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# The food supply crisis as a result of the invasion of Ukraine

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# Key numbers

## by 8-13 million

potential increase in number of malnourished people in 2022-2023, according to the FAO

## by around 75%

fall in exports from Ukraine in March 2022

## by 11.5 million tonnes

wheat production in Ukraine will fall during the 2022/2023 season, according to the USDA

## 33%

Russia and Ukraine's average share in global wheat exports in 2018-2020

## 64.5%

Russia and Ukraine's share in global sunflower oil exports

## 52%

Russia and Ukraine's share in potassium fertiliser deliveries to the EU in 2020

## by 12.6%

increase in FAO food price index in March 2022 (m/m), to the highest level in history

## more than 90%

share of Ukrainian wheat and oilseeds production exported by sea before the Russian invasion

## 75.3%

of wheat exports from Ukraine and Russia went to countries in the Middle East and North Africa in 2020

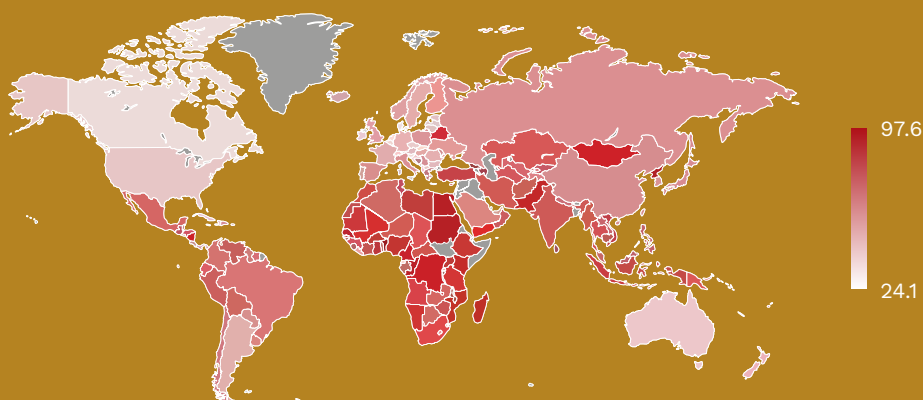
## over 90%

of Benin, Mongolia, Armenia, North Korea, Sudan, Lebanon, and Belarus' wheat comes from Russia and Ukraine

# Key findings

- **Russia's invasion of Ukraine could have global consequences, in the form of a food crisis.** Both countries are among the leading exporters of key agricultural products, such as wheat, barley, and sunflower oil. This creates the risk of shortages of these goods and, above all, prices increases. Russia's invasion of Ukraine has also deepened the crisis on the global market for fertilisers, which have a significant impact on agricultural output. Together, Belarus and Russia accounted for 18% of global fertiliser exports in 2020.
- **The marked increase in prices has diminished the economic availability of food in many countries, especially the poorest ones.** The sensitivity index (SI) created by the PEI shows that the country most exposed to the consequences of Russia's invasion of Ukraine is Benin. The five countries most at risk of the negative consequences of lower deliveries and high prices also include North Korea, Sudan, Nicaragua, and the Democratic Republic of Congo. According to the FOA's estimates, a long-term reduction in food supply and price hikes, could increase the number of people who are malnourished by 8-13 million globally in 2022/23.

Map 1. Sensitivity to the loss of food security



Source: prepared by PEI.

- **The largest share of wheat exports from Ukraine and Russia go to the Middle East and North Africa.** In 2020, as much as 42% of wheat exports from Ukraine and 33.3% from Russia went there. Over 16% of Ukrainian and nearly 10% of Russian wheat went to South Asia. Sub-Saharan African countries are a major recipient (19.3% of Russian wheat and 4.3% of Ukrainian wheat). The following countries are the most dependent on wheat imports from Ukraine: Lebanon (64%), Tunisia (54%), Pakistan (48%) and Iran (38%). They will be particularly hard hit by the lack of supplies from Ukraine and have to find new sources of wheat imports.
- **The significant restriction of agricultural product export from Ukraine has given Russia the opportunity to increase or mitigate the food crisis in the Middle East and Africa.** Many African and Asian countries were much more dependent on wheat imports from Russia than on imports from Ukraine. The Kremlin is struggling with trade impediments due to sanctions, but also limiting exports to achieve political goals by causing food crisis and accusing the West of it. At the same time, the high prices are conducive to an increase in export revenues.
- **Even the end of the most intense phase of military operations will not lead to a rapid drop in food prices; rather, it will result in them stabilising at a high level.** The outbreak of the war made food markets unstable: in March 2022, the global food price index increased to 159.3 points (12.6% month on month), the highest level ever, and only decreased slightly in May, to 157.4 points. However, prices were already high before. Moreover, high energy commodity prices will further increase food prices and make it difficult to increase the supply of grains; the high price of gas makes price fertilisers expensive.
- **There are other threats: extreme weather conditions and the export restrictions introduced by other countries.** Drought, floods, and other natural disasters will reduce the harvest. India has introduced a wheat export ban due to drought, which led to a further increase in prices on global markets in May.
- **Rising food prices will drive inflation in Central Europe.** As a result of Russia's invasion of Ukraine and drought in Europe and beyond, food prices in next two years will be higher by 10%.
- **Measures are needed to increase the supply of grains on the global market and the economic availability of food.** In particular, the capacity of the transport corridors from Ukraine needs to be increased, as the Russian invasion and the blockade of Black Sea ports has disrupted existing export routes. According to estimates, at the start of May, there were still about 20 million tonnes of grains in Ukraine, mainly corn and wheat, which had not yet been exported (Matuszak, 2022).

# Introduction

**Russia's invasion of Ukraine has shaken global food markets, which were already unstable. Food markets' nervous reaction resulted from Ukraine and Russia's position as major exporters of many agricultural products, including wheat, corn, sunflower, and rapeseed oil. The war has limited opportunities to sell these products abroad, which, given both countries' significant share in global exports, has created the risk of shortages in some markets.**

The concept of food security has taken on a special significance. According to the Food and Agriculture Organization (FAO), food security is defined as a state in which “all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (www1). It can be considered at various levels and dimensions: individual, household, national, global, social, health, economic and physical.

The Russian invasion of Ukraine has a direct impact on food security in many countries by reducing the physical availability of numerous agricultural products as a result of transport disruptions. The war's negative impact on food security has also been indirect. The marked increase in prices has reduced the economic availability of food in many countries, especially the poorest ones.

This report considers these two levels of the war's impact on the food security of Europe, the Middle East and Africa. In the first section, we used the synthetic Sensitivity Index (SI) developed at the

Polish Economic Institute to identify the countries most exposed to a fall in their inhabitants' food security. The report also shows which goods from Russia and Ukraine play an important role globally, in terms of production and exports, and the characteristics of global trade in these products. It also sets out the losses suffered by Ukraine so far during the hostilities and shows the war's impact on global food prices. The report also presents potential opportunities for maintaining food security and the challenges ahead for the agricultural and food sector. The appendix contains a discussion of the trade balance for selected agricultural and food sector. In it, we highlight which regions are the safest in terms of food supply, the main exporters, or the greatest shortages in terms of individual agricultural and food products.

# 1. Map of areas at risk of food crisis

## Methodological notes

Wheat is the staple grain consumed worldwide. Russia's invasion of Ukraine is significant for the wheat market, as both countries are major producers and exporters of it. Russia was included in the index due to trade restrictions related to the (primarily financial) sanctions imposed on Moscow and the Kremlin's ability to use food exports as a political or crisis-inducing tool. To show which regions and countries are the most vulnerable to the war's negative consequences in terms of food security, we used the synthetic Sensitivity Index (SI). Created for this purpose by the Polish Economic Institute, the index is based on FAO data for 2017-2020. The SI index consists of values from 0 to 100. The higher the number, the more a country appears to be at risk in terms of food security.

**The index takes into account both the direct and the indirect impact of Russia's invasion of Ukraine on global food security.** The direct impact relates the risk of lower deliveries from abroad as a result of interrupted supply chains. The indirect impact occurs through food prices. When prices are high – as they are now – spending on food in countries with a relatively low level of development rises sharply. As a result, these countries' inhabitants buy less of it and cannot meet their nutritional needs.

The index takes into account three elements relating to the direct impact of the invasion.

**The first is the country's self-sufficiency when it comes to wheat production.** The self-sufficiency index is defined as the ratio between production and domestic consumption, calculated as the sum of production and imports, minus exports, and adjusted for the change in stocks. A lower index value means that the country is less self-sufficient a country when it comes to producing wheat and that more of its domestic consumption must be covered by imports. It is therefore more vulnerable to reduced supplies from abroad. If the indicator is below 1, the country is not self-sufficient.

**The second element is Ukraine and Russia's share in a given country's wheat imports (in terms of quantity).** The higher it is, the greater the disruption on a given market when supplies of wheat from Ukraine and Russia fall. We include Russia because it is limiting the supply of wheat in world markets.

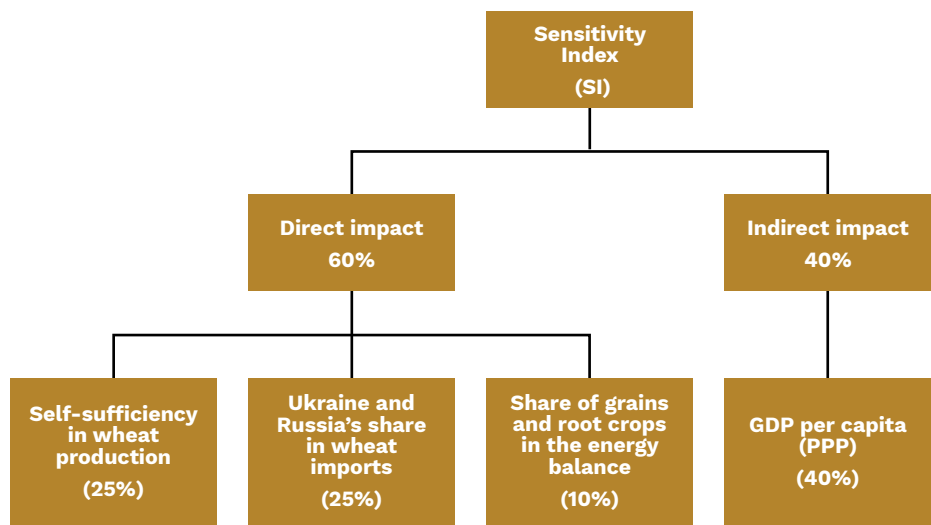


**The third element, which is slightly less important, is the share of grains and root crops** in the energy balance of individual countries' inhabitants. Unfortunately, the FAO statistics do not allow grains to be studied alone. Nevertheless, it can be assumed that the higher this share, the more susceptible a given country is to disruptions on the grain market.

**The indirect impact of Russia's invasion of Ukraine was included in the synthetic Sensitivity Index in the form of a given country's GDP per capita in 2018-2020, expressed in purchasing power parity (PPP).** The lower the per capita income level, the less food is available to a given country's inhabitants.

The synthetic sensitivity index was created by weighting standardized variables. The SI index, when multiplied by 100, takes values in the range of <0.100>.

**Image 1. The construction of the Sensitivity Index**



Source: prepared by PEI.

# The ranking

Benin's food security is most exposed to the consequences of Russia's invasion of Ukraine, with a SI of 97.6. North Korea (SI = 97.3), Sudan (92.5), Nicaragua (90.8) and the Democratic Republic of Congo (89.8) were also among the five countries the most at risk. In 2020, these countries had a combined population of 178 million. In the next five countries in the ranking, the SI was in the 87.2-89.2 range. The countries in this group – Armenia, Egypt, Lebanon, Georgia, and Rwanda – had a total population of over 125 million.

**Table 1. The 20 countries most at risk of losing food security**

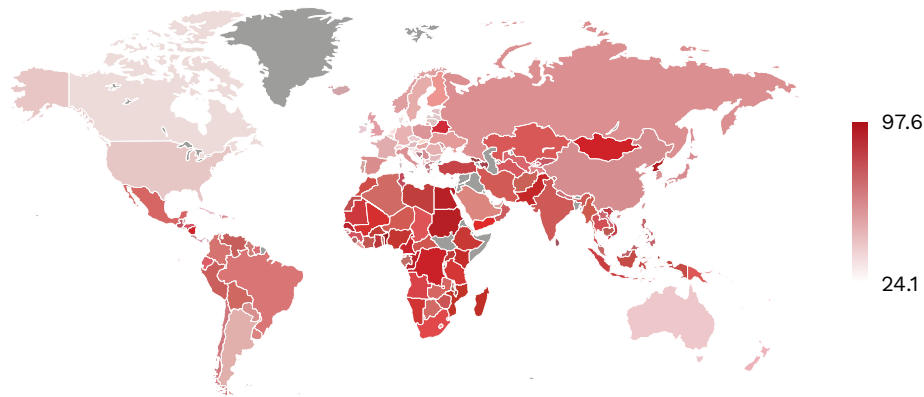
| Place | Counter                      | Sensitivity Index | GDP per capita (PPP) | Self-sufficiency in wheat production | Ukraine's share in wheat imports | Russia's share in wheat imports | Share of grains and root crops in inhabitants' energy balance |
|-------|------------------------------|-------------------|----------------------|--------------------------------------|----------------------------------|---------------------------------|---|
| 1.    | Benin                        | 97.6              | 3 389                | 0                                    | 0                                | 100                             | 68  |
| 2.    | North Korea                  | 97.3              | 1 700                | 7                                    | 0                                | 98                              | 68  |
| 3.    | Sudan                        | 92.5              | 4 322                | 23                                   | 2                                | 92                              | 53  |
| 4.    | Nicaragua                    | 90.8              | 5 706                | 0                                    | 0                                | 84                              | 52  |
| 5.    | Democratic Republic of Congo | 89.8              | 1 133                | 3                                    | 7                                | 63                              | 61  |
| 6.    | Armenia                      | 88.9              | 13 521               | 31                                   | 3                                | 96                              | 42  |
| 7.    | Egypt                        | 88.4              | 12 169               | 48                                   | 26                               | 60                              | 66  |
| 8.    | Lebanon                      | 88.2              | 14 451               | 14                                   | 64                               | 29                              | 45  |
| 9.    | Georgia                      | 88.0              | 14 984               | 16                                   | 0                                | 89                              | 52  |
| 10.   | Rwanda                       | 87.2              | 2 225                | 9                                    | 0                                | 67                              | 52  |
| 11.   | Senegal                      | 87.1              | 3 465                | 0                                    | 11                               | 48                              | 66  |
| 12.   | Pakistan                     | 87.0              | 4 854                | 101                                  | 48                               | 42                              | 51  |
| 13.   | Congo                        | 86.6              | 3 878                | 0                                    | 0                                | 60                              | 61  |
| 14.   | Mongolia                     | 86.4              | 12 566               | 88                                   | 0                                | 100                             | 42  |
| 15.   | Cameroon                     | 85.8              | 3 857                | 0                                    | 0                                | 60                              | 55  |
| 16.   | Yemen                        | 85.5              | 2 200                | 3                                    | 19                               | 33                              | 66  |
| 17.   | Azerbaijan                   | 85.4              | 14 694               | 66                                   | 0                                | 85                              | 58  |
| 18.   | Mozambique                   | 84.2              | 1 318                | 2                                    | 1                                | 43                              | 69  |
| 19.   | Burundi                      | 84.0              | 778                  | 13                                   | 0                                | 54                              | 50  |
| 20.   | Madagascar                   | 83.7              | 1 620                | 1                                    | 0                                | 36                              | 79  |

Source: prepared by PEI.

In the other countries in top twenty, the SI was in the 83.5-87.2 range. Six of them are in Africa (Senegal, Congo, Cameroon, Mozambique, Burundi, Madagascar) and four of them are in Asia (Pakistan, Mongolia, Yemen, and Azerbaijan). They had almost 400 inhabitants in 2020, 220 million of them in Pakistan.

The European countries most at risk are Belarus and Albania. However, Belarus – Russia's partner in the invasion of Ukraine – is far from the expected difficulties in ensuring that its inhabitants have access to food. The EU countries highest in the ranking – Greece, Malta, and Cyprus – are only in the second hundred, with no threat to food security. The countries at the bottom of the SI are Luxembourg (24.1) and Canada (31).

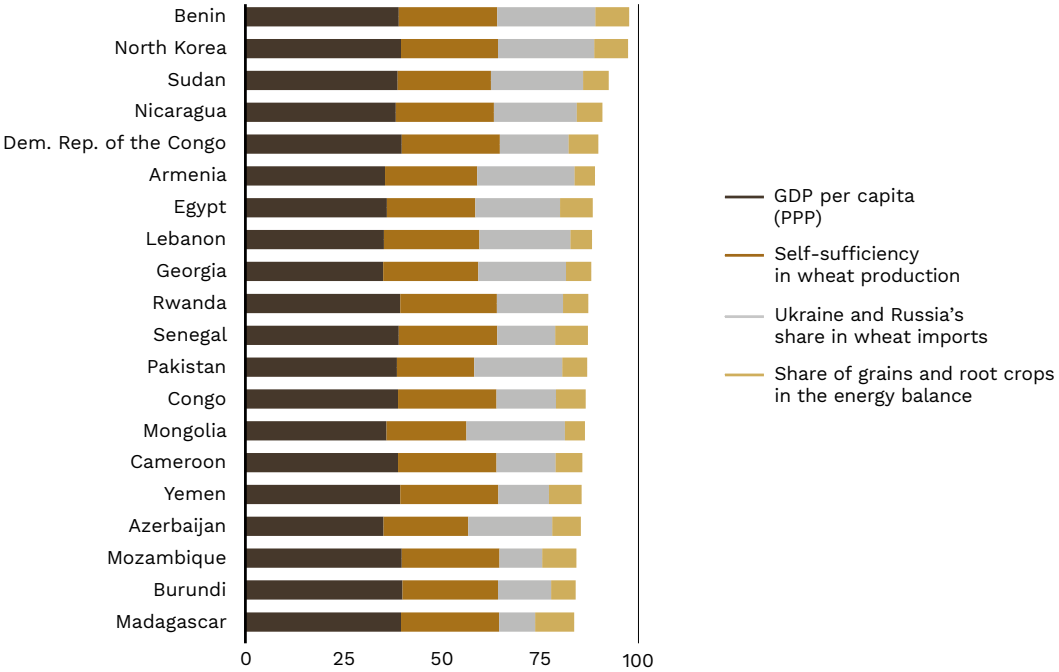
**Map 1. Sensitivity to loss of food security**



Source: prepared by PEI.

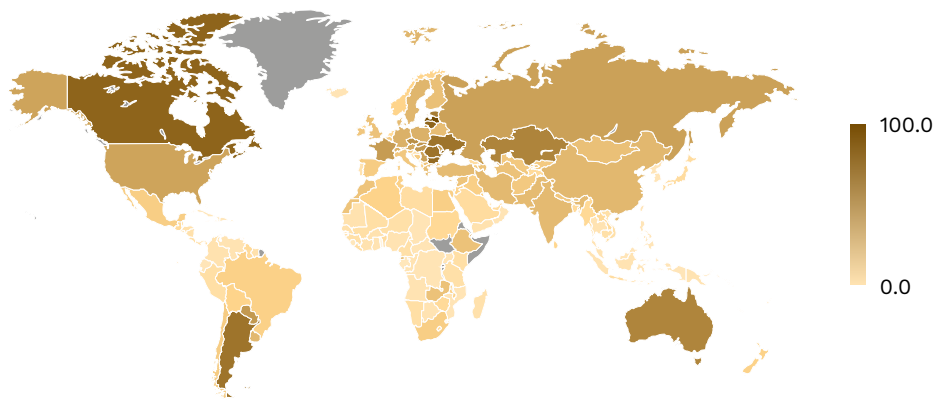
Individual elements' contribution to the size of the index varied between countries. Most countries are not self-sufficient when it comes to wheat production; hence this variable's relatively high importance in the index. In many countries, wheat is not grown at all. Wheat crops are mainly located in North America (the Great Plains and the Great Lakes), Europe, North Africa, India, and China, as well as in the south-eastern part of South America, and southern and eastern Australia. In fact, most of Africa, the Middle East, and East and Southeast Asia do not grow wheat. This includes Asian countries with big populations, including Indonesia (275 million), the Philippines (110 million), as well as many African countries, such as Benin, Senegal, Burkina Faso, Ghana, and Guinea.

**Chart 1. Decomposition of the SI according to its components (in points)**



Source: prepared by PEI.

**Map 2. Self-sufficiency in wheat production in 2018-2020 (scale 0-100)**

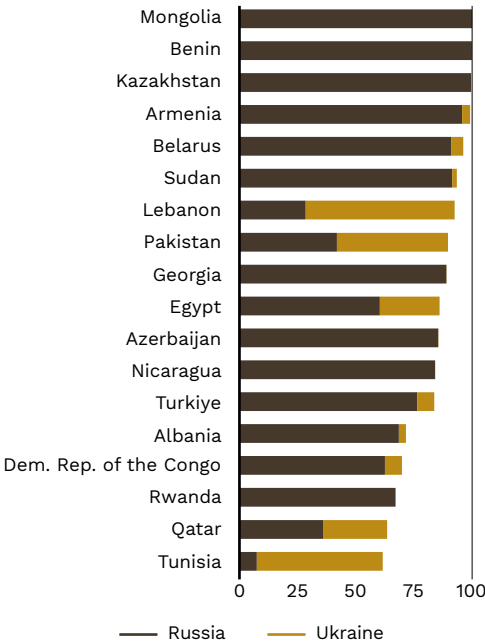


Source: prepared by PEI based on FAO data (2020).

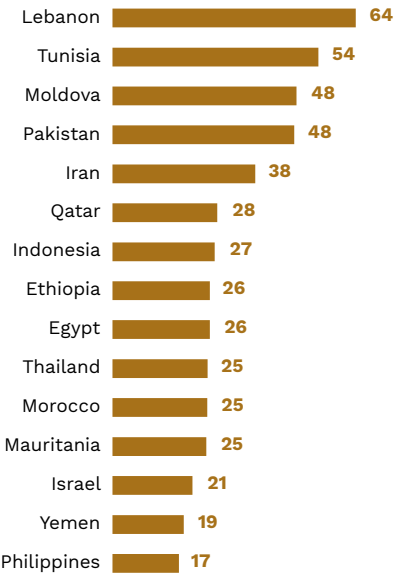
For many countries, Ukraine and Russia were the largest suppliers of grain, including wheat. The most important destination for wheat exports from Ukraine and Russia is the Middle East and North Africa. In 2020, 42% of wheat exports from Ukraine and 33.3% from Russia went there. Over 16% of Ukrainian and nearly 10% of Russian wheat went to South Asia. Countries in Sub-Saharan Africa are important recipients of wheat, too. In 2020, 19.3% of Russian wheat and 4.3% of Ukrainian wheat was exported there.

Lebanon (64% of wheat imports), Moldova (48%, which is not exposed to wheat shortages because it has a direct overland infrastructure connection with Ukraine) and Pakistan (48%) are the countries most dependent on imports from Ukraine. Iran, Qatar, Indonesia, Ethiopia, Egypt, and Thailand import more than 25% of their wheat from Ukraine, too. If we consider dependence on imports on Russia, where trade has been significantly impeded by the sanctions, the dependence increases and the list of countries grows. Benin, Mongolia, North Korea, Armenia, Belarus, and Sudan were practically completely dependent on wheat imports from Russia. Dependence on both Ukraine and Russia increases to 93% in the case of Lebanon, 90% for Pakistan, 89% for Georgia, 86% for Egypt and 84% for Turkey. Russia and Ukraine's share in wheat deliveries to other countries in Africa (Tanzania, Senegal, Uganda) and Asia (Sri Lanka) was also high, above 40%.

**Chart 2. Russia and Ukraine's share in selected countries' wheat imports in 2018-2020 (%)**



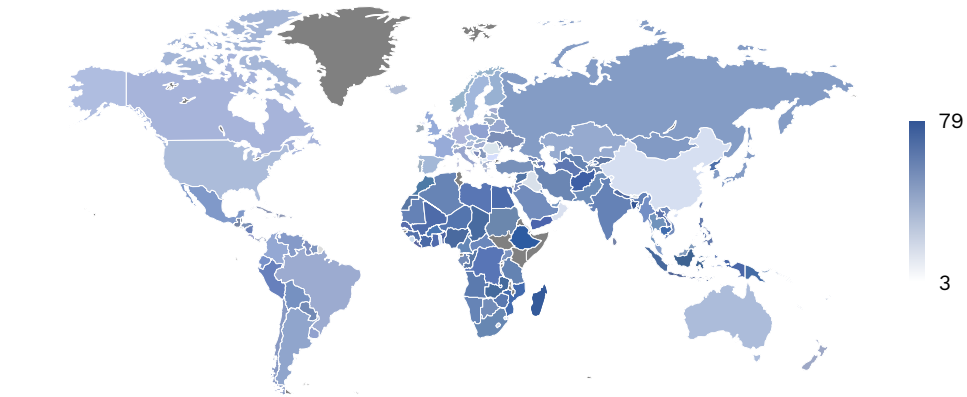
**Chart 3. Ukraine's share in selected countries' wheat imports in 2018-2020 (%)**



Source: prepared by PEI based on WITS-Comtrade data (2022).

The share of grains and root crops in the energy balance of individual countries' inhabitants affected the SI's value. Most countries in Africa had an index of over 60%, or even 75% in some cases, such as Madagascar and Ethiopia. In certain Asian countries – including Bangladesh, Cambodia, South Korea, Indonesia, Yemen, and Nepal – the share of grains and root crops in the energy balance exceeded 60%, too.

**Map 3. Share of grains and root crops in residents' energy balance in 2017-2019 (%)**



Source: prepared by PEI based on FAO (2020) data.

# 2. Ukraine and Russia's significance in global food and fertiliser deliveries

## 2.1. Production and exports of agricultural and food products

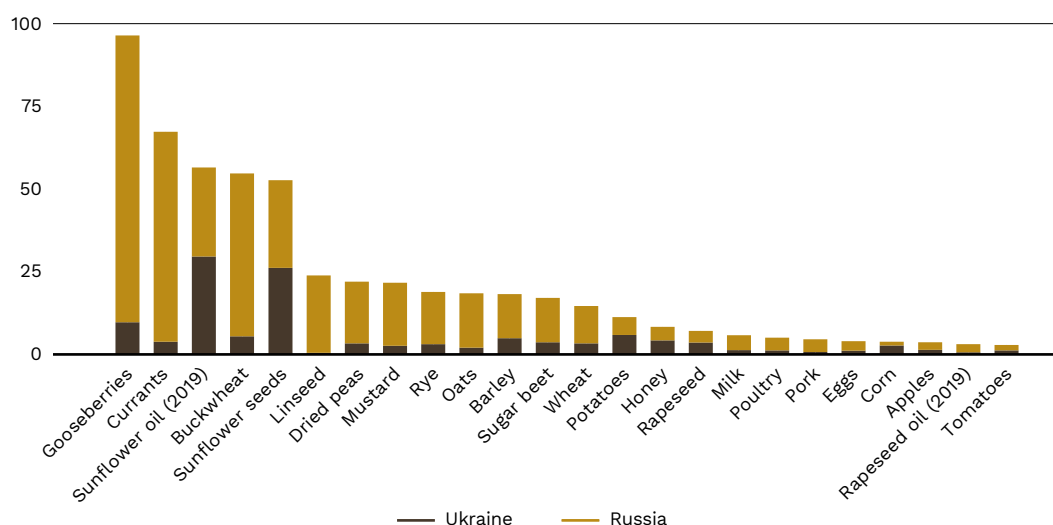
Grains are among the main agricultural products in Ukraine and Russia. According to FAO data, in 2020, the total **wheat** harvest in both countries amounted to 111 million tonnes, 14.6% of the global wheat production. Russia (11.3%) was the world's third-largest producer of wheat, after China and India. The country is the largest exporter of wheat; China and India mainly produce it for domestic needs. According to the FAO, in 2020, Russia delivered as much as 37.3 million tonnes to foreign markets, 19% of the world's wheat exports. Ukraine (3.3%) was eighth globally in terms of wheat production, and it exported almost 18.1 million tonnes, less than half as much as Russia. Together, the countries accounted for 28% of global wheat exports, in terms of quantity.

Around 21 million tonnes of **barley** was harvested in Russia in 2020, 13.3% of global production, making it the world's largest producer. Ukraine was tenth, with a harvest of 7.6 million tonnes (4.9%). It was the world's second largest supplier of it, after France; Russia was third. The countries' combined share in exports amounted to 26% (13% each). In addition to barley, both countries are also significant producers of **rye and oats**: their combined production accounted for 18.9% and 18.4% of global production, respectively, which translated into a negligible share in exports (less than 1% and 2.5%). Russia and Ukraine were responsible for nearly 55% of the world's buckwheat production. Russia is the world's largest exporter of it.

Another major crop (primarily for feed) is **maize**. Together, the countries harvested almost 44 million tonnes of it in 2020, nearly 4% of global production. After the US, Argentina and Brazil, Ukraine was the fourth-largest exporter of it, with a global share of 14.5%. Russia's share was insignificant (just 1.2%).

The most important industrial crops in both countries include oil crops, especially **sunflower**. Russia is the largest and Ukraine the second-largest producer of sunflower seeds. Each of them harvested over 13 million tonnes in 2020, 52.6% of the global production and 22.4% of exports. Russia was the second-largest supplier of sunflower seeds (after Romania), and Ukraine the tenth-largest supplier. They are also the largest producers of **sunflower oil**. In 2019, Ukraine produced 5.8 million tonnes of it (29.5% of global production), putting it in first place globally. Production in Russia was only slightly lower: over 5.3 million tonnes (27%). Together, the countries accounted for 56.5% of global production and 64.5% of supplies. Ukraine was the world's largest exporter of sunflower oil (44%), with Russia in second place.

**Chart 4. Ukraine and Russia's share in global production of selected articles in 2020, in terms of quantity (%)**



Source: prepared by PEI based on FAO (2020) data.

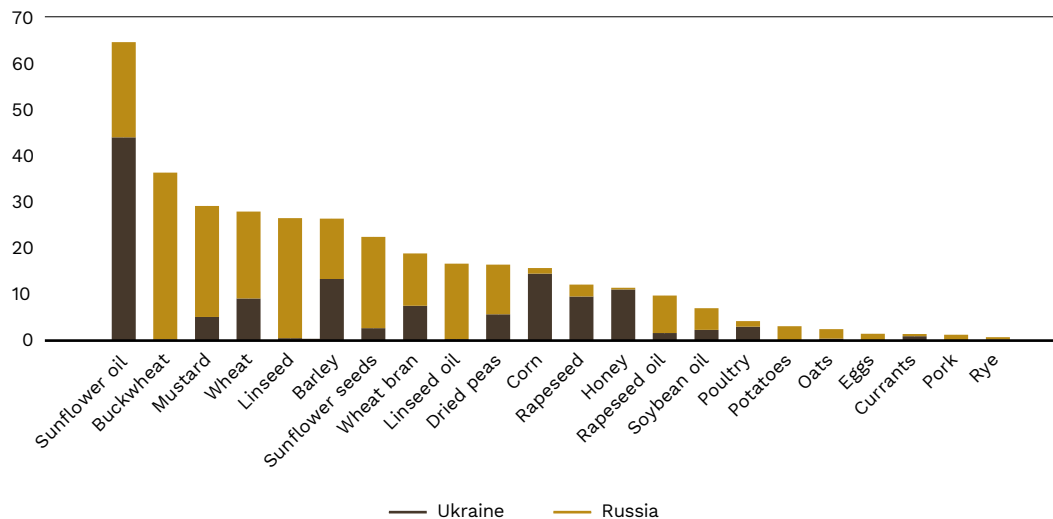
Ukraine and Russia are also major producers of **rapeseed and rapeseed oil**: total grain production accounted for (7.1%) of global production, and oil production for 3% (data for 2019). Ukraine was the second-largest exporter of rapeseed after Canada. Russia was more important in rapeseed oil exports: in 2020, it exported 686,000 tonnes of it, which gave it an 8% share and third place in global exports. Together with Ukraine, it accounted for 10% of the world's rapeseed oil exports. Russia and Ukraine also exported other types of oils, including soybean and linseed oil, but they were less important in the food economy.

Among the industrial crops, the production of **sugar beet** also deserves attention. Russia is the largest and Ukraine the-ninth largest producer of it in terms of volume. In both countries, over 43 million tonnes of beet were



harvested in 2020, which accounted for 17% of global production. However, most of the sugar produced from it is destined for the domestic market. As a result, the countries' combined share in global exports of **refined sugar** was just 4.2% in 2020.

**Chart 5. Ukraine and Russia’s share in global exports of selected articles in 2020, in terms of quantity (%)**



Source: prepared by PEI based on FAO (2020) data.

Russia and Ukraine are also major producers of **vegetables**. They are responsible for 22% of global production of (dried) peas, 11.3% of potatoes, 8.6% of pumpkin, and 6.2% of cabbage and cruciferous plants. This translated into exports. In 2020, the countries' total share in the global exports of dried peas amounted to 16.4%. Ukraine was the fourth-largest supplier of apple juice (with a 6% share) and the sixth-largest supplier of tomato juice (4.7%).

In terms of meat, Russia and Ukraine were both relatively big producers and exporters of **poultry meat**, in terms of their global share. In 2020, they supplied over 611,000 tonnes of it to global markets, 4.2% of global exports. Ukraine was the seventh-largest supplier and Russia the fourteenth-largest supplier of this type of meat globally.

Moreover, in 2020, Ukraine was the fifth-largest, and Russia the seventh-largest, producer of **natural honey** in the world. In total, they produced 134,000 tonnes of honey, 8.3% of world production. In 2020, Ukraine was the second-largest exporter of it globally (11% share), after China.

## 2.2. Production and exports of fertilisers

**Russia's invasion of Ukraine compounded the crisis on the global market for fertilisers, which are important for agricultural results.**

Russia is an important exporter of natural gas, which is used in the production of nitrogen fertilisers. In April 2022, gas prices were as much as four and a half times higher than a year earlier.

Writing about fertilisers, it is impossible not to mention Belarus, which actively supported the Russian invasion. In 2020, both countries accounted for 18% of global fertiliser exports. Belarus was the second-largest, and Russia the third-largest, exporter of potash fertilisers. In 2020, their share in global exports amounted to 21% and 15.5%, respectively. Canada exported the most. With a share of 11.5%, Russia was also the second-largest exporter of nitrogen fertilisers, after China. Qatar, Saudi Arabia, and the Netherlands were next. With a share of 14.1%, Russia was the third-largest exporter of compound fertilisers, after China and Morocco. Belarus was tenth. Ukraine exported small amounts of nitrogen fertilisers.

**The EU is an important market for Russian and Belarusian fertilisers.**

In 2020, 22% of nitrogen fertilisers and 20% of potassium fertilisers exported from Russia, and 8% of potassium fertilisers from Belarus, went to the EU market. Russia and Belarus accounted for 52% of EU imports of potash fertilisers from third countries, 44% for multi-component fertilisers and 28% for nitrogen fertilisers.

**In 2021, Poland was only self-sufficient in the production of nitrogen and phosphorus fertilisers. In the case of potassium and compound fertilisers, production was lower than domestic consumption (defined as the sum of production and imports, minus exports).** Russia and Belarus were particularly important in the supply of potassium fertilisers to Poland; together, they accounted for 57% of the value of imports in this category. 35% of Polish imports of compound fertilisers and 21% of nitrogen fertiliser supplies came from Russia. Belarus was responsible for 10% of compound fertiliser imports to Poland, and 8% of nitrogen fertilisers. Imports from Ukraine were low.

# 3. The impact of the war

## 3.1. Wartime damage in Ukraine

**The Russian invasion of Ukraine has destroyed many cities, energy and transport infrastructure, and agricultural crops.** The war is affecting every stage of agricultural production and trade, causing problems relating to sowing, harvesting, transporting, and exporting it, as well as obtaining the appropriate raw materials.

**The war significantly reduced sowing in the spring: a large part of the acreage was covered by the hostilities and, even after the Russian troops withdrew from central Ukraine, it remained mined.** According to the data of the Ukrainian association of grain producers and exporters, by the middle of June, Ukraine had planted 13,4 million ha of spring grains and oilseeds. This means that, in the spring of 2022, around 20% less was sown than in 2021 due to the Russian invasion, occupation and mining of fields. Forecasts on the extent to which agricultural production will fall in 2022 differ hugely, as much will depend on how the war develops. On April 20, Ukraine's Minister of Agriculture Mykola Solsky estimated that it would drop by 40-70% in 2022, depending on the product (www2). This is in line with the Ukrainian Grain Association's estimate, which points to an overall decrease in grain and oilseed crops by 43 million tonnes; that is, 40 %. It estimates that 18 million tonnes of wheat will be harvested in 2022, half that in 2021, which was a record year. This means that, taking into account the size of the harvest and current stocks, Ukraine could export 10 million tonnes of wheat during the 2022/2023 season, half of what it exported last year. The corn harvest and exports are also expected to decrease by around 30% (www3).

**As a result of the maritime blockade of Ukrainian ports, traditional export routes for agricultural production ceased to operate.** Ukraine previously exported by sea around 90% of its key agricultural products: grains, oilseeds, corn, and oils. Most grain was transported by rail to the Black Sea coast and exported by ship from four major Ukrainian ports: Odesa, Yuzhne, Chornomorsk and Mykolaiv. The most important ports were partially destroyed and Russia blocked them. The Russian invasion also led to the loss of access to the Sea of Azov. As a result, exports by sea were suspended and have to travel overland; some of the grains went to the port of Constanța in Romania, as well as to Baltic ports, including in Poland.

In terms of the means of transport used for exports, rail transport dominated in March-May 2022 (51%). Water transport accounted for 38% of exports, and road transport for 11%. The reorientation of the economy towards military operations and missile attacks on railway infrastructure seriously impeded and

limited transport. Logistics have been further complicated by the need for reloading due to the difference in track gauge and the insufficient capacity of railway lines in neighbouring countries.

**Infographic 1. Export routes for agricultural goods during the war (March-May 2022)**



**4-7 million tonnes**

Ukraine's monthly exports of grain and oilseeds in 2021

**around 3 million tonnes**

Ukraine's exports of grain, oilseeds and oils in March-May 2022

**30%**

of Ukraine's exports of grain, oilseeds and oils were transported through Poland in March-May 2022

**20 times less**

Ukraine's wheat exports in May 2022, compared to May 2021

**51%**

of Ukraine's food exports were transported by rail in March-May 2022

Source: prepared by PEI based on Ukrainian Grain Association data (<https://uga.ua>)

**According to the Ukrainian authorities, in March 2022, the total volume of exports fell by 58% compared to February.**

Last year, Ukraine exported around 4-7 million tonnes of grain per month. In March, after the start of the Russian invasion, it exported less than 330,000 tonnes of grain, oils, and oil-seeds. A rebound took place in April, when 1.1 million tonnes of grains were exported (www4); this rose to 1.56 million tonnes in May. In the face of the constraints on infrastructure capacity, this should be considered a success. Nevertheless, the dramatic fall in exports means that Ukrainian warehouses contain huge amounts of grain, which could mean that there is not enough space to store the entire harvest this year. At the end of May, the Ukrainian authorities estimated that 22-25 million tonnes of food had been left in ports while waiting for exports. The pace of sowing so far and the favourable weather conditions mean that the key challenge is to ensure export routes for Ukrainian crops.

**Russia is banking on Ukraine's economic devastation and, in occupied areas, Russian troops are plundering crops and the equipment necessary to grow them and harvest them, such as tractors and combine harvesters.**

There are numerous reports of agricultural equipment being exported deep into the Russian Federation (www5) and Russian attempts to sell Ukrainian grain (www6). The Ukrainian authorities estimate that Russia has exported 400,000 tonnes of grain. The exact data seems very difficult to verify.

#### **Opportunities to export Ukrainian grain via Polish seaports**

Up to 25 million tonnes of grain are waiting to be exported from Ukraine. The Russian blockade of Black Sea ports means that it cannot be transported via traditional routes. One of the alternatives is to send it through Poland, where there are grain-loading terminals in Gdynia, Gdańsk, Świnoujście and Szczecin. Over 6 million tonnes of dry agricultural products were loaded in these ports in 2020, half of them at the Baltic Grain Terminal in Gdynia, 1.4 million tonnes in the Szczecin-Świnoujście port complex, and 1.3 million tonnes at the Gdansk Bulk Terminal (GUS, 2021). In total Polish terminals could load a total of around 0.7 million tonnes of grain per.

The biggest problem for Ukrainian grain exports could be railway infrastructure. Insufficient throughput at border crossings, the need for transshipment at the border due to the different track gauge, shortages of wagons for transporting grain, bottlenecks, and repairs of the railway network in Poland will make transit difficult. Michał Litwin, general director of the Association of Independent Railway Carriers, estimates that, in April, Polish cargo carriers managed to transport 600,000 tonnes of Ukrainian grain.

**In the near future, Ukrainian agriculture could struggle with a lack of fuel and labour.**

Russia's tactic is to destroy energy infrastructure. The only refinery operating in the country and numerous fuel storage facilities have been destroyed. Imports from Belarus and Russia – the most important directions until recently – have been suspended, so EU countries have become the main source of supplies for Ukraine. Agriculture has to compete with other

strategic sectors for limited fuel resources, and defence must be prioritised. The war could also make it difficult for farmers to access other necessities, such as plant protection products. However, according to the Ukrainian government's declarations, the shortage is not big (in mid-April, farmers had 54% of the funds needed in the first half of the year). If the war is still ongoing during the harvest season, the shortage of workers in individual regions could also be a problem; a large part of the population has fled to western Ukraine, abroad, or was drafted into the army.

**A direct result of the Russian invasion is the introduction of export restrictions by a number of countries.** In mid-March, Russia banned the export of wheat, corn, and other grains to members of the Eurasian Economic Union to counter the re-export of agricultural crops. Restrictions on exports of agricultural produce have also been introduced by countries including Egypt, Turkey, Hungary, Indonesia, Moldova, and Serbia. Ukraine and Russia also banned the export of fertilisers. The restrictions also apply to the export of fertilisers from Belarus. The consequences will partly be spread out over time: fertilisers are needed now to grow wheat in the northern hemisphere, and soon they will be needed in the southern hemisphere. This will further push up prices on global markets.

## 3.2. Russia's attitude to the food crisis

**In the case of Russia, while there have been no major disruptions to food crops and production, there is uncertainty about the war's impact.** Russian military operations in the Black Sea are also making it difficult to export Russian crops, including from Russia's largest port in Novorossiysk. The costs of transport have also been increased by the international sanctions imposed on Russia in connection with the war, an increase in the cost of ship insurance, and other transport difficulties. In connection with the war, the Russian authorities have also blocked ship traffic on the Sea of Azov, through which Russia exported 12–15 million tonnes of wheat per season (around 40% of total exports) (www7).

**Russia could try to trigger a global food crisis to discourage Western countries from providing Ukraine with military and financial support, and so that sanctions are eased.** It must there be assumed that Russia will be determined to maintain the blockade of Ukrainian sea exports. Another factor worsening the situation on the global food market is Russia's introduction of an export quota for wheat shortly before it invaded Ukraine. From February 15 to June 30, 2022, Russian exporters can only export 8 million tonnes of wheat (www8). The Russian authorities are deliberately maintaining uncertainty on the market, hinting at the possibility of extending the export quota or introducing a total embargo. Russia is also trying to persuade other members of the Eurasian Economic Union to introduce export quotas for grain (Kazakhstan is a major exporter).

At the same time, it is forecast that the harvest in Russia will increase of around 5 million tonnes this year, compared to 2021. In April, Russian wheat exports increased compared to previous years. A complete suspension of exports therefore seems unlikely, but Russia could, like during other food crises, intentionally destabilise the grain market to achieve its political goals, such as the lifting of sanctions (Gabelli, 2019). At the same time, Moscow is trying to take advantage of the food crisis. In its propaganda, it has accused the West of causing it. In the UN, it announced its readiness to export 25 million tonnes of grain between August and December.

### 3.3. Estimated consequences

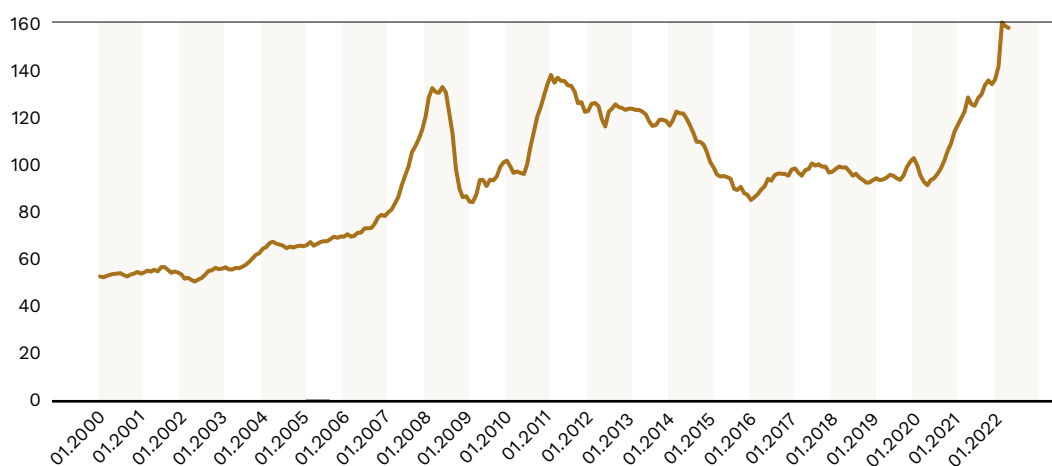
**According to FAO estimates, if there is a long-term reduction in food supply, the number of people globally who are malnourished could increase by 8-13 million in 2022-2023.** According to the FAO, the Asia and Pacific regions will be most affected, followed by Sub-Saharan Africa, the Middle East, and North Africa (FAO, 2022). The UN has indicated that 69 countries are at high risk of poverty and malnutrition. The main reasons are the consequences of the Russian invasion – rising food and energy prices and limited access to financing – and the crisis caused by the pandemic. These countries are home to 1.2 billion people, 362 million of whom are already poor and 142 million of whom are malnourished (UN, 2022).

# 4. The increase in prices

**Food security is influenced not only by self-sufficient production or supplies – that is, physical access to food – but also by prices.** For this reason, the index takes into account the purchasing power of individual countries (in the form of GDP per capita in PPP) to identify the countries for which the increase in prices limit access to food. High prices affect the poorest countries the most. However, the deterioration in living conditions will be felt by the poorest people in every country in the world, for whom food constitutes a major part of household expenses.

**Before Russia invaded Ukraine, world food prices were already high.** In February 2022, the FAO Food Price Index was at 141.1 points (FAO, 2022). This meant that food was 41.1% more expensive than the average in 2014-2016 (the reference period). The prices of vegetable oils and grains were particularly high; in February 2022, their price indices amounted to 201.7 and 145.3 points, respectively. This resulted from the tight situation on the supply side; mainly low inventories and growing demand. In addition, the rapid economic recovery after the COVID-19 pandemic since the end of 2020 pushed up oil prices significant. The higher the oil price, the faster the demand for biofuels increases, leading to greater demand for the grains and oilseeds used to produce biofuels. Dairy prices rose before the invasion, too, to a lesser extent.

Chart 6. FAO food price index (2014-2016 = 100)



Source: prepared by PEI based on FAO (2020) data.

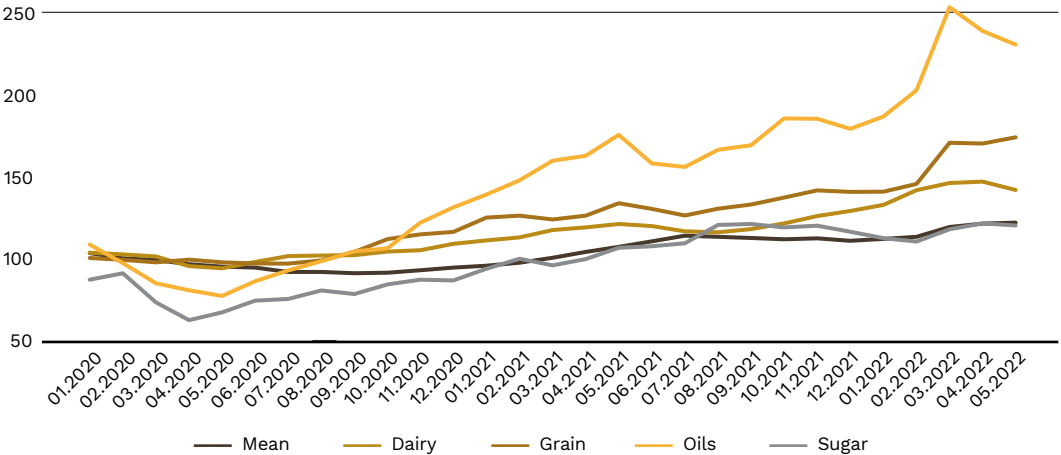


This stemmed from the lower supply of milk from the largest producers: New Zealand (unfavourable weather conditions) and the EU (a reduction in the cattle population due to rising costs). The pressure on prices was also intensified by the constantly growing demand for dairy products in certain countries in Asia, mainly China.

**The outbreak of the war further destabilised food markets and prices soared.** In March 2022, the world food price index rose to a record 159.7 points (by 13.1% month on month). By May, it had only decreased slightly compared to March, to 157.4 (a decrease of 2.3 points in two months).

**In March 2022, the grain price index reached 170.1 points, an increase of 24.9 points compared to February (17.1%).** This is the result of the sharp increase in global prices of wheat and corn, mainly as a result of broken supply chains from Ukraine (the closure of Black Sea ports) and, to a lesser extent, from Russia (problems with the transport of grains). In April 2022, grain prices only decreased slightly (by 0.4%) compared to March, before increasing again in May (by 2.1%). This was caused by the ongoing blockade of Ukraine's Black Sea ports and concerns about the condition of crops in the US. The price increases were counteracted by larger supplies from India and Russia, as well as the weakening in demand for grain due to high prices (FAO, 2022).

**Chart 7. FAO food price subindices (2014–2016 = 100)**



Source: prepared by PEI based on FAO (2020) data.

**In March 2022, the price index for oils also increased significantly.** It amounted to 251.8 points, an increase of 50.1 points compared to February. Again, the markets reacted to Russia's invasion of Ukraine and the reduction in supplies. In April and May, the price index fell by 22.5 points.

The slightly lower demand due to high prices and the weakening in China had a dampening effect, and pressure on prices was aggravated by the uncertainty about palm oil supplies from Indonesia.

**After Russia's invasion of Ukraine, the prices of products that had risen moderately during the previous months – meat and sugar – increased, too.** Until recently, only beef was responsible for the rise in the meat price index. The start of the war coincided with a reduction in the supply of pork in Western Europe amid high demand, which increased its price. Disruptions in poultry supplies from Ukraine and countries affected by avian influenza increased poultry meat prices. For meat producers, the rising cost of fodder was also significant.

**The prices of dairy products increased relatively little in March 2022 (by 3% month on month). However, prices remain high.** On the one hand, the high prices result from the lower supply of milk from New Zealand and the EU. On the other hand, they stem from the growing demand in China for dairy products. In addition, more expensive fodder started to push up milk production costs.

**The tense situation on food markets will continue until the war in Ukraine ends.** This will make the supply of basic agricultural products more predictable and limit the speculative factor, which further pushes up prices when the situation is unstable. Much will also depend on the outcome of the war. Assuming Ukraine regains access to the Black Sea, demining and making waterways operational could take some time. Even then, it is unlikely that prices on the global market will drop significantly. Rather, they will stabilise at a high level, which results from the increase in the prices of means of production observed for several months now, which affects the prices of agricultural products.

**Persistently high food prices will have a significant impact on inflation.** Food is already the main component in the price increases in Poland and other Central European countries. Fuel and food prices are the two main drivers of inflation. After the summer holidays, food prices in Europe could be 20% higher than last year, including due to drought. Their persistence and likely further increases will accelerate inflation.

# 5. Prospects – how can global food security be ensured?

## 5.1. Increasing the supply of grain on the global market

### Improving transport routes' capacity

**The closure of Ukraine's most important Black Sea ports has basically deprived Ukraine of its main export routes.** According to estimates, at the start of May, there were still around 20 million tonnes of grain in Ukraine, mainly corn and wheat, that had not yet been exported (Matuszak, 2022). The opportunities for overland exports, using rail and road transport, directly to recipients or to seaports in Poland and Romania, are severely limited. These transport corridors' capacity is estimated at around 10-15% of the seaports' capacity. According to Ukraine's Ministry of Agricultural Policy and Food, 920,000 tonnes of grain and 169,000 tonnes of oilseeds were exported in April. For comparison, nearly 44 million tonnes were exported during the 2020/2021 economic year.

As a result, the international community is taking steps to improve transport routes' capacity. On April 22, 2022, the prime ministers of Poland and Ukraine signed a memorandum on strengthening railway cooperation. The document provides for the creation of a joint railway company that will handle connections with Western markets. This aims to facilitate the transport of Ukrainian grain to ports on the Baltic, from where it will be shipped to foreign recipients.

**On May 12, 2022, the European Commission presented an action plan aimed at establishing "Solidarity Lanes" to enable the export of Ukrainian grains.**

The EU transport commissioner announced that "20 million tonnes of grains have to leave Ukraine in less than three months using the EU infrastructure. This is a gigantesque challenge, so it is essential to coordinate and optimize the logistic chains, put in place new routes, and avoid, as much as possible, the bottlenecks". To this end, short-term actions should focus on organising additional rolling stock, ships, and trucks, increasing the capacity of transport networks and transshipment terminals, simplifying customs inspections, and enabling grain to be stored in the EU. In the medium to long term,

the Commission will work to increase new export corridors' infrastructure capacity and to create additional infrastructure links as part of Ukraine's reconstruction. The Commission's announcements seem very difficult to implement in the light of railway and road routes' current capacity. To achieve the EC's three-month target, the volume transported would have to increase at least sevenfold. The United States is also involved in solving logistical problems. In June President Biden announced the construction of temporary silos on the border Polish with Ukraine to facilitate the export of grain.

**It seems that, to avoid a global food crisis, the international community needs to take action to unblock the transport corridors leading through the Black Sea.** Mines need to be removed and routes leading to Ukrainian ports protected so that cargo ships can pass. Political action focuses also on unblocking transit through Belarus. This would enable grain to be transported by rail to the Lithuanian port of Klaipeda without changing the distance between the wheels (www9).

## Increasing grain production

**In principle, grain production can be increased in two ways: by increasing the acreage of crops or by improving the yield, the average harvest per hectare cultivated.** Wheat is grown in the Northern Hemisphere in a strip stretching from the Great Plains and Great Lakes in the United States, through Europe, parts of Central Asia, India, and China. In the Southern Hemisphere, wheat is grown in parts of Brazil and Argentina, and eastern and southern Australia. The possibilities for increasing crop acreage seem limited. According to long-term forecasts by the International Grains Council, over the next four seasons, the wheat cultivation area will not change, oscillating around 220 million hectares. However, the average yield per hectare will increase from 3.5 to 3.7 tonnes, which will increase wheat production by 5% to 821 million tonnes (IGC, 2021). Corn production will increase to 1277 million tonnes, by 98 million tonnes compared to the 2021/2022 season, with an increase in yield from 5.9 t/ha to 6.2 t/ha. Consumption will increase, too, mainly as a result of increased demand in the feed industry and its use in ethanol production. It is expected that, in the 2021/2022 season, 15% of corn produced will be used for ethanol production. For both corn and wheat, most of the grain produced will be traded.

**According to estimates by the United States Department of Agriculture (USDA) in mid-May 2022, global wheat production will increase by 4 million tonnes during the 2022/2023 season (to 775 million tonnes).** The largest fall compared to the start of 2022 will be in Ukraine (by 11.5 million tonnes, 35%). Production in Canada (by 11.5 million tonnes), Russia (by 5 million tonnes) and the US (by 2 million tonnes) will increase. Corn production in Ukraine will decrease by more than half, from 42 million tonnes during the 2021/2022 season (to 19.5 million tonnes) in 2022/2023. More is expected to be harvested in Brazil (10 million tonnes) and Canada (5 million tonnes). Global corn production will fall by 25 million tonnes overall, to 1180 million tonnes.

Paradoxically, the lower grain harvest in Ukraine in 2022 may reduce the problems with its storage. Even with large amounts of grain from last year's

harvest still in warehouses, there should be plenty of storage space. There is no doubt that grain elevators will not be emptied before the new harvest.

### **High prices of energy resources will make it difficult to increase the supply of grain**

**High gas prices mean that producing fertilisers is expensive, in particular nitrogen fertilisers.** According to World Bank data (World Bank, 2022), in the period between January 2021 and April 2022, the prices of urea, one of the most popular nitrogen fertilisers, increased by a factor of almost three and a half, to the highest-ever level. Expensive fertilisers mean that some producers use less of them, which will certainly translate into lower yields and harvests. For every type of crop, the level of fertiliser used is strongly correlated with harvest obtained.

**Moreover, high crude oil prices could reduce the supply of grain and oilseeds, as some of the harvest could be converted into ethanol.** An increase in crude oil prices makes ethanol production more production. It is expected that 15% of corn production will be used to produce ethanol during the 2021/2022 season.

## **5.2. Ensuring the economic availability of food**

**The war and accompanying uncertainty are destabilising the food market, along with speculative actions, which push up prices further.** Even when the war ends, food prices will not fall rapidly; rather, they will stabilise at high levels. High prices, rather than physical supply shortages, will threaten the food security of millions of people in the poorest countries. The increase in prices will make food less financially available to them and they have to buy less of it, which will lead to malnutrition and, in extreme cases, hunger. African countries are the most exposed to this risk.

**It is therefore in the international community's interest to counteract all kinds of processes that may threaten food security in relatively low-income countries.** As history has shown, problems accessing food are often the cause of social unrest, which can lead to uncontrolled migration. One example is the Arab Spring of 2011-2012.

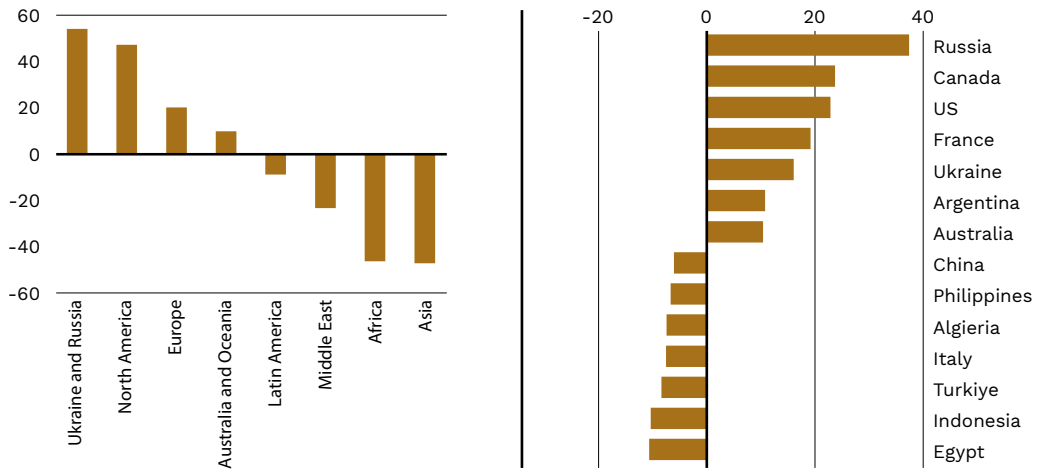
# Appendix 1. Trade balance in selected agricultural and food products

One of the indicators that shows whether a country or region is self-sufficient in the production of a certain agricultural product is the balance of trade for that product. If a country or region is a net exporter of an item, it exports more than it imports. In other words, production not only covers domestic consumption, but the surplus can be exported. In contrast, if a country or region is a net importer, it imports more than it exports. Domestic production does not cover domestic consumption, so the country has to import. For a given product, countries and regions with a trade surplus can be considered self-sufficient. Those with a trade deficit are not self-sufficient.

## Wheat

The largest surplus in wheat trade in 2018-2020 was recorded in Russia and Ukraine (53.6 million tonnes per year, on average) and North America (46.7 million tonnes); that is, the US and Canada. The largest net importers were Asia (47.2 million tonnes), Africa (46.4 million tonnes) and the Middle East (23.5 million tonnes). China is the world's largest producer of wheat (17.6% share in 2020), but high domestic consumption means that it must supplement wheat production with supplies from abroad. Egypt and Indonesia were also large net importers of wheat in 2018-2020 (with a deficit of over 10 million tonnes per year, on average), as were Turkey (8.4 million tonnes) and Algeria (7.5 million tonnes). Europe is self-sufficient in wheat production: in 2018-2020, it had an average surplus of nearly 20 million tonnes per year. In addition to net exporters (including France, Romania, Bulgaria, and Germany), there were also net importers: Italy, the Netherlands, Spain, and Belgium.

**Chart 8. Trade balance for wheat in 2018-2020 (average per year, in millions of tonnes)**

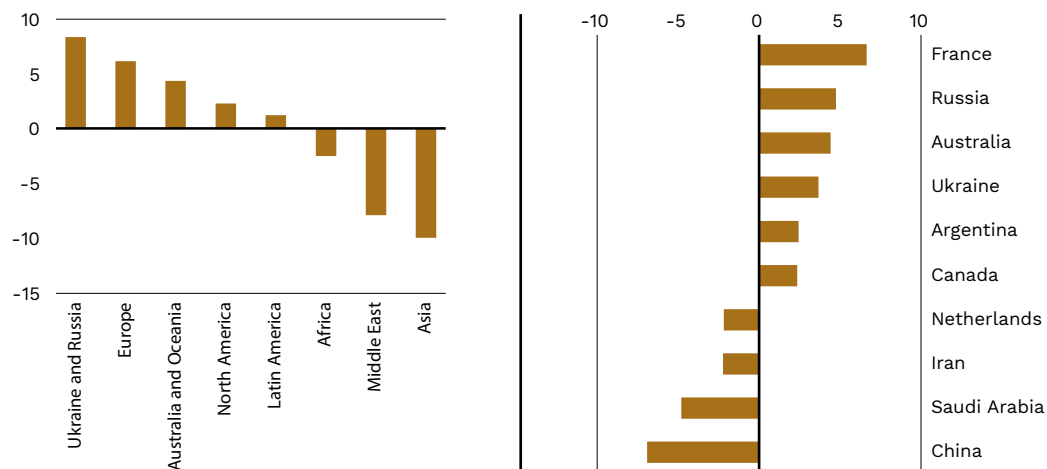


Source: prepared by PEI based on FAO (2020) data.

## Barley

In the case of barley, which used to produce groats and in brewing, as well as for feed, Russia and Ukraine also had the largest surplus among the regions analysed. It amounted to over 25 million tonnes per year, on average, in 2018-2020.

**Chart 9. Trade balance for barley in 2018-2020 (average per year, in millions of tonnes)**



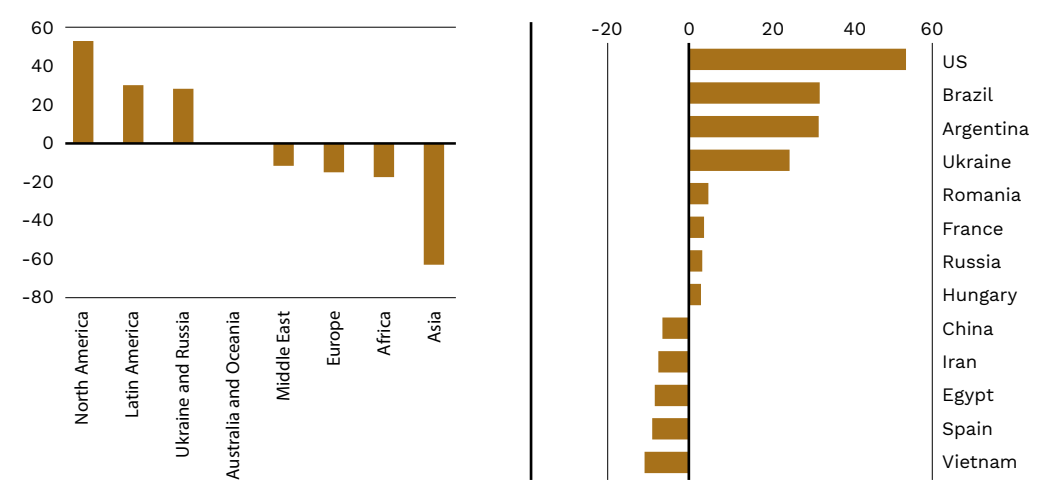
Source: prepared by PEI based on FAO (2020) data.

Europe was also a large net exporter (18.6 million tonnes), mainly from France, Great Britain, Romania, Germany, and Denmark. The largest net importer was Asia (including China and Japan) and the Middle East (including the United Arab Emirates and Iran). In 2018-2020, these two regions had a deficit of 37.3 million tonnes and 23.7 million tonnes per year, on average.

### Maize

Corn is primarily used to produce animal feed and biofuels, and, to a lesser extent, in the production of food and household chemicals. North America is the largest net exporter. In 2018-2020, the trade surplus was 53.1 million tonnes per year, on average, with the US accounting for almost all of it. South America (including Brazil and Argentina), Russia and Ukraine were also major suppliers, with a surplus of 30.2 million tonnes and 28 million tonnes, respectively. The largest net importer was Asia (63.1 million tonnes per year, on average, in 2018-2020), mainly Japan, South Korea, and Vietnam. Africa (including Egypt) and the Middle East (including Iran) had a high deficit, too. European countries also imported more than they exported. The net exporters include Romania, France and Hungary, and the net importers include Spain, Italy, and the Netherlands.

**Chart 10. Trade balance for corn in 2018-2020 (average per year, in millions of tonnes)**



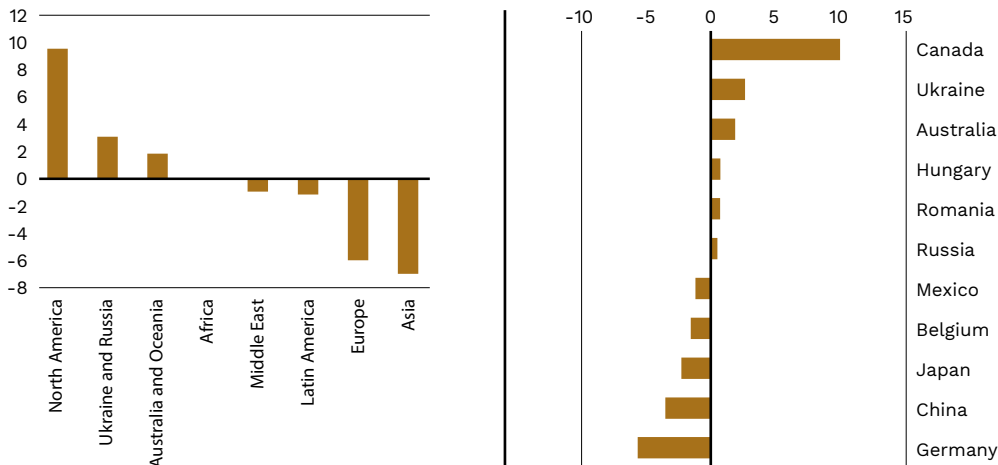
Source: prepared by PEI based on FAO (2020) data.



## Rapeseed

Rapeseed is the most important oilseed. It is used to produce food (mainly oil), but also biofuels and animal feed. North America (9.6 million tonnes per year, on average) had the highest surplus in 2018-2020, almost exclusively due to Canada, the world's largest producer and exporter of rapeseed (its share was 26.9% and 47%, respectively). China (19.3%) and India (12.6%) were also large producers, but due to significant domestic consumption, they were not net exporters. On the contrary, with a deficit of 7 million tonnes per year, Asia was the largest net importer of rapeseed. The second region with a negative trade balance was Europe (-6 billion tonnes), mainly due to large imports by Germany, the Netherlands and Belgium.

**Chart 11. Trade balance for rapeseed in 2018-2020 (average per year, in millions of tonnes)**

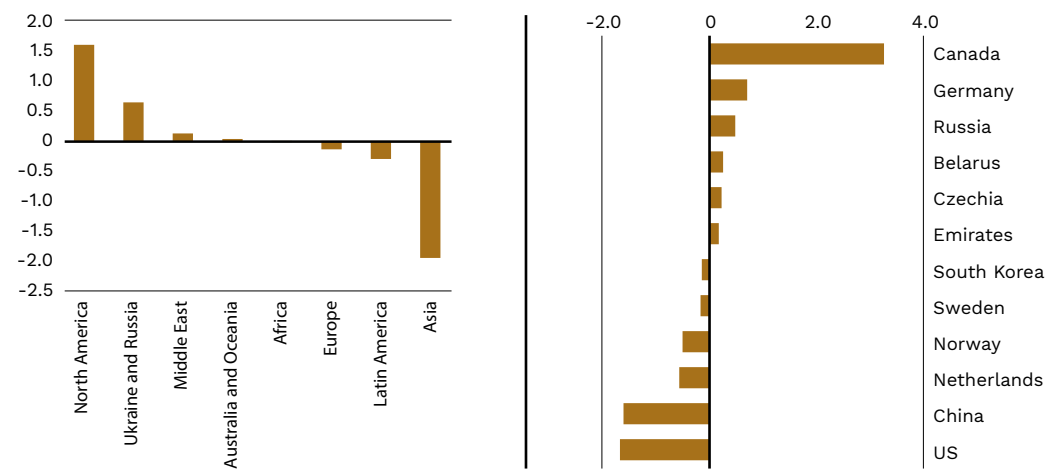


Source: prepared by PEI based on FAO (2020) data.

## Rapeseed oil

In the case of rapeseed oil, the situation is similar to that for rapeseed. Canada is the largest producer and exporter, so North America had the largest rapeseed oil trade surplus in 2018-2020 (1.6 million tonnes per year, on average). Again, Asia was the largest recipient of rapeseed oil (mainly due to Chinese imports); the deficit amounted to 1.9 million tonnes. Europe was also a net importer, but – unlike with rapeseed – Germany exported more rapeseed oil than it imported. The situation was similar in the Czech Republic and France, while the Netherlands, Norway and Sweden were major net importers.

Chart 12. Trade balance for rapeseed oil in 2018-2020 (average per year, in millions of tonnes)

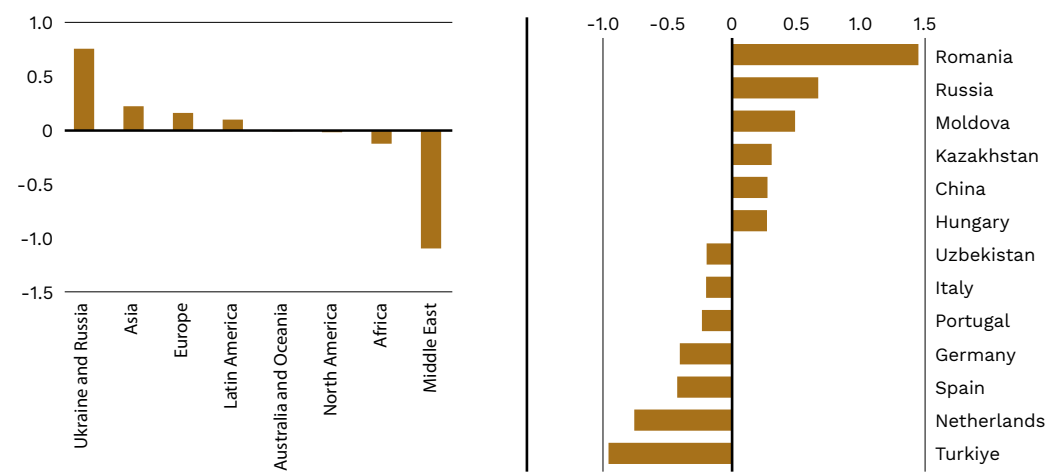


Source: prepared by PEI based on FAO (2020) data.

### Sunflower seeds

Russia and Ukraine are the largest net exporters of sunflower seeds. In 2018-2020, the trade surplus was close to 0.8 million tonnes per year, on average. Sunflower seeds are used widely: they are pressed to make cooking oil and the residues from this process are used as ingredients in feed. They are also used in the production of household chemicals. Asia, Europe, and Latin America were much smaller net exporters. Some European countries had a large trade surplus (including Romania, Moldova, and Hungary), whereas some had a large deficit (including the Netherlands, Spain, Germany, Portugal, and Italy). The largest net importer (1.1 million tonnes per year, on average, in 2018-2020) was the Middle East, mainly due to the large imports by Turkey.

Chart 13. Trade balance for sunflower seeds in 2018-2020 (average per year, in millions of tonnes)

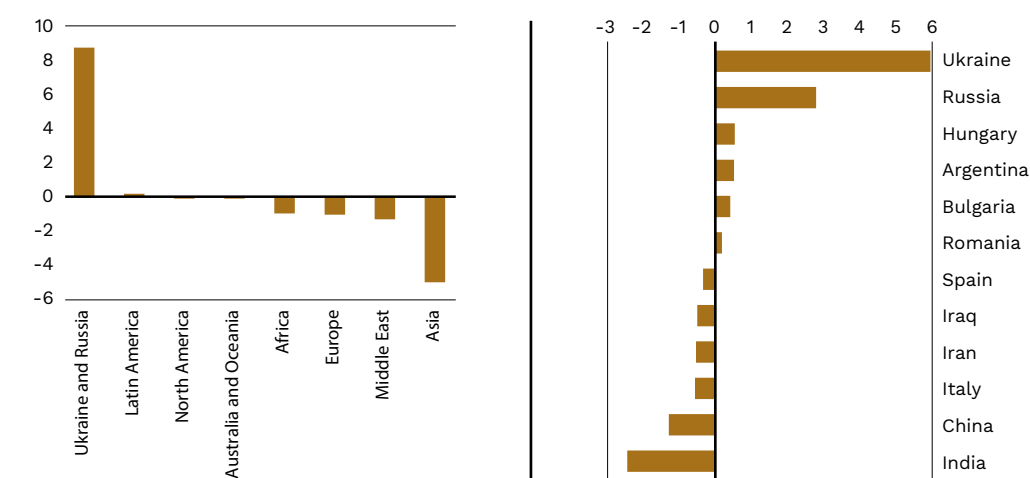


Source: prepared by PEI based on FAO (2020) data.

Sunflower oil

Russia and Ukraine had the largest trade surplus in sunflower oil, as in the case of sunflower seeds. In 2018-2020, it was 8.8 million tonnes per year, on average.

Chart 14. Trade balance for sunflower oil in 2018-2020 (average per year, in millions of tonnes)



Source: prepared by PEI based on FAO (2020) data.

These countries were the leading producers and exporters of this oil. In 2019, Ukraine was responsible for 29.5% of global production, and Russia for another 27%. In exports, their shares were 44% and 20.5% respectively (2020). Asia was the largest net importer of sunflower oil, with a deficit of 5 million tonnes. This was due to large imports by India and China.



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