War in Ukraine and Impacts on California Food and Agriculture

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The Russian invasion of Ukraine is a tragedy for those in the region and an ongoing threat to food security in many places. California agriculture can help mitigate some food shortfalls, but direct impacts on food and agriculture in California are relatively modest.

Russia’s invasion of Ukraine, which began on February 24, 2022, disrupted normal operations for Ukraine’s farms, food processing, and shipping. Ukraine is a major exporter of key agricultural commodities such as wheat, corn, barley, and sunflower oil. Russia is also a significant exporter of some of the same commodities. The major commodities exported by either Ukraine or Russia are not major exports for California. Nonetheless, the war has several potentially significant impacts for California, including the disruption of international food markets, effects on local food prices, higher farm costs, including fertilizer and energy, and direct commodity impacts for sunflowers, wheat, and walnuts.

This article reviews the situation and outlook for Ukraine’s agricultural production and exports, provides an overview of the impacts (and potential impacts) on international markets, and examines linkages with food commodities produced in California.

Situation and Outlook for Ukrainian Agriculture

At the start of the war in February, little agricultural activity was underway in Ukraine, but exports of previous harvests were disrupted. Ukraine exports the majority of its agricultural commodities through ports on the Sea of Azov and the Black Sea. All Ukrainian sea ports have been closed since the beginning of the war, but some exports have continued via other transportation channels. According to the Ukrainian Ministry of Agriculture, some exports of wheat, corn, sunflower oil, and other crops were being shipped by rail and through the ports on the Danube River. Nonetheless, at the end of May 2022, stocks of commodities still waiting to be exported were much larger than is typical for late spring.

The planting season in Ukraine begins in late March and continues through the end of May (see Figure 1) for all major crops except winter cereals.

Figure 1. Ukraine Crop Calendar

- **Barley (Spring)**
- **Barley (Winter)**
- **Corn**
- **Sunflower**
- **Wheat**

such as winter wheat, barley, and rye. Winter cereal crops are planted in late August and harvested in July, so they were already in the ground at the start of the war and needed tilling and fertilizer applications come spring and summer. Winter wheat accounts for over 90% of wheat grown in Ukraine. Winter barley accounts for 42% of Ukrainian barley production, and spring barley accounts for 58%.

The production and harvest of crops for the 2022/23 production and marketing year depend on what farmers are able to plant, cultivate, and harvest. Exports then depend on subsequent marketing and export logistics. A productive season depends on success at each link in the supply chain.

Some of the most productive farmland is located in the southeastern regions of Ukraine that have been occupied by Russia during the spring of 2022. The map of wheat production by region (Figure 2) is an example of the pattern of production in Ukraine; the patterns for other grains and oilseeds differ from wheat, but in general much of the agricultural area of Ukraine has been under threat.

According to the Ukrainian Ministry of Agriculture, about 30% of farmland has been occupied, unsafe, or has been otherwise unable to be farmed. It is unclear what is happening on farms in the occupied territories. Media reports that stocks of agricultural commodities and farm machinery have been stolen by the occupying forces and transported across the border to Russia. Farms that had been previously occupied but were later liberated had been pillaged, and fields are filled with landmines.

Farmers elsewhere in the country are proceeding with the planting season but face shortages of labor, fuel, and fertilizer, as well as depressed local prices for commodities. Local prices are low for commodities such as corn, because stocks remain from the previous growing season, that would typically have been exported already. About 14% of the labor force is normally employed in agriculture. Although farm workers are partially exempt from being conscripted to the defense forces, the number of people available to farm is much lower than last year.

The USDA published projections for the production of major crops grown in Ukraine as of June 10, 2022. Corn production for the 2022/23 growing season is projected to be down 26% from the prior 5-year average, wheat down 21%, sunflowers down 32%, and barley down by 35%. The June report shows projections for corn, sunflowers, and barley based on relatively complete 2022 planting information, which indicates more corn than the May report, but less sunflower seeds and barley. Wheat in Ukraine is mostly winter wheat, and projected production has not changed since last month.

### Agricultural Exports by Ukraine and Russia

In 2021, Ukrainian exports (by value) as a share of world exports were 57% for sunflower oil, 17% for barley, 15% for corn, 11% for wheat, and 3% for walnuts. That makes Ukraine the world’s top exporter of sunflower oil, the third largest exporter of corn (behind the United States and Argentina), the fifth largest exporter of barley (behind the United States and France), the third largest exporter of barley (behind Australia and the EU), and the fourth largest exporter of walnuts (behind the United States, Chile, and China).

Ukrainian sunflowers are primarily crushed and exported as vegetable oil. Sunflower cake is a byproduct of oil production and is used for animal feed, primarily within Ukraine. Snack sunflower seeds are a small share of sunflower consumption and account for very little of the sunflower trade. Developing countries that tend to be most reliant on food commodity imports from Ukraine are now the most vulnerable to disruption, food...
shortages, and high food prices. As usual, the poor are hurt worse. This may apply especially to destinations for Ukrainian sunflower oil and wheat.

India, the largest importer of Ukrainian sunflower oil, accounted for 25% of exports in 2021, and China was a close second, with 20%. Countries in Europe, as a group, accounted for 31% of exports in 2021, and about 14% of sunflower oil from Ukraine is exported to the Middle East. In 2021, 52% of corn exported from Ukraine went to China and 32% of corn went to Europe.

Ukrainian wheat exports are important for several developing countries that rely on relatively low-priced wheat for human consumption. Main destinations for wheat from Ukraine in 2021 were Egypt (18%), Indonesia (13.5%), Turkey (8.1%), Pakistan (7.4%), and Morocco (5.8%). An additional 16% of Ukrainian wheat was exported to other countries in Africa, and 15% was exported to countries in the Middle East.

Before the Russian invasion of Ukraine, global wheat prices had risen for several reasons unrelated to the war. With the 2021/22 Ukrainian wheat harvest underway, a major concern is blockage of ports and shipping lanes that threaten exports from Ukraine. Countries that rely on wheat from Ukraine and Russia, such as Egypt and other countries in Africa, the Middle East, and South Asia, are experiencing lower wheat imports. Recent reports indicate that consumers in some of these countries have already suffered from reduced imports and the rise in prices that began before the war started.

Port and shipping concerns have become increasingly significant as the war disrupts exports from Ukraine. The most significant disruptions, including complete blockages, apply to shipping from the ports along the southern coast of Ukraine on the Black Sea. Some of these ports have been under Russian control or significantly damaged. But even if agricultural commodities could be loaded, as at the important port of Odessa, the shipping lanes across the Black Sea have been controlled or threatened by Russian mines and war ships. Road, rail, and river transit are slow, expensive, and not feasible for the vast quantities of bulk commodities that Ukraine would typically ship.

On June 10, 2022, the USDA predicted a 61% fall in Ukrainian corn exports and a 45% fall in wheat exports for the 2022/23 marketing years. As this is being written in June 2022, it is not clear if there is a feasible negotiation with Russia that might allow bulk exports of food products to get through the Black Sea to developing country customers.

**Figure 3. Retail Fertilizer Prices in the United States**

Rising Prices of Fertilizer and Energy

Fertilizer prices have been rising since the summer of 2020, long before the war in Ukraine began. Ukraine exports small quantities of nitrogen fertilizer. Russia is the world’s largest exporter of fertilizer, including nitrogen, phosphate, and potash fertilizer, and is a major exporter of natural gas, which is used in the production process of nitrogen fertilizer. Prices of fertilizer in the United States have risen since the start of the war, continuing their upward trend (see Figure 3).

Fuel prices—natural gas, gasoline, and diesel—have also risen this year after falling at the end of 2021. The patterns differ somewhat this year, but a common element has been the substantial and more variable increases since the invasion became imminent. In 2022, California diesel prices rose by less than 10% in January and February, before a jump of 20% in early March and a rise of another 5% since then.
Fertilizer and energy are costly inputs for many crops in California. The share of fertilizer in operating costs is about 10% for almonds and processing tomatoes, and about 18% for corn silage. By contrast, for strawberries and lettuce, which are labor-intensive, fertilizer accounts for less than 2% of operating costs. Similarly, energy for cultivation, irrigation, and harvesting is a sizable share of costs for some crops. Transportation and processing fuels, such as for drying rice or manufacturing milk powders or tomato paste, are also a large share of post-farm costs that depress farm prices to compensate for higher costs of processing and shipping to markets.

**Potential Impacts on California Food and Agriculture**

Market disruption and higher fertilizer and fuel prices will have direct impacts on farm returns already under pressure from drought and several other challenges. The severity of the impacts will vary by crop. Dairy (for which corn silage is used as feed), almonds, and grapes, are the top three agricultural commodities in California by value. Costs to produce corn silage, almonds, and grapes will be significantly affected by rising fertilizer and fuel prices. As noted above, off-farm energy costs also depress farm prices as they increase food prices for consumers.

California does not import significant amounts of agricultural commodities from Ukraine, and direct competition in international markets is limited. However, the walnut market is an exception. California is the leading exporter of walnuts, followed by Chile and China, with Ukraine a distant fourth. Still, walnut prices have fallen substantially in recent years with pressure from Chinese exports, and Ukraine competes directly with China in several low-price walnut markets.

California sunflowers are grown almost exclusively as seed for sowing, and Ukraine and Russia are major customers. In 2021, California grew 45,000 acres of sunflowers that were harvested in the fall. Exports from California ports are typically concentrated in the months from September through February for spring planting at their destinations. California exported as usual in the fall and winter months, with a major share of exports shipped to Ukraine. However, industry reports indicate that disruptions at Ukrainian ports caused some California exports to be diverted to other destinations or returned to California. The outlook is uncertain for 2022/23 exports, which will commence this coming fall.

California production of wheat overlaps with Ukraine, but the markets differ. California farms plant about 400,000 acres of wheat each year, but harvest only a quarter of that, with most of the rest used for silage. Of the harvested wheat acreage, about 20% is durum wheat used for pasta. California exports very little wheat and does not compete with Ukraine in the low-price segment.

California wheat prices are generally higher than the U.S. national average and, like all wheat prices, rose from 2019 to 2020 and again from 2020 to 2021 (Figure 4). The effect of the Russian invasion of Ukraine may have influenced the resumption of the rise in wheat prices from February through April 2022, but several other factors, including prospects for lower U.S. yields, also affected wheat markets. High wheat prices may encourage more wheat to be harvested for grain in California rather than for silage, but drought may have even more influence.

The increase in farm costs, as well as costs of processing and transportation, drive up consumer prices of food and other farm-based consumer products. Nonetheless, the increase in U.S. food prices due to the war in Ukraine will likely be, at most, moderate for two reasons.
First, for the farm commodities in which Ukraine plays a significant world export role, the U.S. commodity market is large and supplied largely by domestic substitutes. For example, in pre-war times Ukrainian corn production was a bit less than 10% of U.S. production. The projected shortfall in Ukrainian corn exports this year (about 14 million tons) is about 8% of world exports and about 4% of U.S. corn production. Year-to-year variation in U.S. corn production due to normal weather and market fluctuation is much more than 4%. That means that, although regional dislocation in the markets that Ukraine usually supplies may be severe, and the production and export blockages in Ukraine are a tragedy, the results within U.S. commodity markets will continue to be modest.

Second, for most of the food products that may face higher farm prices because of the Russian invasion of Ukraine, the farm price share in retail prices is quite small. For example, for corn, soybeans, or barley, which are primarily fed to livestock before moving toward food consumers, the impact on food prices is indirect and small. Even for wheat, which goes directly to food products, the farm price is only about 17% of the retail price of wheat flour. More relevant, the farm cost share of wheat in a loaf of bread is only about 4%. Thus, even a 10% increase in the price of wheat in the United States would only raise the price of bread by 0.4%. Even if the price of milling and transport rose slightly because of war-induced increases in the price of energy, the increase in the price of bread in the United States is likely to be below 1%. Many factors have been causing higher food prices in the United States, but the war in Ukraine is a minor contributor.

**Final Remarks**

The crisis in Ukraine has been an evolving tragedy, evident to all. Food production in Ukraine has been hit hard, and its ability to export food commodities has been attacked directly. The impacts on Ukraine and on low-income consumers in countries that rely on imports from Ukraine have been severe. However, direct effects on California food and agriculture have been moderate at most.

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**For additional information, the authors recommend:**


