AgriFood economics centre

PM

2022-04-29

Impacts on agricultural markets of a large production loss in Ukraine

Torbjörn Jansson (torbjorn.jansson@slu.se) och Fredrik Wilhelmsson (fredrik.wilhelmsson@agrifood.lu.se)

AgriFood Economics Centre

Contents

Tables

Introduction

In the wake of the war in Ukraine, prices of cereals and oilseeds have risen strongly, both on the world markets and in Sweden. The price of wheat on the French exchange MATIF rose by 35% between February 1 and April 5 (ZMP, 2022), and on the Swedish market by around 30% during the same period (Jordbruksaktuellt, 2022). The rising prices may increase poverty and hunger globally when more people will be unable to afford food and the World Food Programme of the United Nations can afford less food aid (World Food Programme, 2022). The expectation of a harvest loss in Ukraine and reduced exports from Russia can be a part of the explanation but may not explain the whole price increase. Prices of many agricultural commodities were rising already before the war. The wheat price on MATIF, for instance, increased by about 20% between February 1, 2021 and February 1, 2022, and most of the increase took place during fall 2021. High prices on fossil fuels and fertilizers are other important factors that can affect prices, as are speculation and uncertainty.

Ukraine and Russia together produce a large share of the world's sunflower oil, and are major exporters of the cereals wheat, barley and maize. The war threatens to reduce harvests in Ukraine and has stopped the exports of already harvested cereals from the country. The Russian exports may be affected by sanctions and Russian export restrictions. We investigate what impact reduced harvests in Ukraine and possibly in Russia may have on world market prices and food supply, to shed light on to what extent the food price increases depend on real food shortage.

When production in one country decreases, trade, production, and consumption in other countries change as well. Therefore, it is not sufficient to study historical production and trade data to analyse the potential impact on prices and food supply. If consumers can easily switch to other suppliers or other types of food, a large reduction of supply in one country need not affect prices and overall food consumption much. Conversely, if the products are important in consumption and difficult to replace, then even a small change in production can have a large impact on prices. If production in other countries can expand quickly, and countries trade, then that will reduce the impact of a harvest loss on prices. We use a simulation model for our analysis in order to capture the complex market interactions that determine how much prices are affected by reduced production and trade.

All other things equal, a large reduction in supply will have a larger impact on prices than a small one. Therefore, we begin by describing the relative importance of Ukraine and Russia in global agricultural production and trade. We focus on wheat, barley, maize, and sunflower oil, where Ukraine and Russia are major suppliers to the world markets. However, the simulation model also covers other agricultural goods.

Global production and exports of cereals and sunflower oil

Table 1 shows the largest producers' shares in the global production of selected cereals in 2020 and sunflower oil in 2019. Ukraine is a large producer of many agricultural commodities, most importantly of sunflower oil (26% of global supply). Ukraine and Russia combined supplied more than half the sunflower oil produced globally in 2019 (FAOSTAT, 2022). Ukraine is also an important producer of the cereals wheat, barley and maize (2-3% of global production) while Russia is the world's largest producer of barley and the third largest producer of wheat. Therefore, reductions of production and exports from Ukraine and Russia could have large effects on the world markets.

Table 1: Distribution of the global production of selected products across countries in 2020 (percent of global production).

Barley		**Wheat**		**Maize**		**Sunflower oil**	
Russia	**9**	China	13	USA	19	**Ukraine**	**26**
Spain	5	India	11	China	14	**Russia**	**25**
Germany	5	**Russia**	**8**	Brazil	6	Argentina	6
Canada	5	USA	5	Argentina	2	Turkey	5
France	5	Canada	3	**Ukraine**	**2**	Hungary	3
Ukraine	**3**	**Ukraine**	**2**	**Russia**	**1**		

Source: FAOSTAT (2022)
Note: For sunflower otabil year 2019

A large share of the global production of agricultural products is consumed domestically; hence the country with the largest production is not always the largest supplier to the world market. To illustrate the importance of countries on the world market, Table 2 shows the countries with the largest shares of global exports. With 44%, Ukraine was the world's leading exporter of sunflower oil in 2020. Its share of global exports of barley (13%), wheat (9%) and maize (15%) are also high; much higher than its corresponding shares of global production. Since a large share of Ukraine's production is exported, a significant harvest loss in Ukraine could have larger impact on global agricultural markets than what is implied by the smaller shares of Ukraine in global production.

Table 2: Global exports shares by country 2020 (percent)

Barley		**Wheat**		**Maize**		**Sunflower oil**	
France	18	**Russia**	**19**	USA	27	**Ukraine**	**44**
Ukraine	**13**	USA	13	Argentina	19	**Russia**	**21**
Russia	**13**	Canada	13	Brazil	18	The Netherlands	5
Australia	11	France	10	**Ukraine**	**15**	Turkey	5
Canada	7	**Ukraine**	**9**	Romania	3	Hungary	3

Source: FAOSTAT (2022)

Countries with the largest import from Ukraine and Russia are not automatically those that are most affected by a disruption in production and/or trade due to the war. Trade often responds quite quickly to changes in supply and demand and reallocates products to where demand is. Furthermore, other trade links of importing countries and the dependence on imports will affect the impact. Thus, the countries most affected may well be other countries than those that imported large volumes from Ukraine and Russia previously. Even so, trade flows before the war are of significant interest as the impact of trade restrictions or sanctions may be affected by the destinations of exports. In addition, countries with large volumes of imports from Russia may be less inclined to support sanctions against Russia. Historical data also provide a basis for our analysis.

Table 3 shows the top export destination countries for Ukraine and Russia. The largest shares of Ukraine's exports is shipped to China, India, Saudi Arabia and Egypt. However, in the year 2020 10% of the maize exports went to Spain and 10% of the sunflower oil exports was shipped to the Netherlands. Thus, Ukraine is a significant supplier of maize and sunflower oil to the EU. The top export destinations for Russia are roughly the same as for Ukraine with the addition of Turkey that is a more important export destination for Russia than for Ukraine. Furthermore, no single EU country is among the top export destinations for Russia. It is noteworthy that, at the moment, none of the top export destinations for Russia, with the exception of South Korea, has imposed sanctions against Russian exports according to the Reuters list of sanctions (Minami et al., 2022)

Table 3: Top export destinations for Ukraine and Russia in 2020 (percent of exports).

	Barley		Maize		Sunflower oil		Wheat	
Russia	Saudi Arabia	51	Turkey	28	China	24	Egypt	22
	Jordan	14	Viet Nam	22	Turkey	20	Turkey	21
	Turkey	9	South Korea	10	India	14	Bangladesh	5
	Tunisia	7	China	9	Uzbekistan	6	Azerbaijan	4
	Libya	3	Georgia	8	Egypt	6	Sudan	4
Ukraine	China	28	China	28	India	28	Egypt	17
	Saudi Arabia	22	The Netherlands	11	China	18	Indonesia	15
	Libya	10	Egypt	10	The Netherlands	10	Bangladesh	8
	Tunisia	9	Spain	10	Iraq	7	Pakistan	7
	Israel	8	Turkey	5	Spain	6	Turkey	6

Source: FAOSTAT (2022)

Russia has imposed export taxes and quotas that limit exports of wheat (Reuters, 2022). In addition, Russia has decided to ban export of sunflower seeds and to limit exports of sunflower oil and meal by imposing export quotas. (Dagens industri, 2022). Even though top importers from Russia have not imposed sanctions against the country, Russia's exports might be affected by sanctions that complicate international payments and transports. The impacts of the war on production in Russia is unclear. The exports from Ukraine have been stopped due to the war.

Scenarios

We simulated the impact of harvest losses in Ukraine and partly in Russia, but kept all other things unchanged. The purpose was to isolate the effect of a direct production loss caused by the war from other factors that might also cause price increases, such as the fluctuations on fertilizer and fossil fuel markets. In Ukraine, we assumed a massive reduction in agricultural production to picture a situation where the war disturbs or prevents agricultural activities in large parts of the country. In two scenarios we extended the scenarios with production losses in Ukraine by adding production losses in Russia, to represent scenarios where either production is actually lost there due to e.g. war related shortage of inputs, or where Russia chooses to limit exports, with reduced supply outside of Russia as a consequence. We analysed the following scenarios, all of them for the year 2022.

Table 4: Description of scenarios in the analysis

Code	Explanation
REF	Reference scenario. No war, input prices as before 2021.
U50	Production of wheat, barley, maize, and sunflower seeds in Ukraine is reduced by 50%, all else as in REF.
U75	Production of wheat, barley, maize, and sunflower seeds in Ukraine is reduced by 75%, all else as in REF.
U50R10	As U50, plus a loss of 10% of Russia's production of wheat, barley, maize, and sunflower seeds.
U75R25	As U75, plus a loss of 25% of Russia's production of wheat, barley, maize, and sunflower seeds.

In the scenarios, we reduced production by the percentages shown in the table at prices prevailing in the reference scenario. One response to the production loss is that prices increase, and that producers respond by increasing production. Therefore, the final production changes in the model in Ukraine and Russia will differ slightly from the scenario assumptions after markets have adapted, as shown in our results.

Our scenarios apply to changes within a single calendar year. In such a short time, producers have limited possibilities to respond to price changes compared to what is plausible in the medium term (five to ten years), which is what the model is usually used to show. To adjust the model to represent short-run reactions, we reduced all *supply elasticities* in the model by a factor ten. That means that we assumed that in the short run, production only changes by about a tenth of the amount by which it would change in the medium term. Consumers and processing industry were assumed to adapt to changing prices in the same way as in the medium term.

The scenarios were computed using the simulation model CAPRI (CAPRI, 2022), which is a model of production, consumption, and trade in agricultural products in the whole world, with a focus on European countries. The model contains production of most crops and animal products such as meat, milk and eggs. Animal and crop production are interlinked via feed use and substitution in consumption. Some processing industries are represented in CAPRI. Of particular interest is the oilseed industry, since both Ukraine and Russia are major producers of sunflower oil. The oilseed industry buys inputs such as sunflower seed, rapeseed, and soy, and produces vegetable oils and a protein-rich feeding stuff. When Ukraine's production of sunflower seeds is reduced, Ukraine can reduce exports of sunflower seeds, and the processors in Ukraine can supply their inputs from other regions of the world. Therefore, sunflower oil production shrinks less than sunflower seed production, and oilseed processors in the rest of the world face higher input prices. It is uncertain to what extent Ukraine would actually be able to import sunflower seeds. The consequence for the simulation outcomes of these arrangements should be limited, since the global production of sunflower seeds is likely to be processed to oil whether it is in Ukraine or elsewhere. It is the total supply of sunflower seeds that is the key determinant of prices and quantities of sunflower oil.

The model simulates trade among individual larger countries or blocks of countries. Trade is governed by demand for products via differences between import prices and the price of domestic supply. How much imports are affected by an increase or decrease of the price difference across different origins varies among goods, and the model has been constructed to take such differences into account. A consequence of the way that trade is modelled in CAPRI, and in most other global trade models, is that small trade flows remain small even if prices change a lot, while it is easier to make larger changes in absolute terms to large trade flows. Furthermore, no new trade flows can be created in simulations that were not there in the reference scenario, e.g. if Sweden does not export wheat to Ukraine today, Sweden will not start exporting it in the scenarios regardless of how large the price changes may become. It is, in a sense, expensive to switch trading partners.

The model is comparative-static, which means that it computes a market equilibrium that lasts "forever". Most of the model data comes from 2012, so in order to create the reference scenario we had to make a forecast for 2022. We achieved that by using data from FAOSTAT for 2020 (2019 for sunflower oil production), that we made the model reproduce as close as possible. That makes the reference scenario a kind of assumption of how the world might look in equilibrium in 2021 without the war and without the rapid price increases for certain inputs that took place during fall 2021 and the beginning of 2022, while the other scenarios show how that equilibrium changes.

Results

In general, reduced production in Ukraine and Russia leads to reduced exports from those countries and increasing prices in all parts of the world. In this section, we first present impacts on prices, then on production and trade of the selected commodities, and finally what the scenarios imply for global food production and consumption. Appendix 1 contains tables showing more results for production, prices and exports from Ukraine to various destinations.

Prices

The model simulations show price increases for all products in all regions in all scenarios compared to the reference scenario. The impacts vary between regions depending on their trade relations. The impacts are, as expected, largest in Ukraine, but this result may not be relevant because the markets in Ukraine are affected by the war in many ways that are not captured by the model (population decrease, reduced consumer expenditure, *et cetera*). Outside of Ukraine, the impacts are largest in Russia in the scenarios where we have a production reduction in Russia.

For most regions and products, the impacts are smallest when Ukrainian production is reduced by 50% (U50), larger when production in Russia is also affected by 10% (U50R10), even larger when production in Ukraine is reduced by 75% (U75), and largest when also the production in Russia decreases by 25% in addition to the 75% decrease in Ukraine (U75R25), i.e.

U50 < U50R10 < U75 < U75R25

Figures 1-4 show import price changes for the four commodities wheat, barley, maize and sunflower oil in the four scenarios compared to the reference scenario, for selected regions. The import price is the average price of all import flows entering each region. The table to the right shows region codes that are used in the diagrams. Further down below, we look at EU prices in greater detail.

Region codes in the figures:

Code	Explanation
AFRLDC	LDC in Africa
PAK	Pakistan
EU	EU
MED	Algeria, Egypt, Israel and Tunisia
MOR	Morocco
MIDE	Middle East (Lebanon, Saudi Arabia and more)
IND	India
INDO	Indonesia
BGD	Bangladesh

The import prices of wheat (Figure 1) increase by 5 to 10% in the selected regions in U50. In the most extreme scenario, U75R10, the largest increase is found in Pakistan (+46%), while the increase in the EU is 19%. The prices are more strongly influenced by changes in wheat production in Russia than in Ukraine.

The import prices of barley (Figure 2) are generally changing less than those of wheat, even if the price increases here too fall in the 5-10% range in U50. In the most extreme scenario, the price increase is largest in the region MED (Algeria, Egypt, Israel and Tunisia), where it amounts to 24%. The price increase in the EU is 6-17% depending on the scenario.

The import prices of maize (Figure 3) are even less affected than those of barley in most regions. The largest price increases are again found in MED (+21%). Import prices of the EU increase more strongly than in many other regions (7-18%) and more strongly than for barley. The explanation is that Ukraine is an important supplier of maize to the EU, in particular to Spain.

The import prices of sunflower oil increase more than the cereals prices in the scenarios with production reduction in Ukraine. The increase in U50 becomes 10-15%, and in the most extreme scenario (U75R25) 20-32%. The large price increases reflect the dominant position of Ukraine and Russia on the world market for sunflower oil.

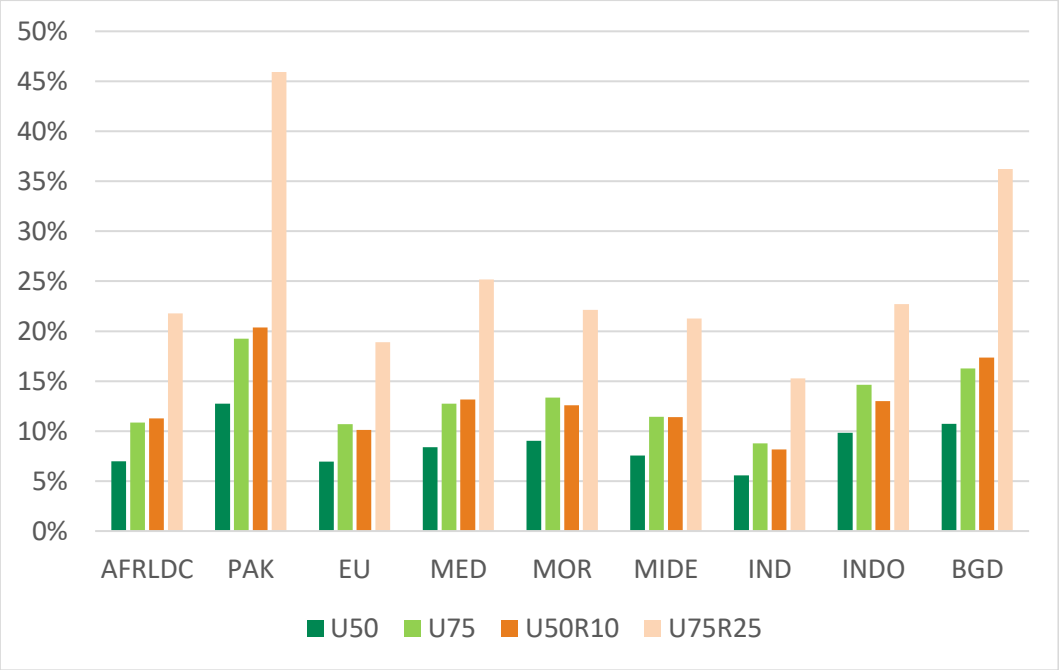

Figure 1: Percentage increase in import prices of wheat compared to the reference scenario.

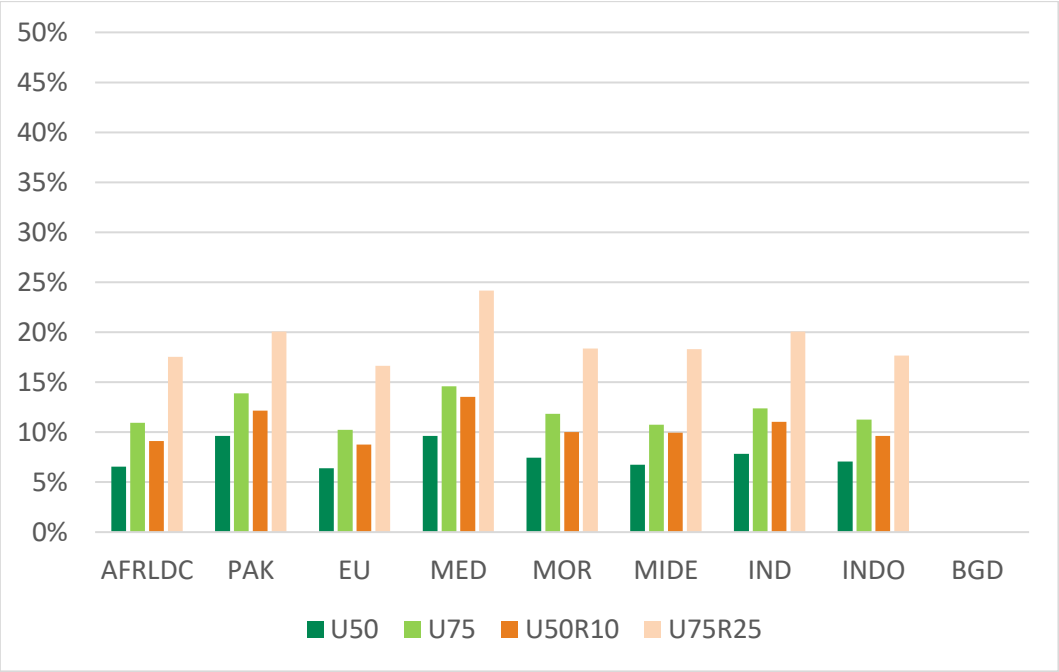

Figure 2: Percentage increase in import prices of barley compared to the reference scenario.

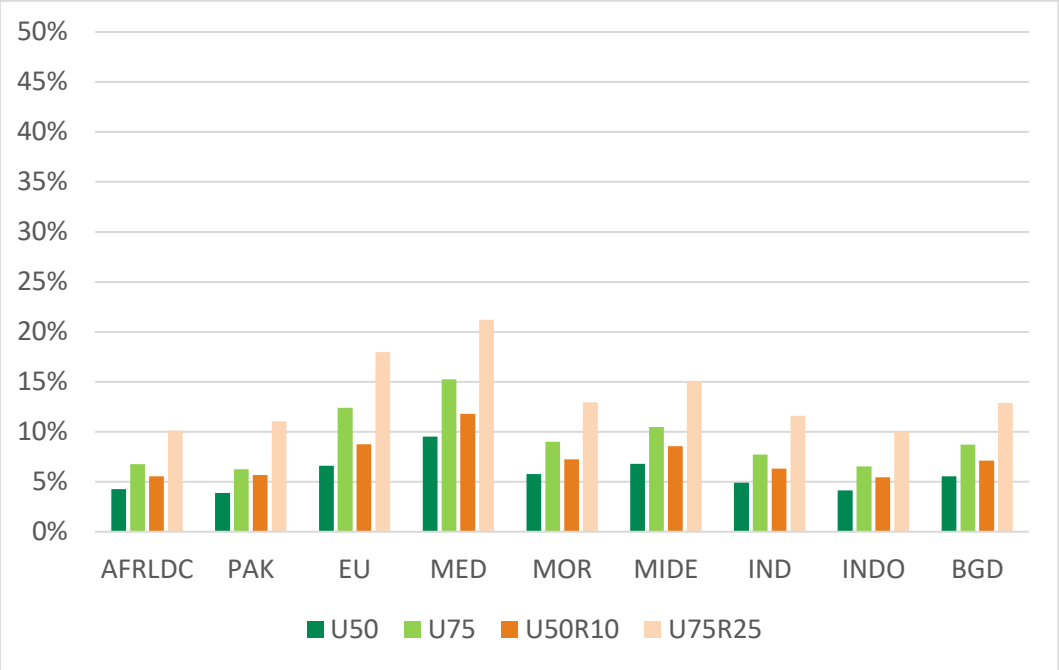

Figure 3: Percentage increase in import prices of maize compared to the reference scenario.

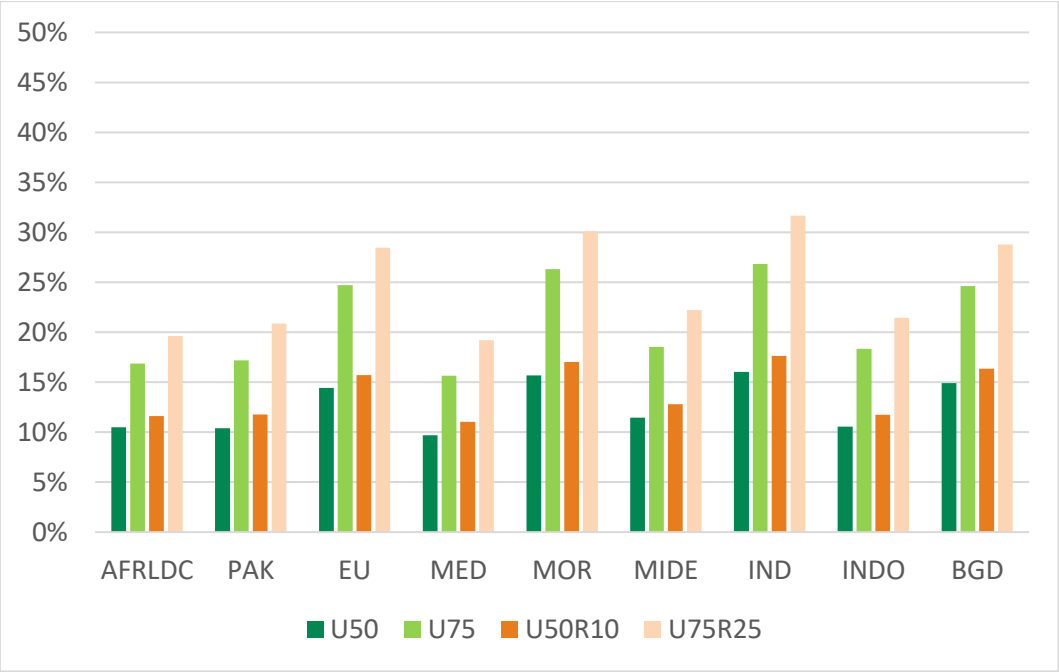

Figure 4: Percentage increase in import prices of sunflower oil compared to the reference scenario.

The prices of producers, importers and consumers may be differently affected. The producer price, i.e. the price that the farmer receives, is relatively closely linked to the import price, but since imported goods are assumed to be somewhat different from domestic ones, the import price and producer prices may evolve somewhat differently. For the cereals (wheat, barley, maize), the producer prices in the EU increase at about the same rate as the import prices, by 7-20% depending on the scenario. On the market for sunflower oil, the import price increases more than the producer price (in this case the factory price).

In general, the impacts on consumer prices are much smaller than the impacts on producer prices. The explanation is that consumption to a large extent takes place in the form of processed foods where the price of the agricultural commodity is only a small share of the production costs, and the other costs are assumed to be unaffected in our simulations. The consumer prices of wheat and maize increase by at most 2% in the scenarios (dark green bars in the diagrams below). The degree of processing of the barley that consumers buy (e.g. beer) is lower than that of wheat. Therefore the consumer prices increase more, by 2-7%. Also, much sunflower oil is consumed with a lower degree of processing (e.g. frying oil), and therefore the increases in consumer prices are more similar to the increases in producer prices, 7-12% depending on the scenario.

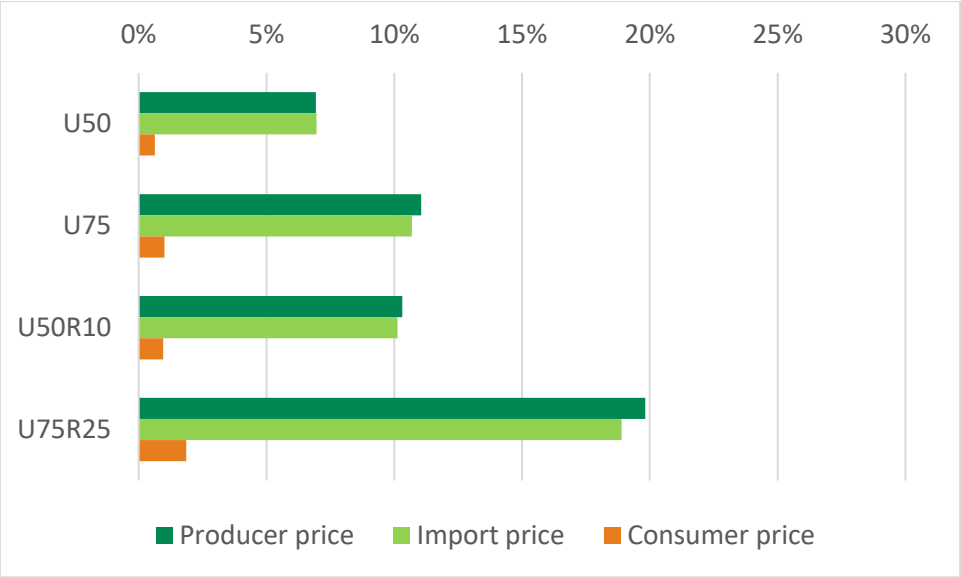

Figure 5: Price changes for wheat in the EU compared to the reference scenario.

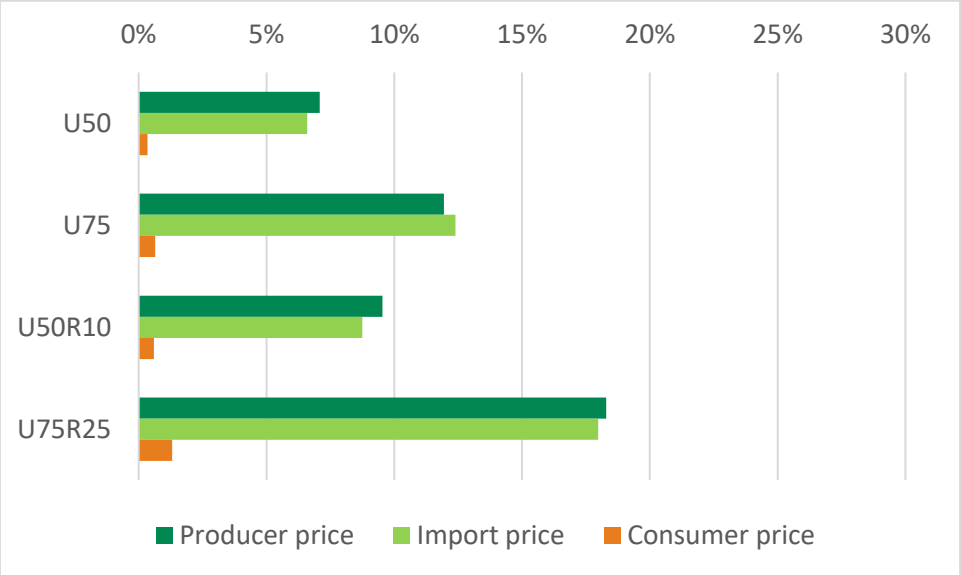

Figure 6: Price changes for maize in the EU compared to the reference scenario.

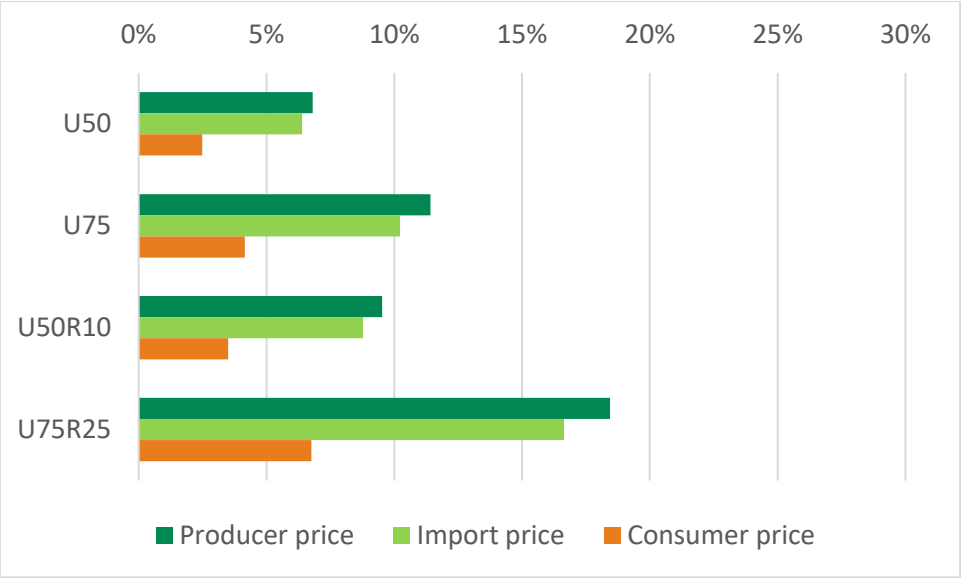

Figure 7: Price changes for barley in the EU compared to the reference scenario.

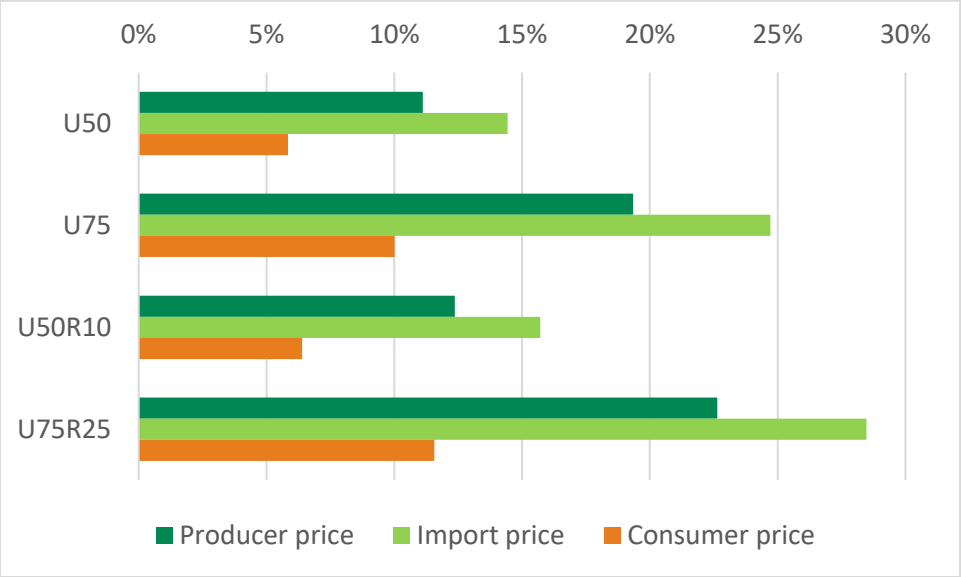

Figure 8: Price changes for sunflower oil in the EU compared to the reference scenario.

Production and trade

The price increases in the model simulations are explained by changes in production and trade. For the cereals wheat, barley, and maize, the effects are relatively uncomplicated. Production decreases in Ukraine and possibly Russia. That leads to less exports from those countries and higher prices in the whole world. Since we assume that only a small adaptation to prices changes is possible, the production response to the higher prices is limited – in most cases just a few tenths of a percent increase of production outside of Ukraine and Russia. This reflects the fact that it is difficult to adapt crop production quickly, since for example most of the wheat that is going to be harvested in 2022 was sawn in fall 2021.

The situation for sunflower oil is more complicated, partly because of the way our model and the scenarios are constructed. Agriculture produces sunflower seeds, which is an input in the vegetable oils industry, which in turn produces sunflower oil and a protein rich by-product that is used as animal feed. The industry can use both domestic and imported seeds. We have modelled the production decrease as a reduction in the harvest of sunflower seeds, while the oil seed processing facilities are assumed to work as before. The initial effect is that the harvests of

sunflower seeds in Ukraine and Russia are reduced, and as a consequence, it increases slightly elsewhere. So far, that is the same effect as we find on the cereals market. Exports of sunflower seeds from Ukraine and Russia is strongly reduced, and therefore the reduction in oil seed processing there is smaller than the reduction in sunflower seed harvest. However, for processors in the rest of the world, less sunflower seeds are available for processing or the input becomes more expensive, and therefore the production of sunflower oil is reduced in the rest of the world. Actual trade flows and processing impacts may become different due to sanctions and difficulties for Ukraine to maintain transportation and processing activities. That should not be critical to the analysis, since the price and total supply of sunflower seeds determines the price and supply of sunflower oil, regardless of where the seeds are processed.

Global food supply

The net effect of reduced production in Ukraine and Russia and increased production elsewhere is that the global food production is reduced (Figure 9). The reduction is larger for cereals and oilseeds, where it is an immediate consequence of the assumed reduction of those commodities in Ukraine and Russia. The markets for animal products are indirectly affected in several ways. Primarily, the prices of important feeding stuffs increase (cereals and the by-product of sunflower oil production). That increases the costs of meat production, and therefore meat production is reduced. The resulting price increases of meat are smaller than those of cereals, and therefore the reductions in meat consumption are also smaller. Beef meat producers are to some extent using silage, hay and grazing for feeding, and those inputs are also only indirectly affected in our scenarios. Therefore, the impacts on beef meat production become smaller than the impacts on pig and poultry meat, where the feed contains more cereals. Reduced feed demand in animal husbandry contributes to dampening the price increase – and hence the reduction in human consumption – of cereals.

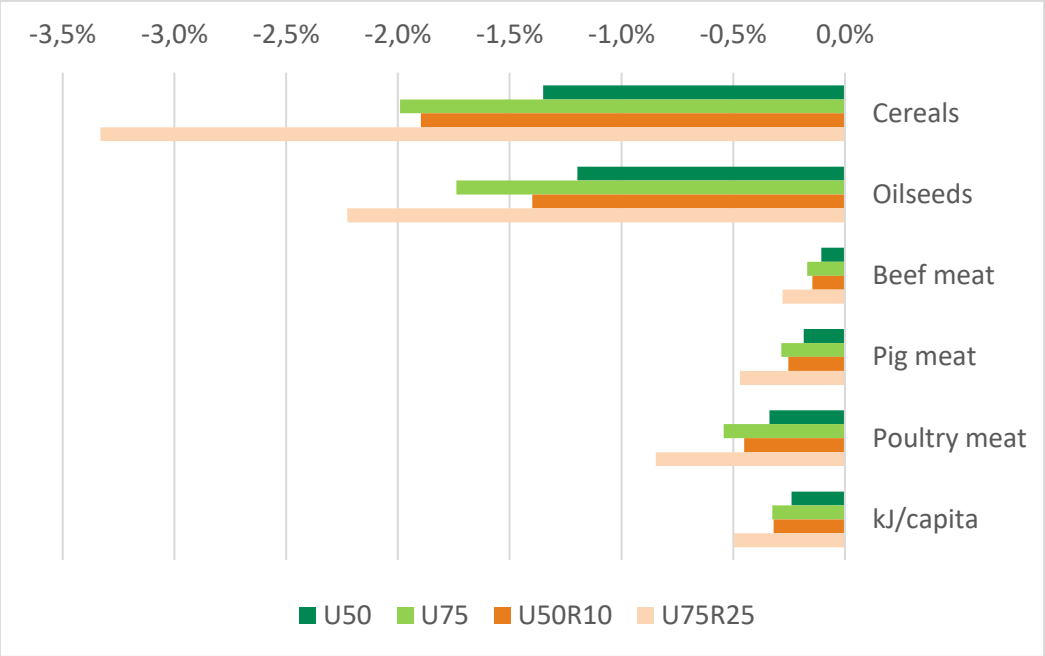

Figure 9: Percentage change in production (tonnes) of groups of food stuffs and change in aggregate food consumption (kJ per person) for the whole world.

If human consumption of all agricultural products is added up in energy equivalents (kJ per person), the results indicate that the global energy consumption is reduced by 0.2 to 0.5% depending on the scenario (bottom bars in Figure 9). For some regions, the effects may become much larger. Figure 10 shows production changes energy intake for all trade regions of the simulation model in scenario U50, sorted from largest to smallest impact. We find the largest

impact in countries that depend strongly on imports from Ukraine for their food supply. The diagram shows that trade and production responses are not able to fully disperse the effects of the production decrease equally to all countries.

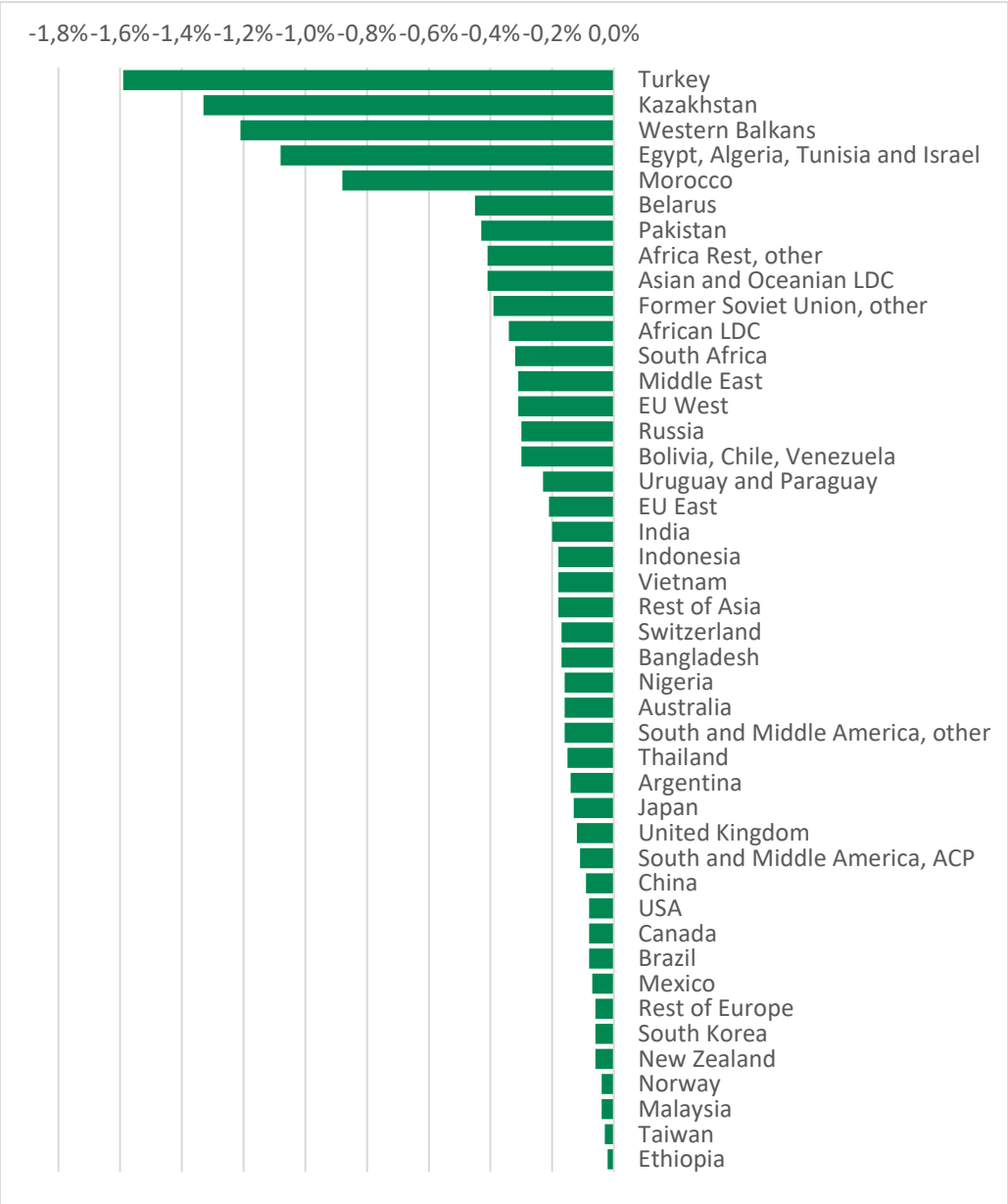

Figure 10: Changed calorie intake in various regions in U50 (% of REF)

Conclusions and discussion

The simulations show that if a large share of Ukraine's production of cereals and oilseeds is lost in 2022, prices will increase all over the world. The price increases are smaller than what has been observed on the markets the last twelve months. A large part of the price increase for wheat occurred already before the war: about +30% between March 2021 and January 2022, and since then prices rose by another 40% (Jordbruksverket, 2022). Only part of the price increases seems to depend on the expected production loss caused by the war. There are several factors that can help explain the remaining part of the price increases: increased prices of fossil fuels and fertilizers are plausible explanations, but also those prices started to rise already before the war. An additional explanation could be uncertainty in itself. If the production outcome is uncertain, a risk averse buyer might be prepared to pay a price premium (risk premium) to

ensure access to supplies upfront. It is certainly also possible that the model underestimates the impacts of the war on production in all scenarios, or that our scenarios are not sufficiently drastic. Nevertheless, it is important to keep in mind that the price increases that have taken place so far largely reflect the expectations of market agents regarding the future, whereas the model simulates a market equilibrium price for the year as a whole. The average prices of 2022 will only be known towards the end of the year.

The higher cereals prices in the scenarios benefit all producers of cereals outside of Ukraine and Russia. All other things equal, the price increases lead to increased profitability among growers. Conversely, buyers of cereals, sunflower oil and sunflower cake are negatively affected. For consumers in rich countries, the impacts are small. For firms producing pig meat, eggs, or poultry meat, the price increases bring higher costs that are not fully matched by higher consumer prices. Therefore, production of those animal products decreases in the simulations.

Regarding global food supply we find that, with the exception of sunflower oil, only a small part of the global production is affected. Most consumers should be able to adapt relatively easily when prices of foods produced from cereals increase by a few percent (1-2% for wheat based products in the EU). For low income households, the price increases might cause difficulties, and for those buying less processed foods (e.g. flour instead of bread) the relative price increase becomes higher, provided that the processing margin is not affected by the war. Nonetheless it is important to point out that if people starve because of a production loss in Ukraine and Russia, it is caused by poverty and not by a global shortage of calories for human consumption. As was mentioned in the introduction, the price increases have already caused a reduction in the volumes of food aid that large international organizations such as the World Food Programme of the United Nations can supply compared to the situation before the war.

Finally, the simulations show that changes in trade flows even out the price fluctuations among regions and limit extreme impacts on individual regions outside of Ukraine, even though countries that import from Ukraine are more strongly affected than other regions. Additional trade restrictions such as export restraints or protective custom tariffs could increase the differences in impacts across regions, while freer trade can help avoiding extreme impacts in individual regions.

References

CAPRI (2022). Online model documentation, downloaded on 2022-04-29 from https://capri-model.org/dokuwiki/doku.php?id=capri:docs

Dagens industri. (2022). Ryssland ska förbjuda export av solrosfrön. Downloaded 2022-04-11 from https://www.di.se/nyheter/ryssland-ska-forbjuda-export-av-solrosfron/

FAOSTAT (2020). FAO.PRODUCTION and FAO.TRADE. License: CC BY-NC-SA 3.0 IGO. Downloaded from 2022-03-28 to 2022-04-13 from https://www.fao.org/faostat/en/#data.

Jordbruksaktuellt. (2022). Marknadsinformation. Downloaded 20220407 from https://www.ja.se/sida/sv/marknad

Jordbruksverket (2022). Nyhetsbrev Downloaded 2022-04-13 from https://jordbruksverket.se/download/18.1818820118001c3be0a111db/1649341509628/Priset-pa-jordbruksprodukter-2022-04-06-tga.pdf

Minami, F., Lawson, H., & Deka, K. (2022). Tracking sanctions against Russia. The latest sanctions and actions taken against Russia by countries, major companies and organisations. Downloaded 2022-04-11 from https://graphics.reuters.com/UKRAINE-CRISIS/SANCTIONS/byvrjenzmve/

Reuters. (2022, March 14, 2022). Russia temporarily bans grain exports to ex-Soviet countries. Reuters. Downloaded 2022-04-11 from https://www.reuters.com/business/russia-may-suspend-grain-exports-until-june-30-interfax-2022-03-14/#:~:text=Russian%20wheat%20exports%20are%20down,15%2DJune%2030.

World Food Programme. (2022, March 31 2022). War in Ukraine pushes Middle East and North Africa deeper into hunger as food prices reach alarming highs. World Food Programme. Downloaded 2022-04-09 from https://www.wfp.org/news/war-ukraine-pushes-middle-east-and-north-africa-deeper-hunger-food-prices-reach-alarming-highs

ZMP (2022). Zentrale Markt- und Preisinformationen GmbH. MATIF Milling Wheat (No. 2) price. Downloaded 2022-04-19 from https://www.zmp.de/en/exchanges/matif-milling-wheat-no-2-price_future.

Appendix 1: Tables showing changes in prices, production, and trade.

Table 5: Producer prices of wheat (change from REF)

	U50	U75	U50R10	U75R25
UKR	28.1%	76.1%	32.7%	85.7%
RUS	7.6%	11.7%	16.7%	41.4%
EU	6.9%	11.0%	10.3%	19.8%
MED	8.0%	12.1%	12.3%	23.1%
CHN	3.4%	5.7%	5.2%	9.8%
USA	7.9%	11.7%	11.0%	19.6%
IND	5.3%	8.1%	7.9%	15.9%
PAK	8.2%	12.0%	12.5%	23.3%
CAN	7.6%	11.4%	10.7%	19.0%
AUS	7.4%	11.0%	10.7%	19.6%
BRA	6.3%	9.5%	9.4%	17.1%
ARG	8.5%	13.0%	12.6%	23.1%
MEX	7.0%	10.6%	10.2%	19.0%
TUR	5.2%	8.0%	9.9%	22.9%

Table 6: Producer prices of barley (change from REF)

	U50	U75	U50R10	U75R25
UKR	31.3%	68.2%	34.6%	77.8%
RUS	8.0%	12.8%	20.3%	52.7%
EU	6.8%	11.4%	9.5%	18.4%
MED	8.7%	13.3%	12.0%	21.4%
CHN	10.3%	15.1%	12.6%	21.0%
USA	2.7%	4.4%	3.6%	6.6%
IND	6.1%	9.7%	8.7%	16.1%
PAK	4.7%	7.2%	6.4%	11.5%
CAN	8.7%	12.8%	10.7%	18.0%
AUS	8.2%	12.9%	11.6%	21.1%
BRA	6.5%	10.4%	9.2%	16.7%
ARG	8.6%	13.5%	12.1%	22.0%
MEX	2.9%	4.6%	3.8%	6.9%
TUR	2.8%	4.6%	4.6%	9.5%

Table 7: Producer prices of maize (change from REF)

	U50	U75	U50R10	U75R25
UKR	25.3%	59.5%	28.0%	68.3%
RUS	6.2%	9.6%	15.4%	38.9%
EU	7.1%	11.9%	9.5%	18.3%
MED	9.3%	14.8%	11.9%	21.6%
CHN	3.8%	5.3%	4.5%	6.9%
USA	1.8%	2.8%	2.3%	4.1%
IND	4.9%	7.7%	6.5%	12.1%
PAK	4.0%	6.2%	5.4%	10.0%
CAN	7.6%	11.4%	9.7%	16.6%
AUS	5.7%	8.9%	7.8%	14.4%
BRA	6.1%	10.0%	8.0%	15.2%
ARG	5.3%	8.4%	6.8%	12.6%
MEX	2.5%	4.0%	3.3%	6.0%
TUR	3.7%	6.0%	5.6%	11.3%

Table 8: Producer prices of sunflower oil (change from REF)

	U50	U75	U50R10	U75R25
UKR	18.8%	32.6%	20.3%	37.3%
RUS	11.3%	18.5%	13.3%	24.0%
EU	11.1%	19.3%	12.4%	22.6%
MED	8.1%	13.3%	9.2%	16.2%
CHN	11.1%	18.0%	12.4%	21.5%
USA	9.2%	16.6%	10.2%	19.3%
IND	13.3%	22.0%	14.7%	25.7%
PAK	9.4%	16.1%	10.9%	19.4%
CAN	9.0%	15.9%	10.0%	18.4%
AUS	11.1%	18.6%	12.3%	21.5%
BRA	4.1%	8.0%	4.6%	9.4%
ARG	6.5%	12.9%	7.3%	15.3%
MEX	10.3%	18.3%	11.4%	21.5%
TUR	10.9%	17.7%	12.4%	21.7%

Table 9: Exports of wheat from Ukraine to selected destinations (1000 t)

IMPORTÖR	REF	U50	U75	U50R10	U75R25
EU	753	-77.1%	-98.0%	-77.6%	-97.6%
MED	4 024	-78.8%	-98.5%	-77.2%	-97.6%
BGD	1 608	-68.8%	-97.1%	-60.4%	-92.2%
INDO	3 139	-70.1%	-97.3%	-71.0%	-96.8%
PAK	1 274	-75.3%	-98.2%	-72.2%	-96.3%
MOR	998	-77.7%	-98.4%	-78.4%	-98.1%
MIDE	871	-78.1%	-98.4%	-77.7%	-97.7%
ASIOTH	803	-77.0%	-98.2%	-77.1%	-97.7%
ASILDC	767	-78.8%	-98.5%	-78.1%	-97.9%
THA	611	-78.8%	-98.5%	-79.7%	-98.3%
TUR	1 041	-78.7%	-98.3%	-73.8%	-95.3%
KOR	424	-79.1%	-98.6%	-80.2%	-98.4%
MYS	387	-71.8%	-97.5%	-72.4%	-97.0%
AFRLDC	187	-81.7%	-98.8%	-80.8%	-98.2%

Table 10: Exports of barley from Ukraine to selected destinations (1000 t)

IMPORTÖR	REF	U50	U75	U50R10	U75R25
RUS	42	-80.0%	-96.8%	-61.8%	-79.0%
EU	100	-85.1%	-97.9%	-84.8%	-97.7%
MED	682	-78.8%	-96.6%	-76.9%	-95.8%
CHN	2 275	-78.5%	-97.0%	-79.2%	-97.1%
MIDE	332	-86.2%	-98.2%	-85.6%	-98.0%
MOR	110	-85.3%	-98.1%	-85.3%	-98.0%
TUR	58	-87.0%	-98.3%	-86.3%	-98.0%

Table 11: Exports of maize from Ukraine to selected destinations (1000 t)

IMPORTÖR	REF	U50	U75	U50R10	U75R25
RUS	15	-74.3%	-96.0%	-59.2%	-84.6%
EU	8 786	-44.9%	-91.5%	-44.6%	-91.4%
MED	4 500	-64.3%	-93.0%	-62.7%	-92.4%
CHN	7 084	-81.1%	-97.8%	-83.4%	-98.4%
BGD	124	-77.0%	-96.6%	-78.2%	-97.0%
TUR	714	-76.4%	-96.3%	-74.7%	-95.4%
MIDE	1 665	-76.7%	-96.7%	-77.0%	-96.8%
KOR	2 074	-77.1%	-96.9%	-78.6%	-97.2%
BLR	77	-56.3%	-90.2%	-43.0%	-78.6%
MOR	284	-73.8%	-95.7%	-74.7%	-96.1%
UK	893	-48.4%	-83.4%	-48.6%	-84.0%

Table 12: Exports of sunflower oil from Ukraine to selected destinations (1000 t)

IMPORTÖR	REF	U50	U75	U50R10	U75R25
EU	2 100	-27.8%	-42.2%	-28.6%	-45.0%
MED	70	-49.2%	-69.5%	-49.6%	-71.1%
CHN	1 279	-40.8%	-62.0%	-41.0%	-63.5%
USA	86	-58.8%	-76.7%	-60.7%	-80.3%
IND	1 239	-28.0%	-45.7%	-28.2%	-46.7%
MIDE	266	-47.1%	-67.6%	-47.7%	-69.6%
CAN	18	-53.3%	-70.4%	-55.0%	-74.1%
AUS	27	-47.7%	-66.0%	-48.7%	-68.6%
UK	95	-33.0%	-48.8%	-34.7%	-52.9%
TUR	85	-49.8%	-69.7%	-48.6%	-68.7%

Table 13: Production of wheat in selected countries (1000 t and change from REF)

	REF	U50	U75	U50R10	U75R25
UKR	26 909	-49.5%	-72.3%	-49.2%	-72.0%
RUS	92 815	0.2%	0.4%	-9.4%	-23.4%
EU	127 749	0.5%	0.7%	0.7%	1.1%
MED	13 231	0.4%	0.6%	0.6%	1.2%
CHN	115 935	0.2%	0.3%	0.3%	0.5%
USA	55 748	0.5%	0.7%	0.7%	1.2%
IND	95 096	0.3%	0.5%	0.5%	1.0%
PAK	24 738	0.5%	0.8%	0.8%	1.5%
CAN	42 409	0.4%	0.6%	0.6%	1.0%
AUS	22 481	0.3%	0.4%	0.4%	0.8%
BRA	4 553	0.6%	0.9%	0.8%	1.4%
ARG	12 158	0.2%	0.2%	0.4%	0.7%
MEX	2 189	0.4%	0.6%	0.6%	1.1%
TUR	17 435	0.8%	1.0%	1.1%	1.5%

Table 14: Production of barley in selected countries (1000 t and change from REF)

	REF	U50	U75	U50R10	U75R25
UKR	7 484	-48.8%	-72.0%	-48.6%	-71.6%
RUS	23 106	0.4%	0.6%	-9.0%	-22.4%
EU	50 720	0.4%	0.6%	0.5%	0.8%
MED	1 564	0.4%	0.6%	0.5%	0.9%
CHN	1 103	0.6%	0.9%	0.8%	1.3%
USA	4 872	0.1%	0.1%	0.1%	0.2%
IND	2 303	0.3%	0.5%	0.5%	0.9%
PAK	95	0.0%	0.1%	0.0%	0.0%
CAN	11 053	0.5%	0.7%	0.6%	1.0%
AUS	13 569	0.3%	0.5%	0.4%	0.8%
BRA	146	0.4%	0.6%	0.5%	1.0%
ARG	10 742	0.4%	0.6%	0.6%	1.1%
MEX	712	0.1%	0.2%	0.1%	0.3%
TUR	7 530	0.6%	0.8%	0.8%	1.1%

Table 15: Production of maize selected countries (1000 t and change from REF)

	REF	U50	U75	U50R10	U75R25
UKR	33 325	-49.8%	-73.7%	-49.7%	-73.4%
RUS	14 982	0.2%	0.3%	-9.4%	-23.4%
EU	62 441	0.7%	1.0%	0.8%	1.2%
MED	6 742	0.5%	0.8%	0.6%	1.1%
CHN	243 096	0.2%	0.3%	0.2%	0.3%
USA	341 048	0.0%	0.0%	0.0%	0.1%
IND	22 323	0.3%	0.4%	0.4%	0.7%
PAK	5 700	0.2%	0.3%	0.3%	0.5%
CAN	14 278	0.4%	0.6%	0.5%	0.9%
AUS	563	0.3%	0.5%	0.4%	0.7%
BRA	69 314	0.3%	0.5%	0.4%	0.7%
ARG	26 869	0.4%	0.6%	0.5%	1.0%
MEX	39 126	0.1%	0.2%	0.2%	0.3%
TUR	6 223	0.9%	1.1%	1.1%	1.3%

Table 16: Production of sunflower oil in selected countries (1000 t and change from REF)

	REF	U50	U75	U50R10	U75R25
UKR	6 396	-30.5%	-46.3%	-31.1%	-48.3%
RUS	5 973	-1.4%	-2.9%	-3.8%	-9.0%
EU	3 277	-4.9%	-9.7%	-6.1%	-11.9%
MED	26	1.7%	0.8%	1.6%	0.5%
CHN	337	-2.1%	-5.1%	-2.9%	-7.0%
USA	139	-5.4%	-14.6%	-6.2%	-16.7%
IND	175	1.6%	2.2%	1.6%	2.4%
PAK	248	-8.3%	-14.5%	-9.7%	-17.1%
CAN	11	-4.1%	-9.4%	-4.8%	-11.0%
AUS	16	-0.6%	-2.5%	-1.3%	-3.9%
BRA	68	-4.3%	-8.8%	-5.0%	-10.4%
ARG	1 047	-4.2%	-10.4%	-4.9%	-12.1%
MEX	13	-3.0%	-8.8%	-3.6%	-10.3%
TUR	1 223	-1.0%	-1.9%	-1.5%	-3.1%

Table 17: Region codes used in the result tables

Name	Abbreviation
Africa LDC, other	AFRLDC
Argentina	ARG
Asian and Oceanian LDC	ASILDC
Asia and Oceania, other	ASIOTH
Australia	AUS
Bangladesh	BGD
Belarus	BLR
Brazil	BRA
Canada	CAN
Switzerland	CH
China	CHN
European Union	EU
Former Soviet Union, other	FSU
India	IND
Indonesia	INDO
Japan	JAP
Kazakhstan	KAZ
South Korea	KOR
Mediterranean countries (Tunesia, Algeria, Egypt, Israel)	MED
Mercosur, other	MER_OTH
Mexico	MEX
Middle East	MIDE
Morocco	MOR
Malaysia	MYS
Nigeria	NGA
Norway	NO

New Zealand	NZL
Pakistan	PAK
Russia	RUS
Taiwan	TAW
Thailand	THA
Turkey	TUR
United Kingdom	UK
Ukraine	UKR
United States of America	USA
South Africa	ZAF

Appendix 2: Comparison of FAO 2020 and CAPRI reference scenario

Table 18: Exports from Ukraine (1000 t). Export to UKR = production.

Importer	Exporter	Product	FAO	CAPRI
UK	UKR	Barley	2	2
UK	UKR	Maize	807	892
UK	UKR	Wheat	31	34
UK	UKR	Sunflower oil	97	95
NO	UKR	Maize	6	7
NO	UKR	Wheat	0	0
NO	UKR	Sunflower oil	1	1
TUR	UKR	Barley	57	58
TUR	UKR	Maize	642	713
TUR	UKR	Wheat	1035	1041
TUR	UKR	Sunflower oil	91	85
CH	UKR	Barley	0	
CH	UKR	Maize	1	
CH	UKR	Wheat	2	2
CH	UKR	Sunflower oil	2	2
RUS	UKR	Barley	40	42
RUS	UKR	Maize	16	15
UKR	UKR	Barley	7636	7484
UKR	UKR	Maize	30290	33325
UKR	UKR	Wheat	24912	26909
UKR	UKR	Sunflower oil	5836	6396
BLR	UKR	Barley	4	
BLR	UKR	Maize	72	77
BLR	UKR	Wheat	1	1
BLR	UKR	Sunflower oil	15	14
KAZ	UKR	Maize	0	0
FSU	UKR	Barley	1	1
FSU	UKR	Maize	6	6
FSU	UKR	Wheat	4	3
FSU	UKR	Sunflower oil	6	6
MOR	UKR	Barley	105	110
MOR	UKR	Maize	265	283
MOR	UKR	Wheat	935	998
MOR	UKR	Sunflower oil	13	13
MIDEAST	UKR	Barley	383	332
MIDEAST	UKR	Maize	1546	1663
MIDEAST	UKR	Wheat	782	871
MIDEAST	UKR	Sunflower oil	239	266
NGA	UKR	Sunflower oil	0	
ETH	UKR	Sunflower oil	2	2
ZAF	UKR	Barley	0	
ZAF	UKR	Wheat	60	66

ZAF	UKR	Sunflower oil	2	2
AFR_LDC	UKR	Maize	1	
AFR_LDC	UKR	Wheat	193	187
AFR_LDC	UKR	Sunflower oil	29	31
AFR_REST	UKR	Maize	9	8
AFR_REST	UKR	Wheat	69	64
AFR_REST	UKR	Sunflower oil	24	26
IND	UKR	Sunflower oil	1863	1239
PAK	UKR	Barley	1	1
PAK	UKR	Wheat	1192	1273
BGD	UKR	Barley	21	
BGD	UKR	Maize	113	123
BGD	UKR	Wheat	1515	1607
BGD	UKR	Sunflower oil	3	3
CHN	UKR	Barley	2263	2275
CHN	UKR	Maize	6298	7072
CHN	UKR	Sunflower oil	1152	1279
JAP	UKR	Maize		1
JAP	UKR	Sunflower oil	5	5
MYS	UKR	Barley	2	
MYS	UKR	Maize	1	1
MYS	UKR	Wheat	365	387
MYS	UKR	Sunflower oil	66	
INDO	UKR	Wheat	2961	3138
INDO	UKR	Sunflower oil	1	
TAW	UKR	Barley	0	
TAW	UKR	Wheat	9	8
TAW	UKR	Sunflower oil	14	16
KOR	UKR	Maize	1913	2072
KOR	UKR	Wheat	473	424
KOR	UKR	Sunflower oil	16	17
THA	UKR	Barley	0	
THA	UKR	Wheat	572	610
THA	UKR	Sunflower oil	13	14
ASOCE_LDC	UKR	Maize	8	9
ASOCE_LDC	UKR	Wheat	709	767
ASOCE_LDC	UKR	Sunflower oil	8	9
ASOCE_REST	UKR	Barley	2	2
ASOCE_REST	UKR	Maize	10	11
ASOCE_REST	UKR	Wheat	758	803
ASOCE_REST	UKR	Sunflower oil	6	7
AUS	UKR	Sunflower oil	24	27
NZL	UKR	Maize	0	
NZL	UKR	Wheat	0	
NZL	UKR	Sunflower oil	7	7
USA	UKR	Sunflower oil	78	86

CAN	UKR	Maize	16	18
CAN	UKR	Sunflower oil	16	18
MEX	UKR	Sunflower oil	3	3
MSA_ACP	UKR	Sunflower oil	6	7
RSA	UKR	Maize	1	
RSA	UKR	Wheat	33	36
RSA	UKR	Sunflower oil	11	12
MED	UKR	Barley	679	682
MED	UKR	Maize	4051	4499
MED	UKR	Wheat	3624	4025
MED	UKR	Sunflower oil	63	70
MER_OTH	UKR	Sunflower oil	2	2
WBA	UKR	Wheat	22	24
WBA	UKR	Sunflower oil	9	8
MER	UKR	Sunflower oil	0	
EU	UKR	Barley	96	100
EU	UKR	Maize	8763	8807
EU	UKR	Wheat	734	754
EU	UKR	Sunflower oil	1913	2100

Table 19: Imports to the EU (1000 t). Import from the EU = production

Importer	Exporter	Product	FAO	CAPRI
EU	UK	Barley	1113	268
EU	UK	Maize	166	
EU	UK	Wheat	308	
EU	UK	Sunflower oil	17	4
EU	NO	Barley	0	0
EU	TUR	Maize	11	11
EU	TUR	Wheat	84	81
EU	TUR	Sunflower oil	4	4
EU	CH	Barley	1	0
EU	CH	Maize	1	1
EU	CH	Wheat	1	
EU	CH	Sunflower oil	0	0
EU	RUS	Barley	3	3
EU	RUS	Maize	213	222
EU	RUS	Wheat	319	299
EU	RUS	Sunflower oil	19	20
EU	UKR	Barley	96	100
EU	UKR	Maize	8763	8807
EU	UKR	Wheat	734	754
EU	UKR	Sunflower oil	1913	2100
EU	BEL	Barley	2	
EU	BEL	Maize	22	
EU	BEL	Wheat	4	
EU	BEL	Sunflower oil	6	
EU	KAZ	Wheat	146	129
EU	KAZ	Sunflower oil	0	0
EU	FSU	Barley	31	30
EU	FSU	Maize	221	222
EU	FSU	Wheat	68	61
EU	FSU	Sunflower oil	120	120
EU	MOR	Sunflower oil	4	
EU	MIDEAST	Sunflower oil	0	2
EU	NGA	Maize		1
EU	NGA	Wheat		1
EU	ZAF	Maize	32	33
EU	IND	Maize	0	
EU	IND	Wheat	1	
EU	CHN	Barley	0	
EU	CHN	Sunflower oil		2
EU	THAI	Maize	1	
EU	AUS	Wheat		3
EU	NZL	Barley	0	
EU	NZL	Maize		1
EU	NZL	Wheat	0	

EU	USA	Barley		1
EU	USA	Maize	11	9
EU	USA	Wheat	974	832
EU	USA	Sunflower oil	0	0
EU	CAN	Maize	547	550
EU	CAN	Wheat	2049	1880
EU	MEX	Maize	0	
EU	MEX	Wheat	23	
EU	MSA_ACP	Maize		1
EU	RSA	Barley		1
EU	RSA	Maize	5	4
EU	MED	Sunflower oil		0
EU	MER_OTH	Maize	10	4
EU	WBA	Barley	44	44
EU	WBA	Maize	2821	2835
EU	WBA	Wheat	160	155
EU	WBA	Sunflower oil	165	163
EU	MER	Maize	4301	4301
EU	MER	Sunflower oil	18	18
EU	EU	Barley	56074	51351
EU	EU	Maize	78668	69728
EU	EU	Wheat	135967	133215
EU	EU	Sunflower oil	4256	3538

About AgriFood Economics Centre

AgriFood Economics Centre provides economic expertise in the fields of food, agriculture, fishing and rural development. The Centre is a cooperation for applied research between the Swedish University of Agricultural Sciences (SLU) and Lund University. The aim is to supply government bodies with a solid scientific foundation supporting strategic and long-term policy choices.

Publications can be ordered free of charge from **www.agrifood.se**

AgriFood Economics Centre
PO Box 7080
SE-220 07 Lund
SWEDEN

https://www.agrifood.se
mail: info@agrifood.se

AgriFood economics centre