



IN THE EYE
OF THE STORM

FOOD

SECURITY

IN THE MENA REGION

In the Eye of the Storm Food Security
in Mena Region
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EXECUTIVE SUMMARY

According to a report by the United Nations Food and Agriculture Organization on the state of food security and nutrition in the world in 2022, it is estimated that between 702 and 828 million people were affected by hunger in 2021, consisting of 278 million people in Africa, 425 million in Asia, and 56.5 million in Latin America and the Caribbean. The number has grown by about 150 million since the outbreak of COVID-19 pandemic. The Russia-Ukraine War, involving two of the biggest producers in agriculture and staple cereals globally, is disrupting supply chains and further affecting global grain, fertilizer, and energy prices, leading to shortages and fuelling even higher food price inflation. Additionally, food security is a significant challenge in the Arab region which is facing rising economic, socio-political, and environmental challenges impacting the food security of its growing population.

Hence, our study has examined the factors that affect food security, and our analysis allowed us to determine the top five factors affecting food security: climate change, conflict, overpopulation, inflation, and scarce resources. The study will analyze each factor separately and their effect on food security globally and in many regions, with a focus on the Arab region. Secondly, the study will analyze factors of food insecurity separately and its impact on four significant countries: Egypt, the United Arab Emirates, the Kingdom of Saudi Arabia, and Jordan.

We found that the factors we examined have mainly negative effects on food security, with the exception of climate change, which will positively affect some regions for the time being, and natural resources, which has some aspects that effect food security positively. Additionally, we found that the factors are interconnected since for example, conflict negatively affects food security, and it could increase food prices, as in the current Russia-Ukraine War. Likewise, the adverse impacts of climate change are expected to raise food prices further and dampen the region's food demand translating into direct increases in malnutrition levels.

Finally, after reviewing the effects of factors on food security, we elaborated some recommendations in order to deal with the adverse effects.

INTRODUCTION

According to the United Nations Food and Agriculture Organization (FAO) report on the state of food security and nutrition in the world in 2022, it is estimated that between 702 and 828 million people were affected by hunger in 2021, consisting of 278 million people in Africa, 425 million in Asia and 56.5 million in Latin America and the Caribbean. The number has grown by about 150 million since the outbreak of COVID-19 pandemic.⁽¹⁾

Food security has recently been high on the political agenda due to volatile food prices, using food crops as biofuel or fodder, and droughts. Indeed, the importance of food security was even addressed in a round table session in “the climate implementation summit” COP27 that indicates that “climate change has impacted several sectors of the national economies and activities, in particular agriculture and food production, augmented by other challenges be it geopolitical, cost of finance or supply chain related, and in a time of increased food insecurity, hence, it is to imminent to have relevant measures in place for sustained food security and to manage any potential food crisis.”⁽²⁾

Hence, food insecurity occurs when people’s access to the food they produce themselves or to food in markets is disrupted, reducing the volume and quality of foods available to them; the resulting diets provide insufficient nutrients for an active and healthy life. Food insecurity can be experienced either as a normal condition (chronic food insecurity) or because of cyclical shortages or a shock (acute food insecurity).⁽³⁾

Food insecurity is as old as humanity, and it is predicted to worsen further due to the economic slump and downturns caused by the COVID-19 pandemic, continuous conflicts, and climate extremes. According to an FAO-WFP estimate, the number of people experiencing acute food insecurity and needing immediate assistance is

1. FAO, IFAD, UNICEF, WFP and WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO, p.10.

2. Cop 27, (2022). The Sharm el-sheikh climate implementation summit, round table on “food security”, p:1.

3. FAO, (2022). Hunger and food insecurity, p.1.

expected to rise to 222 million in 53 countries and territories.^[4]

The start of the war in Ukraine, involving two of the biggest producers in agriculture and staple cereals globally, is disrupting supply chains and further affecting global grain, fertilizer, and energy prices, leading to shortages and fuelling even higher food price inflation.

We are now only eight years from 2030, but the distance to reach many SDG 2 targets is growing more expansive each year. There are efforts to progress towards SDG 2, yet they need to prove more in the face of a more challenging and uncertain context.

The intensification of the major drivers behind recent food insecurity and malnutrition trends (i.e., conflict, climate extremes, and economic shocks), along with the high cost of healthy foods and growing inequalities, will continue to challenge food security and nutrition. This will continue to be the case unless agri-food systems are reformed, more robust, and capable of providing sustainably and inclusively low-cost, nutritious foods and affordable healthy meals for all sustainably and inclusively.^[5]

Further, after the sharp rise in international prices of wheat and other staple foods in the wake of Russia's February invasion of Ukraine, domestic food prices for consumers continue to rise in most countries. Meanwhile, ongoing uncertainties —not the least of which is the continuing war— augur for continued turmoil in global food markets.^[6] As a result, global food security remains at high risk; hundreds of millions of people already face acute food insecurity, and their numbers are rising, according to the Global Report on Food Crises.^[7]

Food security is a significant challenge in the Arab region. It was even addressed by the secretary-general of the Arab League at a recent Arab League meeting; he noted that many Arab countries were affected by the Russia-Ukraine War since they depend on food imports from Russia and Ukraine matter of food security must be addressed. Indeed, the Arab region is facing rising economic, socio-political, and environmental challenges impacting the food security situation of its growing population.^[8]

4. FAO and WFP, (2022). Hunger Hotspots. FAOWFP early warnings on acute food insecurity: October 2022 to January 2023 Outlook. Rome, p.vii.

5. United Nations. (2022). The Sustainable Development Goals Report, PP:3-26.

6. UN, (2019). Policy brief issues in the Arab region, p.4.

7. FAO, IFAD, UNICEF, WFP and WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO, p.2.

8. UN, (2019). Tracking Food security in the Arab region, p.11.

This study will start by analysing and reviewing the top factors affecting food security globally and in many regions, especially the Arab region. Secondly, the study will analyse factors of food insecurity separately and statistically and its impact on four significant countries: Egypt, the United Arab Emirates, Saudi Arabia, and Jordan.

The justification of the choice of these four countries relies on the fact that Egypt is the biggest country in the Northern African region, United Arab Emirates and Saudi Arabia are the largest economies in the Gulf region, and Jordan is the most stable country in the Levant.

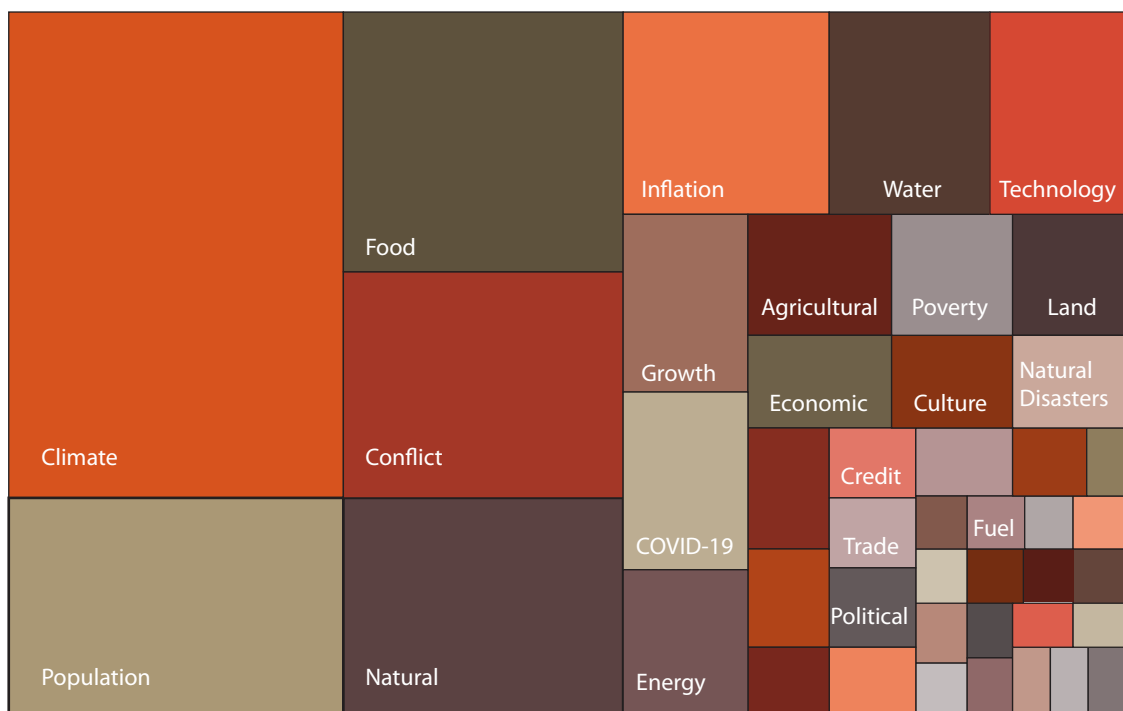
The analysis will allow us to identify how each factor affects food security and come up with results and recommendations on how to deal with the identified issues.

LITERATURE REVIEW

It is commonly acknowledged that food security is a complicated and multidimensional issue that may be measured using many methods. According to FAO, Food security is usually defined by four pillars or indicators: availability, access, usage, and stability. Numerous research has demonstrated the importance of assessing food security indicators and difficulties among various world states.⁽⁹⁾

Regarding our study, to analyze the factors that affect food security and their impact on food insecurity, we gathered 180 studies, including 100 studies, 50 reports, and 30 theses, to examine the most common factors that impact food security in 2000 and 2022. All these studies will appear in (Appendix 1). The graph below illustrates the distribution of studies on various variables:

Figure 1 - Distribution of Studies on Different Variables



The review of the studies above allowed us to identify the most significant factors that affect food security. These factors are climate change, conflict, overpopulation, food prices, natural resources, COVID-19, agriculture, poverty, culture, migration, and technology.

9. Hall et al., (2017). *The impact of population growth and climate change on food security in Africa: looking ahead to 2050*. *International Journal of Agricultural Sustainability*, 15(2), 124-135.

DETERMINING THE INDEPENDENT VARIABLES

We chose to work on the five most important factors related to the Middle East region among those that have been studied in the most significant number of studies, which are: Climate Change, Overpopulation, Conflict, Natural Resources, and Inflation; the following table shows each how many the papers studied each chosen factor:

Table 1 – Five Most Independent Variables Studied by the Literature

Factor	Number of Studies	% of Total
Climate Change	57	31%
Overpopulation	27	15%
Conflict	23	12.7%
Natural Recourses	22	12.2%
Inflation	15	8.3%
Total	144	80%

Besides, we also found that the number of studies on food security increased significantly in the past two years, reflecting the importance of food security, especially after the outbreak of COVID-19 pandemic that severely affected the whole world.^[10]

CLIMATE CHANGE

Climate change continues to harshly impact food security globally, regionally, and domestically inside countries. Climate change has impacted food safety, particularly in the incidence and prevalence of food-borne diseases. Climate change will seriously impact agricultural production in all forms globally.^[11] Climate change will impact temperature, precipitation, and wind speed, affecting water availability and other ecosystem services essential to agriculture and agricultural yields.^[12] Therefore,

10. Kassy et al., (2021). *Food Security Status and Factors Affecting Household Food Security in Enugu State, Nigeria*. *Journal of Health Care for the Poor and Underserved*, 32(1), 565-581.

11. Ouimette, A. P., Ollinger, S. V., Richardson, A. D., Hollinger, D. Y., Keenan, T. F., Lepine, L. C., & Vadeboncoeur, M. A. (2018). Carbon fluxes and interannual drivers in a temperate forest ecosystem assessed through comparison of top-down and bottom-up approaches. *Agricultural and Forest Meteorology*, 256, P:429.

12. Calvin, K., Wise, M., Clarke, L., Edmonds, J., Kyle, P., Luckow, P., & Thomson, A. (2013). Implications of simultaneously mitigating and adapting to climate change: initial experiments using GCAM. *Climatic Change*, 117(3), P: 545.

knowing how these changes affect food production is necessary to guarantee future global food security. Climate change has had few positive effects, such as prolonged growing seasons in northerly latitudes. However, most findings are alike geographically and among essential crops for food, with yield declines anticipated under each climatic scenario.⁽¹³⁾

On the global level, climate change impacts the four pillars of food security: stability, access, availability, and utilization.⁽¹⁴⁾ Climate change could cause more intense rainfall between prolonged dry periods, which may promote crop disease, putting these areas at greater risk of environmental degradation.⁽¹⁵⁾ With this object, global food insecurity has risen primarily due to climate phenomena. In addition, global warming is influencing weather patterns, causing heat waves, heavy rainfall, and droughts.⁽¹⁶⁾

When it comes to the effect of climate change on the African continent, which is the most food insecure, and the most affected by climate change, adverse impacts of climate change were found. In recent years, yields of staple crops such as maize, wheat, sorghum, and fruit crops, such as mangoes, have decreased across Africa, widening food insecurity gaps. The Sahel region of Cameroon has experienced an increasing level of malnutrition. This is partly due to the impact of climate change since harsh climatic conditions leading to extreme drought negatively influence agriculture.⁽¹⁷⁾

Unlike Africa, positive and negative impacts were found in Australia. Declining rainfall and increasing daily maximum temperatures in Australia created water shortages based on models from 50 places. Even though increased atmospheric CO₂ concentrations had a positive impact, yield potential decreased by 27% from 1990 to 2015.⁽¹⁸⁾ In New South Wales, high-temperature episodes during the reproduction stage of crop growth were found to negatively affect wheat yields, with combinations of low rainfall and high temperatures being the most detrimental.⁽¹⁹⁾

13. Zhao, C., Liu, B., Piao, S., Wang, X., Lobell, D. B., Huang, Y., ... & Asseng, S. (2017). Temperature increase reduces global yields of major crops in four independent estimates. *Proceedings of the National Academy of Sciences*, 114(35), PP:9326-9329.

14. Mbow, C., Rosenzweig, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., ... & Xu, Y. (2019). *Food security*, P:452.

15. Rosegrant, M. W., & Cline, S. A. (2003). Global food security: challenges and policies. *Science*, 302(5652), P:1917.

16. World Bank, (2022). *Food Security Update, World Bank Response to rising Food insecurity*.

17. Chabejong, N. E. (2016). A review on the impact of climate change on food security and malnutrition in the Sahel region of Cameroon. *Climate Change and Health*, PP:133-148.

18. Hochman, Z., Gobbett, D. L., & Horan, H. (2017). Climate trends account for stalled wheat yields in Australia since 1990. *Global change biology*, 23(5), P:207.

19. Mekhilef, S., Saidur, R., & Kamalisarvestani, M. (2012). Effect of dust, humidity, and air velocity on efficiency of photovoltaic cells. *Renewable and sustainable energy reviews*, 16(5), PP:2920-2925.

In Asia, the continent where more than half of the world's population lives, the positive effects of climate change on food security have been observed. Multiple factors, such as structural adjustment, scientific and technological progress, and government policies, along with regional warming (1.43°C in the past century), have been put forward as contributing to the observed expanded rice areas and yield in the region.^[20] On the other hand, a study showed that climate change negatively impacts food security, as Agriculture in Pakistan has also been affected by climate change. From 1980 to 2014, spring maize growing periods have shifted an average of 4.6 days per decade earlier, while the sowing of autumn maize has been delayed 3.0 days per decade.^[21] A counterfactual study looking at wheat growth and yield in different climate zones of China from 1981–2009 found that impacts were positive in northern China and negative in southern China.^[22]

Further, in South America also, significant effects were observed. According to a study in Colombia and Bolivia, climate change is affecting crop yields and causing farmers to alter the timing of planting, their soil management strategies, and crop varieties' use and spatial distribution.^[23] Moving to Europe, different climate change effects are observed across the continent. In the Czech Republic, a study documented positive long-term impacts of recent warming on yields of fruiting vegetables (cucumbers and tomatoes) from 4.9 to 12% per 1°C increase in local temperature but decreases in yield stability of traditionally grown root vegetables in the warmest areas of the country.^[24] However, a study in Hungary also indicated the increasingly adverse impacts of temperature on crops. It noted that a warming climate has been partially responsible for crop yield stagnation since the mid-1980s in Eastern Europe.^[25]

They are moving the study-focused region to the GCC region. Climate change will affect several physical, chemical, and biological processes that drive the productivity of agricultural, forestry, and fisheries systems and are likely to contribute to adverse

20. Fenghua, S., Y. Xiuqun, L. Shuang, and others, 2006: The contrast analysis on the average and extremum temperature trend in northeast China. *Sci. Meteorol. Sin.*, 26, PP:157–163.

21. Abbas, G., Ahmad, S., Ahmad, A., Nasim, W., Fatima, Z., Hussain, S., ... & Hoogenboom, G. (2017). Quantification the impacts of climate change and crop management on phenology of maize-based cropping system in Punjab, Pakistan. *Agricultural and Forest Meteorology*, 247, PP:52-54.

22. Mbow, C., Rosenzweig, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., ... & Xu, Y. (2019). Food security, P:452.

23. Keleman Saxena, A., Cadima Fuentes, X., Gonzales Herbas, R., & Humphries, D. L. (2016). Indigenous food systems and climate change: impacts of climatic shifts on the production and processing of native and traditional crops in the Bolivian Andes. *Frontiers in Public Health*, 4, 20, P:1.

24. Potopová, V., Zahradníček, P., Štěpánek, P., Türkott, L., Farda, A., & Soukup, J. (2017). The impacts of key adverse weather events on the fieldgrown vegetable yield variability in the Czech Republic from 1961 to 2014. *International Journal of Climatology*, 37(3), P: 1648.

25. Pinke, Z., & Lövei, G. L. (2017). Increasing temperature cuts back crop yields in Hungary over the last 90 years. *Global change biology*, 23(12), P: 5426.

impacts on global and domestic crop production levels.^[26] Future climate change in the GCC, which includes an increase in temperature, a decrease in rainfall, and an increase in evapotranspiration, will have an even more significant impact on agricultural and food production in an already highly arid region.^[27] According to climate change predictions, the entire area of the GCC will get hotter and drier in the future, with less precipitation.^[28]

After reviewing the previous studies, it is evident that climate change's impact on the world's food security differs from one region to another. In some parts, climate change has positive effects on it, and in other areas, negative impacts.

CONFLICT

Another important factor affecting food security is conflict. Indeed, all the studies agreed that competition is one of the most important factors affecting food security and that food insecurity can be the reason for the conflict. How a battle is fought can, directly and indirectly, impact food security. For example, when crops, agricultural land, or critical infrastructure are damaged or destroyed by fighting, it can instantly affect people's access to food. Nevertheless, broader impacts, such as the closure of trade routes and collapse of local markets due to insecurity, even far from where the fighting occurs, can be further damaging.^[29]

Violent conflict and food security are inversely correlated. On the one hand, war directly affects food systems, affecting people's capacity to produce, trade, and access food. On the other hand, the emergence and persistence of conflict may be influenced by food shortages. However, the mechanisms by which a conflict results in increased food insecurity or vice versa are intricate and particular to each situation.^[30]

According to an FAO report, most conflicts mainly affect rural areas and their populations. This is particularly true for civil disputes, which currently are the most common form of armed conflict. However, the effects of competition on food security

26. Spiess, A. (2012). *Food security in the GCC economies*. In *The GCC Economies Springer*, New York, NY. P: 88.

27. Shahid, S. A., & Ahmed, M. (2014). Changing face of agriculture in the Gulf Cooperation Council countries. In *Environmental Cost and Face of Agriculture in the Gulf Cooperation Council Countries*, P:1.

28. Bucchignani, E., Mercogliano, P., Panitz, H. J., & Montesarchio, M. (2018). Climate change projections for the Middle East–North Africa domain with COSMO-CLM at different spatial resolutions. *Advances in Climate Change Research*, 9(1), PP:66-80.

29. ICRC, (2022) *Food security and armed conflict (2022)*, p.2.

30. Caroline et al. (June 2021). *Food systems in conflict and peacebuilding settings pathways and interconnections*, Stockholm international peace research institute, p.1.

and nutrition are solid and unmistakable. It is the primary driver of food insecurity and malnutrition, both acute and chronic. The long-lasting effects of conflict are on human development due to increased malnutrition, which tends to affect children the most and leave lifelong physical and mental handicaps. The impact of conflict on food security varies across conflict zones. Still, standard features are food production and food systems disruption, plundering crops and livestock, and loss of assets and incomes, directly and indirectly affecting food access.^[31]

Another report by Stockholm Research Institute finds that violent conflict can affect food production through three main channels: the destruction of assets and resources, the destruction of human capital, and increased risks and diversion of resources in the broader operating environment. Further, the report finds that it impacts the distribution and marketing of food distribution. Conflict can change the institutional market environment, disrupt distribution, and market links, shift market dynamics, and reduce the availability of goods. In addition, the report above finds that food insecurity is not only a consequence of violent conflict but can also contribute to its emergence and duration. Food insecurity is linked to deficiencies in the food supply chain. Shortages, coupled with drivers and shocks, can increase the likelihood of food insecurity, contributing to violent conflict.^[32]

Similarly, an FAO study explains that food security worsens dramatically when food is used as a weapon in conflict. The devastation caused by warfare is sometimes exacerbated by natural disasters, which frequently result in starvation and hunger. Droughts and floods, damage to rural infrastructure, logging, asset divestitures by households, land mining, deforestation, and mass migration all have a detrimental long-term impact on food production and food security.^[33]

Furthermore, a report by the International Food Policy Institute asserts that, on a broader scale, in Africa, violent civil conflict events were more common in countries that were also harder hit by climate- and weather-related disasters. The total number of people affected by such disasters is significantly correlated with the number of violent civil conflict events and fatalities in these events. Countries particularly vulnerable to climate- and weather-related disasters and violent civil conflicts include most countries in the Greater Horn of Africa (Ethiopia, Kenya, Somalia, South Sudan,

31. FAO (2016). Peace and food security: Investing in resilience to sustain rural livelihoods amid conflict, p.14.

32. Caroline et al. (June 2021). Food systems in conflict and peacebuilding settings pathways and interconnections, Stockholm international peace research institute, p.6,13.

33. Teodosijević, S.B. (June 2003). Armed Conflicts and Food Security ESA Working, FAO Paper No. 03, p.26.

and Sudan), Mali, Nigeria, and Zimbabwe.^[34] Also, the case of Mozambique confirms this aggravation of hunger when bad weather combines with war-induced weaknesses. The prolonged drought of 1991-93 in southern and eastern Africa caused famine in war-torn Mozambique but not in its more politically stable neighbours, Botswana and Zimbabwe.^[35]

The Arab region was not far from these conflicts; in 2014, millions of lives were affected, even lost, and houses, roads, schools, and hospitals in Gaza, Iraq, Nigeria, Syria, and Yemen were destroyed. Moreover, these conflicts often worsen food and nutrition insecurity. A report by the International Food Policy Research Institute (IFPRI) found that in addition to the humanitarian tragedies associated with these conflicts, the destruction of infrastructure and disruptions in access to markets often renders goods and services excessively expensive or makes them unavailable altogether. Moreover, investors and tourists often abandon conflict-affected areas, and clashes between conflicting parties force millions of refugees to flee to safer places within the affected countries or across the border to neighbouring countries. As a result, economies often contract, instability and insecurity spill over national borders, and food and nutrition insecurity rise. For example, almost the entire population of Gaza needs assistance, and about half of the people in Syria and Yemen are suffering from severe food insecurity.^[36]

On the global level, according to the Global Report on Food Crises, in 2021, 139 million people were pushed into acute food insecurity because of armed conflict and other security threats– an increase of almost 40 million people compared to the year before. In 2022, the impacts of the armed conflict in Ukraine are felt across the globe as it worsens the situation.^[37] According to a UN report, commodity prices are reaching record highs across the board. On the 8th of April 2022, FAO published its third consecutive record food price index, and food prices were 34% higher than last year and have never been this high since FAO started recording them. Similarly, there was an increase in crude oil prices by around 60%, and gas and fertilizer prices have more than doubled.^[38] This is because Russia and Ukraine are significant players in global agri-food markets. Together, the two countries account for 53% of international commerce in sunflower oil and seeds and 27% of global trade in wheat.

34. Clemens Breisinger et al. (2015). Global food policy report, international food policy research institute, p:55.

35. Slobodanka B. Teodosijević, (June 2003). Armed Conflicts and Food Security ESA Working, FAO Paper No. 03, p.26.

36. Clemens Breisinger et al. (2015). Global food policy report, international food policy research institute, p:51.

37. Food Security Information Network, (2022). Global Report on Food Crises, World Food Programme p. 3,7.

38. UN brief Number 1 (2022). Global Impact of war in Ukraine on food, energy and finance systems, p.3.

The effect of the crisis on food is bothersome. Some countries are mainly dependent on agri-food commodities coming from Ukraine and Russia. Indeed, lower-income countries are the most exposed. Based on UNCTAD calculations, on average, more than 5 % of the poorest countries' imports are products that are likely to face a price hike resulting from the ongoing war in Ukraine. The share is below 1% for more affluent countries.⁽³⁹⁾

Between 2018 and 2020, Africa imported \$3.7 billion in wheat from Russia (32% of total African wheat imports) and another \$1.4 billion from Ukraine (12% of total African wheat imports). The corresponding wheat imports from the two countries by the least developed countries were \$1.4 billion (29%) and \$0.5 billion, respectively (10%).

Let us look at some specific African countries, including the least developed ones. We will find that their dependence on wheat imports from Russia and Ukraine is far higher than these overall percentages. As many as 25 African countries, including many least developed countries, import more than one-third of their wheat from the two countries, and 15 import over half.⁽⁴⁰⁾ Hence, the African continent will be more severely affected and food insecure if the conflict persists.

To further assert the impact of conflict on food security, the president of the Security Council issued the following statement on behalf of the Council on the 29th of April 2020: "The Security Council stresses in this regard that armed conflict, violations of international humanitarian law and international human rights law and food insecurity can be drivers of forced displacement, and, conversely, forced displacement in countries in armed conflict situations can have a devastating impact on agricultural production, food security, and livelihoods of displaced communities and their hosting communities, recalls the relevant prohibition on the displacement of civilians in armed conflict, and stresses the importance of fully complying with international humanitarian law and other applicable international law in this context."

To summarise, conflict, whatever its form, hurts food security as it affects food production and people's access to food, and competition does not only impact food security. Still, it can be a contributing factor that causes food insecurity.

39. UNCTAD, (March 2022). The impact on trade and development of the war in Ukraine, p. 3,4.

40. Ibid, p.5.

INFLATION

Multiplying food prices globally in the past decades increased food security challenges. Rising food commodity prices in 2021 significantly pushed approximately 30 million additional people in low-income countries toward food insecurity.^[41] In addition, in 2022, due to the Russia-Ukraine War, food commodity prices have further increased, which caused a severe impact on the poorest countries that will not afford to buy food and will be food insecure. Incomes and food prices play a critical role in food access, given that most food consumed in urban areas is purchased. On average, impoverished urban households in 20 low and middle-income countries were found to spend more than 50% of their budget on food.^[42]

In North America, a study was made on Alaska's food security. According to this study, recent upsurges in the price of fuel in rural Alaska, coupled with high costs of grocery store foods and decreased efficacy of hunting and fishing, have led to a food crisis in many regions of rural Alaska.^[43] In Africa, a study claims that Nigeria has rapidly grown into a powerful food-importing nation as the government has neglected the agricultural sector since petroleum is considered a more viable resource for economic development. This situation quickly polarised the country into high and low-income groups. Unfortunately, while only a tiny fraction of the population benefited from the oil wealth, the people suffered the misfortune of food insecurity as they could hardly afford the rising prices of imported foods.^[44]

In Asia, in the short run, food security in the country has been intimately connected to rice prices. High rice prices significantly impact the number of individuals living below the poverty line and the quality of their diet.^[45] Further, a study was made on GCC countries to examine the effect of the inflation of food prices on food security. It found that food price inflation significantly affects food availability and stability but shows no significance on food access and utilization.^[46]

So, we can conclude that a rise in food prices negatively impacts food accessibility

41. World Bank, (2022). Food Security Update, World Bank Response to rising Food insecurity.

42. Ruel, Marie T., James L. Garrett, and Sivan Yosef. "Food security and nutrition: Growing cities, new challenges." IFPRI book chapters (2017) P:29.

43. Fazzino, D. V., & Loring, P. A. (2009). From crisis to cumulative effects: Food security challenges in Alaska. *Napa Bulletin*, 32(1), 152-177.

44. Matemilola, S. (2017). The challenges of food security in Nigeria. *Open Access Library Journal*, 4(12), P:1.

45. Timmer, P. (2004). Food security in Indonesia: current challenges and the long-run outlook. Center For Global Development Working Paper, (48), P:1.

46. Elzaki, R. (2022). Challenges of the Food Security in the Gulf Cooperation Council Countries: An Empirical Analysis of Fixed and Random effects, P:22

since the inflation in food prices makes people unable to buy it, and then they become food insecure.

OVERPOPULATION

Overpopulation and the booming numbers of the world's population raise worries about the food demands globally, especially after the world's population officially reached 8 billion on the 15th of November 2022 and is expected to hit the mark of 9.6 billion by 2050, which means that the global food demand will continue to grow. The leading causes of hunger and malnutrition are natural cataclysms, armed conflicts, population growth, and poverty. The global financial crisis has adjusted the dynamics of poverty and, consequently, the problems of hunger challenge.^[47] A recent study examined different population changes and confirmed that countries with a predicted decline in population progress had higher food security. In contrast, those with an expected rapid population growth tended to suffer the worst food security shocks. Furthermore, the study shows that population growth and land-use change could significantly impact food security.^[48]

First, in Asia, a study was made on Pakistan's food security and its relation to overpopulation. The study found that overpopulation increases the gap between food supply and demand, making food security more challenging in Pakistan.^[49] Similarly, in Africa, a study conducted in Nigeria demonstrated that food security is mainly caused by a shortfall in domestically produced food in Nigeria because the growing population rate in Nigeria is 3.2%. In contrast, the growth in food production has been less than 1%. This shows that the demand for food reflected by overpopulation is greater than the supply reflected by agricultural production.^[50]

Another study was made on India's food security, and it revealed results that the limited resources and exponentially increasing population are the main borders to achieving the successful National Food Security Act 2013 (NFSA) that India's government implements to fight against hunger and protect the rights of the people to

47. Prosekov, A. Y., & Ivanova, S. A. (2018). Food security: The challenge of the present. *Geoforum*, 91, 73-77.

48. Molotoks et al., (2021). Impacts of land use, population, and climate change on global food security. *Food and Energy Security*, e261, p.1.

49. Ahmad, M., & Farooq, U. (2010). The state of food security in Pakistan: Future challenges and coping strategies. *The Pakistan Development Review*, PP:918-920.

50. Metu, A. G., Okeyika, K. O., & Maduka, O. D. (2016, May). Achieving sustainable food security in Nigeria: Challenges and way forward. In *Proceedings of the 3rd International Conference on African Development Issues*. PP: 182-186.

food.^[51] Likewise, the same results were revealed by a study conducted to examine the effect of overpopulation on the food security of the GCC region. The results show that population growth is a significant driver of food security indicators in the GCC countries, particularly the food stability indicators.^[52] Growing populations provide a crucial strategic problem for the GCC nations. A study investigates how population growth has significantly and negatively influenced the economies of the GCC countries. The GCC countries' populations have grown considerably due to many migrant workers.^[53] The population of the GCC is significantly made up of migrants, with the most significant percentages estimated to be in the UAE (88%), followed by Qatar (76%), Kuwait (74%), Bahrain (51%), and Oman (41%), with Saudi Arabia having the lowest numbers (32%).^[54]

In brief, overpopulation is seen as a critical factor that threatens food security in the whole world; as mentioned in the above studies, as the increase in the population widens, the gap between the food supply and demand upturns.

NATURAL RESOURCES

Another factor affecting food security is the scarcity of natural resources. A natural resource refers to air, forests, water, land, minerals, fisheries, and wildlife delivered by nature. The demand for resources will likely continue to grow in the coming decades. According to the United Nations Environment Program (UNEP), energy demand is set to grow by 50% by 2030. The number of minerals, ores, fossil fuels, and biomass consumed globally per year could triple between today and 2050. Global growth in water demand is also set to increase by 50 % over the same period compared with current consumption.^[55] Therefore, it was essential to address the link between natural resources management and food security.

There are significant links between natural resource management and food security. For example, environmental degradation may result in reduced production and food availability. In contrast, food insecurity may encourage the overexploitation of finite resources as people turn to unsustainable methods to meet their immediate needs.

51. Tanksale, A., & Jha, J. K. (2015). Implementing national food security act in India: issues and challenges. *British Food Journal*, P:133.

52. Elzaki, R. (2022). Challenges of the Food Security in the Gulf Cooperation Council Countries: An Empirical Analysis of Fixed and Random effects, P:22

53. Alharthi, M. (2019). Determinants of Economic Development: A Case of Gulf Cooperation Council (GCC) Countries. *International Journal of Economics and Finance*, 11(11), P:12.

54. World Bank, (2020). International migrant stock (% of the population).

55. National intelligence council report, (2013). natural resources in 2020, 2030, and 2040: Implications for the United States, p.2.

This complex relationship calls for increased attention to promptly identifying and addressing food insecurity to help prevent unsustainable resource use.^[56] Therefore, monitoring food security as communities adjust to new circumstances is particularly crucial in the context of climate change and economic crises. To understand how natural resource management affects people's access to food and to direct action, reliable and timely food security measurement is essential.^[57]

A study emphasized that sustainable agricultural productivity growth is vital for food security growth. This is because increasing agrarian production leads to higher revenues, improving people's ability to buy other essentials and increasing food supplies and consumer prices. This can be especially important for the many people who depend on agriculture for their livelihoods and experience food insecurity.^[58] Variations in the number of resources used in agricultural production, such as labour, land, and fertilizers, can be blamed for changes in agricultural output throughout time. In addition, the quality of the resources, particularly natural resources like land, significantly impacts agrarian production.^[59]

According to another study, land is one of the essential resources used in agricultural production, which encompasses the soil, climate, and other qualities. Natural resources provide essential ecosystem services, often known as ecosystem services, in the form of public and consumptive functions. Climate cycles, nutrient recycling, soil production, and other ecological processes are all supported by environmental processes. Agriculture, unquestionably the fundamental component of peoples' livelihoods, continues to be based on soils. Land and other resources interact with food security through production, consumption, and other processes. Better access to food thus enables improved investment in improving and protecting resources that help create future food security.^[60]

According to a study, one-third of the food produced globally is lost or wasted. Food losses and waste also influence other natural resources, which are limited. The per capita usage of resources for food losses is highest in North Africa and West-Central Asia. Three essential related resources are freshwater, cropland, and fertilizers. Water

56. IFAD, 2014.

57. Food and Agriculture Organization of the United Nations (2014). *Managing Systems at Risk*, p. 30.

58. Mark et al., (2013). *Food Security in a World of Growing Natural Resource Scarcity: The Role of Agricultural Technologies*.

59. Eric et al., (2015). *The World Bank Group's 15-2013 Agriculture for Action Plan: A Lesson in Privatization, Lack of Oversight and Tired Development Paradigms*. Development Report No 22.

60. Wiebe, K. (2001). *Natural resources, agricultural productivity, and food security*. Issues in food security. Economic Research Services United States Department of Agriculture. Agriculture information bulletin 3)765)

is scarce in many regions, and water scarcity is one of the most pressing challenges faced by human populations.⁽⁶¹⁾ The study found that around one-quarter of the produced food supply is lost within the food supply chain (FSC). These lost and wasted food crops represent 24% of the freshwater resources utilized in food crop production, 23% of the total global farmland area, and 23% of actual international fertilizer use.

The analysis concluded that implementing the present minimum loss and waste percentages in each FSC phase might save nearly half of the food supply losses and the accompanying resources necessary to create them. If FSC losses could be cut in half, an additional one billion people could be fed with appropriate food supplies, and essential resources could be protected.⁽⁶²⁾ Reducing food losses and waste is an important step towards increased food security and resource use efficiency in food production. Hence, reducing food losses and waste is considered one of the most promising measures to improve food security in the coming decades.

In Africa, natural resources are crucial for nutrition and food security, as about 75% of protein consumption is derived from plant sources. In addition, fisheries, bush meat, and livestock grazed in the wild provide animal protein. For example, fish makes up 60 % of the total animal protein consumed annually in hyper-arid Mali. In Central Africa and West Africa, Bush meat (wild animals and birds) is a significant source of animal protein, making up more than 80% of consumption in some areas. Furthermore, during times of stress, such as drought, illness, and economic turmoil, food collected from the wild plays a vital role. This suggests that proper management and usage of natural resources offer food and other services, contributing to rural communities' food security and livelihood improvement.⁽⁶³⁾

In the context of GCC countries, the physical scarcity of land and water resources in the countries of GCC is largely compensated through high-energy reserves and economic abundance. However, with yearly rainfall in most parts of the GCC region rarely topping 100 mm, water resources are scarce and increasingly overexploited. Even though the GCC countries do not have sizeable agricultural potential, agricultural water usage is one of the primary causes of the overuse and depletion of water resources. Arable land is scarce, accounting for just 4.3% of the GCC region. Nonetheless, the share of water used for irrigation and livestock in the region is like the global average of 70%. It is considerably more significant in some countries, such as Saudi Arabia, the UAE,

61. M. Kummu et al., (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use, *Science of The Total Environment*, Volume 438, Pages 489-477, p.478.

62. Ibid, p.488.

63. UNEP et al., (2009). "Biodiversity in Africa "In: *Encyclopedia of Earth*. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science, and the Environment).

and Oman. At the same time, agriculture's contribution to total economic added value or GDP is low, averaging around 0.8%.^[64]

Indeed, the main issue regarding agriculture in the GCC is water. Food and water are inextricably linked. Therefore, water security is often framed as a component or subset of food security. Water is a scarce resource in the GCC due to the hot weather, sparse rainfall, and high evaporation rates (more than 3,000 mm/year). Furthermore, there is no surface water. The GCC region has the world's worst water resources, both in absolute and per capita terms, due to the region's arid environment and rapid population expansion. With regards to rainfall, in 2014, all the GCC countries were listed among the 15 countries receiving the least amount of rain globally. As a result, the GCC has one of the lowest per capita freshwater availability rates in the world, with an estimated 82.6 m³ in 2017 compared to a global average of almost 6,500 m³. All GCC countries are regarded to be under absolute water scarcity, defined as fewer than 500 m³ of renewable water resources per capita per year.^[65]

The physical scarcity of water and land resources contrasts with high fossil fuel reserves. GCC countries possess over 40% of global proven oil reserves and 20% of international natural gas reserves. Except for the State of Qatar, most gas reserves are consumed domestically, even though much of the oil is exported, resulting in substantial state earnings. The region's average energy use far outstrips the global average. Water production consumes a large portion of the countries' energy. Conservative estimates of electricity usage for desalination in the GCC countries range from 4 to 12% of total electricity generation, with higher estimates reaching more than 20% in the UAE and 13% in Qatar, 7% in Saudi Arabia, or around 8% in Kuwait and Bahrain. Furthermore, energy is used for surface and groundwater withdrawals. On the other hand, water is used to extract fossil fuels and produce hydropower and excellent power plants.^[66]

However, in the MENA region, water use for the last two energy production systems is relatively low. Regarding water use in producing fossil fuels, certain countries in the region use valuable desalinated water in the extraction process and mineral production. The GCC's energy and water production systems are highly linked. They also effectively provide their people with universal access to water and power. The

64. Al-Saidi, M., & Saliba, S. (2019). Water, Energy and Food Supply Security in the Gulf Cooperation Council (GCC) Countries—A Risk Perspective. *Water*, 455 (3)11.

65. Ben Hassen, T., & El Bilali, H. (2019). Food Security in the Gulf Cooperation Council Countries: Challenges and Prospects. *Journal of Food Security*, 7(5):159-169. P.162.

66. Al-Saidi, M., & Saliba, S. (2019). Water, Energy and Food Supply Security in the Gulf Cooperation Council (GCC) Countries—A Risk Perspective. *Water*, 11(3), 455.

crucial infrastructure for achieving energy and water security consists of desalination plants, power plants, electrical grids, and water and energy distribution networks. In addition, infrastructure projects such as solar power plants and wind farms are being implemented more frequently to boost renewable energy resources.

Last, according to a World Bank report, the state of the world's natural resource base significantly depends on whether poverty has been eradicated. Poverty and environmental degradation are intricately linked, often in a self-perpetuating negative spiral in which poverty hastens environmental deterioration and degradation causes or worsens poverty —the so-called poverty trap. Poverty remains a significant, persistent challenge in the evolving world. Based on this, reversing the trend of resource depletion in developing countries necessitates focusing on poverty eradication.⁶⁷⁾

67. World Bank (2012). Linking Gender, Environment, and Poverty for Sustainable Development: A Synthesis Report on Ethiopia and Ghana. *Social Development Department Sustainable Development Network. Report no. P125713.*

DEFINING THE FACTORS

After determining the factors of food insecurity, we head to define the dependent factors and independent factors affecting it; we start with the dependant and then proceed to define the independents as follows:

FOOD SECURITY

Food security was defined at the World food summit in 1996: “Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences and enables them to live an active and healthy life.” The widely accepted definition reinforces the multidimensional nature of food security and includes food access, availability, use, and stability.

- First, food availability is defined as the availability of sufficient quantities of food of appropriate quality supplied through domestic production or imports (including food aid).
- Second, food access refers to the entry by individuals to adequate resources to acquire the right foods for a nutritious diet.
- Third, food utilization—using food through a good diet, clean water, sanitation, and healthcare to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security.
- Fourth, food stability means that a population, household, or individual must always have adequate food security. They should not risk losing access to food due to sudden shocks or cyclical events. The concept of stability refers to food availability and access to food.

CLIMATE CHANGE

Many international organizations working in the field of the environment relied on temperature change as a final criterion for defining climate change and even defined climate change as a change in temperature, for example:

United Nations Framework Convention on Climate Change (UNCCC) has described climate change as any change attributed directly or indirectly to human activity that alters the composition of the global atmosphere and is in addition to natural climate variability observed over comparable periods.⁽⁶⁸⁾ NASA emphasized the same meaning when it defined climate change as a long-term change in the average weather patterns that determine Earth's local, regional, and global climates.

United Nations itself referred to climate change as long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. Nevertheless, since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil, and gas.⁽⁶⁹⁾

OVERPOPULATION

Overpopulation is determined by two factors: the number of people and the availability of natural resources; therefore, the population is not an issue if it has access to adequate natural resources.

The Organization for Economic Co-Operation and Development (OECD) emphasized the same meaning when referred to as exceeding certain threshold limits of population density when environmental resources fail to meet the requirements of individual organisms regarding shelter and nutrition. As a result, it gives rise to high mortality and morbidity rates.⁽⁷⁰⁾ The University of Cambridge went in the same direction when it defined it as having too many people for available food, materials, and space.⁽⁷¹⁾

CONFLICT

Conflict can be defined as a threat, or perceived threat, to an individual's interests, values, or needs. In politics, this plays out in a range of ways; in some cases, parties will agree on goals but disagree on how to achieve them, and in other cases, parties will disagree on goals, and lastly, sometimes parties will not agree on the facts to the dispute obscuring any potential for problem-solving.⁽⁷²⁾

68. United Nations Framework Convention on Climate Change. (2022). For the purposes of this Convention.

69. United Nations. (2022). What Is Climate Change?

70. Organization for Economic Co-operation and Development, (2022). Overpopulation.

71. University of Cambridge, (2022). Overpopulation.

72. Marshall, G. (2022). Political Conflict, Measurement of.

NATURAL RESOURCES

Natural resources can be defined as any biological, mineral, or aesthetic asset afforded by nature without human intervention that can be used for some benefit, whether material (economic) or immaterial. What is considered a “resource” (or, for that matter, “natural”) has varied over time and from one society to another. Examples of assets that can be considered natural resources include forests, surface water, and groundwater, and the fertile lands or the soil and minerals within them (rather than the crops that grow on them), as well as energy resources (such as petroleum, natural gas, and heated water [that is, geothermal energy], contained within layers of rock.^[73] Further, the world bank defines it as the total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.^[74]

INFLATION

The European Central Bank defines inflation: “In a market economy, prices for goods and services can always change. Some prices rise; some prices fall. Inflation occurs when there is an overall increase in the prices of goods and services, not just of individual items; it means one can buy less for 1 today than one could yesterday. In other words, inflation reduces the currency’s value over time.”^[75]

The International Monetary Fund used an example to describe inflation by saying that consumers’ cost of living depends on the prices of many goods and services and the share of each in the household budget. To measure the average consumer’s cost of living, government agencies conduct household surveys to identify a basket of commonly purchased items and track the cost of buying this basket over time. (Housing expenses, including rent and mortgages, constitute the most significant component of the consumer basket in the United States.) The cost of this basket at a given time expressed relative to a base year is the consumer price index (CPI), and the percentage change in the CPI over a certain period is consumer price inflation, the most widely used measure of inflation. (For example, if the base year CPI is 100 and the current CPI is 110, inflation is 10% over the period).^[76]

73. Britannica, (2022). Natural resource: Additional Information.

74. World Bank, (2022). Metadata Glossary.

75. European Central Bank, (2022). What is inflation?

76. International Monetary Fund, (2022). Inflation: Prices on the rise.

ANALYSIS

After defining the independent variables, we will analyze each factor separately as follows:

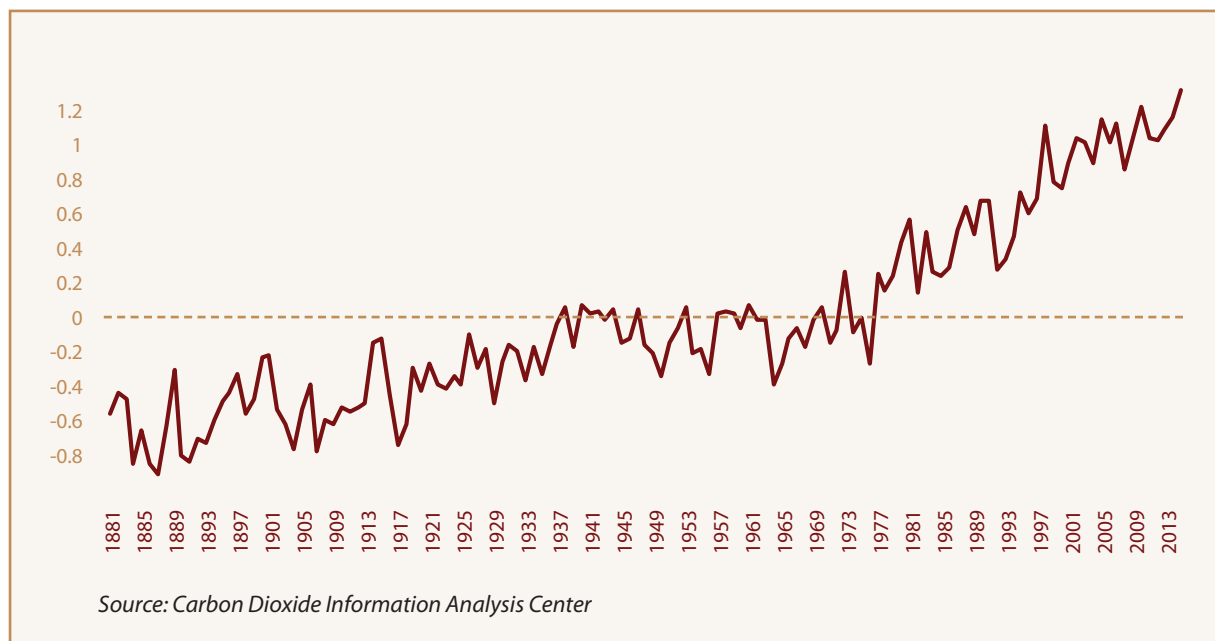
CLIMATE CHANGE

There are many indicators to measure climate change, including the level of CO₂ emissions, the rate of sea level rise, and average temperatures during the year. However, to quantitatively measure the impact of climate change, we preferred to use an average of maximum temperatures in the four countries under study due to its availability over a long period.

Climate change is a long-term shift in the weather patterns that characterize the Earth's local, regional, and global climates. These alterations have a wide variety of implications synonymous with the term.

Since the middle of the 20th century, changes in Earth's climate have been driven by human activity, notably the burning of fossil fuels, which increases the amounts of heat-trapping greenhouse gases in Earth's atmosphere, increasing the average surface temperature of the planet. The following graph illustrates the constant rise in temperature over the last many decades:

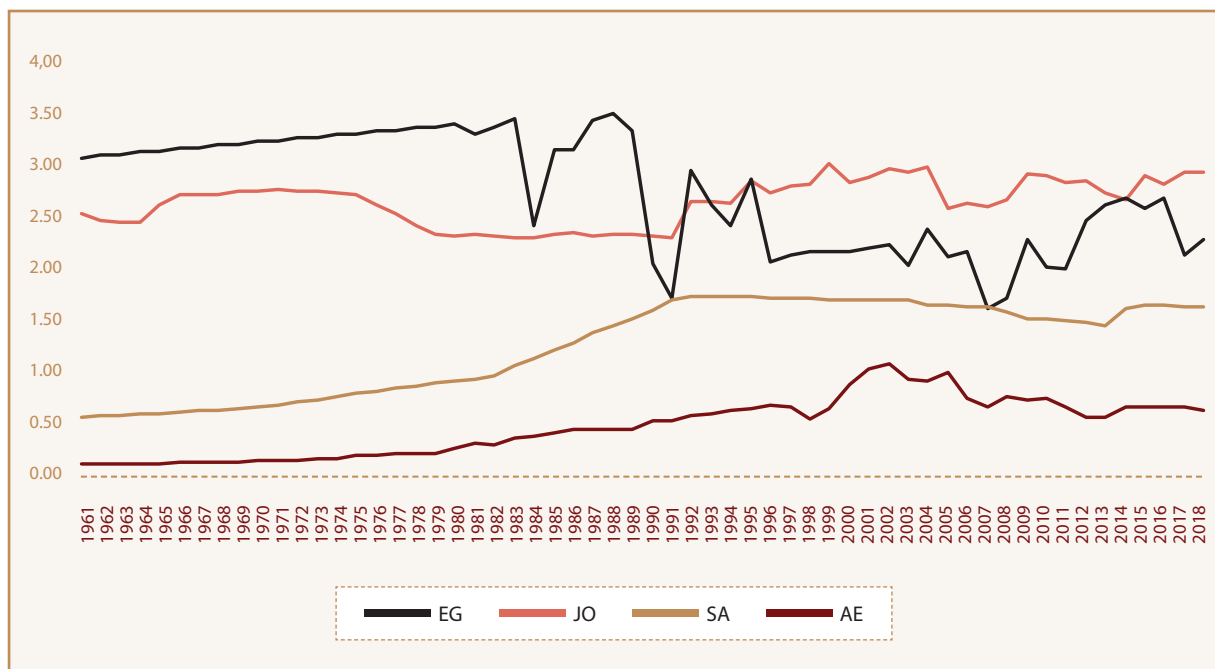
Figure 2 - Global Temperature Anomalies



The figure shows the trend of temperature rise through the last two decades and the rapid pace of the rising since the fifties of the twentieth century, and there is an approximately two degrees rise in almost two decades. Temperature ultimately affects all living creatures and all patterns of human economic activity.

The same situation applies to the regional context, where temperatures in the Middle East and North Africa tend to rise continuously, which inevitably affects food security. A plant is a living creature whose growth is affected by the temperature of its environment. Temperature fluctuations also affect the soil and the air; this is reflected in plant growth, which is one of the primary sources of nourishment. The graph below depicts the temperature trend in the four nations studied for elevation.

Figure 3 - Temperature Trend in the Four Studied Countries



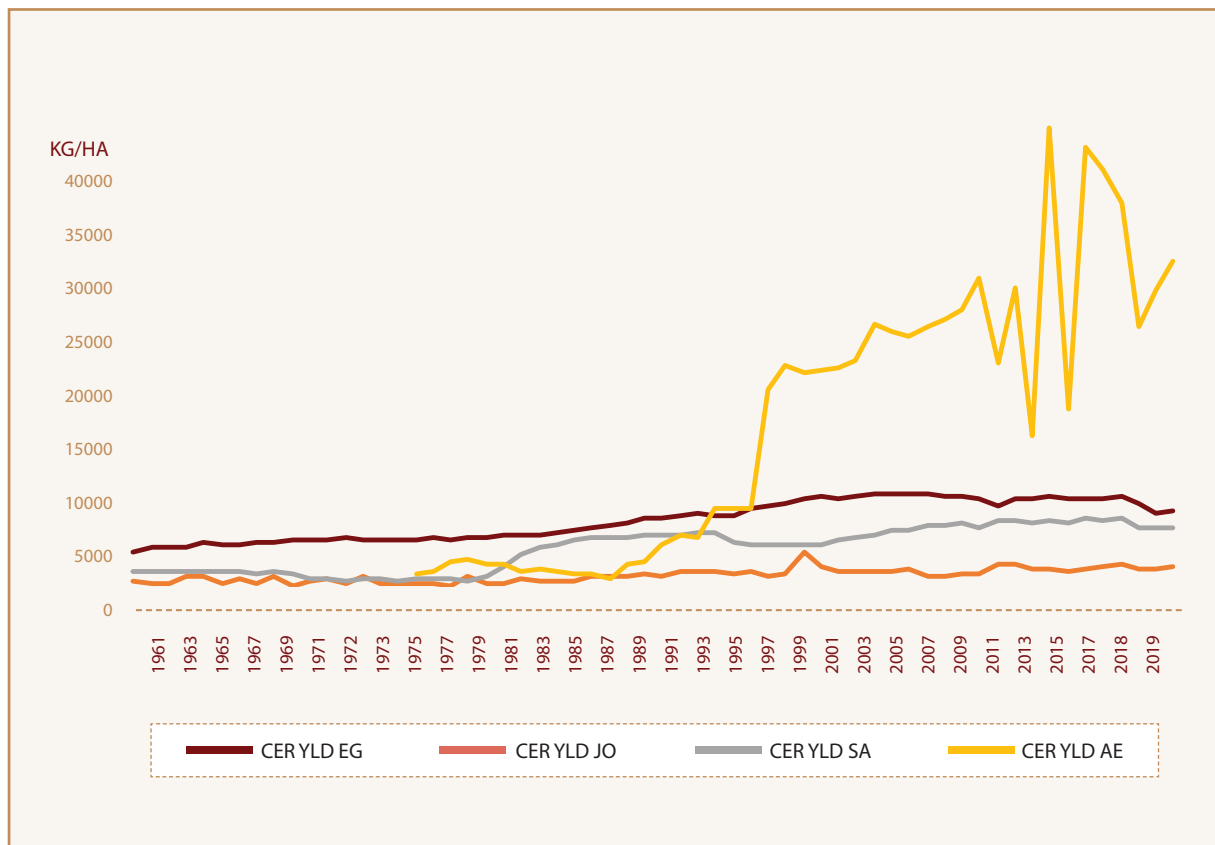
The figure shows the general elevation trend in the four countries, where the lowest temperature in the United Arab Emirates was recorded at 32.8 degrees Celsius. In comparison, the highest was 35.17 degrees Celsius as the highest country among the four, followed by Saudi Arabia, which recorded the lowest temperature at 31.4 the highest—at 33.9, followed by Egypt, which has a minimum temperature of 28.9 and a maximum of 31.8. Finally comes Jordan, with a minimum temperature of 24.7 and a maximum of 28.6 during the years under study.

In addition to the elevation trend, the four countries share a minimum-to-maximum temperature difference of more than two degrees, which is also above the global average, as previously indicated.

To measure food security quantitatively, we selected the productivity index per hectare of agricultural land. This semi-neutral indicator measures the productivity of the land regardless of horizontal expansions that may affect other indicators, such as the total productivity of the country, or price changes that may affect other indicators, including the country’s food exports.

Although the usage of agricultural fertilizers may affect the productivity of the land, climatic conditions continue to have the most significant impact on productivity, as temperature affects the plant itself in addition to accessible water quantities, soil quality, and air humidity. Finally, to attain more certainty, we used two data series for two different crops, grains, and vegetables, to reduce the error margin to an acceptable degree when measuring. The following graphs show the productivity of the four countries of the crops:

Figure 4 - Hectare Production by Kilogram of Cereals in the Four Countries

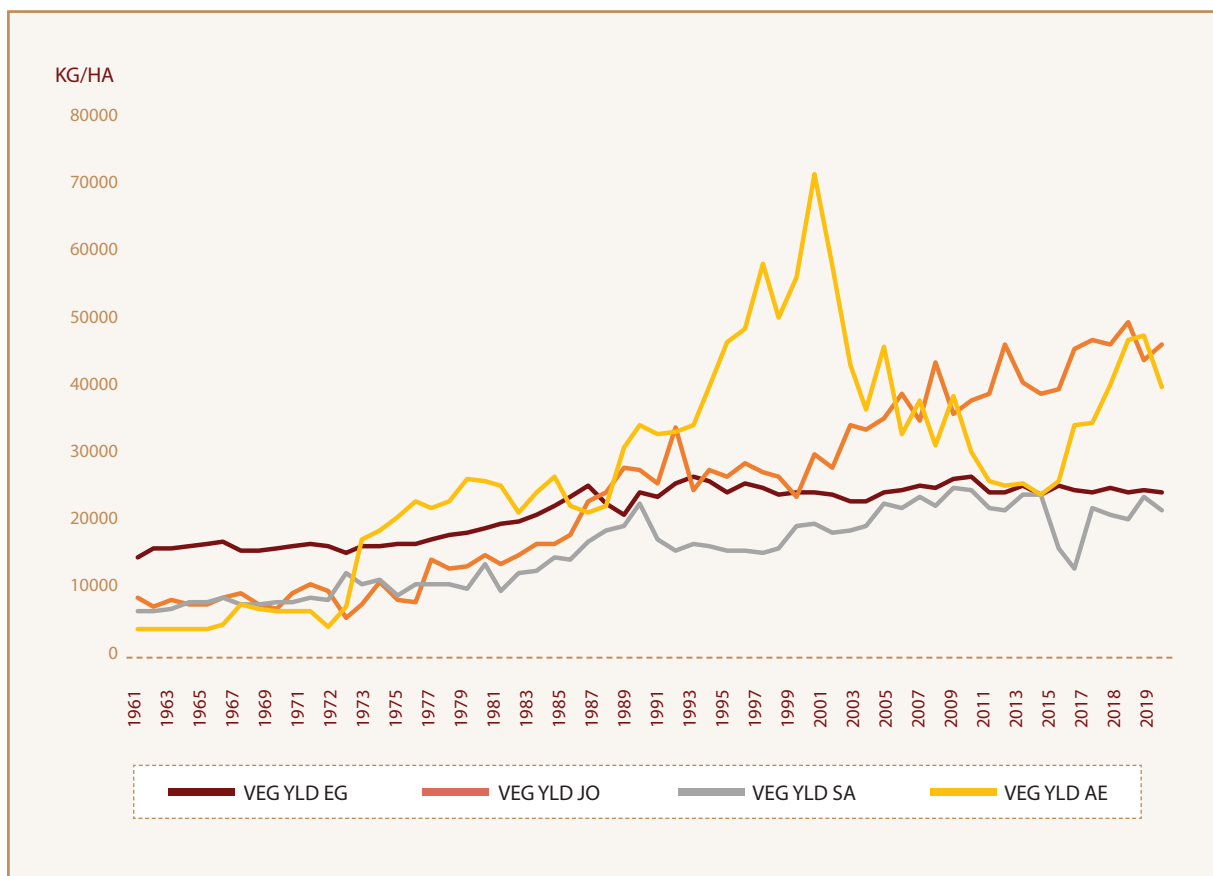


Given the high temperatures in the four nations, the graph depicts the dominating rise in cereal output per hectare, indicating a positive correlation between productivity and temperature. However, it is also noted that there are significant differences between the productivity of a hectare in the United Arab Emirates and that of the other three countries, where the average yield during the study period reached 13.2 tonnes per hectare, compared to Egypt, which is the country closest to the UAE in terms of productivity at 5.4 tonnes per hectare.

Interestingly, the productivity per hectare in the four nations decreased between 2017:2020, from 7.4 tonnes to 6.1 tonnes in Egypt, from 2.03 tonnes to 1.7 tonnes in Jordan, and from 5.6 tonnes to 4.4 tonnes in Saudi Arabia, and then from 30.7 tonnes to 26 tonnes in the UAE.

In terms of the general pattern of increase, the recent drop in productivity, and the rise in hectare productivity in the United Arab Emirates, the same trends can be noticed in the study of vegetable crops in the four nations, as indicated in the graph below:

Figure 5 - Hectare Production by Kilogram of Vegetables in the Four Countries



It is worth noting that the yield of one acre of vegetables in the four countries is twice that of grain, as shown in the following table:

Table 2 – Production Mean of Cereals and Vegetables Through the Study Period in Four Countries

	Egypt	Jordan	KSA	UAE
Cereals	5471.8	1068.4	3197.7	13283.7
Vegetables	21818.5	24608.5	15950.2	28018.2
Ratio	398%	230%	498%	210%

The previous graphic analysis is reinforced by the statistical analysis of the impact of climate changes represented by temperature as an independent variable on the productivity per hectare of grains and vegetables as a dependent variable during the period between 1961 and 2020, the results of which are shown in the following table:

Table 3 – Regression Analysis of Climate Change over Yield

	Egypt		Jordan		KSA		UAE	
	Cereals	Vegetables	Cereals	Vegetables	Cereals	Vegetables	Cereals	Vegetables
Coefficient	7	9	1	10	6.2	15.8	18.1	19.4
R Square	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.2
Significance	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0

It is clear from the table that the coefficient is positive for all indicators, which means that there is a positive relationship throughout the period between the increase in temperature and the productivity of hectares.

It also turned out that productivity per hectare in Egypt increased by 7 kg of grains and 9 kg of vegetables. In contrast, productivity increased by 1 kg of grains and 10 kg of vegetables in Jordan. Saudi Arabia touched 6.2 kg of grains and 15.7 kg of vegetables, while the UAE reached 18 kg of grains and 19.4 kg of vegetables for every 0.1-degree Celsius increase.

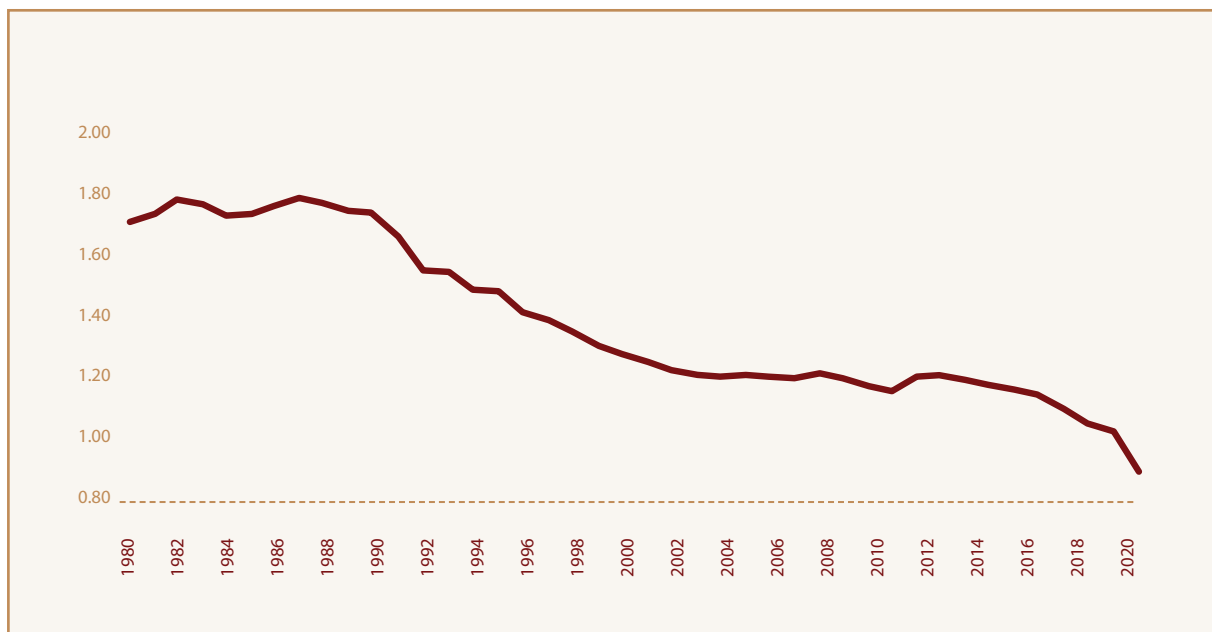


On the other hand, R Square showed a high contribution of climate change to the productivity of a hectare of agricultural land, reaching 46% for grains and 34% for vegetables in Egypt, while 35% of grains and 44% of vegetables in Jordan, as well as 44% of grains and 43% of vegetables. Vegetables in Saudi Arabia, and finally, 42% of grains and 18% of vegetables.

OVERPOPULATION

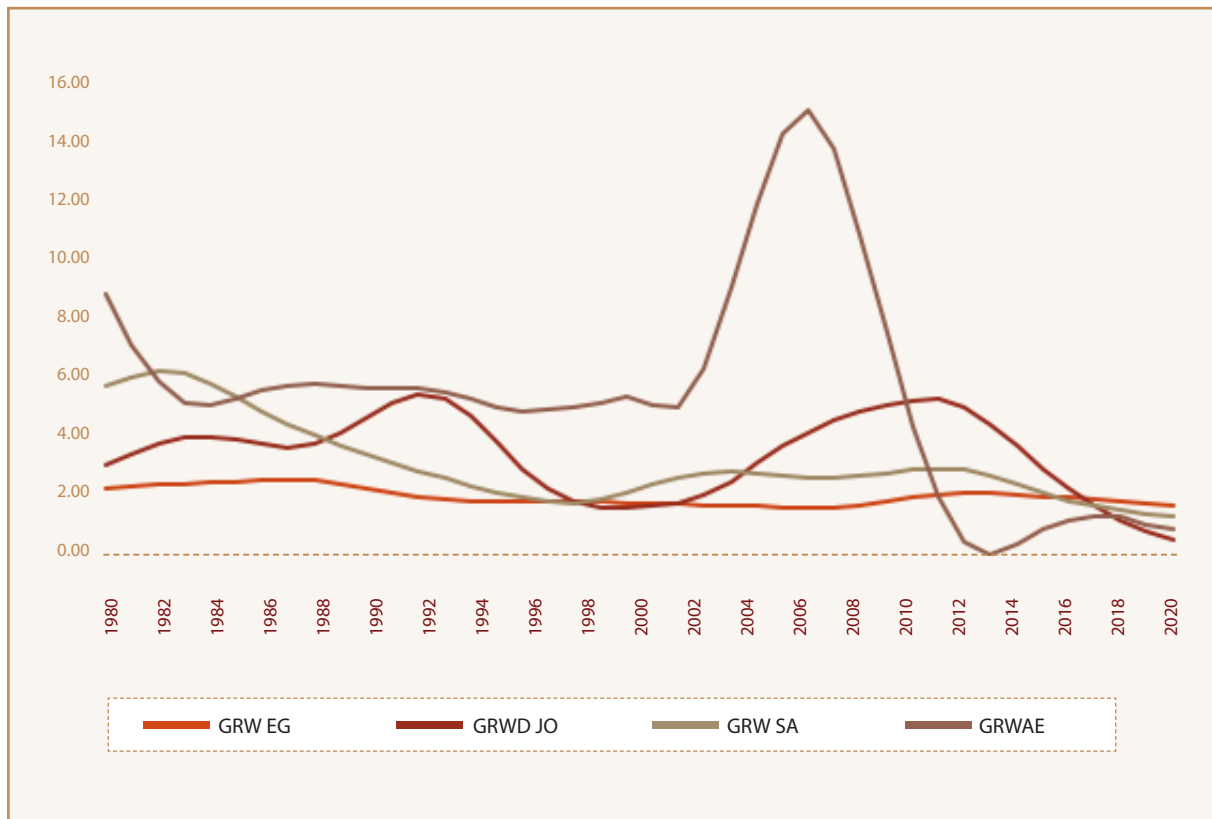
Due to the lack of data before 1981, we used the two indicators of the population growth rate in the four countries as an independent variable to determine the impact of overpopulation on food security, while we used the proportion of undernourished in the population as a dependent variable to assess the effect of the population growth rate on the food security in the four countries, the following graph shows the world population growth rate in the period as mentioned earlier:

Figure 6 - Growth Rate of the World Population



The graph indicated the steady fall of population growth rates from 1.8 percent in 1980 to less than 1% in 2021. Despite this, the world's population continued to rise until November 2022, when it reached 8 billion, up from 4.4 billion in 1980, indicating that the world's population nearly doubled throughout the research period. The four countries of the study have the same trend as the following graph illustrates:

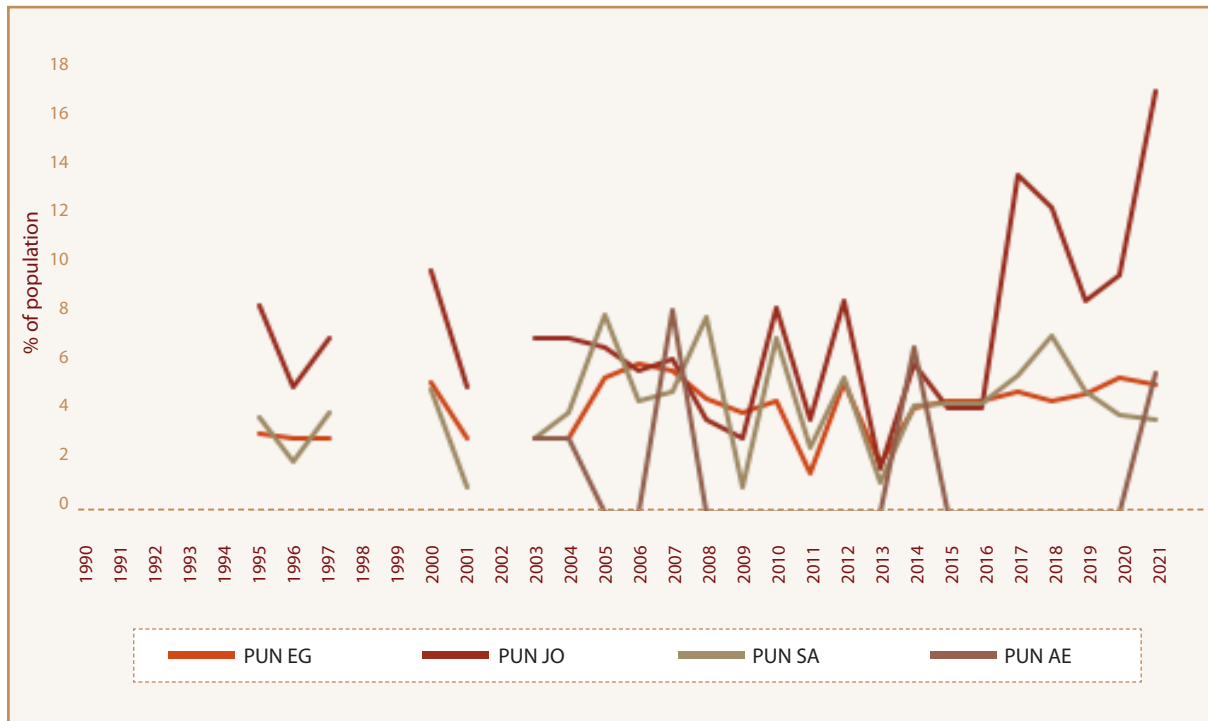
Figure 7 - Growth Rate of the Four Countries of the Study



Despite the general trend of diminishing population growth rates in the four countries, it is evident from the graph that their rates are about double the global average. The average growth rate over the study period reveals that it reaches 1.4% globally, 2.1% in Egypt, 3.5% in Jordan, 3.2% in Saudi Arabia, and 5.6% in the UAE.

This indicates that the burden of the population in the countries under study is at least twice that of the rest of the world, and this burden increases in light of what we mentioned previously about the trend of declining production rates of crops; consequently, it is anticipated that this will be reflected in the inadequacy of food to the population, thereby increasing the proportion of the population who receive less than their food sufficiency, which is precisely demonstrated in the following graph:

Figure 8 - Proportion of Undernourishment in the Population

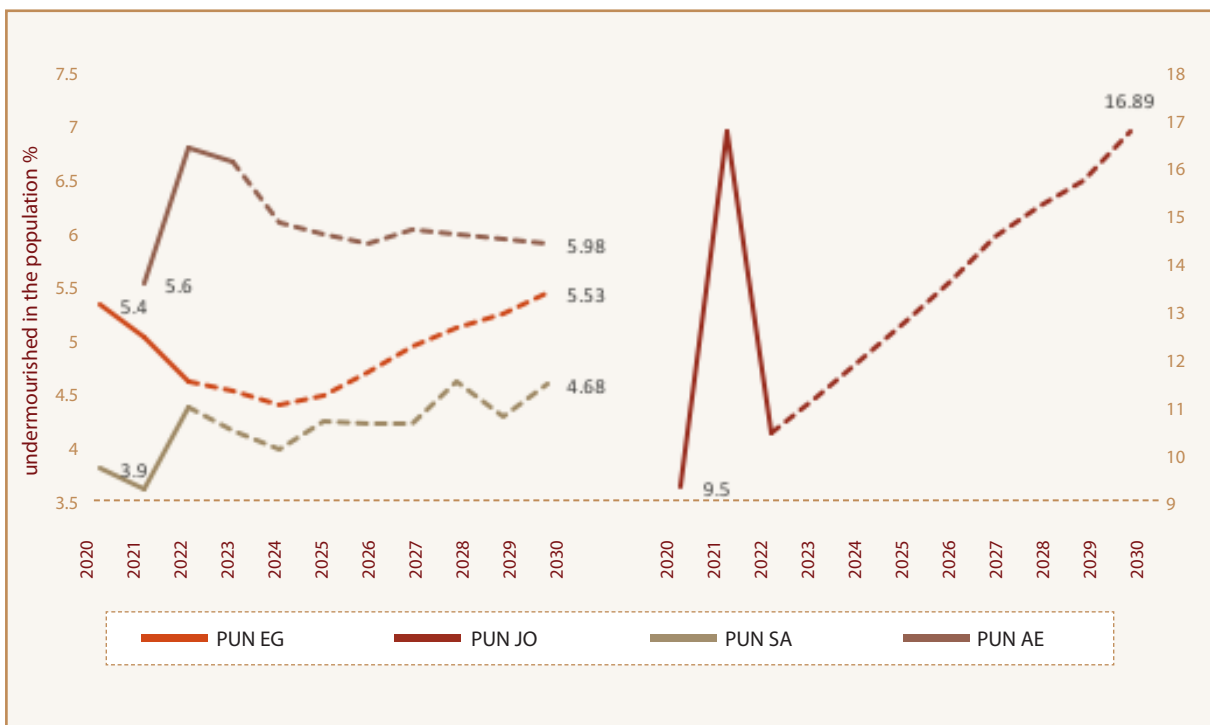


The figure shows the tendency of the undernourished population to rise, despite the favourable economic growth rates achieved by the four countries during the period under study, which led to an increase in per capita levels of GDP in the four countries, except the United Arab Emirates, which witnessed a decrease due to the total population jumps that occurred during the same period as the per capita GDP decreased to the levels of 36.2 thousand dollars in 2021 from the levels of 42.7 thousand dollars in 1980, which is the opposite of the prevailing trend in the other three countries, where the per capita GDP in Egypt increased to 3.8 One thousands of only 500 dollars in 1980, and in Jordan from the levels of 4.4 thousand dollars after it was at 1.6 thousand.

Except for Egypt, the population suffering from malnutrition increased in three of the four nations, from 6% to 16.9% in Jordan, from 3% to 3.7% in Saudi Arabia, and from 1% in 1980 to 5.6% in 2021 in the UAE. These increases are explained by the rise in the number of expatriate workers in the three countries, who suffer from the high cost of living to income, in addition to the slowdown in economic growth rates relative to the population growth in Jordan.

What is of great concern is the tendency of the percentage of the population suffering from undernourishment to increase, according to our estimates, especially in the medium term, before the percentage declines again by 2030 in the four countries, apart from Egypt, which will witness a continuous rise in the medium and long term, the following graph shows the future estimates:

Figure 9 - Estimations of the Percentage of Undernourishment in the Population in the Four Countries

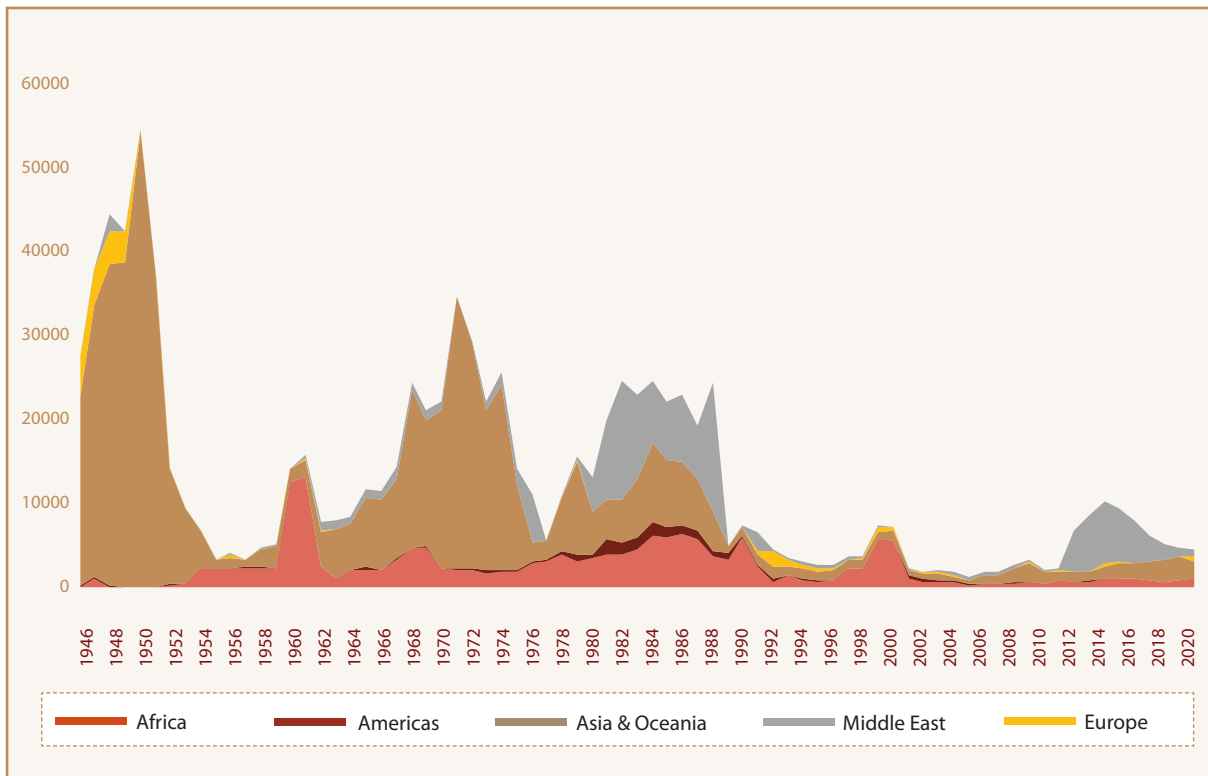


Due to the cultural and religious beliefs of the population in the four countries, controlling population growth rates becomes a strategic challenge. Furthermore, if the UAE and Saudi Arabia intervene to reduce the population by lowering expatriate employment will have an impact on the economic performance of the two nations. In the case of Egypt and Jordan, the financial framework of the two countries and the state’s expenditure patterns serve as a driving force for increased reproduction.

CONFLICT

To quantify the impact of conflict on food security, we selected two variables: the number of disputes and the number of matches victims, along with data from 1946. In the case of statistical analysis, we will adhere to the research period to produce a quantitative assessment of the impact; hence, despite the significance of the Russian-Ukraine War, its effects will not be included in this analysis. Nevertheless, we shall examine the impact of this conflict when evaluating situations and developing solutions. The graph below depicts the evolution of combat victims from 1946 to 2020.

Figure 10 - Number of Conflict Victims by Continent



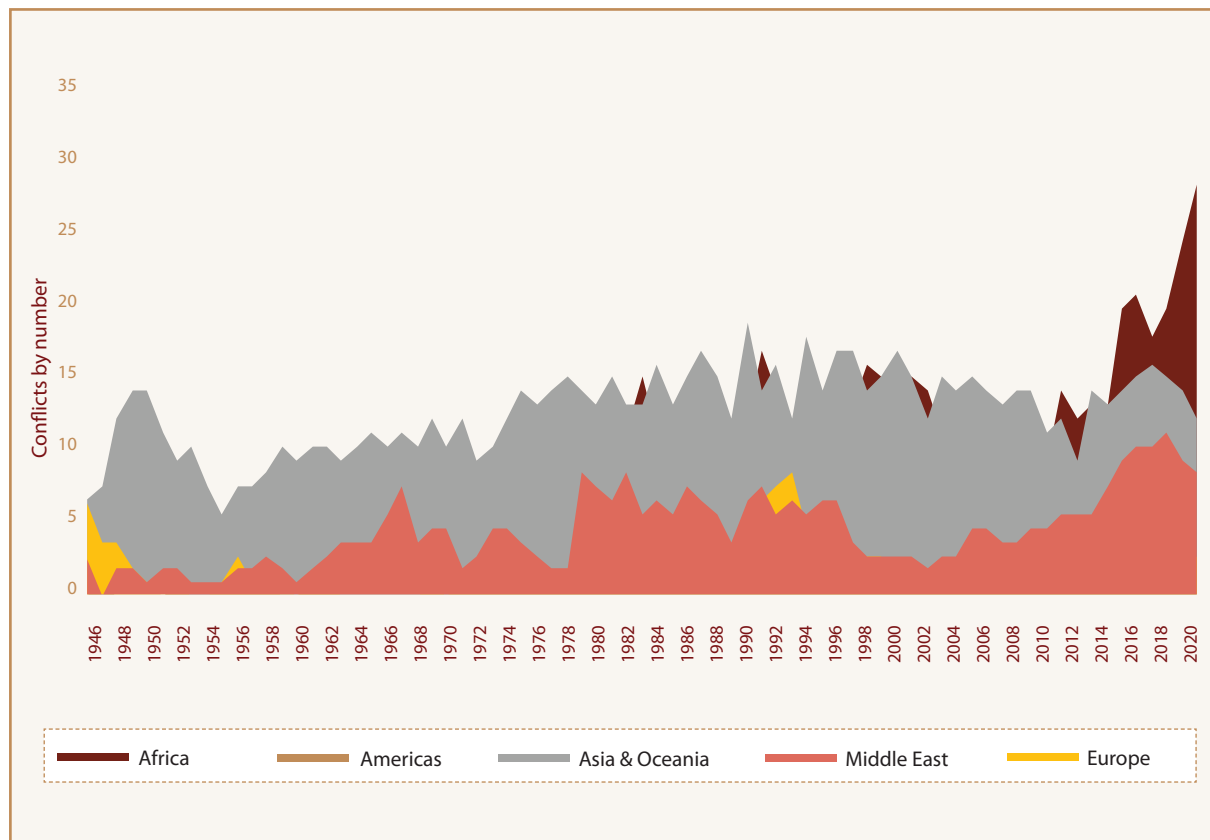
Since the 50s of the previous centuries, the number of victims has decreased due to the end of World War II and the world's tendency toward peace. However, the numbers rose again in the 1970s due to ongoing wars in the Middle East between Iraq and Iran and the Lebanese civil war before decreasing again. To fall by the end of the nineties and then surge with the Arab Spring and conflicts in Syria, Yemen, and Iraq.

Asia has had the most human casualties since 1946, with 6.3 million people killed, followed by Africa, around 1.8 million, and the Middle East, with 1.6 million. After 1990, however, the Middle East topped the list with approximately 494.5 thousand people,

Asia with 445.1 million people, and Africa with 443 thousand people. This places the Middle East at the top of the list and the centre of the effects of conflicts.

When examining the number of conflicts, however, we find a similar result for the absolute number since 1946, when the number of hostilities on the continent reached 1,013, followed by Africa with 471 conflicts, and finally, the Middle East with the equivalent of 355 matches. Since 1990, the number of disputes in Asia has reached 475. In Africa, it has reached 471, and in the Middle East, it has reached 189. However, the most significant number of victims was concentrated in the Middle East, indicating an increase in the intensity of the conflict in general, as the following graph demonstrates.

Figure 11 - Number of Conflicts by Continent



Most of the conflicts in the Middle East were civil wars or wars driven by foreign intervention, meaning that war events occur on the territory of the country and within its cities, not at its borders. This significantly impacts the food production and transportation infrastructure, including agricultural land, transportation networks, markets, and where it is manufactured and prepared for consumption.



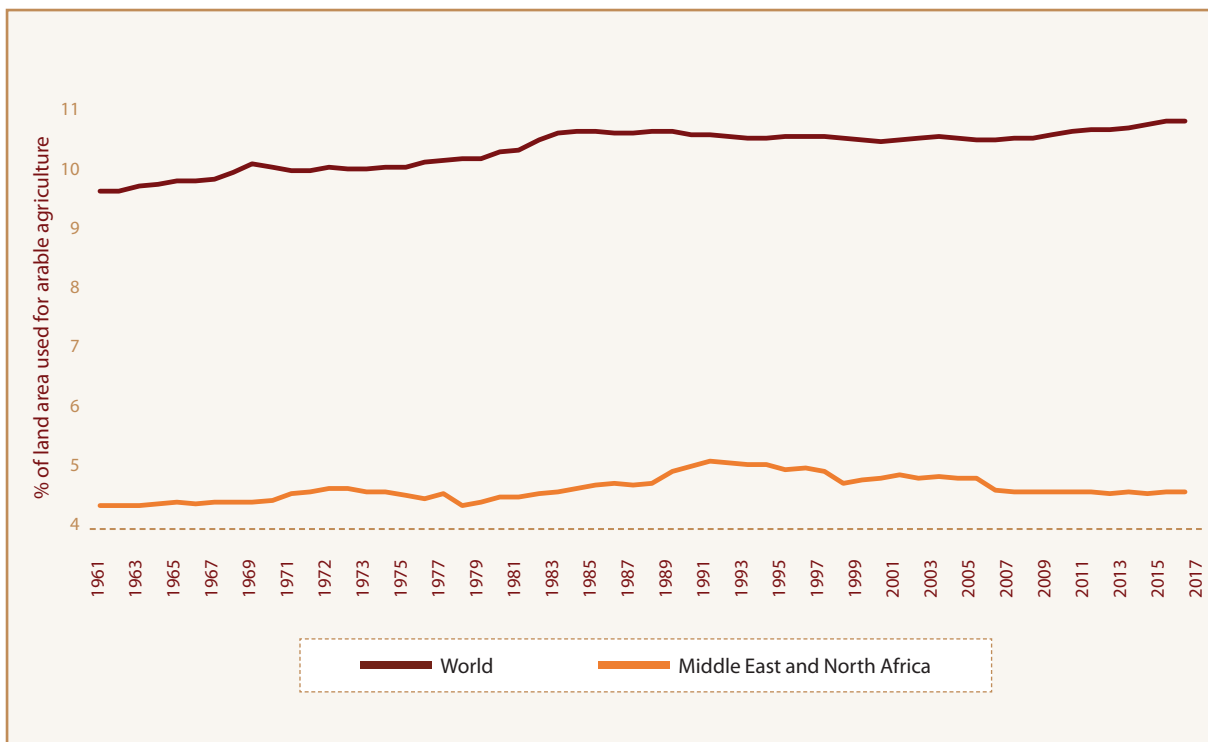
The conflicts occurring in Asia and Africa have an impact on food security in the Middle East, which imports a significant portion of its food from both, or the food received is transported through sea lanes, such as the Suez Canal, the Bab al-Mandab Strait, and the South China Sea, which have witnessed armed conflict, or those who are expected to experience or have seen conflicts in the medium term.

Conflicts also necessitate increased military spending, whether to engage in them or prepare for their entry. Unfortunately, this spending frequently comes at the expense of social expenditure on health, education, and food, resulting in decreased funding available to provide food, which increases food insecurity.

NATURAL RESOURCES

So many natural resources are difficult to count, but in food security, three primary resources can be identified that have a substantial impact: agricultural land, water, and energy. In addition, it enjoys enormous resources of power, whether fossil or renewable. The following figure compares the grounds available for agriculture in the Middle East and the world:

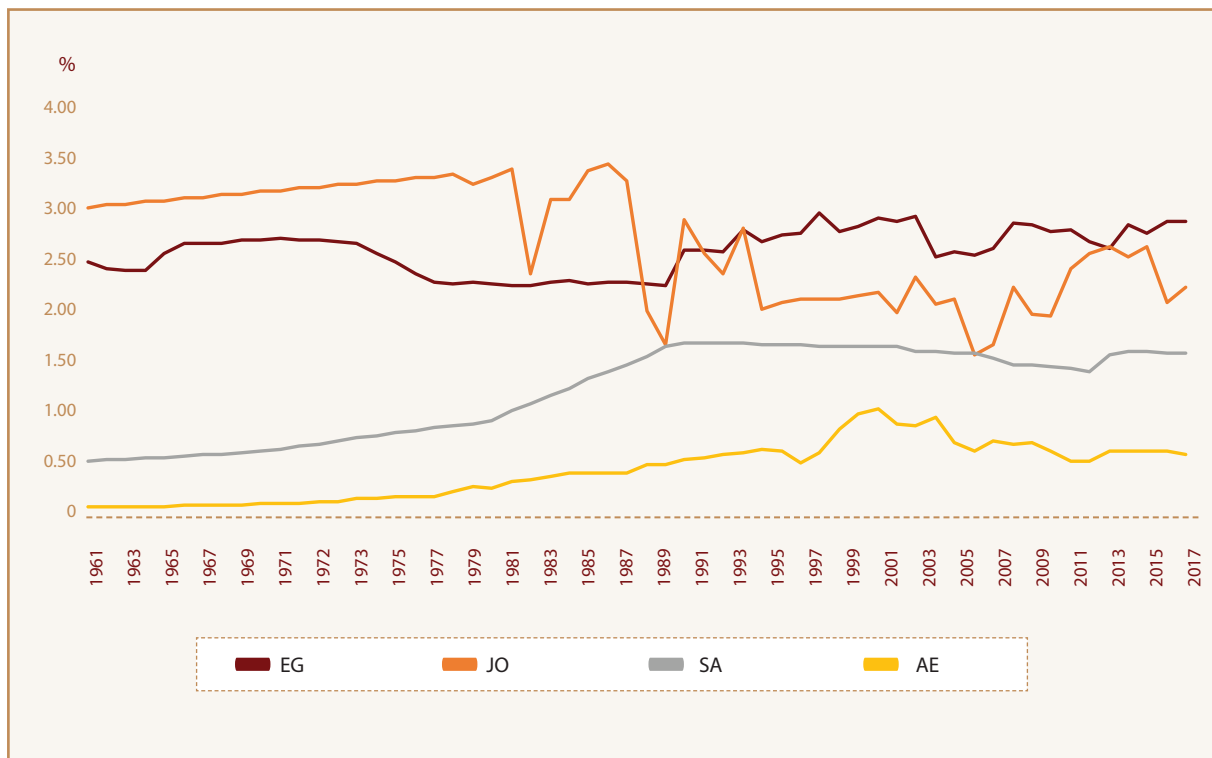
Figure 12 - Share of Land Area Used for Arable Agriculture



The figure shows that the land available for cultivation in the Middle East region is less than half of that open to the world, as it averaged during the period shown in the figure 4.6% in the Middle East, while it was 10.3% in the world, in addition to that the availability in the Middle East is declining, while in the world tends to rise. This reduction is a significant problem for the region, exacerbated by the region's overpopulation, which reduces the amount of food available to the populace and heightens the region's reliance on outside sources for food.

Compared to the Middle East area average, the proportion of cultivable land in the four countries under consideration is significantly lower. Most of them are less than two-thirds, as it stands in Jordan and Egypt at 2.6%, in Saudi Arabia at 1.2%, and in the UAE at 0.4%. This means that the rate of land available for cultivation in Saudi Arabia and the Emirates is less than a tenth of the global average, whereas, in Egypt and Jordan, it is approximately 25%. The following graph compares the situation of the four states:

Figure 13 - Share of Land Area Used for Arable Agriculture of the Four Countries



The figure illustrates the position of the cultivated area in the four countries, which appears to be almost flat on the graph since at least the nineties of the previous century, with a very slight upward trend that is difficult to distinguish, which describes the difficult situation facing the four countries under study due to population growth, high temperatures, and the dominance of conflicts in the Middle East and the two neighbouring continents.

On the other hand, the Middle East region possesses the world's largest oil and natural gas reserves, making its countries one of the vital energy exporting countries. Moreover, it controls the global energy market through the Organization of Petroleum Exporting Countries (OPEC).

Table 4 – Ten Countries with the Highest Oil Reserves

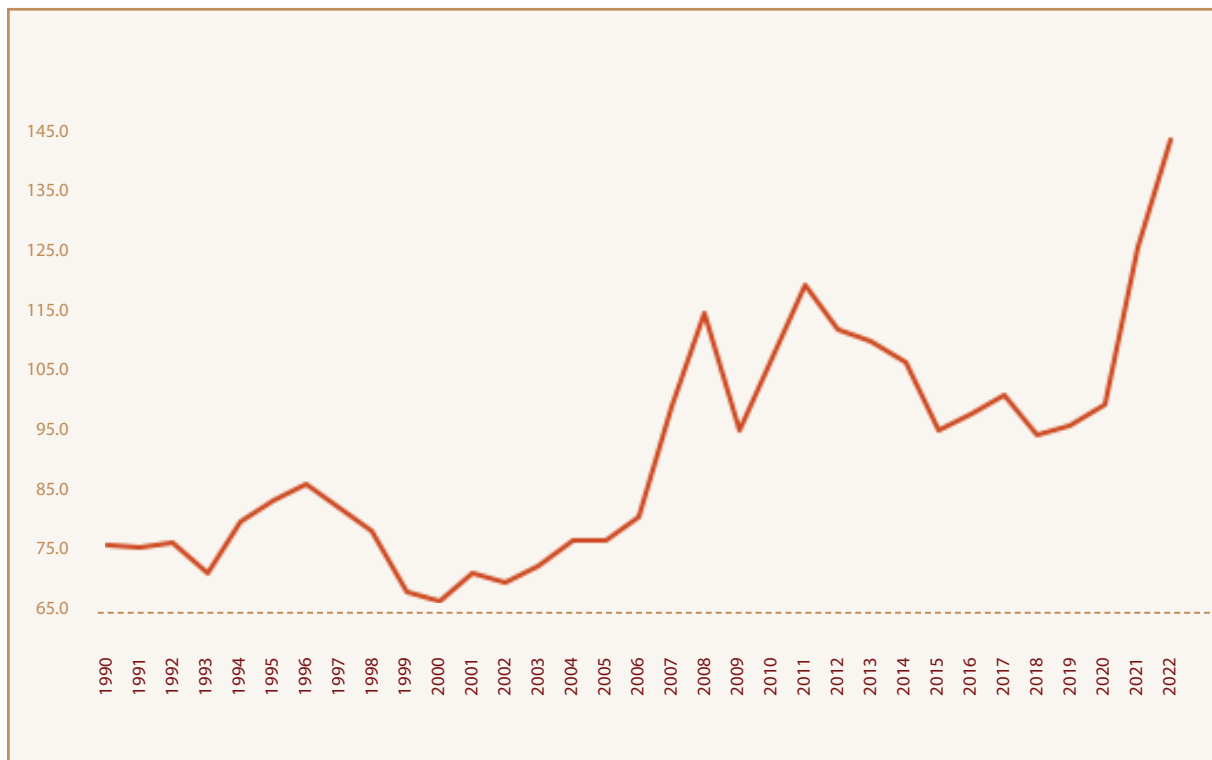
#	Country	Oil Reserves (BB)	World Share
1	Venezuela	300.0	18.20%
2	Saudi Arabia	266.6	16.20%
3	Canada	170.9	10.40%
4	Iran	157.5	9.50%
5	Iraq	143.1	8.70%
6	Kuwait	101.5	6.10%
7	United Arab Emirates	97.8	5.90%
8	Russia	80.0	4.80%
9	Libya	48.4	2.90%
10	Nigeria	37.1	2.20%

The table shows that there five of ten countries with oil reserves are Middle East countries. Likewise, in the matter of renewable energies, the Middle East region is considered among the best in the production of electric power from solar energy due to its location on the Tropic of Cancer, which receives radiation and heat from the sun with relatively greater suspicion than the rest of the world, in addition to the vast areas of the desert that dominate the region, allowing it to expand the installation of solar farms. Undoubtedly, energy's weight affects food security directly by providing water for the expansion of agriculture or providing the cash needed to import food.

INFLATION

Most of the factors mentioned earlier affect the quantities of food produced, putting pressure on its availability. With the intensification and convergence of these factors during the last twenty years, the available amounts of food in the markets began to decrease. At the same time, the demand for it increased, which led to severe waves of inflation in food prices, which is clearly illustrated by the FAO Food Price Index (FFPI), which is presented in the following figure:

Figure 14 - FAO Food Price Index



The figure shows the extent of the rise in food prices during the last twenty years, as they rose from 67.1 points to 142 points, or by about 220%. Food prices significantly affect access to it and thus the ability of a more significant number of the population to provide appropriate food, which raises levels of food insecurity.

RESULTS

We conclude the study's results as follows:

- After reviewing more than 180 studies, including scientific publications, reports, and doctoral and master's theses published between 2000 and 2022, it was determined that 43 variables affect food security.
- Five of the forty-three variables attracted the attention of 144 studies, accounting for 80% of the studies analyzed. Studies continued to focus on them without disruption from 2000 to 2022, showing their significance and influence.
- Climate change, conflict, overpopulation, natural resources, and food inflation are the five variables that substantially impact the Middle East and North Africa region. Therefore, the study sought to determine their effect on food security in the region.
- When investigating the influence of climate change reflected by a rise in temperatures on agricultural land productivity, it was discovered that the relationship is generally favourable. Still, we have recently observed the opposite trend as temperatures have reached extraordinarily high levels.
- We also observed that the region's population growth is more than double the global average, increasing the number of individuals suffering from malnutrition despite the region's countries' strong economic growth.
- We expect that the proportion of the population suffering from malnutrition will continue to rise as a general trend in the future, reaching more than 4% in the countries studied by 2030, reaching about one-fifth of the population in Jordan at more than 16%.
- In terms of conflict, it was found that despite the decline in the number of victims in the last thirty years, the number of conflicts tended to rise, and the MENA region topped the world in the number of conflicts.

- We also found that most conflicts registered in the region are either civil or civil at the behest of external countries, causing friction within the state's borders and disrupting food production, manufacture, and distribution to consumers.
- The study found that the amount of land accessible for agriculture in the region is less than half the global average.
- The region has substantial energy resources, whether fossil or renewable, that can be used to reclaim more lands through water desalination processes and highly purified agricultural investment.
- In the past 30 years, food prices have climbed by about 220%, hurting the region's rising population's access to food.

Overall, the factors mainly examined negatively affect food security except for climate change which positively affects some of the regions for the time being, and natural resources, which some of its aspects affect positively.

Additionally, the factors are interconnected since, as examined above, conflict negatively affects food security. Therefore, it could increase food prices, as in the current Russia-Ukraine War. Likewise, the adverse impacts of climate change are expected to raise food prices further and dampen the region's food demand translating into direct increases in malnutrition levels.

RECOMMENDATIONS

After illustrating the various different factors that affect food security in the analyzed countries, we will now indicate some recommendations to reduce the impact on food security. As explored at the beginning of the study, the definition of food security revealed that it has four dimensions namely accessibility, availability, utilization, and stabilization. The recommendations are divided in harmony with each dimension, which means that there are recommendations specific to each dimension as well as economic policies as follows:

ACCESSIBILITY

Improve Infrastructure

Improving and developing the infrastructure in the analyzed countries such as an expansion in roads and railways infrastructure. The governments need to invest in infrastructure and are currently working on a variety of transport and road infrastructure investments, and that should include an investment in roads between the governments analyzed in this study, allowing them to have alternative trade roads in case of political tensions or conflicts.

Investment in Renewable Energy

The world is now transiting to a green economy through the use of renewable energy in an attempt to mitigate the negative impact of climate change, especially in the MENA region that is mostly affected by climate change. Over the last few years, governments have been investing in clean energy. However, more investment should be made in renewable energy in order to allow water desalination since water scarcity is a prevalent issue in the countries analyzed.

Investment in R&D in Agriculture

To enhance agricultural production, governments need to integrate and adopt new improved agricultural technologies as well as a transfer of know-how on how to increase productivity in an effective way and how to cultivate crops through modern methods. In addition, there is also a need to carry out practices of irrigation water management to achieve high water use efficiency and increase the productivity of

existing water resources and also to produce more food with less water. Further, the R&D is necessary for cultivating the already available land through expanding in arable land, desert cultivation, vertical crop cultivation

Water Reuse

Wastewater is largely unexploited for agriculture in Arab countries, it should be used in irrigation for agriculture in Arab countries, as according to FAO report by converting wastewater to any irrigated agriculture, yields of most crops can increase by 100 to 400%, while allowing the growth of alternative crops with higher income and value.

Support Domestic Agricultural Production

Supporting producers to increase production and productivity needs to be done in a manner that improves the efficiency and resilience of farming systems. In order to support the agricultural domestic production, governments can support the agricultural domestic production by subsidizing the local products by 15 to 20%, in order to make it cheaper than imported food products. In that case, people will buy local products more, and will depend more which will decrease the amount of the imported food products and boost the domestic production.

Increasing Fish Farms

The focus should not be only on agriculture and on how to boost agricultural product, but also on other alternatives that don't require agriculture like fish farms. Indeed, the population in the analyzed countries are the biggest consumers of fish and fish products among the MENA region, which increases the demand for seafood. Hence, increasing fish farms would help in terms of meeting the population demand and having reserves.

Import Animal Feed

The animals need to be well fed, being in a healthy environment and changing their nutrition mix. Hence, the governments can put into place a strategy that allows the import of feed for animals in order to increase animal production.

AVAILABILITY

Investing Agriculture Abroad

Expansion and diversification of investments in the field of agriculture in countries with low-cost employment and large tracts of arable land. The countries in which the governments can invest are various namely Sudan, Kenya, India, Argentina.

Starting with Sudan, it has vast land and water resources that are perceived as ripe for agricultural development investment. Sudan has the potential to supply all the cereal, sugar, fodder and other essential foodstuff needs of the GCC, but the country urgently needs to resolve its regional conflict. Second, Kenya has a vast agricultural which is referred to as arable land, and it represented in 2020 48% of the total land.

Third, India is the largest agricultural production country in the world for milk, jute and pulses. It ranks as the 2nd largest producer of rice, wheat, groundnut, sugarcane, vegetables, fruits and cotton. In addition, it has engaged in major agriculture production of spices, fish, livestock, poultry and plantation crops.

Fourth, Argentina possesses vast and cheap agricultural land and it is the largest producer in the world of yerba mate, one of the 5th largest producers in the world of soy, maize, sunflower seed, lemon and pear, one of the 10th largest producers in the world of barley, grape, artichoke, tobacco and cotton, and one of 15th largest producers in the world of wheat, sugarcane.

Setting up Food Hubs

The world has been witnessing a number of crises during the past two years, i.e., the COVID-19 and the Russia-Ukraine War. Therefore, it is important to stockpile to ensure supplies for domestic consumption, and secure strategic reserves. The governments can measure the domestic consumption for 3-5 months and establish different stockpiles, one for meat and chicken, one for cereals, one for the seafood, and one for strategic products. These stockpiles will be located in various areas to ensure the equal geographical distribution in all the areas of the countries.

In addition, stockpiling can reinforce purchasing power by signaling to sellers that countries have alternative sources of supply, militating against price gouging.

Reproduce Wasted Food

The Arab region is characterized by food waste, and in order to reduce food waste, governments can repurpose food waste to feed animals which will increase animal production

Diversifying Sources of Food Imports

The analyzed countries should not rely on only one resource to import food supplies, but should diversify their sources, to not find themselves in a position where they cannot provide food supplies especially following the current Russia Ukraine conflict and its impact on wheat

Including Food Security in the School Curriculum

Educational courses explaining the concept of food security and its importance, will contribute into changing eating habits, and will improve the nutritional knowledge of children. Further, it will disseminate a food policy rationalization that will start from school and it will result in the reduction of food waste and stabilizing markets for local producers.

STABILITY

Long-run Agreements

The governments can conclude long term agreements with the largest producing countries of agricultural commodities for a period of ten years in order to ensure food supplies for a long time. The largest producing countries of agricultural commodities in 2021 were China, United States, Brazil, India, Russia, France, Mexico, and Japan.

ECONOMIC POLICIES

- Implementing economic policies supporting the agricultural field through providing incentives to any investor who desires to invest in this field.
- Providing loans for agriculture investors with a rate lower than the market rate, for example with 200 points lower, and making the payment of the loan over a longer period, for example, three years.
- Providing no income or corporate tax for five years, and giving more incentives to specific countries that are leading countries in agriculture technology, i.e, USA, Israel, India, China.
- Providing no tariffs or customs on the entry of machinery and equipment that will be used in agriculture for 5 years.

BIBLIOGRAPHY

1. Abbas, G., Ahmad, S., Ahmad, A., Nasim, W., Fatima, Z., Hussain, S., ... & Hoogenboom, G. (2017). Quantification the impacts of climate change and crop management on phenology of maize-based cropping system in Punjab, Pakistan. *Agricultural and Forest Meteorology*, 247, 42-55.
2. Ahmad, M., & Farooq, U. (2010). The state of food security in Pakistan: Future challenges and coping strategies. *The Pakistan Development Review*, 903-923
3. Alharthi, M. (2019). Determinants of Economic Development: A Case of Gulf Cooperation Council (GCC) Countries. *International Journal Of Economics And Finance*, 11(11), 12.
4. Al-Saidi, M., & Saliba, S. (2019). Water, Energy and Food Supply Security in the Gulf Cooperation Council (GCC) Countries—A Risk Perspective. *Water*, 11(3), 455.
5. Britannica, (2022). Natural resource: Additional Information.
6. Bucchignani, E., Mercogliano, P., Panitz, H. J., & Montesarchio, M. (2018). Climate change projections for the Middle East–North Africa domain with COSMO-CLM at different spatial resolutions. *Advances in Climate Change Research*, 9(1), 66-80.
7. Calvin, K., Wise, M., Clarke, L., Edmonds, J., Kyle, P., Luckow, P., & Thomson, A. (2013). Implications of simultaneously mitigating and adapting to climate change: initial experiments using GCAM. *Climatic Change*, 117(3), 545-560.
8. Caroline et al. (June 2021). Food systems in conflict and peacebuilding settings pathways and interconnections, Stockholm international peace research institute.
9. Chabejong, N. E. (2016). A review on the impact of climate change on food security and malnutrition in the Sahel region of Cameroon. *Climate Change and Health*, 133-148.
10. Clemens Breisinger et al. (2015). Global food policy report, International food policy research institute.
11. Cop 27, (2022). The Sharm el-sheikh climate implementation summit, Round table on “food security”.

12. Elzaki, R. (2022). Challenges of the Food Security in the Gulf Cooperation Council Countries: An Empirical Analysis of Fixed and Random effects.
13. Eric et al., (2015). The World Bank Group's 2013-15 Agriculture for Action Plan: A Lesson in Privatization, Lack of Oversight and Tired Development Paradigms. Development Report No 22.
14. European Central Bank, (2022). What is inflation?
15. FAO (2016). Peace and food security: Investing in resilience to sustain rural livelihoods amid conflict.
16. FAO, (2022). Hunger and food insecurity.
17. FAO, (2006), Policy brief issue 2.
18. FAO, IFAD, UNICEF, WFP and WHO. 2022. The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO.
19. FAO and WFP, (2022). Hunger Hotspots. FAO WFP early warnings on acute food insecurity: October 2022 to January 2023 Outlook. Rome.
20. Fazzino, D. V., & Loring, P. A. (2009). From crisis to cumulative effects: Food security challenges in Alaska. *Napa Bulletin*, 32(1), 152-177.
21. Fenghua, S., Y. Xiuqun, L. Shuang, and others, 2006: The contrast analysis on the average and extremum temperature trend in northeast China. *Sci. Meteorol. Sin.*, 26.
22. Food Security Information Network, (2022). Global Report on Food Crises, World Food Programme.
23. Food and Agriculture Organization of the United Nations (2014). Managing Systems at Risk.
24. Hall, C., Dawson, T. P., Macdiarmid, J. I., Matthews, R. B., & Smith, P. (2017). The impact of population growth and climate change on food security in Africa: looking ahead to 2050. *International Journal of Agricultural Sustainability*, 15(2), 124-135.
25. Hochman, Z., Gobbett, D. L., & Horan, H. (2017). Climate trends account for stalled wheat yields in Australia since 1990. *Global change biology*, 23(5), 2071-2081.

26. ICRC, (2022) Food security and armed conflict (2022).
27. IFAD, 2014.
28. International Monetary Fund, (2022). Inflation: Prices on the rise.
29. Kassy et al., (2021). Food Security Status and Factors Affecting Household Food Security in Enugu State, Nigeria. *Journal of Health Care for the Poor and Underserved*, 32(1), 565-581.
30. Keleman Saxena, A., Cadima Fuentes, X., Gonzales Herbas, R., & Humphries, D. L. (2016). Indigenous food systems and climate change: impacts of climatic shifts on the production and processing of native and traditional crops in the Bolivian Andes. *Frontiers in Public Health*, 4, 20.
31. M. Kummu et al., (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use, *Science of The Total Environment*, Volume 438, Pages 477-489.
32. Marshall, G. (2022). Political Conflict, Measurement of.
33. Matemilola, S. (2017). The challenges of food security in Nigeria. *Open Access Library Journal*, 4(12), 1.
34. Mbow, C., Rosenzweig, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., ... & Xu, Y. (2019). Food security.
35. Mekhilef, S., Saidur, R., & Kamalisarvestani, M. (2012). Effect of dust, humidity and air velocity on efficiency of photovoltaic cells. *Renewable and sustainable energy reviews*, 16(5), 2920-2925.
36. Metu, A. G., Okeyika, K. O., & Maduka, O. D. (2016, May). Achieving sustainable food security in Nigeria: Challenges and way forward. In *Proceedings of the 3rd International Conference on African Development Issues*.
37. Molotoks et al., (2021). Impacts of land use, population, and climate change on global food security. *Food and Energy Security*, e261.
38. National intelligence council report, (2013). natural resources in 2020, 2030, and 2040: implications for the United States.

39. Nelson et al., (2010). Food Security, Farming, and Climate Change to 2050: Scenarios, Results, and Policy Options. Washington, DC: International Food Policy Research Institute.
40. Organization for Economic Co-operation and Development, (2022). Overpopulation.
41. Ouimette, A. P., Ollinger, S. V., Richardson, A. D., Hollinger, D. Y., Keenan, T. F., Lepine, L. C., & Vadeboncoeur, M. A. (2018). Carbon fluxes and interannual drivers in a temperate forest ecosystem assessed through comparison of top-down and bottom-up approaches. *Agricultural and Forest Meteorology*, 256, 420-430.
42. Peng, W., Berry, E.M., (2019). The Concept of Food Security. In: Ferranti, P., Berry, E.M., Anderson, J.R. (Eds.), *Encyclopedia of Food Security and Sustainability*, vol. 2, pp. 1-7, p.2.
43. Pinke, Z., & Lövei, G. L. (2017). Increasing temperature cuts back crop yields in Hungary over the last 90 years. *Global change biology*, 23(12), 5426-5435.
44. Potopová, V., Zahradník, P., Štěpánek, P., Türkott, L., Farda, A., & Soukup, J. (2017). The impacts of key adverse weather events on the field-grown vegetable yield variability in the Czech Republic from 1961 to 2014. *International Journal of Climatology*, 37(3), 1648-1664.
45. Prosekov, A. Y., & Ivanova, S. A. (2018). Food security: The challenge of the present. *Geoforum*, 91, 73-77.
46. Rosegrant, M. W., Koo, J., Cenacchi, N., Ringler, C., Robertson, R. D., Fisher, M., ... & Sabbagh, P. (2014). Food security in a world of natural resource scarcity: The role of agricultural technologies. *Intl Food Policy Res Inst*.
47. Rosegrant, M. W., & Cline, S. A. (2003). Global food security: challenges and policies. *Science*, 302(5652).
48. Ruel, M. T., Garrett, J. L., & Yosef, S. (2017). Food security and nutrition: Growing cities, new challenges. *IFPRI book chapters*, 24-33.
49. Shahid, S. A., & Ahmed, M. (2014). Changing face of agriculture in the Gulf Cooperation Council countries. In *Environmental Cost and Face of Agriculture in the Gulf Cooperation Council Countries* (pp. 1-25). Springer, Cham.

50. Spiess, A. (2012). Food security in the GCC economies. In *The GCC Economies* Springer, New York, NY.
51. Tanksale, A., & Jha, J. K. (2015). Implementing national food security act in India: issues and challenges. *British Food Journal*.
52. Tarek Ben Hassen and Hamid El Bilali. (2019). Food Security in the Gulf Cooperation Council Countries: Challenges and Prospects. *Journal of Food Security*, 7(5):159-169.
53. Timmer, P. (2004). Food security in Indonesia: current challenges and the long-run outlook. Center For Global Development Working Paper, (48).
54. Teodosijevic, S. B. (2003). Armed conflicts and food security.
55. UN, (2019). Tracking Food security in the Arab region.
56. UN, (2019). Policy brief issues in the Arab region.
57. UN brief Number 1 (2022). Global Impact of war in Ukraine on food, energy and finance systems.
58. UNCTAD, (March 2022). The impact on trade and development of the war in Ukraine.
59. United Nations (2020). Statement by the president of the security council, S/PRST/2020/6.
60. United Nations. (2022). The Sustainable Development Goals Report.
61. United Nations. (2022). What Is Climate Change?
62. UNEP et al., (2009). "Biodiversity in Africa "In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment).
63. United Nations Framework Convention on Climate Change. (2022). For the purposes of this Convention.
64. University of Cambridge, (2022). Overpopulation.
65. Wiebe, K. D. (2001). Natural resources, agricultural productivity, and food security (No. 1474-2016-120831).

66. World Bank (2012). Linking Gender, Environment, and Poverty for Sustainable Development: A Synthesis Report on Ethiopia and Ghana. Social Development Department Sustainable Development Network. Report no. P125713.
67. World Bank, (2022). Food Security Update, World Bank Response to rising Food insecurity.
68. World Bank, (2020). International migrant stock (% of the population).
69. World Bank, (2022). Metadata Glossary.
70. Zhao, C., Liu, B., Piao, S., Wang, X., Lobell, D. B., Huang, Y., ... & Asseng, S. (2017). Temperature increase reduces global yields of major crops in four independent estimates. *Proceedings of the National Academy of Sciences*, 114(35), 9326-9331.

APPENDIX

No.	Author	Title	Year
1	Mbow	Food Security	2019
2	Prosekov	Food Security: The Challenge of the Present	2018
3	Cole	The Science of Food Security	2018
4	Alonso	Culture and Food Security	2018
5	Peng	The Concept of Food Security	2019
6	Rosegrant	Global Food Security: Challenges and Policies	2003
7	Pirani	Interplay of Food Security, Agriculture and Tourism Within GCC Countries	2016
8	Hassen	Food Security in the Gulf Cooperation Council Countries: Challenges and Prospects	2019
9	Elzaki	Challenges of the Food Security in the Gulf Cooperation Council Countries: An Empirical Analysis of Fixed and Random Effects	2022
10	Efron	Food Security in the Gulf Cooperation Council	2018
11	Al-Handhali	Food Security in the GCC Countries: Towards a More Diversified and Sustainable Economic Development	2020
12	Shah	Gulf Cooperation Council Food Security: Balancing the Equation	2010
13	Ben Hassan	Impacts of the COVID-19 Pandemic on Food Security and Food Consumption: Preliminary Insights from the Gulf Cooperation Council Region	2022
14	Gani	Achieving Food Security Through Live Animal Imports in the Gulf Cooperation Council Countries	2020
15	Wheeler	Food Security, Obesity, and the Politics of Resource Strain In Kuwait	2015
16	De Laurentiis	Overcoming Food Security Challenges Within an Energy/Water/ Food Nexus (EWFN) Approach	2016
17	Dodo	Understanding Africa's Food Security Challenges	2020



18	Barrett	Overcoming Global Food Security Challenges Through Science and Solidarity	2021
19	Nwajiuba	Nigeria's Agriculture and Food Security Challenges	2012
20	Misra	Climate Change and Challenges of Water and Food Security	2014
21	Žmija	Small Farming and Generational Renewal in the Context of Food Security Challenges	2020
22	Meyers	World Population, Food Growth, and Food Security Challenges	2015
23	Hamza	Water Availability and Food Security Challenges in Egypt	2004
24	Singh	Human Overpopulation and Food Security: Challenges for the Agriculture Sustainability	2019
25	Hertel	Trade in Technology: A Potential Solution to the Food Security Challenges of the 21st Century	2020
26	Mwaniki	Achieving Food Security in Africa: Challenges and Issues	2006
27	McCarthy	Global Food Security—Issues, Challenges and Technological Solutions	2018
28	Gregory	Soils and Food Security: Challenges and Opportunities	2012
29	Ringler	Water for Food Security: Challenges for Pakistan	2013
30	Fazzino	From Crisis to Cumulative Effects: Food Security Challenges in Alaska	2009
31	Havas	Food Security: Its Components and Challenges	2011
32	Ericksen	Food Security and Global Environmental Change: Emerging Challenges	2009
33	Syampungani	The Potential of Using Agroforestry as a Win-Win Solution to Climate Change Mitigation and Adaptation and Meeting Food Security Challenges in Southern Africa	2010
34	Matemilola	The Challenges of Food Security in Nigeria	2017
35	Rhodes	Soil Erosion, Climate Change and Global Food Security: Challenges and Strategies	2014
36	Schollaert	Future Pace Data to Address Marine Food Security Challenges	2019
37	Martin-Shields	Food Security and Conflict: Empirical Challenges and Future Opportunities for Research and Policy Making on Food Security and Conflict	2019

38	Synder	Food in the Last Frontier: Inside Alaska's Food Security Challenges and Opportunities	2015
39	Eme	Challenges of Food Security in Nigeria: Options Before Government	2014
40	Timmer	Food Security in Indonesia: Current Challenges and the Long-Run Outlook	2004
41	Gernah	Addressing Food Security Challenges Through Agro –Raw Materials Processing	2013
42	Nelson	Climate Challenges, Vulnerabilities, and Food Security	2016
43	Chan	Prospects and Challenges of Fish for Food Security in Africa	2019
44	Brussaard	Reconciling Biodiversity Conservation and Food Security: Scientific Challenges for a New Agriculture	2010
45	Davies	Food Security Initiatives in Nigeria: Prospects and Challenges	2009
46	Sage	The Interconnected Challenges for Food Security from a Food Regimes Perspective: Energy, Climate and Malconsumption	2013
47	Dev	Food Security in India: Performance, Challenges and Policies	2010
48	Ramachandran	Food & Nutrition Security: Challenges in the New Millennium	2013
49	Kharaishvili	Challenges for Sustainable Food Security in Georgia	2017
50	Mbow	Agroforestry Solutions to Address Food Security and Climate Change Challenges in Africa	2014
51	De Haen	The Economics of Natural Disasters: Implications and Challenges for Food Security	2007
52	Campbell	Reducing Risks to Food Security from Climate Change	2016
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