

REVIEW

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Conflict in Ukraine and the unsettling ripples: implications on food systems and development in North Africa

Tarek Ben Hassen^{1*}  and Hamid El Bilali²

Abstract

The ongoing conflict in Ukraine has profoundly impacted food systems in North Africa. This paper aims to analyze the impact of the conflict on food security in North Africa and the potential long-term consequences for the global food system. The research explores both scholarly and grey literature, including government reports, academic articles, and news articles. The findings indicate that food systems in North Africa have been particularly affected by the conflict in Ukraine, owing to its influence on the global economy, trade dynamics, and food prices. The consequent high fertilizer prices have also affected local food production, decreasing yields and increasing food prices. However, those countries with substantial financial resources (cf. Algeria) will likely be able to mitigate the adverse effects on their citizens. In contrast, countries with limited resources (cf. Egypt, Morocco, and Tunisia) or failed states (cf. Libya) may struggle to ensure the food security of their populations. The findings highlight the importance of considering these impacts when addressing global food security challenges. The food security situation in North Africa serves as a reminder of the interconnectivity of global food systems and the need for continued efforts to ensure food security for all.

Keywords Food security, War, Conflict, Ukraine, Russia, North Africa, MENA, NENA

Introduction

Despite contributing a mere 2% to the global gross domestic product (GDP), Russia and Ukraine are notable producers and exporters of essential agricultural commodities, energy resources, and fertilizers [1]. These countries produce approximately 30% of the world's wheat, 20% of maize, and 70% of sunflower oil. In 2021, they ranked within the top three global exporters of wheat and maize and exported over 50% and 25%

of the world's sunflower oil, respectively [2]. Russia and Ukraine hold the top and fifth positions in wheat exports, accounting for 20% and 10% of total exports. Their contribution to the wheat market is vital in specific global markets, principally in the Middle East and North Africa (MENA) region, where wheat is a fundamental food source [3]. Russia and Ukraine are important contributors to barley's global production and export, accounting for 20% of the total output, and are the third and fourth exporters [4]. Therefore, over 12% of the world's caloric trade is exported by Russia and Ukraine [5]. In addition, before the conflict, Russia was a significant oil and natural gas supplier and the world's largest exporter of fertilizers, e.g., nitrogen, potassium, etc. [2, 6–8]. Indeed, in 2021, Russia held the top position as the primary exporter of nitrogen while also ranking as the second-largest supplier of potassium and the third-largest

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exporter of phosphorous. In addition, in 2021, Russia contributed 18% of the world's total coal exports, 11% of crude oil exports, and 20% of natural gas exports, making it a prominent force in the international energy market [8].

Consequently, in addition to massive human casualties and destruction, the Ukraine/Russia conflict, starting on 24 February 2022, more than a year ago, has threatened global food security by disrupting agricultural production and commerce in one of the world's most important food-exporting areas [9, 10]. It has considerably contributed to fast-increasing global food prices, exacerbating existing food system vulnerabilities intensified by climate change and the COVID-19 pandemic [11–14]. The conflict's eventual military impact and results are still unclear more than a year later [15], and most experts predict a long-lasting conflict, where neither side can emerge victorious [16]. However, the consequences for Ukrainian agricultural productivity and food security are obvious [9, 10, 17, 18].

Since this conflict opposes two global breadbaskets and leading energy, and fertilizer suppliers, few countries will escape its effects. Military conflicts in today's globalized world may worsen food insecurity in areas outside the battlefield [19]. Undeniably, the conflict has exacerbated the vulnerability of several countries, especially in the Global South [20]. It threatens their food security with potentially severe humanitarian consequences, particularly in the regions that are most reliant on Russian and Ukrainian food exports, such as MENA [21]. The MENA region is the world's most water-scarce region, resulting in high levels of food import dependency [22, 23]. It is also considered one of the most vulnerable regions in the world concerning climate change [24–26]. Furthermore, the region is also prone to political instability, fragility, and persistent conflict (cf. Syria, Yemen, Somalia, Sudan), resulting in a significant number of refugees hosted by neighboring countries and a widespread issue of food insecurity [27].

This paper will examine how the conflict in Ukraine has affected food security in North Africa (cf. Egypt, Morocco, and Tunisia) and the potential long-term consequences for the global food system. We choose to focus on these three countries for several reasons. First, Egypt, Morocco, and Tunisia are significant importers of wheat, a major export commodity for Ukraine. Hence, any disruption in Ukraine's wheat production and export due to the conflict could significantly impact the food security and economy of these countries. Second, food price hikes inflict a significant budgetary burden on governments in most countries, in addition to causing social and political unrest. Egypt, Morocco, and Tunisia have all experienced political and social instability in recent years

related the food security, especially during the “Arab Spring.” Although food insecurity did not cause all Arab Springs in 2011, increasing food prices exacerbated pre-existing social discontent, causing protests in numerous Arab countries [28]. Food price increases were the “precipitating condition for social unrest” [29]. Therefore, we choose to focus on these three countries as they are more vulnerable to the potential adverse effects of the conflict in Ukraine on food security, which could exacerbate existing social and political challenges.

Accordingly, this study has three main goals: (i) To assess the current situation of food security in North Africa; (ii) To analyze the consequences of the conflict in Ukraine on food security and food systems in North Africa and the potential long-term socio-economic effects on the region; and (iii) To contribute to a deeper understanding of the interconnections between conflicts, food security, and the global food system.

Materials and methods

“The paper draws upon a comprehensive review of both scholarly and grey literature, such as reports, policy documents/briefs, and working/discussion papers. As for the scholarly, peer-reviewed literature, a search was carried out on the Web of Science in February 2023 using the following string: *Ukraine* AND Russia AND (war OR conflict OR invasion) AND (Egypt OR Morocco OR Tunisia OR “North* Africa”) AND (“food *security” OR “food supply” OR “food import*” OR “food system” OR nutrition)*. The search returned only three articles—Ben Hassen and El Bilali [10], Feng et al. [30] and Abdalla et al. [31]—and two of them—Ben Hassen and El Bilali [10], and Feng et al. [30]—which resulted eligible, were included in the present review. Given the lack of data from the scholarly literature, the authors relied on the grey literature. In this case, the review process involved gathering and analyzing such literature produced in English, French, and Arabic by diverse organizations. These include a range of prominent organizations and sources, such as the Food and Agriculture Organization of the United Nations (FAO), the World Bank, the World Food Program (WFP), the International Food Policy Research Institute (IFPRI), the International Monetary Fund (IMF), the United Nations Conference on Trade and Development (UNCTAD), the United Nations Development Program (UNDP), and the Organization for Economic Cooperation and Development (OECD).

In addition, various sources from regional organizations such as the United Nations Economic and Social Commission for West Asia (ESCWA) were consulted, as well as non-governmental organizations (NGOs), consulting firms (e.g., Deloitte, KPMG and McKinsey), and international newspapers (e.g., The New York Times, The

Washington Post, Egypt Independent, Le Point, Reuters, The National News, etc.). Finally, global news platforms, such as Bloomberg and Radio France Internationale, were also reviewed for their insights and perspectives on the topic. These sources were selected due to their reputation for providing in-depth coverage of current events and their ability to offer unique insights and perspectives on the studied topic.”

A review of the war’s immediate and long-term consequences

The onset of the war had adverse effects on the global food markets due to various factors. First, the effects of the COVID-19 pandemic were still being felt across the world’s economy, especially in many vulnerable countries. As a result, many countries that rely on imports have few resources to weather another crisis [32]. Before the conflict, food, and fertilizer prices had already increased significantly. This was attributed to various factors, such as the COVID-19 pandemic, which caused disruptions in the supply chain, as well as a surge in global demand [33] and drought and unfavorable harvests in South America in 2021 [11]. The war has many immediate and long-term indirect impacts on global food security. The primary outcome of the war was the impact on agricultural production in Ukraine. The conflict has already impacted three subsequent crops: 2021, 2022, and 2023 [34].

First, regarding 2021 crops, when the invasion started, most of the crops from the preceding year had not yet been shipped. Due to the conflict, Ukraine’s grain exports sharply decreased as its Black Sea ports were closed for several months until July 2022, forcing it to rely on slower and more expensive overland export routes [34]. In late July, Turkey and the United Nations mediated a Ukraine-Russia “grain corridor,” the Black Sea Grain Initiative (BSGI), that enabled grain shipments from three main Black Sea ports [35]. The first deal was signed for 120 days and has subsequently been extended many times, with the most recent extension set to expire on July 17, 2023 [36]. The Initiative relieved market pressure and prevented a humanitarian disaster and economic breakdown [37]. Grain exports from Ukraine have increased significantly since the Initiative’s inception [38]. Over 31.5 million tons of agricultural products have been exported under the provisions of the agreement as of June 9th, 2023, with 57% going to developing countries. Maize (51%), wheat (11%), and sunflower oil (5%) accounted for the bulk of exports [36].

However, the agreement’s extension and execution have been uncertain. Russia briefly suspended its participation in October 2022 but resumed shortly after. In addition, Russia’s recent restriction on exports from the

Pivdennyi port in June 2023 has disrupted ship traffic at Ukrainian maritime ports, resulting in a decreased supply of vital food provisions to global markets [36]. As a result, the amount of food exports through the maritime humanitarian corridor has decreased significantly, from 4.2 million metric tonnes in October 2022 to 1.3 million metric tonnes in May 2023, the lowest volume reported, since the Initiative began in 2022 [39].

Second, the conflict has also hampered Ukraine’s capacity to produce a new crop in 2022. Producers struggled to plant, harvest, and sell 2022 crops because of the conflict’s direct and indirect effects, such as increasing energy and fertilizer prices [34]. The violence has also hindered agricultural operations, with stolen machinery, landmines, and attacks causing significant damage to fields and equipment [40]. The Russian army’s purposeful destruction of infrastructure and agricultural land jeopardizes future harvests in Ukraine [41]. The fighting has also disrupted March-to-May maize and sunflower growing. Ukraine’s 2021 harvest backlogs also impede 2022 harvest storage [42]. Furthermore, several producing areas devastated by the war, such as Kherson and Zaporizhzhia, account for a substantial part of Ukraine’s pre-conflict production [43]. As a result, Ukraine will likely export 39.5 million tons of grain and oilseeds in 2022–23, compared to an export potential estimated at 55 to 60 million tons [43].

Third, these difficulties will influence the 2023 crop. Ukrainian farmers are anticipated to cut their winter grain planting area by at least 30% due to increased seed and fuel costs and low grain selling prices [44]. According to estimates, the conflict would cost farmers and agricultural firms \$23 billion in missed revenue, damaged equipment, and higher transportation expenses this year [40]. As a result, private estimates suggest that Ukraine’s grain harvest may shrink by 35–40 million tons in 2023, notably 12–15 million tons of wheat and 15–17 million tons of maize [34].

The decline in production and export has led to a shortage of many crops on the global market. As a result, the international price of agricultural commodities has skyrocketed, threatening to drive millions into starvation and poverty, especially in Low-Income Food-Deficit Countries (LIFDCs) [8]. As of June 20, 2023, the World Bank [45] reports that domestic food price inflation is still high worldwide. As of that date, inflation was higher than 5% in 66.7% of low-income countries, 81.4% of lower-middle-income countries, and 77% of upper-middle-income countries, and many countries were seeing double-digit inflation [45]. Rising price volatility is a concern, because it increases market uncertainty, influencing production choices and encouraging speculative behavior [11].

In addition, the war has complex indirect implications for energy and fertilizer prices, which are major exports of Russia and indirectly impact food prices. High energy prices raise fuel and fertilizer costs and redirect food production to biofuels. Since fertilizer manufacturing uses natural gas, energy costs have increased. Local manufacturing has decreased worldwide, especially in Europe [46]. Fertilizer costs have doubled, since the crisis began, despite a recent dip. This may reduce the usage of fertilizers and agricultural production in developing nations, where farmers already use fertilizer sparingly [47]. High energy and fertilizer costs are more harmful to food prices and global food security than Ukrainian and Russian food export restrictions [48]. The Agricultural Market Information System (AMIS) February 2023 Update shows a 40% drop in fertilizer prices from last Spring's nominal highs. This can be attributed to the reduction in natural gas costs and the reopening of European fertilizer factories. Despite this decline, prices are roughly twice what they were 2 years ago [49]. European production constraints, sanctions on Russia and Belarus, and Chinese trade restrictions continue to affect fertilizer markets [30, 50].

Furthermore, as seen during the 2007–2008 food crisis [51], in the first weeks of the conflict, several countries restricted exports to safeguard local food supplies and reduce inflation (India: wheat; Indonesia: palm oil, etc.), which forced other food exporters to limit exports to protect their own populations [52]. The result was a reduction in supply, an increase in global prices, and a worsening food crisis [53]. In late May 2022, export restrictions affected 17% of worldwide caloric food and

feed shipments. Many governments eased restrictions after May 2022 [54]. As of June 5, 2023, 20 nations had enforced 27 food export bans, and 10 had adopted 14 export-limiting restrictions, including export licenses, export taxes or duties, bans, or a combination of these [45].

Impact of the conflict on food security in North Africa

Most countries in the MENA region, including North African ones, are especially exposed to price volatility. They are structurally reliant on global markets, partly because their agricultural production is hampered by geographical and climatic constraints, as well as a rising population [55]. Already 4 months after the outbreak of the conflict, Ben Hassen and El Bilali [10] warned that “If the war deepens, the food crisis will worsen, posing a challenge to many countries, especially those that rely on food imports, such as those in *the Middle East and North Africa (MENA) region.*” Although making up just 4% of the world’s population, the MENA region accounts for a third of all cereal sales yearly. Ukraine exports over 50% of its wheat and one-third of its maize and sunflower oil to MENA countries [21] (Fig. 1).

Furthermore, in many countries, the combination of rising commodity prices, rising production costs, and ongoing currency devaluation results in increased domestic food inflation [57]. Food inflation has exacerbated food insecurity and escalated social tensions. It also burdens governments’ finances, which are dealing with growing food import expenses and a reduced ability to pay further social protection for the most

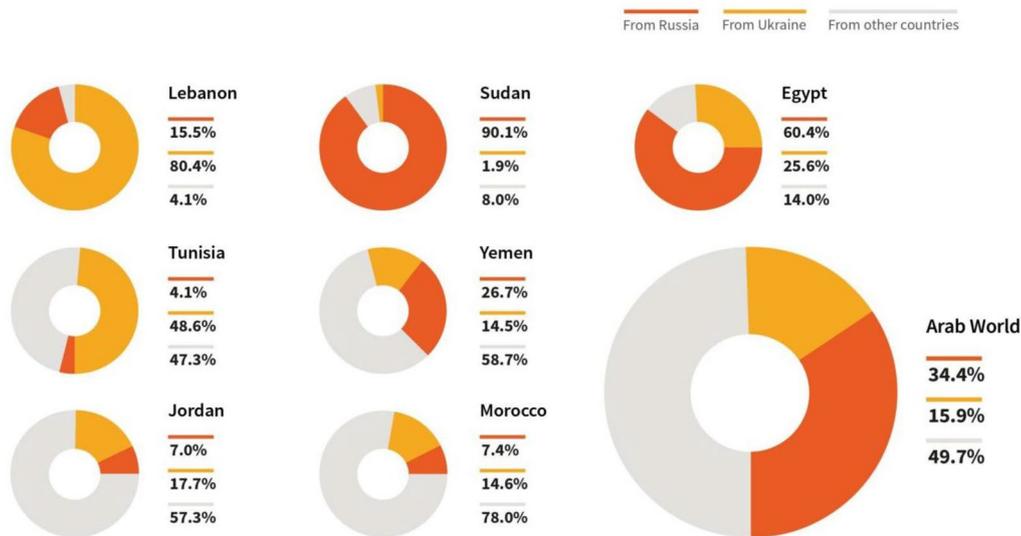


Fig. 1 Dependency of some Arab countries on wheat imports from Russia and Ukraine (in value) (2020). [56] Source: Arab Reform Initiative

vulnerable [47]. While MENA countries have some similarities regarding food security challenges, there are also significant differences in their rankings and overall performance on the Global Food Security Index (GFSI). For instance, some countries such as the United Arab Emirates (UAE) and Saudi Arabia have relatively high rankings in the GFSI due to their strong performance across multiple dimensions of food security. On the other hand, countries such as Yemen, Syria, and Sudan have lower rankings on the GFSI due to various factors that affect food security in these nations (Table 1).

North Africa includes Morocco, Algeria, Tunisia, Libya, and Egypt and constitutes the northern edge of the African Plate. North Africa is a heterogeneous group of five countries: Egypt, Libya, Tunisia, Algeria, and Morocco, ranging from oil and gas-rich countries, such as Algeria and Libya, and more diversified economies, such as Egypt, Tunisia, and Morocco, with key sectors being agriculture, tourism, and manufacturing. Consequently, it is anticipated that the economic effects of the conflict in Ukraine will vary across the region, with middle-income countries, which rely on the importation of energy and food, being the most negatively impacted [3]. Indeed, the oil-rich, such as Algeria have significantly benefited from the rise in energy prices, which has helped to mitigate the region's exposure to the historically exorbitant prices of food staples. However, the region's energy importers, such as Egypt and Tunisia, have seen their economic

recovery from the pandemic stymied by significant inflation in food and energy import expenses [59].

The region is also characterized by its demographic diversity, with a young and growing population that presents both challenges and opportunities. Furthermore, North Africa, like the rest of the MENA area, is very vulnerable to climate change. Extreme heat and water scarcity are common in the region. North Africa is expected to be severely impacted by climate change, with temperatures peaking and precipitation dropping [23]. This implies that by 2050, 100% of the population will be subjected to very severe water stress [60].

Food inflation in North Africa is a significant source of socio-economic instability, since governments rely heavily on imports from global markets, especially cereals, a substantial component of the local diet. Wheat is critical in these nations, accounting for over a third of the total food supply. Concerns about the effect of rising food prices on state finances have grown (due primarily to the government subsidies in place). Price spikes have worsened a complicated economic environment, with many countries still recovering from the COVID-19 pandemic, growing public debt, and expenditure cuts [8]. Due to food subsidies, global grain prices have not necessarily affected local prices, but the high import reliance rate has tested North African governments' long-term inflation control. The structural vulnerability of regional food systems increases the socio-economic burden, and a prolonged Russia–Ukraine war raises fears about regional

Table 1 Ranking of MENA countries in the Global Food Security Index (GFSI) 2021

Country ^a	Overall GFSI score (and rank)	Score (and rank) in the subcategory "affordability"	Score (and rank) in the subcategory "availability"	Score (and rank) in the subcategory "quality and safety"	Score (and rank) in the subcategory "natural resources and resilience"
Algeria	63.9 (54)	77.9 (47)	58 (56)	62 (67)	50.7 (51)
Bahrain	68.5 (43)	79.2 (46)	67.5 (21)	79.9 (41)	39.1 (107)
Egypt	60.8 (62)	66.5 (68)	60.0 (49)	60.7 (71)	52.0 (44)
Jordan	64.6 (49)	80.4 (42)	55.2 (64)	63.5 (64)	54.2 (36)
Kuwait	72.2 (30)	80.1 (44)	72.3 (12)	86.4 (20)	43.0 (93)
Morocco	62.5 (57)	75.1 (52)	51.8 (74)	72.3 (50)	49 (57)
Oman	70.0 (40)	88.8 (18)	57.3 (59)	83.8 (28)	45.2 (76)
Qatar	73.6 (24)	83.8 (31)	74.4 (9)	83.5 (29)	43.4 (91)
Saudi Arabia	68.1 (44)	75.0 (53)	67.8 (20)	79.8 (42)	44.3 (84)
Sudan	37.1 (110)	31.8 (107)	31.6 (109)	52.4 (85)	41.4 (99)
Tunisia	62.7 (55)	74.4 (56)	54.0 (66)	72.1 (53)	47.6 (60)
Turkey	65.1 (48)	67.6 (67)	61.6 (42)	75.8 (47)	56.4 (27)
UAE	71.0 (35)	75.9 (50)	71.3 (14)	88.8 (16)	43.6 (88)
Yemen	35.7 (112)	39.3 (96)	27.6 (112)	37.4 (108)	42.1 (96)

^a The scores for all GFSI indicators are between 0 and 100, while the rank indicated in () is among 113 countries (Rank 1 being the best rank). Ranks up to 0.01 billion were rounded up (i.e., 0.045 = 0.01)

Source: Al-Saidi [58] (Based on Data for the Global Food Security Index (GFSI) 2021 available at <https://impact.economist.com/sustainability/project/food-security-index/>)

instability [61]. Besides its exposure to climate change, agriculture in North Africa is characterized mainly by poor productivity levels and a heavy reliance on rainfall. This is due to various factors, including a lack of investment in the sector, insufficient access to credit and markets, and limited access to information and training on new and better farming methods. Furthermore, the reliance on rainwater makes the sector highly vulnerable to variations in the amount and distribution of rainfall, which are likely to become more unpredictable in the future due to climate change [55].

Consequently, North Africa imports a significant part of its food needs, especially cereal, accounting for 16 to 17% of worldwide wheat imports. For instance, Algeria is Africa's largest food importer, importing approximately 75% of its food needs, and Egypt is the world's largest wheat importer. The reliance on food imports not only increases the region's dependence on international markets for its food supply but also exposes it to price volatility. Furthermore, in these countries, governments actively engage in wheat and other grain imports, with state agencies sometimes being the biggest or only legally allowed importers [62]. In several countries, governments will face challenges in controlling their budget deficits in 2023. This is due to the persistent impacts of the COVID-19 pandemic, which has had far-reaching consequences for the global economy. In addition, the region is facing the effects of drought, which can cause crop failures and reduce food supplies. This, coupled with the rise in prices of essential goods, such as cereal and oil and the overall increase in inflation worldwide, is putting further strain on the economy. All these factors contribute to a general slowing of the economy, making it more difficult for governments to manage their budget deficits effectively [3, 63].

So far, the government's reaction to the crisis has involved restrictions on food exports, attempts to establish alternative sourcing relationships, and talks with international financial organizations. In some instances, all nations in the area have restricted exporting certain food products, including grains and their derivatives, as well as fruits, vegetables, and other items. Tunisia and Egypt have started or finished negotiations with either the World Bank or IMF for financial aid or loan programs [62]. In addition, policymakers in the region have implemented price controls and subsidies to reduce the cost of certain goods, such as food and energy, domestically compared to the global market price. As a result, MENA inflation rates were lower than they would have been without assistance. For example, in Egypt, from March to July 2022, the average year-on-year inflation rate was 14.3%, but it would have been 18.4% if the government had not intervened [64].

Egypt

The conflict exacerbated Egypt's vulnerable condition. Egypt is highly vulnerable to the high global food prices and trade shocks caused by the conflict due to its reliance on food imports, especially wheat. Feng et al. [30] predicted that "the conflict would lead to soaring agricultural prices, decreasing trade volume and severe food insecurity especially for countries that rely heavily on grain imports from Ukraine and Russia, such as Egypt and Turkey". Indeed, imports account for more than 40% of Egypt's calorie consumption, and the country is the world's largest importer of wheat, a crucial component of the country's food supply. In recent years, Egypt had imported between 12 and 13 million tons of wheat per year, with about 85% coming from Russia and Ukraine before the conflict began. Imports of cereals have continued to rise faster than domestic output during the last three decades [65]. The Egyptian government spends more than \$3 billion per year on wheat imports, most of which goes toward the country's decades-long bread subsidy program, the *Tamween* ration card system, which serves 73% of Egyptian families [66]. Subsidies are financially unsustainable for the government, yet they are socioeconomically necessary to maintain social peace [21].

This dependence on imported wheat is due to a combination of factors, including a lack of sufficient arable land and water resources and a population of 105 million growing at a rate of 1.9 percent a year, which requires a steady wheat supply to meet its food needs. Furthermore, Egyptians consume between 150 to 180 kg of bread per capita, more than twice the global average [21]. In addition, the country's government heavily subsidizes wheat and bread, which results in a significant demand [67]. Furthermore, the dependence on imported wheat makes Egypt's economy more vulnerable to currency fluctuations. The country relies heavily on foreign currency to import wheat, and if the value of the Egyptian pound decreases, it can become more expensive. This might hurt the country's food security and economy. Supply disruptions, high global market prices, and other factors have all led to significant rises in local food inflation, which is expected to reach 31% in November 2022. This, in turn, contributes significantly to rising overall annual inflation, which rose from 6% to 21.3% between January and December 2022, the highest rate in 5 years [68] (Fig. 2).

Food price inflation affects low-income families more, since they spend more of their income on food. Strong social protection may help disadvantaged families during food price spikes. Egypt invests much in social protection and food subsidies; *Tamween*, the Egyptian food subsidy program, serves 73% of families. Egypt has

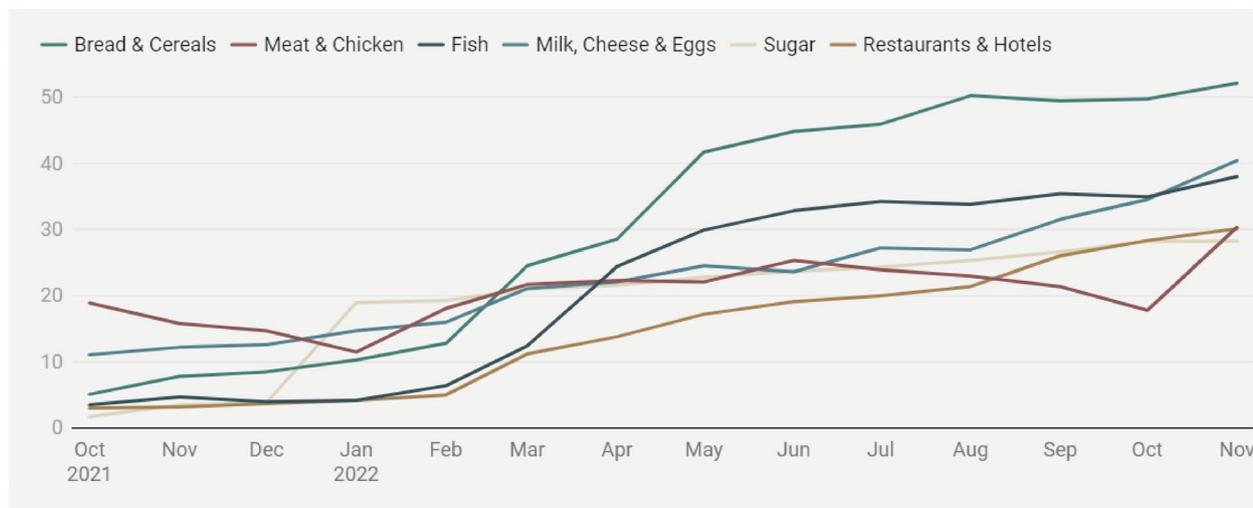


Fig. 2 Rates of annual food inflation in Egypt before and after the Russia–Ukraine conflict. [65] Source: Abay et al.

maintained food subsidies throughout the crisis, keeping prices stable [65].

A study by Abay et al. [65] highlighted that even though the prices of several essential food items (e.g., bread, cereals) have significantly risen, the government's food subsidy program may have helped safeguard the consumption of these items by households to some extent. However, the shift towards less healthy foods from high-protein foods is regrettable. It may worsen the double problem of malnutrition and the already high prevalence of overweight and obesity in Egypt, linked to food subsidies and high-calorie foods. Ultimately, the impoverished households in Egypt encountered significant challenges in 2022 that may impede their progress out of poverty [65]. Furthermore, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) have offered \$22 billion in central bank deposits and investments to assist Egypt in recovering from the Ukraine conflict. The Gulf nations helped Egypt to avert a revolt, remembering the bread riots in 1977 in Egypt's major towns, the hunger riots in 2008, and the Arab Spring in 2011 [69]. Furthermore, the tourism industry in Egypt is expected to suffer due to the ongoing conflict in Ukraine, with a projected decrease of 35% in the number of tourists [70].

Consequently, the shortage of foreign currency has also affected the country's ability to import goods, leading to further inflation. This has created a vicious cycle, where high inflation leads to a decline in consumer spending, which in turn leads to a decrease in economic growth. Daily price increases have caused citizens to curb their spending, limiting their purchases to the bare minimum [71].

The government has adopted several policies to mitigate the situation. The Ministry of Trade and Industry placed a 3-month export embargo on wheat, flour, lentils, cooking oils, maize/corn, fava beans, and pasta on March 20, 2022 [72]. In addition, the government froze the price of unsubsidized bread to prevent further price increases [73]. The government has promised social mitigation packages that include expanding cash transfer programs, such as Takaful and Karama, increasing pensions and public sector pay, and enacting tax measures to help people cope with the growing cost of living. Furthermore, to address the impact of global economic conditions and the conflict in Ukraine, as well as to restore macro-fiscal stability and support the structural reform program, Egypt has sought assistance from the International Monetary Fund (IMF). The aim is to implement a comprehensive economic program to address adverse spillover effects. Overall, the macroeconomic situation in Egypt is predicted to be weakened by the concomitant shocks during the financial year (FY) 2022/23 before gradually improving over the medium term [74]. To diversify the origin countries, the government approved India as a wheat supplier and, in April 2022, started negotiations for wheat purchases with Mexico, Pakistan, Argentina, and the USA [62].

Tunisia

Tunisia is one of the most vulnerable countries due to its low grain storage capacity and fiscal difficulties. In addition, the ongoing drought has hampered agricultural output for the last 3 years. Already in a political and economic crisis, Tunisia is feeling the full force of the consequences of Ukraine's conflict [75]. Since February 2022,

the topic of food insecurity due to the conflict has been a prominent issue in public discourse, emphasizing Tunisia's dependence on food imports as the country relies on imported sources to meet over half of its food needs [76]. Tunisia heavily relies on cereal imports for 84% of its soft wheat and 40% of its durum wheat, and 50% of its barley. Historically, Ukraine was a primary supplier for Tunisia, alongside Canada and the European Union. Indeed, Ukraine and Russia account for more than half of the country's cereal imports. As a result, fears focus on the risks associated with the war for wheat and barley provisioning. The country also suffers from a chronic insufficiency in terms of storage capacities, which are limited to 3 month needs [76].

Even before the conflict, food security in Tunisia was an ongoing concern due to various factors, such as climate change, population growth, and economic instability. In fact, climate change poses a significant threat to food security in Tunisia. The country is already experiencing rainfall patterns and temperature changes, which can negatively impact crop yields. In addition, Tunisia is prone to drought, leading to water shortages and further harming agricultural production. For example, the 3-year ongoing drought has depleted Tunisia's reservoirs and aquifers, endangering key crops and forcing the government to increase water prices. Furthermore, since September 2022, only 110 million cubic meters of rain have fallen in Tunisia, approximately one-fifth of the average rate. Hence, officials from the farmers' union and the major trade unions fear grain harvests will suffer, exacerbating the country's food supply issues [77]. Second, since the Arab Spring's revolution of 2011, the country has been facing high levels of political instability and economic stagnation, unemployment, and poverty, which makes it difficult for the

government to fund food imports and for many individuals and families to afford enough food to meet their needs [78]. Hence, the GDP is anticipated to expand at a 3% annual pace in 2022. This will prevent economic output from rebounding to pre-pandemic levels, keeping growth below the global average of 3.2%. In addition, the country's dependence on food imports makes it vulnerable to fluctuations in global food prices. Since the beginning of the conflict, Tunisia has had shortages of several essential products, such as flour, rice, pasta, and vegetable oils [79].

Youth unemployment has now reached 38% and shows no signs of abating, inflation is above 10% per year (Fig. 3), and both the government and key state-owned companies are facing bankruptcy. More recently, the highly anticipated deal with the International Monetary Fund has reached a stalemate, causing concern among many who were hoping for a resolution to the current economic crisis. Confidence in Tunisia's ability to find a way out of this financial predicament has diminished due to the impasse, leading to uncertainty about the nation's prospects [80].

In February 2023, consumer prices increased by 0.5% compared to the previous month. This increase is mainly linked to the rise in the prices of food products by 2.6%. In a monthly variation, the prices of food products increased by 2.6%, mainly due to the rise in the prices of poultry (+5%), fresh vegetables (+4.5%), sheep meat (+4.1%), eggs (+3.4%) and beef meat (+3.3%). In February 2023, the inflation rate increased to 10.4% after 10.2% the previous month. Food prices rose 15.6% year-on-year in February 2023. This rise is due mainly to price increases in eggs (32%), sheep meat (29%), chicken meat (25.3%), edible oils (24.6%), and beef meat (22.9%) [81].

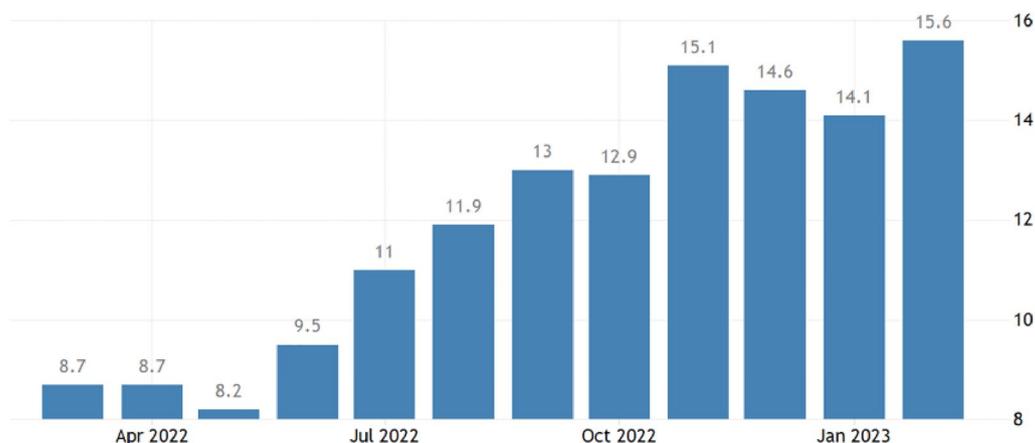


Fig. 3 Evolution of food inflation in Tunisia. [81] Source: Institut National de la Statistique Tunisie

Morocco

In recent years, Morocco has made progress in increasing food production and improving food security, especially in rural areas, but challenges remain. With the adoption of the “Green Morocco Plan” in 2008, the government has implemented various initiatives to boost food production, such as investing in irrigation systems, promoting modern farming techniques, and supporting the development of local agribusinesses [82]. However, Morocco still faces food security challenges, particularly food affordability, and nutrition, with persistent poverty, especially in rural areas. Climate change is also a growing concern for Morocco’s food security, as it can lead to changes in rainfall patterns and crop yields. For instance, Morocco is in the midst of a severe drought, which threatens to increase the quantity of imported agricultural goods and significantly slow the country’s economic development, which is predicted to be just 1.1% in 2022, down significantly from 7.4% in 2021 [62]. Accordingly, cereals’ domestic production and importation are both susceptible to significant fluctuations (Fig. 4).

In addition, although food production has increased, it has not always kept pace with the growing population, leading to increased pressure on resources and food prices and increasing reliance on food imports [84]. Morocco is especially susceptible to shocks caused by conflicts due to its dependence on food imports. In 2020, Morocco imported over \$6.50 billion in agricultural goods, while it exported an average of \$4.20 billion. While cereals are the majority of the country’s

food imports, Morocco imports almost half of its cereal consumption in an average year, vital components of Moroccan daily nutrition, therefore, the government has attempted to diversify its suppliers to lessen its dependency. In the case of wheat, however, Russia and Ukraine accounted for almost half of all imports in 2020: France (33%), Ukraine (32%), Russia (17%), the United States (14%), and other nations (4%) [85].

So far, Morocco has provided a safety net for its sizeable impoverished and susceptible population by subsidizing vital commodities, thus far avoiding the violent protests that emerged during the 2007/08 food and fuel crisis. Given this recent history, the government recognizes the need for continued support to ensure social stability. However, such measures are financially burdensome even during regular years. In 2022, the country will face various challenges, including the ongoing effects of the pandemic, drought, increased cereal and oil prices, global inflation, and a sluggish economy. As a result, the government’s capacity to maintain fiscal deficits at sustainable levels will be tested [83].

According to the High Commission for Planning (HCP), inflation was at 8.3% by the end of 2022, with food prices increasing by 15%. In a country, where poverty and social inequalities have only worsened since the COVID-19 pandemic, the price volatility, fueled by increased basic commodities and exacerbated by a severe drought, crystallizes tensions [86]. Furthermore, analysts at the Policy Center for the New South (PCNS) estimate that low-income households in Morocco spend 40 to 50%

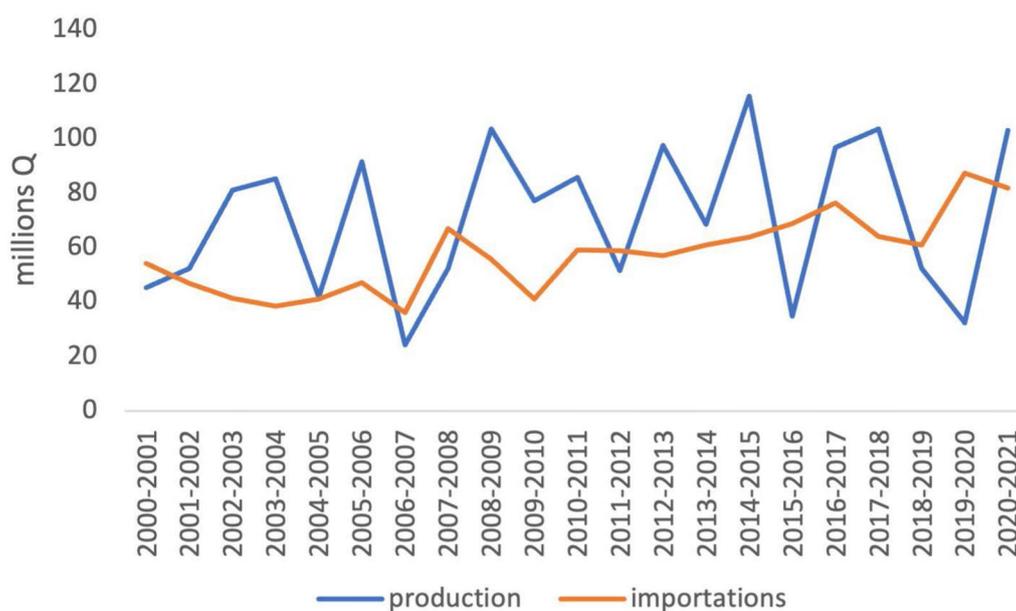


Fig. 4 Evolution of domestic production and imports of cereals in Morocco. [83] Source: Mengoub et al.

of their income on food, with the government's subsidy policy playing a crucial role in this context to safeguarding the purchasing power of households in the face of rising prices. However, it is still not enough to guarantee the food security of the whole population. Furthermore, subsidies are limited to essential products (e.g., flour, sugar), but price increases affect many other food products (e.g., fruit, vegetables, meat). Millions of people are, therefore, left in food insecurity due to this confluence, with no access to adequate nourishment [83].

Consequently, on February 19, 2023, sit-ins were held in many cities around the country at the request of the *Confédération démocratique du travail* (CDT), one of the three most powerful labor unions. The anniversary of the February 20th Movement, which began in Morocco in 2011 in the wake of the "Arab Spring," was also celebrated with marches on Monday, February 20th. The *Front social marocain*, an umbrella group for unions, left-leaning political parties, and other organizations, organized these marches. These last few days have also seen the topic of "cost of living" appear in the Parliament, where many opposition parties have urged the government to take action [86].

Furthermore, maintaining a sufficient supply of wheat/bread to the poor and vulnerable cannot give appropriate access to nutritious meals, an essential aspect of food and nutrition security. The effect of growing inflation on a population with limited buying power has worn down most Moroccans; nonetheless, years of prudent monetary policy and prudent fiscal management have bolstered the country's overall political resilience [80].

Conclusion

The conflict in Ukraine has had a profound impact on the food systems in North Africa, catalyzing the worsening of an already fragile food security situation, as revealed through the analysis of both scholarly and grey literature. The conflict has caused a global ripple effect, disrupting international food trade and causing price hikes. As a result, the food security situation in North Africa has become increasingly precarious, with many people struggling to access enough nutritious food to meet their daily needs. The findings highlight the conflict's significant influence on the global economy, trade patterns, and food prices, which has disrupted agricultural systems throughout North Africa. Food shortages, increasing poverty, and hunger in the region have resulted from the rise in food prices caused by the conflict's ramifications.

Moreover, the conflict has led to higher fertilizer costs, significantly impacting North African agriculture. This expense rise hinders farmers' ability to afford essential fertilizers, reducing agricultural yields and intensifying food scarcity while driving up prices. The International

Food and Policy Research Institute (IFPRI) outlines eight critical global food security challenges, such as record-high commodity prices, scarcity of staples, impacts of the Ukrainian war on planting, unstable fertilizer markets, adverse climate conditions, global economic slowdowns, soaring food inflation, and broader macroeconomic trends [87]. The ongoing Ukraine conflict, likely to persist into 2023 and beyond, is expected to keep energy and food prices high. This scenario will adversely affect import-dependent countries in the region while benefiting energy exporters financially. The escalation in food prices will broadly impact the region, with financially robust countries better equipped to shield their citizens from these effects. In contrast, resource-limited or unstable states face significant challenges in maintaining food security. As highlighted by Galanakis [88], the combined effects of climate change, global warming, the COVID-19 pandemic, and the Russian–Ukrainian conflict underscore the urgent need for a shift towards a more sustainable and resilient global food system [89].

The findings of this study provide valuable insights into the impact of conflicts on food systems and highlight the importance of considering these impacts when addressing global food security challenges. Our research has emphasized the complex and interconnected features of global food systems, mirroring the discoveries from a limited number of previous papers on this subject [19, 32, 58, 90, 91]. It highlights how political and economic conflict in one part of the globe may have a ripple effect on food security and nutritional well-being in other parts of the world. The study uncovers a complex network of interdependencies and susceptibilities within global food networks, whereby disruptions in a particular location may have far-reaching consequences, impacting the accessibility, price, and quality of food in other regions. Our study is in harmony with previous studies. Furthermore, it contributes by examining the distinctive impacts as well as means by which global events impact food systems in locations, such as North Africa. This underscores the need for a more holistic approach to addressing food security challenges, one that considers the broader geopolitical and economic context in which food systems operate.

Finally, as highlighted by the United Nations Economic and Social Commission for Western Asia (ESCWA) in a recent Expert Group Meeting [92], due to the insufficiency of productive capacity, including trade as a component of food security strategies is crucial in the Arab region. With an increasing scarcity of natural resources and persistently low productivity, the area struggles to adapt and respond effectively to emerging crises, such as the COVID-19 pandemic, the war in Ukraine, and the ongoing effects of climate change. Moreover, Arab

countries heavily depend on food imports; therefore, it is crucial to take appropriate measures to improve trade efficiency and foster regional cooperation and collaboration, especially regarding trade negotiations and facilitation during crises that could potentially disrupt food procurement. Furthermore, mitigation efforts should include increasing the proportion of traditional diets to total nutrition, since these diets are healthful and nutritious and might help communities and nations be more resilient. Moreover, food sovereignty should be prioritized to provide countries with greater alternatives regarding what they produce, what they consume, and where their food comes from, allowing them to manage the volatility of global food markets better. In addition, transport inefficiencies and inadequate infrastructure must be rectified, since they are critical to food commerce and market functioning. Because of a lack of adequate national infrastructure, nations may find it simpler to get food from global markets when local or regional capacity is available.

Furthermore, developing creative financial strategies that might increase resilience to such global shocks is critical. Notably, the growing significance of green and sustainable finance is a viable opportunity [93, 94]. This approach, which stresses ecologically and socially responsible investment, might be critical in minimizing the financial repercussions of crises, such as the Ukrainian conflict on food security in North Africa. Green finance may help the region handle the combined economic instability and food scarcity concern by diverting investments into sustainable agriculture practices and green supply chain infrastructure [95].

While this study gives valuable insights into the effect of the Ukrainian crisis on food security in North Africa and the global food chain, several limitations must be acknowledged. First, the study is based mainly on secondary sources, such as government publications, academic studies, and articles. Despite attempts to incorporate diverse sources, data availability and reliability may vary, thereby introducing biases or limitations in the findings. Second, the study focuses explicitly on three North African countries considered vulnerable: Egypt, Morocco, and Tunisia. It is important to note that the findings of this study may not be generalizable to other countries in the region or beyond.

This study provides opportunities for future research that can enhance our understanding of the interaction among conflicts, food security, and the global food system. One potential avenue for future research is to undertake a comparative analysis of the effects of conflicts on food security across various geographical regions. Another possible area of research is to assess the efficacy of existing policies and interventions that aim to

alleviate the impact of conflicts on food security. In addition, it may be worthwhile to identify and scrutinize successful strategies and interventions that strengthen the resilience of food systems in regions affected by conflicts.

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