



# GLOBAL FOOD SECURITY

Dr Rubina Mittal & Pravin Kumar Singh

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# About Us



The World Intellectual Foundation (WIF) is a global non-profit, non-partisan think tank headquartered in Delhi. It works on diverse topics and themes to promote global Peace, Prosperity, and Sustainability.

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## **Dr. Rubina Mittal**

**Director of Research and Innovation**

Dr. Rubina Mittal is an accomplished professional serving as the Director of Research and Innovation at the World Intellectual Foundation (WIF). She is a Professor of Operations Research at University of Delhi.

As an esteemed mathematician, Dr. Mittal possesses exceptional skills in handling complex datasets and mathematical modelling. Her proficiency in these areas has allowed her to tackle challenging research problems and drive innovation within the foundation. In addition to her responsibilities at WIF and Delhi University, Dr. Mittal actively contributes to various organizations and committees, further establishing herself as a thought leader in her domain. She supervises numerous Ph.D. students, fostering their academic growth and nurturing their research potential, her extensive academic experience has uniquely positioned her to craft innovative, thought-provoking, and contemporary policy papers for the foundation. Her insights and expertise contribute significantly to the shaping of intellectual discourse.

Beyond her professional accomplishments, Dr. Mittal actively engages in promoting Gandhian values globally through her role as a core member of Gandhi Smriti and Darshan Samiti, an organization chaired by the Prime Minister of India. She also serves as the Co-Chair of the Education Committee at the PHD Chamber of Commerce and Industry and holds an executive position within FICCI's Education Committee. As a trustee on Sleepwell foundation, she has developed many popular skill development courses at their skill centre in Khurja. Her diverse involvement in various influential organizations, makes her an invaluable asset to the World Intellectual Foundation and a significant contributor to the advancement of knowledge and societal progress.

# Management



**Mr. Basant P. Gupta**

**Director, WIF**

An IIM-B graduate and seasoned engineer, he brings over 22 years of rich experience in the Information Technology and Outsourcing Industries. Renowned for spearheading Business Transformation initiatives across diverse verticals and consistently ensuring the timely delivery of assignments. Mr. Gupta proficiency in business analysis, strategic planning, client relationship management, and program management has played a pivotal role in driving the expansion of WIF projects.



**Ms. Hemangi Sinha**

**Senior Project Head**

With an extensive legal career spanning over 23 years at the Allahabad High Court, Ms. Sinha has embarked on a transformative journey into the Social Sector. Demonstrating a commitment to alleviating the sufferings of the underprivileged, she has founded her own foundation. Ms. Sinha brings her wealth of legal & spiritual expertise to WIF, where she has joined a project focused on examining the operations of various social and cultural organizations worldwide.



**Mr. Rahul Kumar**

**Technical Head**

Mr. Kumar serves as the technical backbone of the foundation, showcasing exceptional expertise in data management and fluency in Geographic Information System (GIS). With a noteworthy background, he has previously contributed significantly to the launch of the first Indian interactive digital mapping portal during his tenure at MapMyIndia. His invaluable technical skills contribute to the foundation's mission and initiatives.

# Our Team



**Mr. Pravin Kumar Singh**

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Pravin is a law graduate from Faculty of Law, DU and holds a Bachelor Degree in Mathematics from Ramjas College, DU.

He has worked with different legal scholars and eminent jurists on different projects. A testament to his scholarly endeavours, his recent contribution to the International Journal of Science and Research graces its pages as a profound opus titled "Studying different Aspects of Population Policy," thereby exemplifying his dedication to scholarly research.



**Mr. Kunal Singh**

**Senior Research Fellow**

An enthusiastic advocate for justice and a Sanskrit Scholar. Kunal has completed his Bachelor's and Master's in Sanskrit Literature from St. Stephen College and is currently a student at University of Delhi's Faculty of Law.



**Mr. Apaar Wadhwa**

**Junior Research Fellow**

Apaar, a capable policy researcher and data analyst specializes in the domain of public policy and administration. Apaar holds Bachelor's in Economics and Master's in Public Administration.



**Mr. Nitesh Birje**

**Technical Assistant**

Nitesh, a dedicated team member with a keen interest in technology-oriented initiatives. His forte lies in graphic design, making him the creative force behind our visual endeavors.

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# ABSTRACT

This study paper examines different aspects of food security amidst the global food crisis. Along with jeopardising international relations, there are pertinent environmental, biodiversity & ecological aspects. The world's food security is in jeopardy on multiple fronts. Without addressing the issue of food insecurity, the world cannot talk about peace. Effective interventions are required to shift the food system's cycle from vulnerable to secure and immune. This paper provides a reality check on where the world stands in terms of basic food security, forcing governments and people around the world to take necessary actions as the clock ticks.

Food, agriculture, and ecology are not the only aspects of food security. It has global causes and effects that range from conflicts to urbanisation to culture to supply chains. The pandemic of COVID-19 has raised concerns about new habits and patterns in the global food system. People's dietary preferences are changing due to the rising population and income. Many factors, such as societal structural causes, impede the attainment of food and nutrition security, such as poverty, unemployment, and inequality. Climate change, natural disasters, declining land and water resource quality and availability, and low investment in sustainable agriculture all have an impact on agricultural production growth.



Source: ORF



# 1. INTRODUCTION

The world is currently facing some of the dire problems that humans could have never thought of and one of them is food insecurity. Today the world is finding it difficult to unfasten this problem. There are certain key drivers that disturb the food security worldwide. Some are prevalent particularly in one part of the world, others are worldwide. The moot question is what routes are we resorting to in order to address this issue?

The situation of the World's food security is at peril on multiple fronts. The world cannot talk about peace without addressing the issue of food insecurity. Effective interventions need to be made to transpose the cycle of the food system from being vulnerable to more secured and immune. This report gives the reality check of where the world is standing in terms of basic food security, and make governments and people, across the globe, to contemplate and take necessary actions as the clock is ticking.

Food security aspects are not just limited to food, agriculture, and ecology. It has worldwide causes and effects ranging from conflicts, urbanization, and culture to supply chains. The COVID-19 pandemic has raised questions about new habits and patterns in the global food system. The dietary preferences of people are changing as a result of rising population and income growth. The attainment of food and nutrition security is hampered by many reasons like societal structural causes (such as poverty, unemployment, and inequality). Growth in agricultural production is also affected due to mainly by climate change, natural disasters, declining land and water resources' quality and availability, and low investment in sustainable agriculture. The global food demand is expected to increase by 1.3% annually between 2021-2030 due to population growth and an increase in per capita income (OECD/FAO, 2021, p. 31). As of 2020, around 690 million people (8.9% of the global population) were hungry, and in 2019, nearly 750 million people (i.e., one in ten people in the world) experienced extreme food insecurity despite the fact that there is enough food produced worldwide to feed everyone (Food and Agriculture Organization, 2020, p. xvi). This trend shows the necessity for everyone to always have access to food in the optimum amount and quality.

Certain regions expect substantial population growth and an income-driven rise in food consumption but might not have the agricultural resources to support the rise in population and food demand. Also, the food demand pattern is changing due to socio-cultural and lifestyle changes. We have come to a point where to tackle changes in precipitation patterns due to climate change, we are injecting chemicals into the atmosphere to change the weather. There is a need for a paradigm shift so as to approach balanced growing human demands with the necessity to expand the resilience and sustainability of the overall environmental ecosystem. Humans need sustainable ways to look forward to building a 'Nutritious-secure' world.

A nutritious secure system is possible only when:

1. There is accessibility and availability of nutritious food at affordable prices at all time to everyone.
2. A person's diet is not affected by any external factors like climate change, disasters, supply chain or geopolitics.
3. People are responsible towards overall Planet's health.

## 1.1 RESEARCH GAP

There has been vast research-based consideration of climate change and food security; however, several research implementation limitations demand reviewing and navigating the space between research conduct and its implementation. Extreme weather and climate change affect food security and the way people make a living in food production systems and their value chains. Moreover, climate change also affects agricultural production systems, food supply chains, and pricing. In order to fulfill future rapidly growing population food needs, researchers must consider shifts not only in global climate change impacts and demographics on food security but also the degree to which food production systems can adapt against climate change. Downstream, food access is associated with a stable and balanced food supply chain. Climate change impacts interrupt the food supply chain and disrupt physical access to markets in various ways. Climate change-induced extreme events such as droughts, floods, and other calamities adversely impact the public infrastructure, damage market access facilities, inundate transport networks, and other hazardous health conditions that make it difficult for people to access markets physically. To address global food insecurity, there needs a proper allocation of resources and for that, coordination at the level of global, regional, and national is required. Developing and least-developing countries should be capable enough to develop strategies for the groundwork. We strive to navigate through gaps and foray into a guideline framework for implementation.

# 2. DRIVERS OF FOOD INSECURITY

## 2.1 POPULATION GROWTH AND URBANIZATION

Today, more than half of the global population lives in urban spaces, and by 2045, this number can increase by 1.5 times (The World Bank, 2020). In 2018, the urban population in the world was 4.2 billion (United Nations, 2018). The global population has reached 8 billion (UNFPA, 2023). The global population is anticipated to increase by 8.5 billion in 2030, 9.7 billion in 2050, and 10.4 billion in 2100. Population growth rate will differ across countries and regions. Over 50% of the predicted increase in the world's population till 2050 will be constituted in just 8 countries: the Democratic Republic of Congo, Egypt, Ethiopia, India, Nigeria, Pakistan, the Philippines, and the United Republic of Tanzania. (Misra, 2022)

Population trends are different across the globe and there are two major reasons. One, the temporary labor migration from the South Asia region has been observed, such as, during 2010-2021; for Pakistan, the net outflow was 16.5 million; India (3.5 million); Bangladesh (2.9 million); Nepal (1.6 million); and Sri Lanka (1.0 million). Two, conflict in many countries have become the major cause of migration such as 4.8 million people from Venezuela, 4.6 million from Syria, and 1.0 million from Myanmar, had migrated during 2010-2021. (Misra, 2022)

Population growth will imply a substantial **increase in the demand for food**. Changes in dietary and consumption patterns can also be affected due to **rapid urbanization as well as population trend across regions**. People in

urban spaces mostly rely on the commercial food chain due to changes in the composition of food demand; one reason being income growth.

Asia, despite having a low level of urbanization, comprises 54% of the global urban population, whereas Europe and Africa are 13% each (United Nations, 2018). There might be a decline in global population growth but Africa and South Asia will see a persistent increase in population growth i.e., 9 billion out of 11 billion global population (Food and Agriculture Organization, 2018, p. 8). So, the demand for food in particularly these two regions is expected to rise significantly.

In many parts of the world, the land around **urban peripheries and rural areas is getting expensive**, making farmers sell their land for non-agriculture purposes, which encourages more urban expansion. Water, a major resource for agricultural productivity, is becoming scarce with rapid urbanization and industrialization, jeopardizing food supplies. Though proper and sustainable infrastructure plays an important part, the lack of infrastructure in many developing countries is hampering food access.

Changes in food demand are affected by **demographic shifts and spatial locations of people**. Different food requirements and consumption patterns, per capita income, and the standard of living influence the demand and quality of food items. Natural disasters, such as droughts and floods, are becoming

more regular, posing a threat to food supplies, and high temperatures also raise the risk of food-borne illnesses, which are more prevalent in urban areas. **Rapid and uncontrolled urbanization** exacerbates these problems. Meanwhile, in some countries or cities, urban infrastructure development lags behind population growth. This increases the population of urban slums, making it more challenging to ensure food security for all.

## 2.2 ECOLOGY AND BIODIVERSITY

Biodiversity is essential for ensuring global food security, supporting nutritious diets, and strengthening rural livelihoods. Every species is an essential part of the overall functioning of ecological ecosystem. Human health relies on nature's health, from food and air to water. That is why **Forest health** is significant for biodiversity and ecosystem stability. Due to population growth and changes in consumption patterns, demand for forest products is on the rise, putting excessive pressure on natural forests. High demand for food, fibre, and minerals often results in land-use changes at the expense of forests. It becomes a challenge to meet the increasing demand while maintaining natural forests. Moreover, forests prevent soil erosion and improve soil fertility. Reducing deforestation and building sustainable forest management contribute to mitigating climate change and can also prevent infectious diseases. The **important global concern should be whether to consider forests as a global common or a national resource**. The International community needs to face the environmental issue together because the problem of one has worldwide consequences.

**Pollinators** have an enormous value in food production and security. They provide micronutrient-rich foods, increase biodiversity, and maintain the ecosystem. Today, pollinator insects are surrounded by various threats like urbanization, the use of pesticides and fertilizers on agricultural lands,

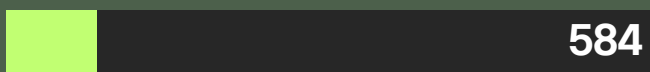
climate change, and many others. Pollinators like bees are essential for 35% of crop production globally. Our reliance on pollinators is most likely going to grow due to the diversification of global diets. Richer countries and people who can afford nutritious food tend to shift towards nutrient-rich foods (like fruits and nuts) and are not just limited to staple crops. Many low-income countries rely on the trade of pollinator-dependent crops like cocoa, soybeans, palm oil, and avocados. The decline in pollinators would reduce crop yields and may have a negative economic impact on some of the world's low economies. If pollinators disappear, crop production in low-middle economies will decline by 8% and in high economies by 5%. (Ritchie, How much of the world's food production is dependent on pollinators?, 2021).

The link between **epidemics and deforestation** is majorly associated with the countries of the intertropical zone with high forest covers, such as the Democratic Republic of Congo and Cameroon from Africa; Brazil, Peru, and Bolivia from South America; Indonesia, Myanmar, and Malaysia from Southeast Asia; and among others (Morand & Lajaunie, 2021). The three most endemic countries in the world currently are Madagascar, Peru, and the Democratic Republic of Congo (Ansarari, Grier, & Byers, 2020).

## Plague Cases



## Plague Deaths



Source: Ansarari, Grier, & Byers, 2020

Between 2010-2015, the number of plague cases was predicted at 3248, and 584 deaths globally, with 75% of cases in Madagascar (Ansarari, Grier, & Byers, 2020). Between 2000 to 2010, there were about 9580 disease outbreaks worldwide, out of which 60% were zoonotic in origin. A country like India witnesses around USD 12 billion loss annually due to a yearly zoonotic disease outbreak (Chaturvedi, 2022). The absence of monitoring and food-safety regulations has led to the emergence of **zoonotic diseases**. Improper animal storage, unsanitary conditions, and improper handling of livestock products became pathways for inter-species transmissions. These diseases not only affect human health but also influence farmers, a country's economy and exports.

The COVID-19 pandemic, caused by zoonotic SARS-CoV-2, was a wake-up call for the world, which devastated global food security status while exposing vulnerabilities of the global food system. The pandemic plunged the world into considering the urgency to ensure the accessibility and affordability of nutritious diets to all.

**Coral reefs** support an estimated a quarter of life in the Ocean (United States Environmental Protection Agency, 2022). Coral reefs are critically threatened by a climate-change-induced increase in temperature which has made oceans warmer than usual, resulting in coral bleaching. Due to warmer oceans, **Australia's Great Barrier Reef** has lost around 50% of its corals since 1995 (IUCN, 2021). Coral reefs protect shorelines from 97% of the energy from floods, strong waves, cyclones, and storms, reducing the risk of casualties, property damage, and erosion. Humans are dependent on reefs for various reasons, and one of them is medicinal purposes like treatments for cancer, arthritis, and many other conditions. Coral reef fisheries contribute to the maintenance of social stability and food security. More than 400 million people in the world's least developing nations reside within 100 kilometres of coral reefs, and most of them reside in rural areas where they are often directly reliant on reef resources for their livelihoods and food security (Teh, Teh, & Sumaila, 2013). The protection of coral reef fisheries is important in order to fulfil fish protein demand at the local and national levels.

Similarly, **mangroves** are also essential to the marine ecosystem. Millions of people and wildlife depend on mangroves to live. They are not just mere plants; instead, they act as a protective wall against seawater abrasion and reduce flood risks. With 92 varieties of mangrove species, Indonesia is home to 23% of the world's total hectares of mangroves, storing 3.1 billion tons of carbon. However, Indonesia is facing a significant loss of mangroves every year; most of them are turning into aquaculture ponds for shrimps. The other reasons are urban expansionism and conversion to palm oil plantations. (The World Bank, 2021)

**Cultural beliefs and values** shape food systems and people's relationships with nature. They also have an impact on food production and consumption. Communities that rely on agriculture, forest biodiversity, and natural resources for nutrition and food security are vulnerable and at risk due to their limited capacity to respond to the consequences of climate change. In terms of resource and information accessibility, social and gender disparities prevail. Extreme weather events resulted in permanent population displacement. Because of cultural and geographical changes, migration alters livelihood alternatives. Because indigenous groups are primarily responsible for biodiversity conservation, their rights to own their land must be safeguarded in order to combat food insecurity.

## 2.3 AGRICULTURE

The global demand for agriproducts is expected to increase at 1.2% per annum during 2021-2030 (OECD/FAO, 2021, p. 30). Because of income growth and changes in dietary patterns, there is a demand for nutritious food and a decrease in the availability and quality of natural resources will result in poverty in middle-income countries as well as urban poverty. This will have a further influence on the broader food system, putting food security at risk. The situation therefore

warrants an increase in agricultural yielding and productivity. This also necessitates a diverse food basket. Diversification of agricultural activities should be planned in order to benefit both individuals and society. It should be structured in order to reduce poverty, increase employment and income, and protect the environment. In India, for example, diversification from cropping patterns to other agricultural activities is emerging.

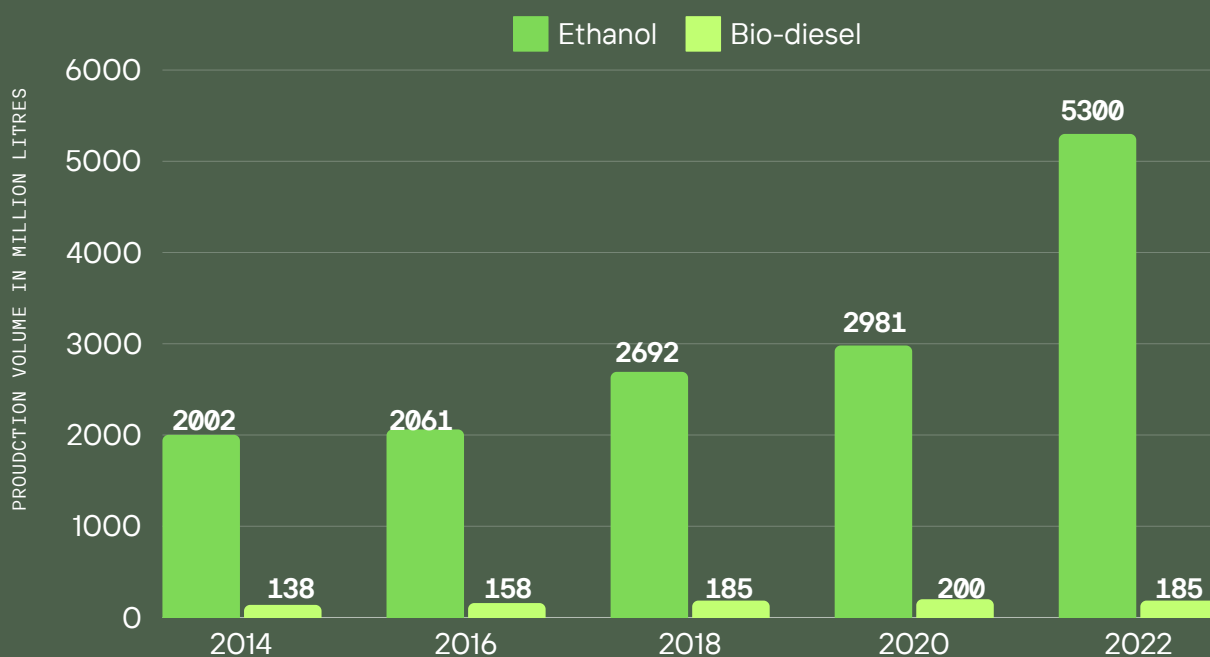
Everything majorly depends on our farming practices from a farmer's income to nutrient content in the crop. These practices include how we grow a crop, how much we grow it, and how we are using it. For instance, globally, most cocoa is grown using monoculture techniques in which farmers cultivate only one type of crop in a specific region, basically to ensure high yield of the crop. Monoculture technique has a tendency to reduce nutrient content in the crop, degrade soil quality, and further disrupt food systems. The **cocoa industry** is a significant contributor to deforestation, the loss of vital habitat for wildlife, and the violation of human rights across the world, especially in **West Africa**, including **Latin America and Southeast Asia**. (National Wildlife Federation)

Due to the prevailing situation of climate change and unpredictable weather conditions, **animal husbandry** has become important for farmers' stable income. As of 2019, India has a total livestock of 1.6 billion on which Indian farmers rely on for their livelihood (National Dairy Development Board, 2019). Today, one of the critical issues that the world must address today is the issue of farmer suicides. In India, between 2018 and 2020, more than 17,000 farmers committed suicide (The Economic Times, 2022).

The Agriculture sector, contributing to global food system, generates 16%-27% emissions (Intergovernmental Panel on Climate Change (IPCC), 2020). Many governments around the world are deliberating on sustainability practices

but bringing that change would also invite certain challenges. Changing agriculture practices all of a sudden would not be easy for the world. How developed countries are taking action towards climate change is appreciable, but things won't be easy to implement (we are at that stage if we don't take steps for collective good then problems will multiply). In 2022, the government of the **Netherlands** took some steps in efforts for climate change mitigation. The government wants to curb nitrate emissions by 50%, generated from livestock farming and fertilizers, by 2030. The problem is over manure (which is a major contributor to global Greenhouse Gas emissions), as emissions of ammonia are harmful to local wildlife and nitrous oxide, a GHG. In order to achieve this target, an overall 30% reduction in livestock numbers would require, which will have a direct impact on farmers (Nugent, 2022).

The yearly demand for **biofuel** is projected to increase by 28% by 2026, i.e., 186 billion litres (International Energy Agency, 2021). The biofuels mainly consist of bio-ethanol and bio-diesel. These are derived from food crops, and crops that are not grown for food intake. There will be growing demand for biofuels as countries are attempting to cut their CO<sub>2</sub> emissions and their dependency on fossil fuels. Biofuel feedstocks may have direct as well as indirect impacts on food availability. Biofuels can directly limit food supplies if they are produced from feedstocks which could have been utilized for food. This can also lead to food insecurity through a lack of purchasing power and food prices. One reason is that **prices of petroleum and food** move in tandem as connected with biofuels. **With the rise of crude prices, blending ethanol from sugarcane and corn with petrol comes in highlight.** This also leads to an increase in prices of other food grains like wheat, which substitute corn (which is an animal feed) for livestock use. In the case of India, ethanol blending can be **advantageous** in two ways: this process can lower the country's share of oil imports, and it can increase the incomes of farmers (for example: By selling the leftover residue from rice harvesting will also result in reduced stubble burning.). India targets 20% ethanol blending in petrol by 2030 (PIB Delhi, 2022). At the same time, there continue to be concerned about food insecurity. India will need to balance food production for domestic supply as well as biofuels.



Source: Statista

## 2.4 CONFLICT

**Food insecurity can be a consequence as well as a contributor driver to the emergence of any conflict.** There is no limit to the damage that war can cause to the food system. Conflicts have a detrimental impact on people's ability to produce, trade, and consume food because of their effects on health, energy, trade, and logistics. The food supply and the lives of the most vulnerable people in a society can be utterly destroyed when there is civil instability or armed conflict.

It has been around 7 years of the humanitarian crisis in **Yemen**. People still face the fear of their life and still bear the burden of challenges of being internal refugees; with no access to basic rights of health, clean drinking water, education, employment, and food. Yemen now has 4.3 million internally displaced persons (IDPs) (reliefweb, 2022). As of 2022, 17.4 million people in Yemen are food insecure and in need of aid however, this number can increase up to 19 million by December 2022 (World Food Programme). 31,000 Yemenis are living in famine-like conditions (World Food Programme, 2022). This is the situation when the staple food prices are increasing due to the ongoing Russia-Ukraine war. An increase in food prices is directly proportional to food insecurity.

The Russia-Ukraine war has resulted in large population displacement, food and nutrition insecurity. Critical infrastructure is being damaged and food supply chains are being disrupted. The war's impacts are seen globally since it involved two of the most significant players in the agriculture commodity market. **Ukraine**, known for its fertile soil, is the top exporter of sunflower oil, corn, and grains. Ukraine is the source of 75% of the world's traded sunflower oil and 14% of the world's corn commerce, whereas nearly 30% of the world's wheat and barley exports are provided

by Russia and Ukraine together (Eoin McGuirk & Burke, 2022). The ongoing conflict has dramatically hampered the supply of these goods. Over 30% of wheat imports from around 50 countries are dependent on Russia and Ukraine (Food and Agriculture Organization, 2022). The major wheat importers may have to look for alternative crop sources. The Russia-Ukraine war worsened the situation of high prices after disruptions from the COVID-19 pandemic.

In 2008, the government of **Haiti** fell after riots over high food prices. Unrest erupted in many parts of the world. Food prices increased worldwide due to a number of reasons, including record oil prices, rising food demand in Asia, and the use of crops for biofuels. Haiti could not reduce or cut taxes on food which had multiplier effects. (Delva & Loney, 2008)

In a protracted crisis, food remains a mere **"means to survive"**. Many countries lack emergency assistance during any violent conflict or protracted crisis. More than 880,000 people in Afghanistan, Somalia, South Sudan, and Yemen are fighting for their lives while suffering from extreme hunger (McFadden, 2022).



Source: Lawrence Freeman

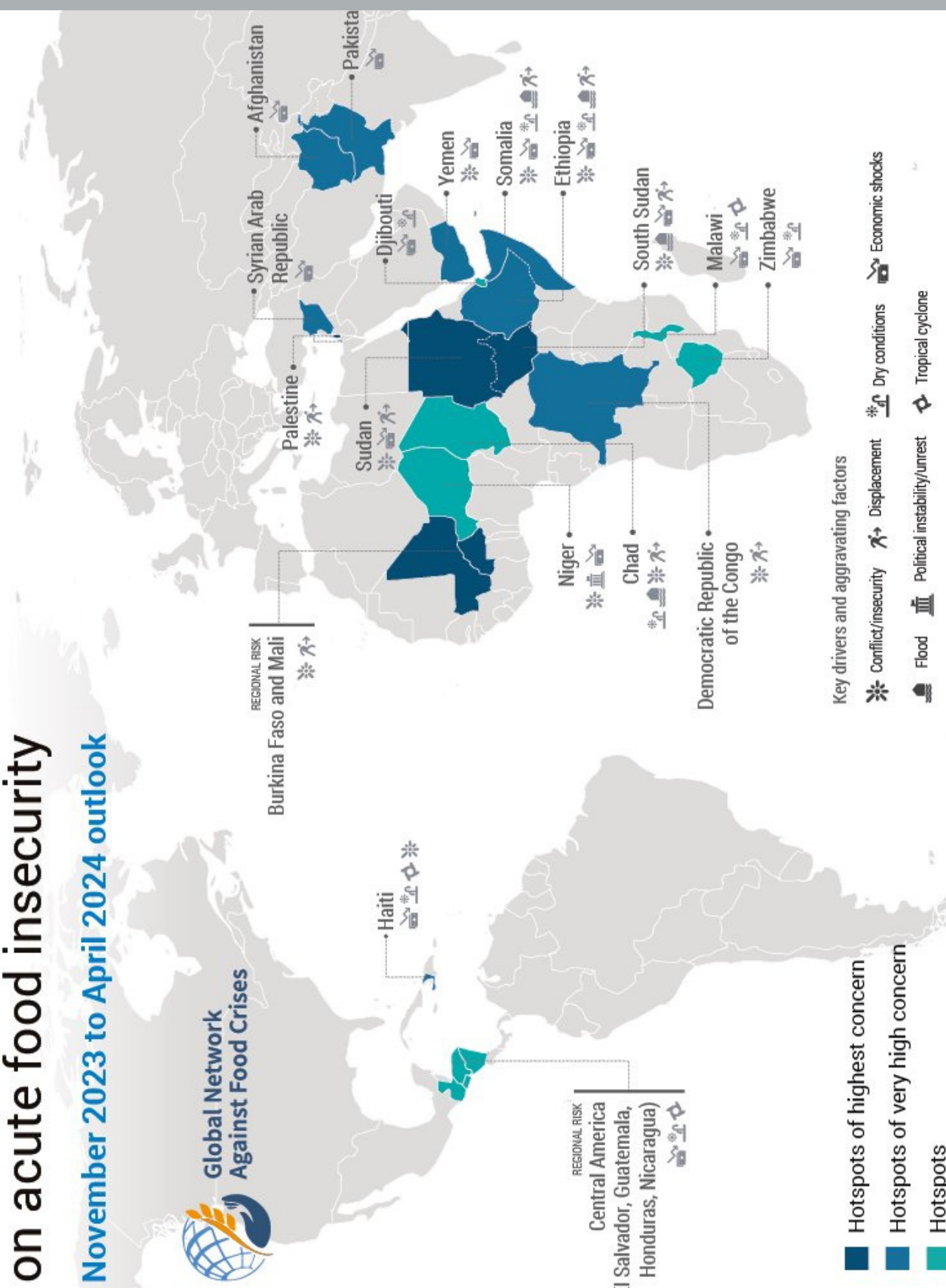


# Hunger Hotspots

## FAO-WFP early warnings on acute food insecurity

November 2023 to April 2024 outlook

Global Network Against Food Crises



## 2.5 DIETARY PATTERN

**Dietary habits depend on culture, geography, and traditions - also changing food consumption patterns-overconsumption- unbalanced diets- food waste.** The shift in the diet composition and per capita calorie intake are mostly **affected by per capita income, urbanization, price fluctuation, technological advancement, supply chain disruption, and issues around globalization.** A global middle-class has emerged as a result of the rapid economic development in developing nations, and their dietary choices are defined by a higher demand for meat, fish, and dairy products, as well as other more resource-intensive goods. Ongoing urbanisation, income growth, and change in food preferences will have substitution shifts in dietary patterns which would be away from nutritious staples like millets, roots and tubers vegetables and towards sugar and processed food items. But the developed countries like France, United Kingdom, and Norway have taken measures to lower the consumption and demand of caloric sweeteners (OECD/FAO, 2021, p. 32).

**In low-income countries,** average diet, will remain dependent on staples which would continue to be 70% of per day calories, by 2030 (OECD/FAO, 2021, p. 33). The **demand for processed food** has increased by people living in urban areas. And there is a global tendency for food system to become more economically and technologically effective in order to deliver food that is comparatively cheap to other items in the market. This has resulted in the declining number of people engaged in primary agriculture.

In some cases, the change in dietary pattern is in regards to extra calories from processed food items and others. There is shift from carbohydrate-rich staples and dietary fibre to animal products like meat and dairy products, vegetable oils and food items high in sugar. These trends can be seen in a way that to what extent one can substitute the other to consume. Some changes are dependent on geography (climate), culture and beliefs.

A recent example is the situation in **Ukraine**, where the dietary pattern of the country might get affected. In 2019, 2691 kilocalories was the average daily per capita intake in Ukraine, with 70.3% plant-based and the rest from livestock products. The yearly per capita beef and veal consumption decreased from 9.6 to 7.7 kgs, in the period 2009-2019. In 2019, wheat usage dominated in the food industry, comprising 85% of the total quantity of cereals (Nykolyuk O., 2021).

Dietary pattern is somewhere responsible for the percentage variation in carbon emissions through **food waste** across regions. Food waste globally contributes to 10% of global greenhouse gas emissions (Gikandi, 2021). Carbon intensities vary from product to product. For instance, cereal production in Asia has a high carbon footprint in Europe due to different types of cereal crops: rice typically has more impact variables than wheat. On the other hand, vegetable production in Southeast Asia is less carbon intensive than in Europe. (Scialabba, 2015)

## 2.6 NUTRITION SECURITY

Access to nutritious food to make up a healthy diet should be a basic human right. Nutrition insecurity is disproportionately impacting communities. As of 2020, a developing country like India had 189.2 million undernourished people which makes up 14% of the total population of the country (India FoodBanking Network). Improving food availability will not be sufficient to have food access for all, for healthier living, would require access to nutritious food for all at all times.

The nutrition and health of the human body come from the soil, and **Soil security** is one of the most less-discussed challenges that the world is currently facing. Soil health is the most important base of food production. Food quality and quantity depend on the soil quality. It is projected that 95% of our food is directly or indirectly dependent on soils (Food and Agriculture Organization, 2015). Apart from providing necessary nutrients, water, oxygen, and root support, soils also act as a buffer to shield plant roots from high fluctuations in temperature. Healthy soil also helps mitigate climate change by maintaining its carbon content. Knowing that soil is a non-renewable resource, still in many parts of the world, increased and intensified agriculture production is continued, which has stretched the soil to its breaking point, leading to deterioration and ultimately the degradation of the land.

Globally, **CO<sub>2</sub> levels** are increasing rapidly and many food crops like wheat, rice, barley, and soybeans, have reduced contents of nutrients. While the food often provides appropriate amounts of essential nutrients but nutrients such as iron, zinc, vitamin A, and iodine, are now scarce for many people worldwide. Additionally, persistent protein and

energy deficient malnutrition results into stunting, wasting, and low birth weight among the world's poorer population. The nutritional quality of the world has improved over the past few decades, but growth has been unequal, with many developing countries witnessing very moderate improvements, like in India, or complete stagnation, like in Africa. (Smith, Thornton, & Myers, 2018)

Nutrition security is also challenged by frequent **extreme events**. The rise in temperature, drought, changes in precipitation patterns, ocean acidification, and other conditions is linked with reduced food production, changing nutrient content, and unequal access to healthy food.

There is ambiguity in the relationship between **personal income and obesity**. In some cases, increase in income, an individual can afford diverse food items which could have minimum subsistence levels and can also be with choices and preferences. In other cases, income increase can lead to choosing healthier options as the capacity to afford increases and also knowledge of nutrition benefits increases. As of 2011, 22.72% of adult obesity prevalence was seen in high-income countries, whereas 20.88% in upper-middle-income countries (Talukdar, Seenivasan, Cameron, & Sacks, 2020, p. 7). Increased consumption of processed food will be responsible for the rise in fat consumption. In regards to regions, North America comprises 30.46% of adult obesity prevalence whereas South Asia has the lowest which is 4.37% (Talukdar, Seenivasan, Cameron, & Sacks, 2020, p. 8).

The affordability of nutrient-dense diets is lowest in **Sub-Saharan Africa**. The cost per calorie is higher for nutrient-rich food like sea

food, legumes, fruits, and nuts whereas it is lowest for starchy staple food. Animal products like eggs and dairy are costlier in poorer regions like sub-Saharan Africa and South Asia (Bai, Alemu, Block, Headey, & Masters, 2020).

In **developed countries**, poverty can be linked with lower-cost diets with key nutrients deficiency (Darmon & Drewnowski, 2015). In 2016, over 1.9 billion people (above 18 years of age) were overweight, globally, out of which 650 million were obese (World Health Organization, 2021). In 2017, 11 million deaths due to poor diets were reported (The Lancet, 2019).

**Prices of livestock products have risen due to the westernization of diets and growing demand for nutritional variety in emerging countries.** Currently, over 50% of the world's livestock production is in Asia, with China dominating most of the market (Aiyar & Pingali, 2020). Diseases like swine flu, avian flu, and foot and mouth disease, which afflict pigs, chickens, and cows respectively, have developed because of poor sanitation and hygiene standards in the livestock industry. With the age of sustainability and affordability of nutritious products for a section of society, a product is identified as sustainable if it has a fair trade certification. This also plays a great role in nutrition security along with economic and social security.

## 2.7 TRADE (IMPORT CAPACITY)

Trade will remain essential for ensuring food and nutrition security, increasing agricultural incomes, and reducing poverty. Trade is an essential mechanism for any country's growth and development. It strengthens value chains, provides access to greater quality of goods and services and more diversified and nutritious food. One of the key determinants

of food security is import capacity of the country which majorly depends on the economy of the country and the dependency factor on the other country.

There is a tendency for countries, with low population growth and density, and favourable natural resources, to export agricultural goods whereas for countries, with high population growth and density, and less favourable natural resources to import agricultural goods.

In order to improve food security, countries have two choices: either facilitate domestic food production or increase imports. In countries where agriculture growth is not possible or limited (due to any reason such as over-dependence on one commodity, prone to natural disasters, less fertile land, or any other condition), imports significantly contribute to the country's food security.

For the regions **Maghreb, the Middle East, and South Asia**, wheat is one of the most consumed food commodities. There are nine major wheat importers in these regions: Morocco, Algeria, Turkey, Iran, Pakistan, Tunisia, Bangladesh, Iraq, and Syria. Local wheat production declined in these countries due to unfavourable weather conditions. However, importing of wheat commodities gets difficult for these countries as they are heavily dependent on black sea supplies, especially Türkiye, which are disrupted for quite a long time. According to the Ukrainian Grain Association (UGA), the wheat exports from Ukraine would be at 10 million tonnes for the 2022-2023 marketing year as compared to 18.5 million tonnes in 2021-2022. (Argus, 2022)

The **European Union (EU)** was Ukraine's major trading partner, accounting for over 40% of its trade in 2019. 35.7% out of 1% of EU goods imported from Ukraine are agricultural

To maintain global food trade, there has been emphasis on enforcing **globally compatible food safety standards** which is a great step but uncertainty in the implementation lies in the different parts of the world, for instance: variability at local produce markets. **Private traders** can ensure compliance with standards as richer consumers can afford to pay more for quality products. Whereas, the customers who purchase from the wet markets tend to have low-income and rely on social connections with vendors which makes food standards to be less applicable.

There is widespread inequality between regions, countries, and local communities. Inequalities are an obstacle to socio-economic progress and political stability. In order to build peaceful and inclusive societies, countries need to primarily follow one of the universal values of the United Nations, which is "Leave No One Behind" (LNOB) (United Nations Sustainable Development Group).

## 2.8 GLOBAL SUPPLY CHAIN

Vulnerabilities in food insecurities can emerge at different stages of the supply chain. At the production level, if crops are not properly grown or damaged due to certain reasons. If the farmer is unable to deliver it to the market, then the food gets wasted. If food does reach retail stores, sometimes people cannot afford it due to higher prices, then a food insecurity situation arises. Logistics play an important role in maintaining a sustainable supply chain, from transportation, packing, and shipment to tracking. There are many constraints that come in the way of food security that put many people at risk of food loss or shortages.

The amount of food that is accessible for human consumption is more than the amount that is actually consumed because along the supply chain some of the food is being wasted or lost. Approximately, 14% of the food

produced worldwide is lost before it comes in the market (OECD/FAO, 2021, p. 32). **Food losses** are more prevalent in those countries where there are no proper marketplaces, poor road infrastructure, and underdeveloped cold storage facilities. Minimizing food loss and waste, as aimed by Sustainable Development Goal (SDG) 12.3, will help in improving food security, enhancing nutrition, and lessening environmental challenges.

In the face of **COVID-19 pandemic**, global food trade was suffered due to **logistics and higher sanitary issues**. The disruption in transportation led to employment crisis in many parts of the world, reducing the purchasing power of people. Though the production of food remained high, the crisis still had a direct impact on food and nutrition security. The pandemic exposed vulnerabilities in terms of transportation, logistics, processing, and packaging. The disruption in global trade flows made countries return to local producers and look for those products which are prevalent for the diet of their population.

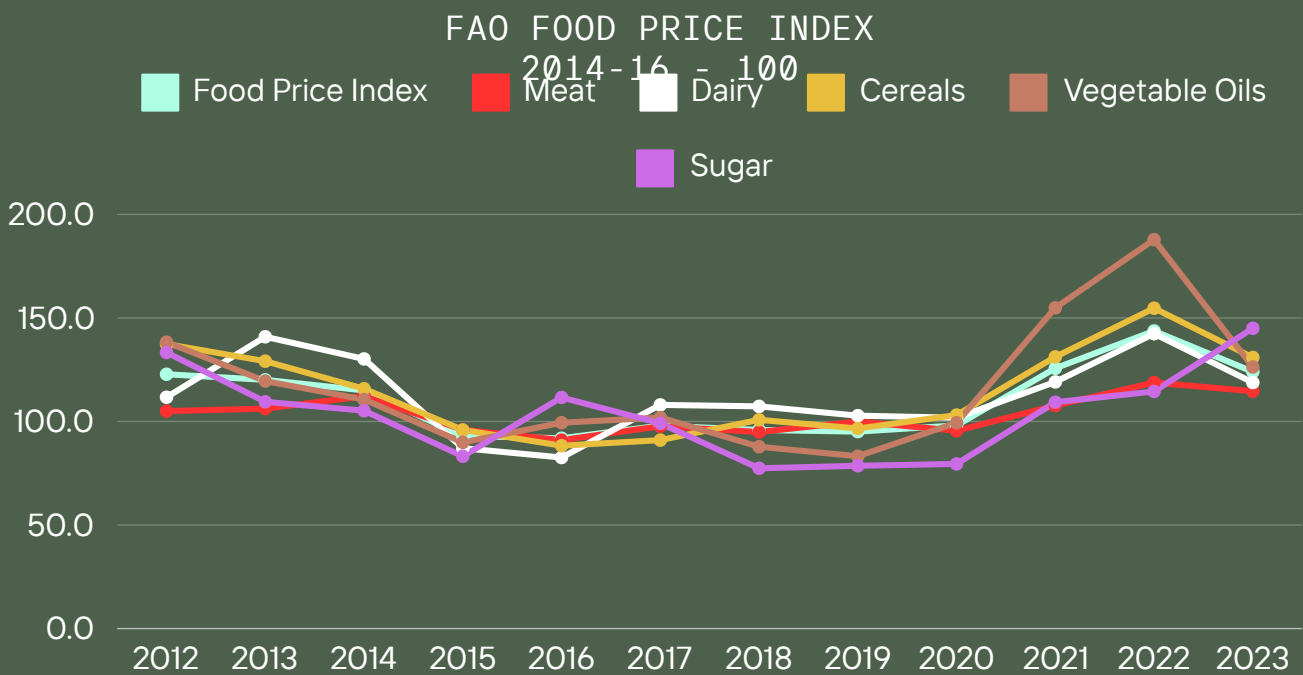
Food prices have risen sharply since the outset of Russia-Ukraine war, endangering millions of people. **Global Energy crisis** is one of the components which has spill-over effect on other sectors like food supply chains. The war increased the strain on global food supply chains, which was under pressure due to COVID-19 pandemic. Both the countries, Russia and Ukraine, are the major food exporters and play a significant role in fertilizer supply globally. The war has led to energy crisis in Europe, especially. **Oil and gas prices** reached their highest levels in almost a decade which also forced many countries to reevaluate their energy supplies. Russia is the world's top exporter of oil to international markets and natural gas fuels to Europe (Tollefson, 2022). Energy is used for a variety

of things in the food and agricultural industries, ranging from power use for automated irrigation systems, gasoline use for farm equipments, and then energy use in various stages of food supply (processing, packaging, shipping, and distribution). Production of pesticides and fertilizers require significant amount of energy, that also aggravates production costs and further leading to higher food prices, creating food insecurity in many parts of the world.

Due to population growth and increased food demand, there is strain on food industry to efficiently deliver supplies. Automation can play an important part in this sector. Many countries are still dependent on manual workforce in agricultural sector. Whereas countries which do not have enough manpower, can rely high-tech machines in the sector. In order to promote food security and quality, lowering the cost of production is urgently needed. The use of automation can be a reliable option because it can lead to considerable increase in cost savings and production efficiency.

## 2.9 NATURAL DISASTERS PLUS CLIMATE CHANGE

Food security gets affected by the climate change events like global warming, changing precipitation patterns, slow-onset climate events (droughts, salinization, desertification, sea-level rise, and other conditions), and higher frequency of extreme weather events (floods, storms, wildfires, landslides, and other conditions). Different regions see different changes as a consequence of climate change. **The underdeveloped and poorest countries or regions struggle the most as they are not capable enough to adapt new changes or situations.** People who are least responsible for climate change are paying the highest price. In any push factor of climate-related calamity, people from rural areas are compelled to migrate in search of shelter or employment. Rural families generally depend on climate-dependent resources like local water resources and agricultural land. Climate change tends to make natural resources less accessible, restraining the possibilities for rural people that depends on local natural resources for trade or consumption.



Source: FFAO Food Price Index (Food and Agriculture Organization, 2023)

The **Arctic region** has warmed roughly four times as quickly as the rest of the world since 1979 (Rantanen, et al., 2022). The biodiversity, including marine species and dependent species, is being impacted by the warming of the Arctic Ocean and the acidification of water. As the permafrost in the Arctic thaws, carbon and methane, two of the main greenhouse gases contributing to **global warming**, are released. In 2016, an anthrax outbreak in Siberia succumbed thousands of reindeers and infected many human lives. This all went down due to permafrost thawing, which was aggravated during summer heat wave (Ezhova, et al., 2021).

The year 2022 saw some extreme **weather changes** like **record-breaking heatwaves** around **Asia, Europe, and North America**. The likelihood of heatwaves, which occurred in 2022, in South Asian countries like India and Pakistan has grown by 30 times because of human-induced climate change (World Weather Attribution, 2022). India's wheat production in 2021 to 2022 crop season, was expected to be about 106.41 million tonnes which is 3.8 million tonnes less than last season's production (Mukherjee, 2022). In first week of May 2022, India received strong heatwaves, hitting a record of 49.2 °C in Delhi (Hrishikesh & Sebastian, 2022). And this became the primary reason why the production of wheat in 2022 in India had been projected to be low. Other reason was wheat prices in India increased in domestic market that stopped the Indian government from supplying wheat to the international market; it was only restricted to a few critical countries.

During the period 1961-2013, the yearly area of drylands, experiencing **drought**, has risen, on an average by over 1% per year (Intergovernmental Panel on Climate Change (IPCC), 2020, p. 259). In 2015, around 500 (380-620) million people lived in degraded areas, due to decline in vegetation productivity during 1980s and 2000s (Intergovernmental Panel on Climate Change (IPCC), 2020, p. 251). People living in desertified

areas are affected adversely by climate change. Somalia is facing a humanitarian catastrophe. In the first quarter of 2022, more than 0.5 million people were displaced by the drought (World Food Programme, 2022). There are two rainfall seasons in the country every year due to the rainfall pattern in the region; and people are prepared and have learnt to tackle the drought. They would save food during times of scarcity or sell off valuable livestock to buy food and water. But these challenges have scaled up now. The country is on the brink of famine as it saw a decrease in recorded rainfall. Generally, precipitation is low across the country (World Bank). As the situation keeps growing worse, over 7 million people are going to face critical food insecurity (McFadden, 2022).

The **Middle East and North Africa (MENA)** region is similarly dealing with water security issues. It is the region with the lowest water availability in the world. Water availability and quality are not just considered for safe drinking water available to all, rather a need for overall health system, including food security, sanitation, and hygiene. Around 9 out of 10 children reside in places with high water stress, which has become detrimental implications for health and nutrition development (UNICEF, 2021). Over the last decade, many countries made investments in weather modification technology in order to deal with water insecurity. In the dry Gulf region, the United Arab Emirates (UAE) has taken the lead in precipitation enhancement techniques, introducing its cloud seeding program in 2002 (Wehbe, 2022). The country is suffering from natural water resources like rain but not from freshwater insufficiency as the country has many desalination plants. The UAE imports 85% of its food but the country is aiming to become self-sufficient by improving its farm efficiently enough (The Economic Times, 2022). Water security is key for agriculture and overall food security. However, the cloud seeding technique does not change natural weather patterns, but it is a temporary phenomenon, efficient for smaller

areas. Unfortunately, it is not a solution for drought relief as to make the technique work; there needs to be moisture in the atmosphere.

On one side, there is one part of the world which is facing extreme drought events then there is another part of the world which is ravaged by flash floods. Pakistan has the highest concentration of glaciers, with 7253 in number, on earth, outside the polar regions (Craig, 2016). Pakistan is battling with catastrophe floods which killed over 1000 people, damaged infrastructure and crops, affecting more than 30 million lives (and the situation is still unfolding at the time of writing this report) since mid-June 2022 (Velez & Rebane, 2022). The country is one of the worst humanitarian crises in the recent times. The devastating flood may cost Pakistan's already-struggling economy USD 10 billion (Dilawar & Mangi, 2022). The destruction of the country's food supplies would undoubtedly raise the demand for imports and put more pressure on the world's agriculture markets.

Climate Change which is aggravating drought frequencies and conditions in the region, also causing heavy rains. Temperature is rising in the **Sahel region** 1.5 times faster than in the rest of the planet. In Mali and Niger, destruction from severe **river floods** were observed in 2019; as water couldn't be absorbed due to land degradation. These natural catastrophes are degrading the natural resources which are vital for agro-pastoral livelihoods that support the economy of the area; but the simultaneous damage to crops and livestock is leading to the economic loss. 2 out of 3 people's livelihood in the region are directly dependent on agriculture and livestock. Furthermore, for the rest of the population, who depends on the local products, is afflicted because of price inflation (Mayans, 2020). In 2007, African Union launched a **Great Green Wall** initiative which aims to restore degraded land in Sahel region, covering 11 countries, by 2030, that will flourish millions of lives by boosting creating green jobs, improving health and food security, and generating income opportunities for local communities. (United Nations Environment Programme, 2021)

Dust storms have risen in frequency in last few decades. And desertification is a cause and consequence for dust storms. Saudi Arabia, the country which is extremely exposed to desertification, is adversely affected by frequent and intensified dust storms, also especially due to climate change (Intergovernmental Panel on Climate Change (IPCC), 2020, p. 264). Dust storms remove fertile upper layer of the soil, damaging crops, smothering livestock, and further leads to serious impacts on livelihoods of dryland farmers.





### 3. COMPARATIVE ANALYSIS

Food diet, habits and international prices vary across the world. We have made average nutritious plate (vegetarian and non-vegetarian) considering and reconsidering representative food items, classifying each of them on the basis of proteins, fats, and carbs for which we have taken the data from multiple sources and took the average in order to arrived at one figure/number. The numbers which we have calculated would not represent absolute or accurate figures/numbers, as these would be representative ones. The protein, fats, and carbs are being calculated for an adult person with the daily calorie intake 2000.

Nutrients	Range (g)
Proteins	50-175
Fats	79-89
Carbs	225-325

Food Items	Protein (g)	Fats (g)	Carbs (g)	Monthly Cost (Average Int. Price) in USD
Flour (125g)	13	12	95	5.1375
Beans (254g)	12	0.9	54	26.289
Lentils (198 g)	17.9	0.752	39.8	6.475
Milk (2 cups)	16	16	24	21.9
Potato (100 g)	1.9	0.1	20.1	4.11
Rice (158 g)	4.3	0.4	45	55.268
Vegetable Oil (14g)	0	14	0	1.42
Cheese (100g)	23	33	3.1	43.251
1 apple (100g)	0.3	0.2	13.8	7.65
1 banana (100g)	1.1	0.3	22.8	4.5
	<b>89.5</b>	<b>77.652</b>	<b>317.6</b>	<b>176.0005</b>

FIGURE (I) - VEGETARIAN PLATE

Food Items	Protein (g)	Fats (g)	Carbs (g)	Monthly Cost (Average Int. Price) in USD
Flour (125g)	13	12	95	5.1375
Beans (254g)	12	0.9	54	26.289
Lentils (198 g)	17.9	0.752	39.8	6.475
Milk (2 cups)	16	16	24	21.9
Rice (158 g)	4.3	0.4	45	55.268
Vegetable Oil (14g)	0	14	0	1.42
Chicken (85g)	20	11	0	11.985
Fish (42.5g)	10.9	1.125	0	2.069
Cheese (100g)	23	33	3.1	43.251
1 apple (100g)	0.3	0.2	13.8	7.65
1 banana (100g)	1.1	0.3	22.8	4.5
	<b>118.5</b>	<b>89.677</b>	<b>297.5</b>	<b>185.9445 ≈ 186</b>

FIGURE (II)- NON - VEGETARIAN PLATE

We took classification of countries, income-wise, by World Bank and compared countries on the basis of that. We took average GDP per capita (The World Bank, 2021) and cost of living (livingcost). For average nutritious food cost, we took the average of vegetarian and non-vegetarian plates, i.e., 181 which is the average monthly cost according to the international prices.

Category	Number of countries
High Income	80
Upper Middle Income	54
Lower Middle Income	54
Low Income	28

FIGURE (I)

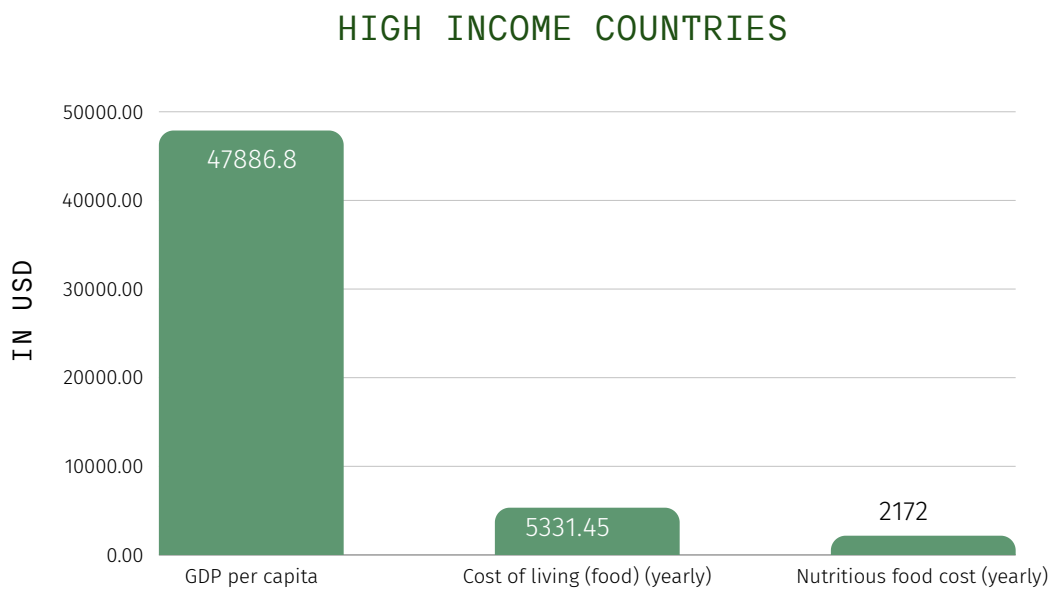


FIGURE (II)

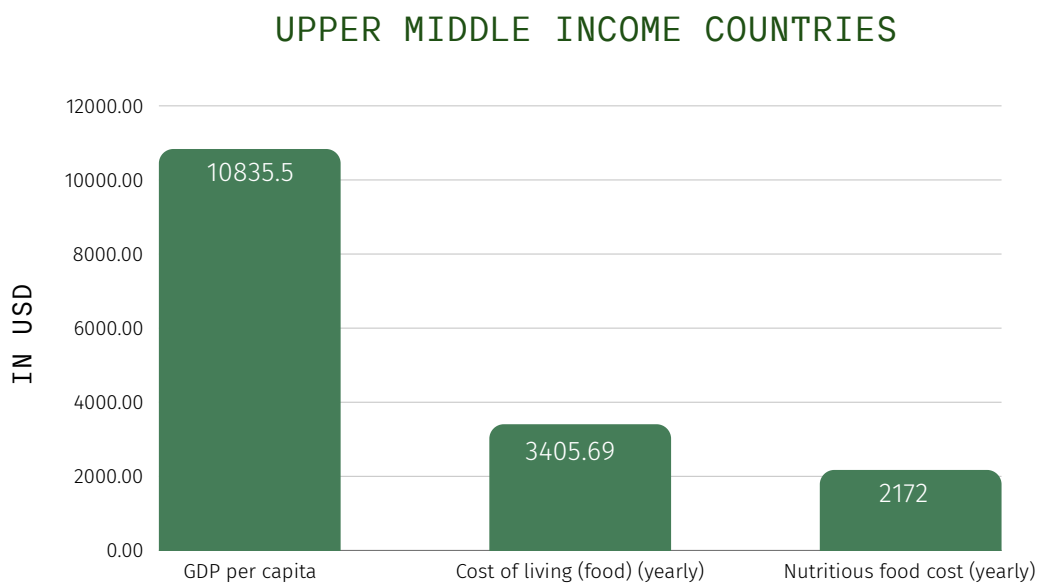
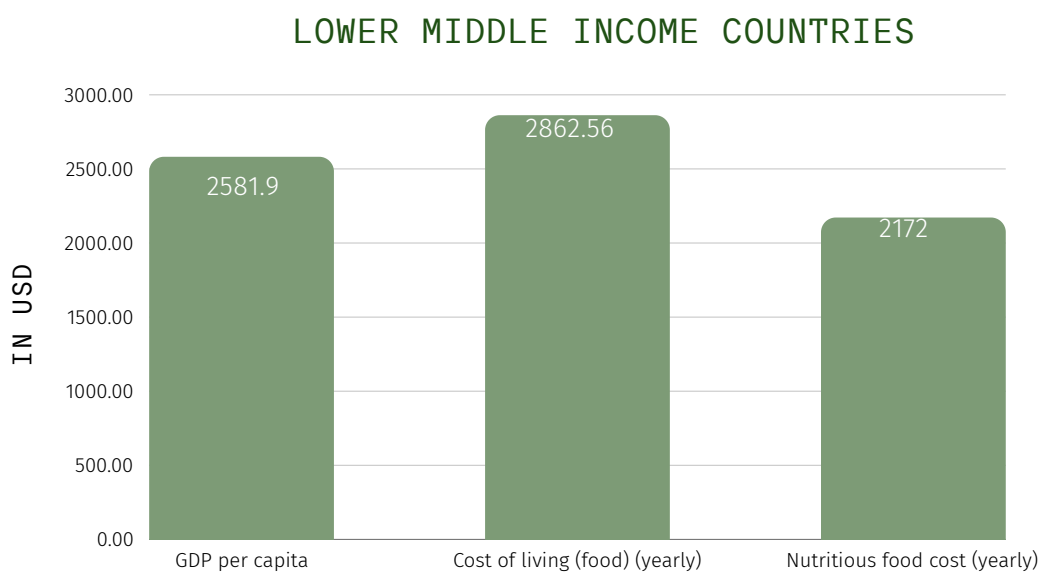
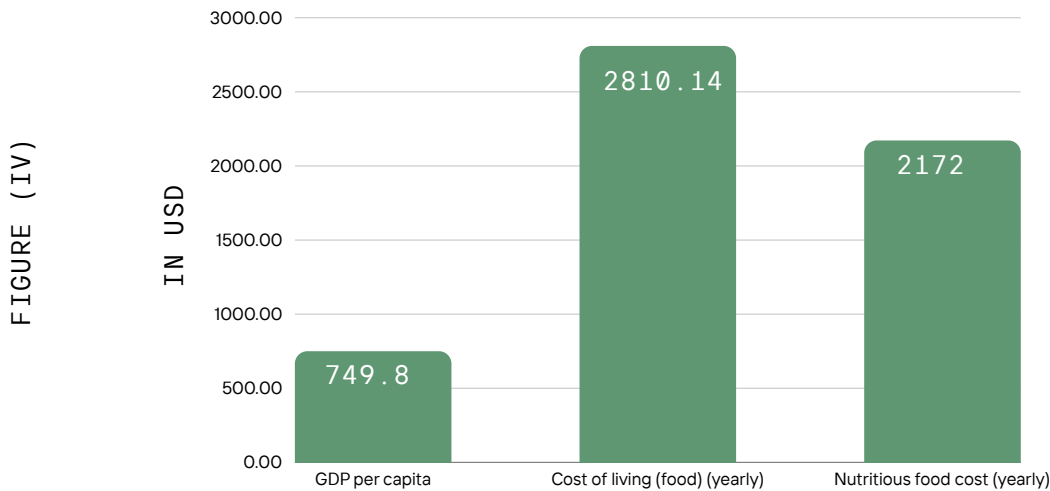


FIGURE (III)

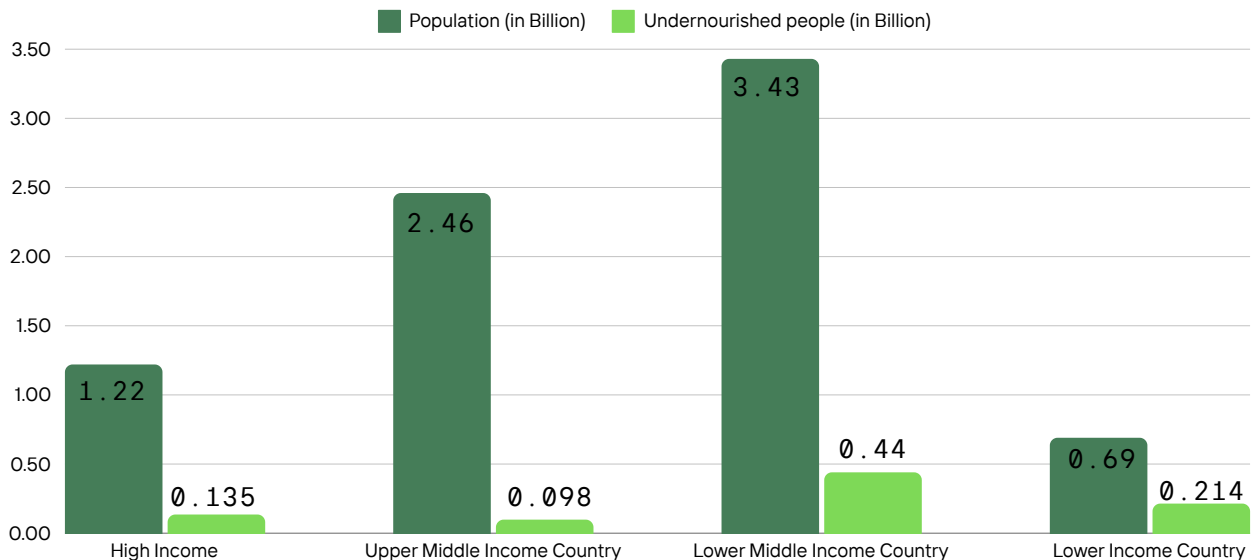


## LOW INCOME COUNTRIES



Right to have food is a dream for millions of people in this world. On one side, millions tonnes of food go wasted and another side, millions sleep hungry every day. Average person in high income and upper middle countries can afford to have nutritious food. Still in both categories, there is one section of the society which is undernourished. So, not every single person has access to or can access to healthy diet in high and upper middle-income countries. There are some core problems governments across the world need to think as to why they are inefficient to provide the basic necessity of life: food.

## POPULATION VS UNDERNOURISHED



Source: World Bank

There are two major reasons to why undernourishment exists in the world: Lack of Purchasing Power (GDP per capita) and Awareness about what and how much nutrition is required to our body. When people become aware of nutrition requirement, demands for the same grows and further production of particular items. Thereby productivity and production are directly proportional. But people can only demand if they have good purchasing power. So, this is a vicious

cycle. The economy of the country needs to be good; no political or financial crisis; no conflict like situation. These are the primary aspects to break the cycle.

In lower-middle and low-income countries, which comprises of 4.12 billion population, the situation of a healthy living for an average person is dreadful. 13% of the total population in lower middle and 31% of the total population of low-income categories are undernourished. Cost of living of “just food” in countries which comes under lower-middle and low-income categories (total 82 countries), is higher than GDP per capita.

There are people around the world who cannot afford or have access to food as we see the situation in low-income countries especially. But there is one different picture to the situation. Globally, on an average, food waste footprint per capita in high income countries is more than in low-income countries due to inefficient food distribution and consumption (Scialabba, 2015). This is just an example to put forward that: Will just good economy or high GDP per capita solve the food security problems or is it the responsibility on part of each one of us?



**The problems of this issue are at very miniscule level in every sector and part of the world. We have some major challenges to which we have provided implementable recommendations from where we can start so that the time when it would be impossible to reverse the situation does not come.**



## 4 . FRAMEWORK

1. Tracking and scoring cities of the country on the basis of planned and sustainable urbanization, considering socio-economic aspects.
2. Whether countries have plan to save their native biodiversity which includes actionable policies for forest health, flora & fauna, and investing in traditional & indigenous knowledge.
3. Whether countries can self-sustain at the time of any crisis. What is their dependency factor on other countries for food commodities? And if it is high, then is that country's economy capable enough for importing food items?
4. Countries need to check nutrient intake per person to track healthy and nutritious dietary pattern
5. Countries need to have soil health card.
6. Countries also needs to keep in check of the balance between average income and food commodity prices.
7. Whether countries have signed and rectified international peace treaties and others so that at the time of any conflict, countries can get help in order to ensure basic food security.
8. Countries to be ranked on the certain issues:
  - Socio-economic inequality in the country
  - Percentage of the population earning below global average income or average income of developed nations.
  - Average disposable income
  - Countries having a legitimate food market system with all food safety requirements
  - Employment discrimination and labor rights
9. Are countries taking actionable steps (making plans are not enough) to mitigate anthropogenic disasters? Are they sustainably restoring the places that are struck by disasters?

## 5. RECOMMENDATIONS

- To address global food insecurity, there needs a **proper allocation of resources** and for that coordination at the global, regional, and national levels are required. Developing and least-developing countries should be capable enough to develop strategies for groundwork.
- **Good and responsible governance:** In order to encourage investment, especially for small-scale producers - labour forces, countries need to strengthen capacity of various institutions in developing countries to have effective policies. Countries should bring out policy reforms whenever necessary. Policies should not be just climate-specific but also prioritize the livelihood of people from rural areas, people suffering due to climate-related disasters, and how to make them resilient enough in case of resource-base changes. Knowledge about soil health will enable people to realize their actions affecting the soil whereas good governance will guarantee the sustainable soil management.
- **Use of Technology and Artificial Intelligence** in forest management and disaster risk management to mitigate the effect of crisis and have better impact assessments
- **International cooperation:** Countries to do collaborative work on R&D in agriculture field. Developed countries to share their research work with other countries in order to curb long-term food crisis. Enhance private-sector investment in countries for development of rural infrastructure, diverse services, technologies, health, irrigation, and so on.
- Nutrition strategies at national as well as global level
- Better coordination among countries at the time of crisis. Countries need to work together and strategize that resources are not being completely consumed before they are replenished. Moreover, the world needs to stop or reduce all the activities that are depleting natural resources while hampering ecological system to reproduce resources. There should also be improved and efficient emergency assistance by international communities at the time of any crisis that can create food insecurity in that particular region.
- **Agriculture:** More sustainable agriculture practices like instead of using synthetic fertilizer, the use of sustainable agricultural intensification methods would be beneficial as it guarantees adequate nutrient availability in the soil. Agriculture education at primary and higher education system. Departments of agriculture, water, land, health, education, and infrastructure should work together to make effective strategies on food insecurity. Countries need to focus on improving the food market system at the national level. Also, governments need to regulate how people communities and people get access to land for agriculture purposes, fisheries, and forests, this has impact on food security. The livelihood of people from rural areas depends on access and control on resources. There should be planned diversification of agricultural activities which should include both individual as well as social gains. It should be planned in a structured way to eradicate poverty, generate more employment & income, and

conserve the environment. For example: In India, diversification is emerging from cropping patterns to other agricultural activities.

- There is a need for **an integrated landscape strategy** to address the pressures on forests. Countries need to take immediate actions to conserve all valuable ecosystems from forests to marine life.
- **Costs of nutrient-dense food** must decrease if healthy diets are to become more widely accessible. There are many factors that affect the price of healthy and nutritious food supply chain to the consumer engagement with food system. Investments in better processing, preservation, and storage to keep food products' nutritional value is essential to maintain food safety. Expanding the variety of crops produced and diversifying into agroforestry, livestock, and/or fisheries goods at the production level is also crucial for improving small-scale producers' incomes.
- Data on **cropping intensity** (average number of crop harvests on 'arable land') should be regularly estimated and reported topography-wise.
- Urbanization needs to be properly and sustainably planned and regulated timely otherwise it can lead to increase in urban slums.
- **Food storage requirements** should be national responsibility. A sustainable food supply indicates that effective food distribution and enough food must be preserved to cover poor harvests and recurring food crisis.
- Countries need to focus on **improving energy efficiency** and speed-up the expansion of renewable energy.
- Countries need to look at their **dependency factors on other countries** and focus on becoming self-sufficient, at the time of crisis at least.
- The world needs to come together for **pandemic preparedness** which should not be just human-centric but also focuses on animal health and diseases' potential to emerge pandemic in animals.
- Taking **proactive measures** along with food-safety interventions will lower the likelihood of new diseases.
- **Income Equality and equitable distribution of opportunities** across sectors. Environmental sustainability addresses an important issue of social justice from paying workers a 'deserved wage' to afford nutritious and healthy lifestyle.
- **Food Sovereignty** can be an answer to many aspects of food insecurity. The traditional knowledge of native biodiversity has become important to conserve and preserve nature, with the ongoing rapid urbanization. The passing-on of the knowledge also helps in preserving culture and community which is important for the wellbeing of a society.



- **Intergenerational solidarity:** Young and coming generations are on the frontline of the consequences and challenges posed by inaction on the environmental crisis. World needs intergenerational solidarity to bring out effective change for healthy future of the planet.
- **National measures to reduce food waste and loss** (post-harvest loss as well). Putting emphasis on the production level of the food supply, which tends to increase supplies and lower the food prices, can be a crucial and foundational step for food security. This is also important for reduction in food losses. Moreover, focusing on the parts of the food supply chain where food losses are highest, will have a major impact on lowering cost on food items. Also, investment in better and improved storage facilities will also help in increasing food safety and preserving food nutrients.
- Today, 2 billion people globally experience micronutrient deficiencies, which are mostly brought on by dietary shortages in vitamins and minerals (Ritchie & Roser, 2017). **Food fortification** could be a method to address these deficiencies.



Source: Lawrence Freeman

## 6. CONCLUSION

To tackle global food insecurity, global, regional, and national coordination and proper allocation of resources are needed. Good governance, policy reforms, and education on soil health are important. Use of technology and international cooperation is also crucial. Sustainable agriculture practices and diversification of agricultural activities are necessary to eradicate poverty, generate employment and income, and conserve the environment. A focus on energy efficiency and renewable energy, pandemic preparedness, income equality, and equitable distribution of opportunities is required. Food sovereignty and intergenerational solidarity are also important. National measures to reduce food waste and loss are crucial for food security. Urbanization needs to be properly planned, and natural resources should be conserved.

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