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IMPACT OF GLOBALIZATION ON FOOD SECURITY AND SAFETY: A REVIEW

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ABSTRACT

An estimated 151 million children under five are severely stunted, 821 million people are under-nourished, and about 613 million women aged between 15 and 49 are anaemic. On the other hand, the increasing complexity of the food chains is resulting in food safety issues influenced by food policies, international standards, domestic and global politics, social demands, and economic aspects. The global impact of food borne illnesses is disturbing and is estimated to be around 420000 deaths yearly, with one in ten people falling ill.
The future of farming is increasingly moving towards uncertainty due to the impact of various factors– population growth, climate change, changing dietary habits, and globalization. The link between food safety and security is known but not yet applied in the actual context. This paper seeks to review the impact of globalization on the food systems, especially the effects on food security and safety, with concomitant mitigation strategies for ensuring safe, secured, and sustainable food systems.

Keywords : Food Safety, Food Security, Food Systems, Sustainable, Globalization

Introduction

The world's population is estimated to reach around 9 billion by 2050, and providing access to safe nutritive food is a massive challenge to most governments all over the globe while preserving the biodiversity to sustain the crop production systems (Burney *et al.*, 2010). The concept of Food Security originated in the 1970s, an outcome of the global food emergency, and was primarily focused on ensuring the availability and stabilization of the prices of primary food materials at all levels, national and international (FAO, 2008). Other critical issues, such as hunger, and the famine that occurred in the 1970s, led to the recognition of the Green Revolution. However, it increased the productivity of the food grains but did not contribute to a concomitant reduction in malnutrition and poverty (FAO, 2008). By the 1990s, food security was recognized as a pressing problem needing attention due to its impact at all levels – individual, household, national, and international (FAO, 2008). Intense agricultural practices over the decades have had negative consequences on soil fertility and the environment, giving rise to new challenges in food security and sustainability of the crop production systems (Tilman *et al.*, 2011). In addition, emerging pathogens, contamination with heavy metals, pesticide residues, and adulterants pose a massive threat to fragile food systems (Wu *et al.*, 2017; Andrade *et al.*, 2018).

Globalization has had mixed effects both on the food systems and the farmers, especially the small landholders across the world. While foreign direct investment, increased demand and incomes of the urban consumers has led to greater accessibility and affordability of processed foods; however, had put the small and marginal farmers at a more significant disadvantage, especially in developing countries (Elizabeth, 2016), contributing immensely to food insecurity and malnutrition.

Food Security – Origins and Numbers

The first definition of Food Security was given at the World Food Summit in 1974; however, the same has gone through several modifications over the years to include nutritional security and food safety. A much broader definition encompassing Food Safety was given in the World Food Summit conducted in 1996 as "Food Security, at the individual, household, national, regional, and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." (FAO, 2008**).** Four indicators for measuring food security were established at the summit – availability (includes quantity, quality, and diversity), accessibility (includes infrastructure and physical access), stability (includes incidences of disturbances), and utilization (ability to consume or unutilized) (Figure 1) (FAO, 2014).

A recent report released by FAO portrays an alarming scenario of the state of food insecurity in the world. A whopping 3.1 billion did not have access to healthy food due to rising food prices owing to the pandemic. It is projected that by 2030 about 670 million will be hungry, and around 11.7% of the world's population will face severe food insecurity in 2021. Also, approximately 22% of children below five years of age were stunted, 6.7% wasted, and 5.7% overweight, with children in deprived rural areas being severely undernourished (Figure 2) (FAO, 2022).

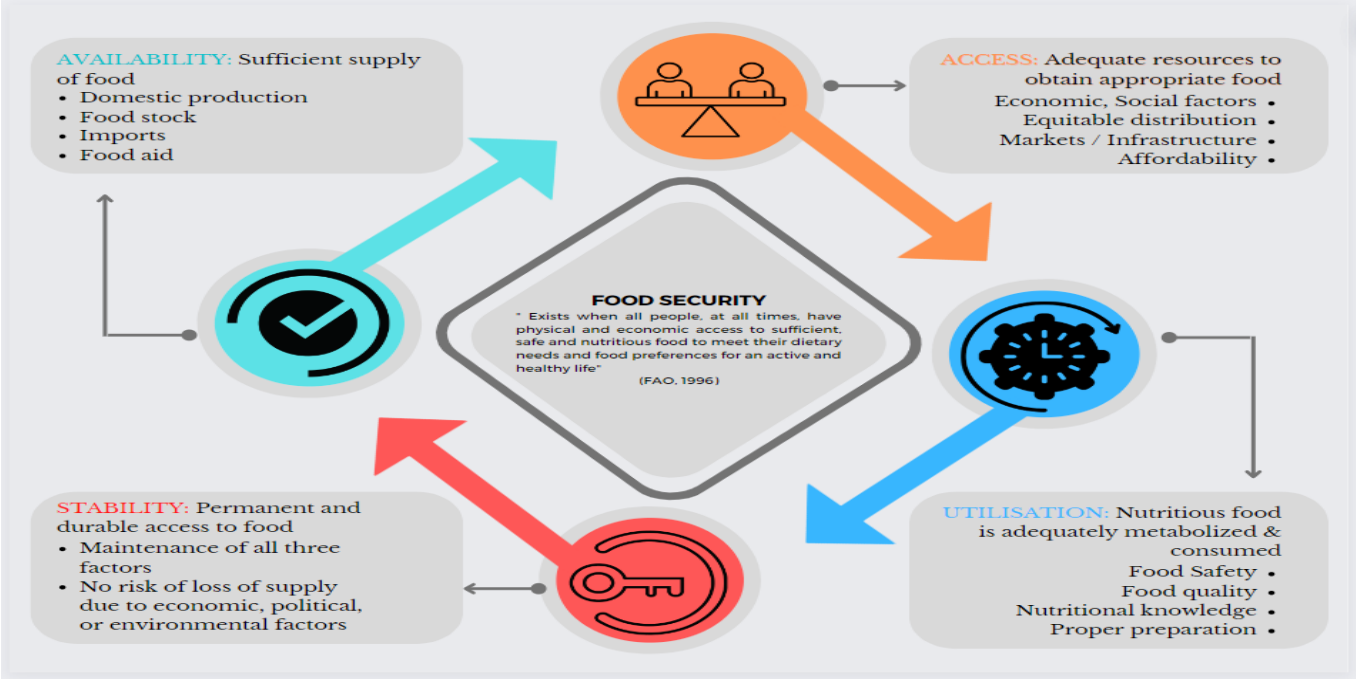
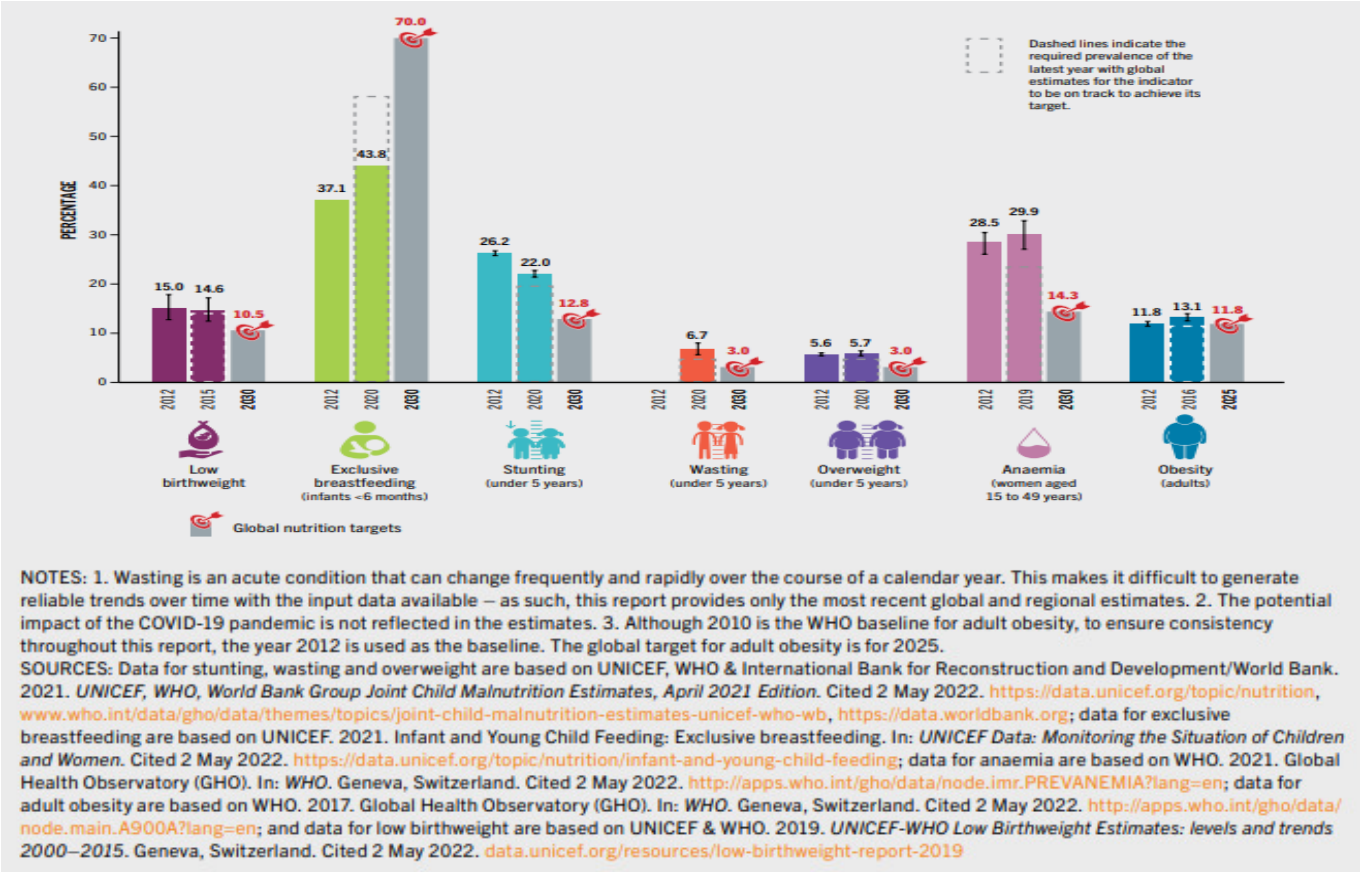


Fig. 1 : Food Security Defined and Factors Affecting the Accessibility, Availability, Stability, and Utilization, Adapted from FAO

Drivers of Food Insecurity

The most critical factors that drive food insecurity and malnutrition include climate change, conflicts, and economic slowdown (inefficient supply chains and low productivity). Low productivity drives up the prices of nutritious foods, and this, together with low incomes, makes food unaffordable, especially in low and middle-income countries (Figure 3). The situation has further worsened with the onset of sudden global health issues such as COVID-19. Several drivers' complex interplay was responsible for driving up the number of people affected by food insecurity globally (FAO, 2022). The impact was very high on low and middle-income countries (70%) of which 41% had high-income inequality.



NOTES: 1. Wasting is an acute condition that can change frequently and rapidly over the course of a calendar year. This makes it difficult to generate reliable trends over time with the input data available – as such, this report provides only the most recent global and regional estimates. 2. The potential impact of the COVID-19 pandemic is not reflected in the estimates. 3. Although 2010 is the WHO baseline for adult obesity, to ensure consistency throughout this report, the year 2012 is used as the baseline. The global target for adult obesity is for 2025.
SOURCES: Data for stunting, wasting and overweight are based on UNICEF, WHO & International Bank for Reconstruction and Development/World Bank. 2021. *UNICEF, WHO, World Bank Group Joint Child Malnutrition Estimates, April 2021 Edition.* Cited 2 May 2022. https://data.unicef.org/topic/nutrition, www.who.int/data/gho/data/themes/topics/joint-child-malnutrition-estimates-unicef-who-wb, https://data.worldbank.org; data for exclusive breastfeeding are based on UNICEF. 2021. Infant and Young Child Feeding: Exclusive breastfeeding. In: *UNICEF Data: Monitoring the Situation of Children and Women.* Cited 2 May 2022. https://data.unicef.org/topic/nutrition/infant-and-young-child-feeding; data for anaemia are based on WHO. 2021. Global Health Observatory (GHO). In: *WHO.* Geneva, Switzerland. Cited 2 May 2022. http://apps.who.int/gho/data/node.imr.PREVANEMIA?lang=en; data for adult obesity are based on WHO. 2017. Global Health Observatory (GHO). In: *WHO.* Geneva, Switzerland. Cited 2 May 2022. http://apps.who.int/gho/data/node.main.A900A?lang=en; and data for low birthweight are based on UNICEF & WHO. 2019. *UNICEF-WHO Low Birthweight Estimates: levels and trends 2000–2015.* Geneva, Switzerland. Cited 2 May 2022. data.unicef.org/resources/low-birthweight-report-2019

Fig. 2 : Data for Stunting, Wasting, and Obesity (Adapted from FAO)

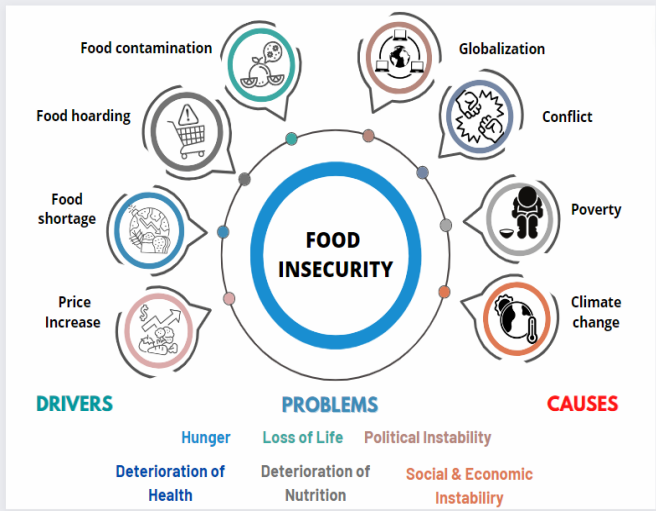


Fig. 3 : Drivers of Food Insecurity

Food Safety

According to WHO, one in ten people globally falls sick annually due to food contamination. The burden of food borne diseases is significant and has been increasing ever since. Several food-related outbreaks were reported in the 1980's and 1990's – some classic cases include

- The most dreadful outbreak of *Salmonella enterica serovar typhimurium* occurred in USA in 1985, involving milk produced by Hillfarm dairy that was operated by Jewel Companies Inc. It was estimated that about 150,000 to 250,000 people were affected and resulting in nine deaths (Ryan *et al.*, 1987)
- An outbreak of *Escherichia coli* O157:H7 in the USA in 1993 caused four deaths of children, with 700 people falling sick from a contaminated hamburger sold by a fast food retailer Jack in the Box (Golan *et al.*, 2004)
- A new variant of Creutzfeldt–Jakob, previously unknown, was implicated with the consumption of sheep meat that was affected by prion disease. It was later identified that the disease jumped from sheep to cows causing Mad Cow Disease (Bovine Spongioform Encephalopathy), causing disruption of the meat supply systems globally, warranting traceability systems (Will *et al.*, 1996)
- Melamine contamination in 2004 affected about 6,000 dogs in Asia – the cause of the outbreak was largely unknown for a long time. The outbreak implicating milk in China in 2008 resulted in the hospitalization of 54,000 babies, causing six infant deaths, and kidney damage in about 300,000 individuals (Brown *et al.*, 2007; Gossner *et al.*, 2009)
- The presence of aflatoxins in the food systems exemplifies the profound deadly impact on the food security and safety aspects of the value chain. The toxins are produced by the fungi *Aspergillus flavus*, and *A. parasiticus* and are often present in several staple foods such as maize, wheat, millets, and peanuts. The pathogen is known to cause cancer in humans, stunting in children, anaemia in women, and increased susceptibility to other diseases such as HIV and malaria (Pitt *et al.*, 2012). Aflatoxin contamination affects all three components of the economy, namely, public health, international trade, and agriculture. Regulations globally restrict the trade of peanuts and maize, severely impacting the economy of the African countries and the majority of the small landholders depend only on the cultivation of these staple crops.

The number of food recalls has increased in the past few years, and the primary source of contamination/infection remains unknown in several cases. An example case – an *E. coli* outbreak in Germany implicated tomatoes from Spain and cucumbers from Holland as the source of infection. A further investigation, however, did not trace it to any of the implicated products; however, consumers opted out of buying these products due to a negative perception of the safety of the products, thus impacting the farmer's income (EU Press Release, 2011). The source of contamination was later traced to bean sprouts, which was further linked to another outbreak that occurred in France. The primary source of contamination in both cases were traced to seeds coming from Egypt. Other lesser known hazards such as allergens and the presence of foreign objects are a cause of concern too.

In addition, genomics has introduced the application of CRISPR-cas 9 technologies for developing new varieties resistant to biotic and abiotic stresses. Some examples include – the modification of *BIN2* gene in lettuce, enabling the regeneration of whole plants with a mutation efficiency rate of about 46% (Woo *et al.*, 2005). The technology was used to alter the colour of the fruits in tomatoes (Hayut *et al.*, 2017). The downside effects include–inaccuracy leading to off-target activity resulting in point mutations, insertions, and deletions (Modrazejewski *et al.*, 2020). Recombinant technologies have had limitations as well–the emergence of zoonotic infectious diseases, a classic example of the outbreak of COVID-19 implicating the meat market in Wuhan province of China (although debatable with the lab leak theory). The complex interaction of the environment, food, and animals/plants makes it all the more challenging ensuring the safety of the food.

Impact of Globalization on Food Security and Safety

Globalization has brought opportunities and challenges in ensuring food, nutritional security, and safety worldwide. Several food aid programmes were launched to ensure the supply of food globally in the initial years (1960's) for overcoming hunger, wherein food was supplied by the developed countries to feed the deprived populations of the developing countries (Friedmann *et al.*, 1982) with an aim to reduce the hunger. Over the years, however, the excessive dependence on foreign resources resulted in political challenges (related to the cold war), especially in the US, that being by far the primary donor. The food crisis in the 1970s (increasing grain prices) shifted the focus from mere supply to availability and access for ensuring food security. In the course of time, FAO incorporated the concepts of utilization, stability, safety, and nutrition, making it more comprehensive.

Trade in agriculture across the countries has been in vogue for centuries; however, the inception of the General Agreement in Tariffs and Trade (GATT) brought new dimensions to the agriculture sector. Food and agriculture were initially excluded from trade liberalization ("free trade")

owing to the instability of the markets, and free trade was considered to be a significant limitation for countries in ensuring food security at the national level (Moon *et al.*, 2010). It was argued that countries have sovereign rights to implement policies for increasing production domestically and have the prerogative of developing the local food systems resulting in rural development (Burnett and Murphy, 2014). However, the trade restrictions have had a differential impact on developing countries. The rich nations backed the local food systems with solid subsidy policies resulting in surplus production that was eventually dumped in poorer nations under the garb of food aid, altering the international markets to their advantage (Friedmann *et al.*, 1982).

The Agreement on Agriculture (AOA) was reached in the Uruguay round of discussions with adoption of some aspects of trade liberalization related to agriculture. The agreement allowed for some tariff reductions on the agricultural products, however, continued to encourage heavy subsidy support in the industrialized countries. The less developed countries on the other hand were required to open up the markets for imports in spite of not having the massive subsidy programmes implemented in their respective countries putting them to a disadvantage (Pritchard *et al.*, 2009; Khor *et al.,* 2010). Intense debates continued over several aspects oftrade liberalization vs. trade restrictions related to agriculture and Doha round of talks aimed to rectify the imbalances by providing for specific provisions for the developing countries by citing the significance of "non-trade" issues related to food security (Clapp *et al.*, 2015).

The developing countries especially in Asia and Africa have been implementing several trade policies over the years such as export bans, price controls, and stock holding schemes to protect the interests of the farmers and for ensuring domestic food security. The programmes also allow for achieving self-sufficiency thereby reducing the dependency on global food markets for food supply. Several theories have been floated for trade liberalization justified by the concepts of comparative advantage (World Bank 2012; Lamy 2013), efficient production resulting in increased production enabling movement of food from regions of surplus to deficit, technology development and knowledge transfer across the countries for further enhancement of production and economic growth (Lamy, 2011). Although convincing, trade liberalization doesn't benefit all the countries uniformly and is largely based on the premise of existence of perfect competition, and perfect mobility of labour and capital within the country which seldom is the case. The complex globalized food value chains are generally dominated by powerful multinational corporations from developed countries (UNCTAD, 2009)–only four firms typically control about 70 percent of the grain market (Murphy, 2012) resulting in distorted markets due to lack of competition (Murphy *et al.*, 2006). The margins gained in the value chains are more often unevenly distributed with few dominant multinationals generally taking a bigger share of the profits as compared to farmers who are involved in the production (McMichael, 2013). Farmers from the developing countries are generally small players in the global scenario and more often the stakes are held and controlled by the corporate who tend to distort and manipulate the prices resulting in inefficiency (Gonzalez, 2011). The small farmers catering to the global food chains more often lose the decision making capacity in several aspects-types of crops to be grown, use of agricultural inputs, marketing of the output (McMichael, 2013) and are highly subjected to the risk of rejection for not meeting the standards (Singh, 2002; Masakure, 2005). In addition, the contract farming results in acquisition of land on a large scale with farmers losing the rights and promotes greater mechanization and intensification of agriculture (White *et al.,* 2012; Cotula, 2012).

The unique aspects of agriculture sector especially its high dependency on the environment makes it less flexible and is generally deeply impacted by the price distortions and the impact is highly profound in the developing countries with about 70–80 percent populations dependent only on agriculture. Globalization of food systems may also result in having a negative impact on the environment and concerns have been raised "the environmental costs of food production might increase with globalization, for example, because of increased greenhouse gas emissions associated with increased production and food transport … There is an urgent need for a better understanding of the effects of globalization on the full food system and its externalities" (Godfray *et al.*, 2010). Trade liberalization may lead to economic growth and efficiency, however, the social aspects such as protecting the livelihoods especially of those in the rural areas, ensuring equal access to food, and having sustainable food systems require greater attention more so in the developing countries. Greater emphasis should be given to the local food systems involving small and marginal farmers with a more inclusive approach of integrating the marginalized sections in the value chains.

Global food trade had opened up immense opportunities with regards to the availability and accessibility of processed and packaged foods in regions across the world. However, the farm to fork food chains have lengthened and are getting more complex warranting new strategies for identifying emerging and unknown food borne threats such as pathogens, allergens, and potential toxins along the food chain. The threat of accidental introduction of pests and pathogens in new geographic areas may massively disturb the food systems and public health. Consumers demand for convenience and life style changes had resulted in increased consumption of ultra-processed foods (Friel *et al.*, 2015) leading to high prevalence of chronic illnesses such as diabetes, cancer, coronary diseases, and obesity (Rayner *et al.*, 2006) in addition to high health costs (Monteiro *et al.*, 2013). There is also a growing risk of epidemics affecting international trade, food security, and public health – the African Swine Fever (ASF) is caused by a DNA virus that causes hemorrhagic fever in pigs and wild boar. The virus was initially identified only in Sub-Saharan Africa, however, it later spread to Europe, and eastern Asia. An outbreak of ASF in China in 2018 resulted in massive reduction of swine populations (Zhang *et al.*, 2019) disrupting global trade (China is the largest producer and trader of pork), and food security for lower sections of the populations affecting the rural livelihoods.

Advances in genetic engineering of crops has had mixed results–it remains highly controversial with regards to labeling, and acceptability (not highly accepted in Europe, Asia, and Africa). Use of genetically engineered crops in developing countries is limited–majority of the farmers own small holdings - cannot afford the heavy input costs leaving

them in indebtedness due to low productivity. The safety of the product and the environmental impact is questionable.

Way Forward

The safety of the food is very critical for ensuring food security (Fig. 4) and should be prioritized in the face of high risks associated with the global value chains. The environment within which food is produced is changing at a faster pace – climate change, emergence of previously unknown pathogens, international standards, growing consumer demand for healthy and safe foods is adding pressure on the producers. The mitigation strategies for preventing unwanted food threats include risk-based approach (identification and analysis of potential hazards in the food chains) policy changes (Codex, EU directives), and certification (nations to encourage and support the small producers for meeting the global quality and safety standards).

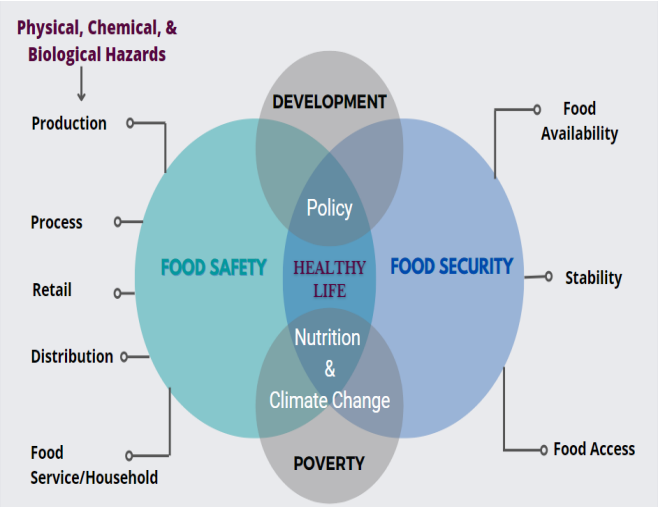


Fig. 4 : Impact of Poverty, Policy, Climate Change, and Development on Food Safety and Security

Ensuring food security especially meeting the food requirements of the vulnerable sections in the developing and under developed countries remains the top most priority of the nations. With limited land available for agriculture it gets even more challenging feeding the populations. The question remains – how to achieve food security? While it is important to meet the food demands, it is also critically essential that environment is protected as it directly effects the sustainability of the food systems. It is often argued that intensification of agriculture is the only alternative for overcoming food insecurity at the expense of sustainability, and accessibility (Loos *et al.*, 2014; Godfray, 2015). Trading of food globally is directly and intensely connected to food security affecting the local food and ecological systems, rural livelihoods, sustainability, and politics. World today is deeply connected on several aspects and closing the borders for food exchange for ensuring self-sufficiency and food security on domestic front may not be a feasible solution at all times. Variations in climate and crop production systems across regions may have different outcomes with regards to the production–surplus in few areas vs deficit in other regions entailing for trading of food from surplus to deficit zones. However, trading in agriculture and food requires a cautious analysis of the trade –offs (Clapp, 2015). Some aspects to be considered while framing policies by national and international institutes should include:

- Recognize and understand the role of agriculture in various cultures and societies. Some regions may need favored status when it comes to trading.
- Ensure sustainability of the environment as it directly effects the sustainability of the food systems. A negative impact may have devastating impact on food security.
- Ensure nutritional security for overcoming problems of undernourishment and obesity.
- Meet the requirements of rural and urban consumers – needs a fine balance of production and consumption.
- Lastly, but the most critical factor is a strong political will of the states.

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