia-controlled areas as of September 6.

3. Why are these findings important on a global scale?

Ukraine is one of the world's top grain producers. Since the invasion, the price of grain has skyrocketed. While the recent UN-brokered deal allowing Ukrainian grain to leave ports blockaded by Russia has lowered the cost of these crops, the price of these commodities is still high and volatile. High prices affect consumers around the world, particularly those that live in import-dependent countries which are often low-income and have a high debt ratio. High global prices can also affect producers' planting decisions for future seasons in other countries. Finally, 40% of the grain that the World Food Programme uses to feed the world's most food-insecure people comes from Ukraine, according to the United Nations.

4. What may happen if there is not enough crop storage in Ukraine?

Without sufficient storage, Ukrainian farmers may not plant as large a crop of winter wheat and other commodities which require similar processing and storage. Skipping or significantly reducing a full winter wheat crop would exacerbate already high and volatile prices, deepening the world's serious food security emergencies by transforming the current crisis of price into a catastrophe of scarcity for years to come. Already 50 million people in 45 countries are only one step away from famine. Ongoing challenges to affordability and new challenges with availability stemming from conflict-driven price volatility in the cereal commodity market mean that these people are already in the emergency phase of food insecurity. The most vulnerable populations – in Afghanistan, Ethiopia, Somalia, South Sudan and Yemen – may slide into famine conditions.

[1] N.B. This report uses metric tonnes. One metric tonne equals 1,000 kilograms, or 2,240 pounds. This is distinct from the American ton, which is 907.1847 kilograms, or 2,000 pounds

5. **How was the assessment conducted and what data was used?**

This assessment was conducted through multi-temporal change detection analysis of 344 grain facilities in Ukraine with commercially collected very high resolution (VHR) satellite imagery. Archival pre-invasion imagery, when available, was compared with recently collected imagery to detect potential damage consistent with bombardment or other conflict-related impacts.

An area of interest (AOI) was identified that included nearly 700 facilities in the regions most affected by bombardment since Russia's full-scale invasion of Ukraine in February of 2022. Open source information from social media and other online sources identifying allegedly attacked facilities supported the prioritization of imagery taskings within the AOI. Yale HRL utilized a combination of data from the Elevatorist provided by the US Department of Agriculture and a machine learning model-based detection by The Department of Energy's Oak Ridge National Laboratory (ORNL) to identify target facilities for analysis.

6. **What is not known about the status of Ukraine's crop storage facilities?**

It is not possible to offer an assessment of the locations where recently collected imagery data were not available. Approximately 50% of the AOI identified for the assessment had not been sufficiently imaged since 24 February. Thus the full impact of the conflict on all of Ukraine's crop storage facilities is not yet known.

Additionally, the assessment was not able to conduct a detailed analysis of specific munitions and weapons systems likely used for every damaged facility. A more in-depth damage analysis is a critical area of future research. This assessment was unable to confirm which crops were stored at each facility, nor how full each storage facility was at the time it sustained damage.

Studies such as this and the recent work at NASA Harvest to track agricultural impact of the conflict suggest that further study and analysis can prove increasingly beneficial in understanding the global impact of the war on food availability, markets, and subsequently the impact on those most in need.