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Global Food Security Strategies, Issues and Challenges

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Abstract: The world economy is in turmoil as a result of the global power crisis, rising commodity prices and the return of the inflation volatility just when the COVID-19 pandemic shows signs of recovery and healing. In Malaysia, food is a pleasant topic to its citizens - young and old, it is a symbol of unity and represents its unique identity. Recently, according to the Malaysian Department of Statistics, the food inflation grew by 4.1 percent in April 2022, despite higher percentages faced by other countries. This contributed to higher household expenditures and less savings. In addition, many Malaysians lost their jobs and incomes due to the pandemic, business entities shut down and high logistic costs forced the food price to increase. To understand the root cause and further implications of the food security issue, an attempt is made by searching through the recent academic literature. This is done by going through the e-library resources. The aim is to find from other researchers who have gone through similar experience in the past and learn from them. For this, 18 articles have been selected for synthesis. From the synthesis, a few significant dimensions have been identified. There are similarities and differences between countries or regions involving the causes and the consequences of food insecurity. Many past studies suggested processes or techniques that lead future farmers into the adoption of the climate smart agriculture. The findings from this study will help to educate, spread awareness and act as a point of reference to the public as well as the authority.

Keywords: Food insecurity, SDG 2 Zero hunger, Climate change, Food independence, Food deficit

Introduction

Familiar as a “Food Paradise” with its diverse multi-cultural backgrounds, food has been a factor of gastronomy tourism in Malaysia. The variety and delicious food originated from its cultural intermixing has set Malaysia apart from any other country. Malaysians are proud of its food and they are very passionate about it. Food is quite easy to find and the prices are still very much affordable as well; hence some may take it for granted in the past. Benjamin Franklin’s expression “eat to live, don’t live to eat” which means humans need to eat in order to survive and very often is used to discourage overeating. Apparently, food security issues were not given much concern in the past as it is today among Malaysians as most have never experienced a global food shortage before. The Department of Statistics Malaysia recorded a 4.1% inflation rate for food and non-alcoholic beverages in April 2022, the consumer price index later rose to 7.3 % in November 2022 (Consumer Price Index Malaysia April 2022; Consumer Price Index Malaysia November 2022). Creating awareness is important and

food is one of the most essential requirements to survive besides air and water for human life. Healthy food is the key to individual physical, emotional health and for human wellbeing.

Recent global COVID-19 pandemic together with other factors for instance population growth, climate change, global spike in prices, unemployment and poverty have triggered food insecurity worldwide and Malaysia is no exception. Russia's war on Ukraine and recent trade-related policies imposed by some countries have also raised international concern on its impact towards a global food crisis. Under the pressure of climate change and COVID-19 pandemic, the global food system itself is struggling even harder to feed its growing population in a sustainable way (European Parliament, 2020). Food and Agriculture Organisation of the United Nation, describes food insecurity as "a person is food insecure when they lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life. This may be due to unavailability of food and/or lack of resources to obtain food" (FAO, 2006). Governments of many countries including Malaysia have called for an urgent action plan to ensure food security. The World Food Summit of 1996 defined food security as "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" and it "should not be used as an instrument for political and economic pressure" (FAO, 2006).

Based on the recent Global Food Security Index (GFSI) in 2022, Malaysia is ranked 41st out of 113 countries with the prevalence of undernourishment of 2.5%. This 11th edition of the GFSI emphasises that the global food environment is worsening (Economist Impact, 2022). In addition, the food inflation index is showing an increasing trend in many upper middle income countries including Malaysia. In September 2021, the price has increased by 1.9 and in just within a year, Malaysians consumers have encountered a significant price increase of 6.9 and the domestic food inflation price is expected to stay high around the world (The World Bank, 2022). The recent food restrictions imposed by 21 countries that have implemented 30 food export bans and six countries with 11 export-limiting measures have partially worsened the global food crisis and exacerbated food insecurity and inflation. The Malaysian government is very much aware of the food crisis and has made some action plans to overcome this. There are many programmes, incentives provided to the citizens and the government has also introduced the "National Food Security Policy" which seems to work during the "2008 Food Crisis" (Tapsir, Elini, Roslina, Noorlidawati, Hafizudin, Hairazi, & Rosnani, 2019). However, there are still many challenges to overcome in safeguarding food security in the future. This understanding can be learned from the experiences of other countries that have far long experienced food insecurity, its main issues as well as the working strategies that they have adopted for survival.

In this study, the interest lies in observing the issues, problems and trends involving food security research in various geographical locations in the world and also to explore the challenges and opportunities to solve food security in Malaysia. Using e-library search, selected past studies and research involving food security from 2017-2022 were analysed. The findings have been presented in a food security matrix in order to identify the main food security dimensions common (or uncommon) to all. The next part of this article will cover the literature review on food security in other countries like Africa, Brazil, Arab Gulf states, USA, India and ASEAN countries including Malaysia, followed by the research methodology of this study. Findings and contributions of this study will be discussed in the next section where all findings will be discussed according to its significant dimensions. The last sections will discuss about the limitations, conclusions and future directions of this study.

Literature Review

Maffra (2017) discussed about food sovereignty as a sustainable solution to the issues of world hunger and climate change. The concept of food sovereignty includes the local production and consumption of goods while aiming for collective well-being of the locals. This is done through the use of sustainable food production techniques such as good soil management practice, prioritising family farming and ensuring high quality and nutrition in food supplies. The author explained the consequences of hunger from the production aspect which affected climate change. In addition, climate change as an interdisciplinary issue was discussed with several possible ways of mitigation. Among others, mitigating climate change involved public policy reforms in order to find ways to reduce pollutions to the environment, heavy use of pesticides and the use of fires to clear lands. The author also emphasised on the importance of soil management as a mean to feed the world population. She also encouraged the involvements of media in order to bring more information and knowledge about world hunger on an international basis.

Otekunrin, Otekunrin, Sawicka and Ayinde (2020) provided a review on the progress of African countries against hunger for the past three decades using the Global Hunger Index (GHI) scores. Three indicators of GHI were used. They were prevalence of undernourishment (percent population), prevalence of stunting in children and prevalence of wasting in children. The authors also presented links between GHI and Human Development Index (HDI), social protection and Global Terrorism Index (GTI). Among many reasons that caused food insecurity in Africa were poverty, corruption, low human capital development, conflicts and extreme weathers. The Malabo Montpellier Report 2017 listed down a few strategies for African countries to attain zero hunger. They were making food and nutrition as a top policy priority, work in collaboration with other stakeholders to deliver intended outcomes, revision of agricultural policies to emphasise on nutrition-rich food production and many more.

Otekunrin and Otekunrin (2021) discussed the importance of healthy and sustainable diets in order to attain SDG 2 Zero Hunger by 2030. They implied that to end world hunger, people's diet should be nutritionally sufficient, economically affordable, socially approved, innovatively and environmental-friendly produced. Their sources revealed that the number of hungry people in Africa has been rising steadily since 2015 to 2019 and is projected to rise further in 2030. In addition, stunting (low height in children under five years of age) declined globally since 2000 to 2019 while 69% of wasting (low weight for height in children under five years of age) children were found living in Asia and 27% lived in Africa (2019). Recommendations have been put forward to look for innovative ways and strategies to improve food sustainability such as prioritising food diet plans as national agendas, giving special focus on children and women, ensuring better access to nutritious food for vulnerable groups and gathering and reporting data on diet quality across countries.

Berchin, Nunes, de Amorim, Zimmer, da Silva, Fornasari, Sima, and de Andrade (2019) analysed the Brazilian public policies in terms of how they contribute to increase food security and family farming, how they are correlated, and which are the major gaps and challenges for the future, as well as its food security governance. This study fulfils the gap on the relationship between social protections, smallholder agriculture and food security in Brazil. Family farming is considered an important strategy in reducing social inequalities and poverty in many Brazilian regions and is responsible for the wide variety of agricultural products in the Brazilian domestic consumption market. Six categories of policies were used by the authors in order to analyse the Brazilian policies: financial aid, food aid, technical support, capacity building, land tenure management/food production, and identify, categorize and monitor. The policies and programmes support food security in Brazil, resulting in poverty alleviation and access to food in enough quality and quantity. As a result, the authors also suggested that budgets for all programmes regarding family farming should be strongly increased, making family farming no longer an alternative farming choice, but instead the main one.

Manap (2018) examined the impact of world food price to food insecurity in selected ASEAN countries by using data from nine ASEAN countries between 2000 until 2016. All data was analyzed using a static panel data analysis known as Random effects model and the results revealed that world food prices significantly give an impact to food insecurity in selected ASEAN countries. According to this study, governments need to increase sufficiency in food production and to reduce reliance on food import, because when world food prices increase ASEAN countries can depend only on domestic food production and reduce dependence on food import, thus, reducing the food insecurity problem.

The review by Sulaiman, Yeatman, Russell and Law (2021) provides critical holistic information about food insecurity in high-risk populations in Malaysia, including prevalence, contributing factors, coping strategies, and consequences of household food insecurity. Unexpectedly, the prevalence of household food insecurity in Malaysia was reported as high, with affected groups including *orang asli*, low-income household/welfare-recipient households, university students, and the elderly. Besides, low socioeconomic background included larger households, living in poverty, and low education was identified as a key contributing factor to household food insecurity in all high-risk groups. Furthermore, coping strategies were identified to manage household food insecurity included food-related coping strategies, non-food-related coping strategies, the acceptance of or resignation to the food shortage situation and emotion focused coping strategies. Lastly, the review revealed the consequences of household food insecurity which included psychological, dietary (macro- and micro-nutrient intakes), nutritional status, and health impacts. The forms of government interventions proposed were price policies, import and export policies and agricultural interventions.

In Food Security: The Challenge of the Present, Prosekov and Ivanova (2018) pointed out that the problem of hunger is still persisted even though sufficient amount of food is produced. Hunger occurred as a result of low income of the population especially in developing countries, and inaccessibility to food supplies by a large number of the people. Furthermore, food is not only an object of import and export, it can also be a subject of

political trade for certain countries to gain superiority over others. One country cannot ensure its food security alone. A group of countries such as Brazil, Russia, India, China and South Africa (BRICS) collaboratively can achieve food independence. This is because these countries occupied 25% of the world land, contributed to almost half of the world population and have a combined gross domestic products of 15.4 trillion dollars. These countries are able to produce significant grain supplies, fats and oil and meat production which will allow them to gain a more significant position in the world.

Food security challenge is a complex issue requiring attention on both humans and the environment. An integrated system of intervention involving transdisciplinary research and innovation is required to enhance yield production, promote reasonable food consumption and reduce food loss and food waste. In the food wedges framework, Cole, Augustin, Robertson and Manners (2018) proposed a link to match food demands and food supplies using innovation and promising technologies. For example, by reducing food waste from farm to customer is an obvious opportunity to increase food security. Both recovering food loss and waste is a huge opportunity to reduce production demand as 1.6 billion tonnes of food is wasted along the chain. Moreover, by educating customers about healthy diets might help to reduce overconsumption of food and obesity issues. Next, by deploying new farming system such as combining weather predictions and hydrological modelling might help to expand water resources in agriculture. Crop and livestock improvement and pest and disease prevention can be achieved by genetic modification or enhancement. Lastly, simple changes to management and adoption of existing technology can negate the impacts on climate change.

Food insecurity was widespread in Africa even before the spread of COVID-19 pandemic. As a result, African workers lost their jobs, incomes and health due to vulnerable working conditions and low productivity. The problems became severe to households that have insufficient credit access and low savings. In addition, the pandemic closed domestic productive activities, production suffered as people cannot go to work, supply chain disrupted, welfare and livelihoods turned bad, poverty and being vulnerable to risk increased. The pandemic disrupted the Sub-Saharan Africa (SSA) food security by disrupting food systems, the lockdowns impacted household incomes and physical access to food indirectly. Endris Mekonnen and Kassegn Amede (2022) provided a review on the dual COVID-19 crisis in SSA food insecurity and unemployment. From the review, they synthesised the future policy directions SSA countries would adopt to contain the associated socio-economic impact of COVID-19 and other pandemics. The pandemic disrupted food market supply causing food price to increase and the control measures such as the lockdowns caused unemployment and income loss. This affected the four food security dimensions (or pillars) of households – food availability, food access, food utilisation and food stability. In terms of unemployment, the youth especially women and those in informal economy were badly affected. The three areas in which the youth were affected are education and training, uncertainties for job seekers and job and income losses. The pandemic made the goal of zero hunger difficult to achieve. Farmers in agribusiness faced threats such as climate change, pests and diseases at the very farm level. The authors suggested three policy actions to curb the socio-economic effects of the COVID-19 and other pandemics. The actions are first, to increase the social protection measures such as social insurance and social assistance programmes (including job assistance programmes) to offer resources for people to sustain economic productivity while keeping their jobs. Secondly, by developing and maintaining strong regional co-operations, partnership and cross-border co-ordination that can provide help and supports, these partnerships could not collapse during a crisis. Lastly, there is a need to provide a strong financial resilience and domestic borrowing in order to speed up entrepreneurial and business recovery.

Food security policies in the Arab Gulf states constitute a form of knowledge-power nexus and facilitate agendas. In the Gulf states, this is done via the private enterprises (known as the Gulf food security complex) to drive innovations and with profit motives. The governance of food security there somehow produces power that serves different objectives. This food security complex uses publications, policy reports, interviews, media articles, conferences and government plans to produce food security as a discursive problem. Over the last decade, more than 7960 articles have been written on food security in the Gulf Cooperation Council (GCC) states which surpassed other countries in the regions. Land grabs or the acquisition of agricultural lands in foreign states is justified through food security discourse. Food security is established as a threat to serve different agendas such as a means for redistributing oil rents. The abundance access to food in the early oil period was a means to ensure that the population felt the benefits of oil wealth, a form of legitimacy. This food self-sufficiency programmes hit the walls of environmental and fiscal boundaries later that in the year 2000, more emphasis was placed on external investments in farmlands and diversified contracts on the international markets. These land acquisitions were being portrayed as a win-win situation or as beneficial to both the host and the investor. Additionally, technology is used as a means to drive an efficiency of agriculture or to apply climate-smart agriculture as solutions to environmental limits. In this article, Henderson (2022) uncovered the politics of the formulation of food security policies in the GCC. However, he noted that the policies focused on

the food production only, they did not address on the issue of distribution and the social relations of production (Henderson, 2022).

Abdullah, Mersat and Wong (2021) conducted a study in Sarawak, Malaysia to understand how local people cope with food security issues during the lockdown phases. The study aimed to fulfill three research objectives: to investigate the conditions of the locals in terms of food security, how they coped to ensure they are food secure during the lockdown duration and the greatest challenges that they faced in maintaining their food supplies. They found that most households are food secure, meaning they have access to food on an ongoing basis like what they did before the Movement Control Order (MCO) or lockdown phases. Households resorted to methods such as altering food sources, purchasing online, and going without favorite foods to do this. The significance of this discovery lies in the fact that it demonstrated the need to include dimensions beyond the mere availability of food when discussing about food security. It also demonstrated that adjusting to the direct and indirect changes brought about by the pandemic is the greatest obstacle in obtaining and sustaining food security at the household level. The survey also discovered that a small percentage of respondents experienced food insecurity throughout the MCO period. This change from security to insecurity happened because of financial limitations caused by the COVID-19 and MCO-related economic shutdowns. Due to these financial difficulties that were caused by the work restrictions during the MCO, some people lost the ability to purchase food.

Additionally, Vågsholm, Arzoomand and Boqvist (2020) examined the trade-offs involved in pursuing the triple objectives of sustainability, food security, and safety while examining various methods for cutting down on food loss, waste, and resource footprints. Vågsholm et al. (2020) proposed a few alternatives to reduce source reduction (food loss and food waste) by deploying big data strategies and intelligent labels and sensors while food donation served to reduce food insecurity. However, food safety, food hygiene training and food reprocessing skills are important considerations for food bank and food business operators. Future options to ensure food security may include stepping up agricultural productivity and implementing circular food networks. Circular food networks involved a system where nutrients will be recycled or involved reprocessing foodstuffs (for example as animal feeds and compost). This practice is more beneficial in terms of resource footprints, sustainability and cheaper to farmers. Since only around one third of the world's grain crop is used for human consumption and the other half is used as animal feed, changing our diets to be more plant-based might help (Willett et al., 2019).

Food security affects economic growth, particularly in dry-land developing nations (Abdul Manap & Ismail, 2019). Panel data from 75 dry-land developing countries and annual data from 1970-2016 were used in this study. Data were analysed using the Generalised Method of Moments (GMM). Variables such as gross domestic product (GDP), food security, life expectancy, poverty and total employment were deployed. Based on its findings, food security has a considerable beneficial influence on economic growth, since increased food security boosts economic growth in dry-land developing nations. In particular, food security has a positive impact on economic growth via life expectancy, total employment, and poverty. The reduction of poverty with better food security can enhance economic growth, particularly in developing countries. Suitable programmes to increase employment, offer of effective relief through public-private food security funds and the provision of crop insurance can be implemented to achieve better food security. In addition, improvement in agricultural productivity via new, better technology can help to reduce poverty, ensure food security and thus, boost economic growth.

Moroda, Tolossa and Semie (2018) analysed the food insecurity status of rural families in the Boset area, East Shewa Zone in Ethiopia and identified their causes. The data indicated that food insecurity is common. More than half of the respondents lacked access to safe drinking water, did not own a toilet, and disposed of waste in an unhealthy manner. When the households were denied the benefits of having sanitation and hygiene facilities, this could be the source of disease and the inability of the human body to absorb food nutrients, hence, resulting into low productivity. Regarding the determinants of food security, it was discovered that educational level, farmland size, total yearly income, proximity to health facilities, and the presence of supportive groups were all positively correlated with food security. On the contrary, factors such as access to irrigable land, frequent drought, distance to input and output market and distance from road transport had negative associations with food security. According to the study, all aspects of food (in)security should be targeted for successful intervention. Local authorities may pay attention to factors with both positive and negative food security relationships. Similarly, a reorganisation beyond a quick solution is needed. In solving food insecurity, local and national sectors must work together.

Another study by Fitzpatrick, Harris, Drawve and Willis (2021) reveals that US adult food insecurity has worsened during the COVID-19 pandemic. Before the pandemic, the disparities in food security have already existed in United States. These disparities continued or probably have widened as a result of the pandemic. Their study focused on variables such as social, economic and health factors in determining levels of self-reported food insecurity among individuals living through a pandemic or similar crisis. Their findings confirmed a pattern documented in past research of the general population and higher-risk populations, which are disproportionately poor and of colour. Race, ethnicity, and socioeconomic level partially influence food insecurity in the US. To further highlight the uniqueness of the present and the need to prepare for emotional uncertainty, the authors highlighted the importance of addressing the symptoms of mental health and the doubts or generalised anxiety exhibited as concerns or fear of COVID-19. The authors reminded that preparations (such as advanced planning) need to be done to face a pandemic-type of event in order to prevent over-burdened and under-resourced disadvantages in the future.

With an overview of the past 23 pandemics worldwide, Roubik, Lošťák, Ketuama, Procházka, Soukupová, Hakl, Karlik and Hejcman (2022) proposed the visions of post-COVID-19 agriculture and its effects on food security. The authors predicted that post-pandemic agriculture will be less-labour intensive with heavy use of automation and precision, the shift towards plant-based diets with the adoption of Information Communication Technology (ICT) to enhance communication and marketing of the crop yields. They also observed that reliance on seasonal foreign workers will discontinue with more focused on local seasonal workers from diverse backgrounds. More customers will continue to shop for food online with the rise of the urban lifestyle with minimum self-supply of food and household reserve. It also meant for repackaging of the crop yields to meet online demands, hotels and tourism sectors and to allow the mobility of the agricultural components to meet its demand and supply especially in fisheries. The movement to reduce the use of farm chemicals or to improve the chemical standards has been seen as ways to improve food safety. On the global obesity issues, they observed that there will be changes in lifestyle with more involvements of physical activities. There might be a shift towards insects and micro-algae as food substitutes. More attentions will be needed to prevent farm bankruptcy in the form of insurance, protection and loss absorptions. They believed more research will be needed to study the negative effects on food security in order to improve food resilience and by making use of economic models, to gauge its effects in the long run.

According to Adekunle and Filson (2020), apart from hunger, food consumption served a few other purposes such as cultural, religious and social reasons. In Islam, eating is considered a form of worship. Halal food is not only present in the dietary requirements but also in the process and storage activities to avoid cross-contamination of the food. Eating halal food can ensure food safety, over-production of meat can be significantly reduced and served as a business model for Canadian export market. However, there is a lack of trust in the market because of the presence of information asymmetry between seller or producer and consumers. In this study, the authors explored the Somali Canadians' perceptions on halal meat in Greater Toronto Area (GTA) as there are numerous halal certification bodies in Canada and there was no centralised agency to oversee the overall halal regulations yet.

Guntur (2021) analysed the tafseer of surat Al-Baqarah verse 247. It turned out that the surat contained messages about values of physical education. The Al-Quran, through physical education treated a human as a unified whole, in body and spirit. Firstly, the verse described the development of the physical body, together with the mind and soul. To maintain a healthy body, Prophet Muhammad SAW mentioned about the importance of sports in particular, to practice archery, swimming and horse riding as these sports represent strong nations. Second, a healthy body needs to eat and drink halal and nutritious food (a balance diet), maintains an adequate rest and ensures cleanliness of clothing, environment and behaviour (ethical values). In Islam, the sources of ethics and values are derived from Al-Quran and Hadith. Thus, physical education involved a process of becoming a person who grows in line with his or her talents, character, abilities and conscience. Thirdly, food and drinks that entered a human body affect their health and well-being, hence, consuming halalan tayyiban (halal and good) food is given priority. Not only halal, tayyiban means food that is not rotten, expired or contains bacteria that will harm the body. The halalan tayyiban concept requires humans to understand the science of nutrition in order to maintain and consume food in the right manner.

Research Methodology

The overall aim of this study is to investigate the issues, problems, challenges and trends involving food security and to find its feasible solutions. In this study, the research objectives (RO) include:

RO1: To conduct e-library search, appraise and synthesise the evidence base of food security in several countries around the world
RO2: To explore the determinants of food insecurity in the global food crisis
RO3: To identify who are impacted by food security issues and who are the responsible parties that play a major role in food security
RO4: To investigate the impacts of recent global pandemic and trade-related policies on the global food crisis
RO5: To identify different feasible solutions adopted as well as adapted by other countries in ensuring food security

As a result, 18 articles have been shortlisted for synthesis. The information derived from these articles will help to answer the research questions (RQ) of this study as follow:

RQ1: What are the issues, problems, challenges and trends involving food security research in the past (between 2017-2022) from around the world?
RQ2: What are the determinants of food insecurity in the global food crisis?
RQ3: Who are impacted by the issue and who are the responsible parties that play a major role in food security?
RQ4: How do the current unanticipated situations like the global pandemic and trade-related policies impact global food security?
RQ5: What are the solutions adopted or adapted by the countries that have experienced food insecurity?

The articles were selected based on meeting the following criteria: duration (the papers were published between 2017-2022), issues of discussion (the articles discussed about food security issues, problems or challenges, trends, strategies that are related to answer the RO and/or RQ) and comparison (the articles helped in making comparisons involving food security experiences, methods, processes, interventions, etc. that differed according to locations, cultures/religion, weather and soil conditions, policies and scale of production). On the other hand, research or articles will be excluded if: they were not written in English, they were not research articles, full paper was not available and not relevant to the discussion of RO and/or RQ.

Discussion and Contribution

Theoretically, the contribution of this research is the discussion of the significant food security dimensions via the food security matrix developed in Table 1. This matrix helps readers to understand the concepts, issues, problems, challenges and trends of food security in various geographical locations around the world. Also, to the best of the authors' knowledge, this is the first research to integrate both eastern and western views on food security in a single framework, taking into accounts the issue of food waste, food safety (halalan tayyiban) and the food contribution towards human civilisation. In practice, this research helps practitioners to draw up an effective plan or strategy to combat food insecurity based on local conditions such as geographical locations, types of soil, weather conditions, demographic factors, policies and interventions from their regulators.

Relevant Terms, Concepts and Definitions of Food Security

A number of authors began by describing or defining the relevant terms and concepts of food security in their studies (Table 2). Food sovereignty was introduced by Maffra (2017), hunger (Otekunrin et al., 2020; WHO, 2019), sustainable healthy diets (Otekunrin et al., (2021); WHO, 2019), family farming (Berchin et al., 2019) and food wastage (Otekunrin et al., 2021; Cole et al. 2018; Vågsholm et al., 2020). Cole et al. (2018) went further to discuss the megatrends in food and agribusiness, Endris Mekonen and Kassegn Amede (2022) revealed food insecurity and its relation to unemployment, Manap (2018) introduced food deficit as a result of high food import bills and Henderson (2022) reported on the Gulf food security complex. Guntur (2021) and Adekunle and Filson (2020) however, explained food security from Islamic point of view with the application of the halalan tayyiban concept which perhaps has been overlooked by many western scholars. Several authors related their food security studies to the Sustainable Development Goal (SDG 2) to tackle Zero Hunger (Otekunrin et al., 2021; Sulaiman et al., 2021; Abdullah et al., 2021).

Furthermore, food insecurity can be categorised into two types: 1) chronic long-term food insecurity as a result of prolonged poverty (Otekunrin et. al., 2020) and lack of access to assets and financial resources; 2) transitory food insecurity which is temporary because of short-term shocks such as unstable local food production, food price and household incomes (Manap, 2018). It can be assumed that the definition of food security is multidimensional as it involved four 'pillars: they are physical availability of food, economic and physical

access to food, food utilisation and food stability (Sulaiman et al., 2021; Endris Mekonnen & Kassegn Amede, 2022; Abdullah *et al.*, 2021; Moroda *et al.*, 2018). The nature of hunger is also a multidimensional issue (Otekunrin *et al.*, 2020; Berchin *et al*., 2019; Moroda *et al*., 2018).

Table 1. Food security dimension

Article No.	Dimension/Author	Terms, Concepts and Definitions	Causes of food insecurity, contributing factors	Role of individuals, society and country	Consequences of food insecurity	Proposed unique solutions, contributions	Policy reform	Political agenda, security	Past pandemic effects (other than COVID-19)	Information asymmetry
1	Mafra (2017)	*	*	*	*	*				
2	Otekunrin *et. al*. (2020)	*	*	*	*	*				
3	Otekunrin *et. al*. (2021)	*	*	*	*	*				
4	Berchin *et al*. (2019)	*	*	*	*	*	*			
5	Manap (2018)	*	*	*	*	*				
6	Sulaiman *et al*. (2021)	*	*	*	*	*	*			
7	Prosekov & Ivanova (2018)		*	*	*	*				
8	Cole *et al*. (2018)	*	*	*	*	*	*			
9	Endris Mekkonen & Kassegn Amede (2022)	*	*	*	*	*	*			
10	Henderson (2022)	*		*	*	*	*	*		
11	Abdullah *et al*. (2021)	*	*	*	*	*	*			
12	Vågsholm *et al*. (2020)	*	*	*	*	*	*	*		
13	Abdul Manap & Ismail (2019)	*	*	*	*	*	*			
14	Moroda *et al*. (2018)	*	*	*	*	*	*	*		
15	Fitzpatrick *et al*. (2021)	*	*	*	*	*	*	*		
16	Roubik *et al.* (2022)					*	*		*	
17	Adekunle & Filson (2020)	*		*			*			*
18	Guntur (2021)	*		*						

* Discussed by authors in their research studies

Determinants of Food Insecurity in the Global Food Crisis

Of late, countries around the world have experienced or are still experiencing the shortage of food supplies. This global food shortage is contributed by a number of issues such as poverty (Maffra, 2017; Berchin et al., 2019; Manap, 2018) or low incomes of the vulnerable populations (Sulaiman et al., 2021), ongoing conflicts and civil wars (Maffra, 2017; Otekunrin et al., 2020; Prosekov & Ivanova, 2018; Vågsholm et al., 2020; Moroda et al., 2018), unstable world political situations (Manap, 2018; Prosekov & Ivanova, 2018; Vågsholm et al., 2020), high prices or inflationary effects (Maffra, 2017; Otekunrin et al., 2020; Manap, 2018; Sulaiman et al., 2021; Vågsholm et al., 2020), extreme weather conditions such as prolonged drought, excessive rainfall, floods and hurricane (Maffra, 2017; Otekunrin et al., 2020; Berchin et al., 2019; Manap, 2018; Sulaiman et al., 2021; Moroda et al., 2018), rapid population growth (Otekunrin et al., 2020) and greater number of children (Sulaiman et al., 2021), pest and diseases problems (Otekunrin et al., 2020), corruptions (Otekunrin et al., 2020), lack of human capital development (Otekunrin et al., 2020, Sulaiman et al., 2021) and the volatility of oil prices that affect food production activities as in machinery and transportation (Manap, 2018).

Families headed by females and chronic diseases also caused people to suffer from food insecurity (Sulaiman et al., 2021). According to Fitzpatrick et al. (2021), sick people who lived in a built environment not conducive to movements may further challenged their abilities to access food. In addition, food accessibility is directly linked to financial security especially for those who relied on daily wages or incomes (Abdullah et al., 2021). Failure in agricultural process, quality flaws of vegetables and fruits, discarded foods that are closed to their expiry dates and massive food recalls by producers or retailers also caused food loss and food waste (Vågsholm et al., 2020). Furthermore, Moroda et al. (2018) claimed that food insecurity also is a result of incompetent governments and their lack of commitments to curb famine.

Vågsholm et al. (2020) identified a few changes that have impacted food security such as rising food prices are correlated with war and social unrest, diversion of edible crops to biofuel production that made price of biofuel crops correlated to oil prices and increase speculation in food price (hedge funds) also posed a risk to food

affordability especially among the low-income groups. Other factors such as rapid urbanisation is causing more than half of the populations to live in cities making urban consumers heavily rely on food consumption while the heavy reliance on imports can cause food shocks as some countries impose export restrictions in times of emergency.

The Role of Individual, Society and Country – People who are affected and who are responsible to help

Food security is a significant concern at various levels (Abdullah et al., 2021) including the elderly, refugees and university students (Sulaiman et al., 2021). The impacts to university students, according to Sulaiman et al. (2021), are prone to be anxious, lack of concentration when studying and have high risks of falling ill while the older generations generally suffer from depression. Abdullah et al. (2021) mentioned about the images of people queuing up at the supermarkets and the shelves were empty. This happened during the COVID-19 pandemic, reflecting about food access and food security issues at the time. It was caused by the logistic restrictions, shortage of manpower and the closure of food eateries during the various phases of lockdowns in Malaysia (Abdullah et al., 2021). In the United States, however, the pandemic worsened the disparities in food security even further among its citizens (Fitzpatrick et al., 2021). On the international level, a group of countries can collaboratively involve in food production activities and trade, indirectly becoming more significant at the international arena (Prosekov & Ivanova, 2018). Policymakers need to work collaboratively with other stakeholders at national as well as with private and development partners to deliver nutritious food (Otekunrin et al., 2020). In Africa, governments should empower women to decide and give more opportunities for them to own and control resources such as lands, food productions and healthcare (Otekunrin et al., 2020; Otekunrin et al., 2021).

Table 2. Relevant terms and concepts

Terms and Concepts	Definition	Author
Food sovereignty	Food sovereignty includes "production and consumption at local level, but aiming for the collective well-being, through using sustainable techniques to produce food (natural fertilisers, adequate planting and collection cycles for each type of food, no use of artificial pesticides and adequate soil management without deforesting, polluting or burning areas), prioritising family farming and the supply of more nutritious and quality food" (p.1). Food sovereignty exists when "consumers have access to the halal food they want instead of mislabeled, contaminated and improperly slaughtered meat" (p.19).	Maffra (2017, p.1); Adekunle & Filson (2020, p. 19)
Food insecurity	Food insecurity is "a situation that exists when people lack secure access to sufficient amount of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level" (p.3).	Maffra (2017, p. 3), Manap (2018), Sulaiman et al. (2021)
Food security	Food security exists "when all people have at all times physical and economic access to sufficient safe and nutritious food to meet their food needs and food preferences for an active and healthy life". Four pillars of food security: 1) Availability – Availability of sufficient quantities of food of appropriate quality, supplied through domestic productions or imports	World Food Summit (1996), Maffra (2017, p. 3), Berchin (2019), Sulaiman et al. (2021), Abdullah et al. (2021), Moroda et al. (2018)
	2) Accessibility – Access by individual to adequate resources for acquiring appropriate food for a nutritious diet	Abdullah et al. (2021), FAO (2006), Moroda et al. (2018)
	3) Utilisation – Utilisation of food through adequate diet, clean water, sanitisation and health care to reach a state of nutritional wellbeing	

	4) Stability – To be food secure, household/individual must have access to adequate food at all times (p.3)	
Hunger	Hunger is "an uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy. It becomes chronic when the person does not consume a sufficient number of calories (dietary energy) on a regular basis to lead a normal, active and healthy life" (p.88).	Otekunrin et al. (2020, p. 88)
Sustainable healthy diets	Sustainable healthy diets are "diets that promote all dimensions of individuals' health and well-being with minimal environmental pressure and impact. They are accessible, affordable, safe and equitable and are culturally acceptable" (p.1).	Otekunrin et al. (2021, p. 1)
Megatrends in food and agribusiness	The five megatrends in food and agribusiness are a less predictable planet, health in mind, choosey customers, one world (globalisation) and smarter food chain. 1) A less predictable planet with limited amount of natural resources, extreme weather events, increasing virulence of microorganisms and parasites, increasing customer demands for environmental and social credentials. 2) Healthy mind includes ageing population, increase chronic illness, increase awareness for better health and well-being, realising the importance of food safety and demand for healthy food. 3) Choosey customers refer to more wealthy middle class society, urbanisation, increase in demand for outside food consumption, demand for accurate information and vendor claims and increase willingness to switch. 4) One world with more connected global value chains, more exposure to food and beverage from other regions and culture, stiff global competition, increase biosecurity risks and increase susceptibility to supply shocks. 5) Smarter food chain includes more global food demand, increase food security concerns, high volume of big data and analytics, global connection and e-commerce solutions and vertical integration, decentralised and agile value chains (p.14).	Cole et al. (2018, p. 14)
Halalan Tayyiban Food	Halal food is food that is not haram (haram means what is prohibited to eat such as pork, carrion, blood and haram because something that is not in its substance such as food that is not permitted by its owner to be eaten) (p.53). Tayyiban food is food that is not rotten, expired or contained bacteria that could harm one's health if eaten (p. 53).	Guntur (2021, p.53): Adekunle & Filson (2020)
Food loss and food waste (Source reduction)	Food loss is lost supplies along the food chain between the producer and the market while food waste is discarding safe and nutritious foods.	Vågsholm et al. (2020).

General Consequences of Food Insecurity

In general, high food prices increases poverty and undernourishment (Manap, 2018). Food insecurity have impacts on the health of populations as a result of poor dietary intakes and low dietary patterns on food

consumption (Sulaiman et al., 2021). In poor countries, food insecurity results into child wasting, child stunting and child mortality and undernourishment (Maffra, 2017; Otekunrin et al., 2020; Otekunrin et al., 2021; Berchin et al., 2019; Sulaiman et al., 2021) in contrast to obesity in wealthy countries (Sulaiman et al., 2021). Another impact of food insecurity is on the health status involving high cases of anemia, hypertension and diabetes (Sulaiman et al., 2021). In addition, university students suffered from anxiety, poor concentration in classrooms and high risk of falling ill as a result of cutting the food budget while the elderly are prone to suffer from depression (Sulaiman et al., 2021).

Proposed Solutions to Food Insecurity Issues

Food security should be made the topmost policy priority by the governments to indicate its importance (Otekunrin et al., 2020; Berchin et al., 2019; Sulaiman et al., 2021; Cole et al., 2018; Endris Mekonnen & Kassegn Amede, 2022). Zero hunger and good nutrition must be incorporated into food policy revisions (Vågsholm et al., 2020) and more enforcement on Smart Climate Agriculture will be needed (Otekunrin et al., 2020). It is important also for nations to work together to achieve political stability and reduce conflicts (Otekunrin et al., 2020; Otekunrin et al, 2021; Vågsholm et al., 2020). Moreover, an improved food data collection and management can help in measuring the achievement of nutrition goals and policies accurately (Otekunrin et al., 2020; Otekunrin et al., 2021). Price stabilisation by the government might help to improve food security, reduce poverty and undernourishment. This is evidenced in Bangladesh (Manap, 2018). To reduce reliance on food import, there is a need to increase local food production (Manap, 2018) or to be self-reliant and at the smallest scale, family farms are big contributors in Brazil (Berchin et al., 2019). In Malaysia, families coped with food insecurity by switching to homecook food instead of eating out, preparing a plan before going out for food shopping trips, switching to cheaper alternatives and starting part-time businesses to generate additional incomes (Sulaiman et al., 2021). Among Canadian immigrants, new policies are needed to reduce the presence of information asymmetry between sellers and buyers as currently there are numerous halal certification bodies with various interpretation of the halal standards. A centralised agency to oversee the implementation of halal regulations will help to instill trust and improve the quality of the meat produced. To improve meat traceability, transparency and authenticity, producers can turn to the use of crypto-labelling by deploying the blockchain technology (Adekunle & Filson, 2020). Table 3 listed down some valuable suggestions and recommendations to tackle the food insecurity and hunger issues. This allows further comparisons between regions, culture, agricultural practices and policies to be done, resulting into some significant similarities and differences for learning purposes and academic contribution. Prosekov and Ivanova (2018) recommended that food production can be increased by increasing land fertility, using sea and ocean water resources, switching to solar power and doing research in genetic modification in crops and breeding (to improve pest resistance). This is also supported by Cole et al. (2018) and Maffra (2017).

Food security can be improved by reducing source reduction (food waste and food loss) from the farmers to the customers (Cole et al., 2018; Vågsholm et al., 2020). In the Gulf states, private vehicles such as the Gulf food security complex helped to drive innovations in food production (Henderson, 2022). These authorities realised on the importance of having secured food resources by justifying land acquisitions and win-win collaborations with foreign states, while at the same time encouraging publications and research and hosting conferences to strengthen their food independence. Thus, food security can be used as political tools to secure international presence (Henderson, 2022) and food loss reduction strategy is a well-reasoned political objective (Vågsholm et al., 2020). Measures such as social assistance programmes, strong regional partnerships and cross-border co-ordinations and financial assistance or domestic borrowings may help Africans to cope with income losses during pandemic experience in the future (Endris Mekonnen & Kassegn Amede, 2022).

Reducing Food Loss and Food Waste: Source Reduction

In fisheries and fish farming, 20-30% of the catch is lost at sea while another 10-15% is used as feed for fish farming resulting into protein and energy losses. In addition, only one third of the cereals and vegetables are used to feed humans while nearly half is used to feed animals (Vågsholm et al., 2020). Massive food recalls are another example of food waste. Food loss and waste indicated how labour, capital, water, energy, land and other resources in the food production are wasted. By eliminating global food waste, the food saved can feed an additional one billion people. According to Al Quran (Al-Isra': 26 & 27), "And render to the kindred their due rights, as (also) to those in want, and to the wayfarer; but squander not in the manner of a spendthrift. Verily spendthrifts are brothers of Satan; and Satan is to his Lord (himself) ungrateful." Food waste is an act that is abhorred in Islam, as it is a resemblance of the act of Satan or brothers of Satan.

Table 3. Food security strategy

Measure	Description	Author
Policy reform; Food policy	Food and nutrition security as topmost policy priority.	Otekunrin et al. (2020), Vågsholm et al. (2020)
Collaboration with stakeholders	Regulators need to work in collaboration with other key stakeholders at national as well as with private and development partners to deliver food and nutrition outcomes.	Otekunrin et al. (2020)
Incorporation of nutrition needs into agricultural policies	Incorporation of nutrition needs into agriculture policy, rural area development plans, social protection and education for implementation.	Otekunrin et al. (2020)
War and conflicts resolution	Working together to gain peace and reduce war and conflicts.	Otekunrin et al. (2020)
Embracing Climate Smart Agriculture	Practice Climate Smart Agriculture to achieve sustainable food security.	Otekunrin et al. (2020); Cole et al. (2018); Maffra (2017); Henderson (2022); Roubik et al. (2022)
Collection and management of current and relevant data	Collection and management of nutritional data for effective interventions.	Otekunrin et al. (2020); Otekunrin et al. (2021)
Women empowerment	Empowering women's groups in decision making and managing resources related to food, nutrition and healthcare; Improving diets of children and women. Reducing gender bias in land ownership.	Otekunrin et al. (2020); Otekunrin et al. (2021); Roubik et al. (2022)
Reducing food wastage – source reduction	Reducing food loss and food waste or capturing more of the produced food is an opportunity to improve food security and a business opportunity; Recovering food wastage is an opportunity to reduce production demand; Food loss is a major contributor to food wastage in developing countries while food waste is common in developed countries where food is lost at the retail and consumer end. Food recall due to safety issues is a food waste.	Cole et al. (2018), Vågsholm et al. (2020)
Food science and technology improvement	By using food preservation and stabilisation can help to extend products' shelf life.	Cole et al. (2018)
Good post-harvest handling practices	Good post-harvest handling practices such as logistics and infrastructure help to prevent the loss of fresh produce.	Cole et al. (2018)
New extraction technologies	Technologies such as ultrasound can improve the recovery of oil from biomass. Preservation technique such as fermentation and separation technologies like forward osmosis can create new value-added food ingredients and bioactives from food loss and food waste.	Cole et al. (2018)
Setting up food bank	The setting up of food banks in various countries help to rescue and redistribute nutritious foods to vulnerable groups. Protection of food donors is needed from liability of donating foods to non-profit organisations.	Cole et al. (2018), Vågsholm et al., 2020
Better access to food information	Customers demand for transparent information involving environmental credentials and food provenance. With digital technology and the Internet of Things (IoT), customers can get access to information and leaner production is possible.	Cole et al. (2018)
Reducing over-consumption of food, educating customers about healthy eating	While trying to improve food security, at the same time obesity is a challenge. Educating people to reduce over-consumption of food and practice healthy eating can help to improve food security. At the same time, healthier processed food will be needed. There will be changes in lifestyle with more physical activities.	Cole et al. (2018); Roubik et al. (2022)
Development of smart biofuel policies and technologies	New technologies to produce biofuels from plants as alternative fuel use.	Cole et al. (2018), Vågsholm et al. (2020)
Pathways to increase food production and environmental protection	1) Expanding land resources used for agricultural production with ways to capture and store rainfall; 2) Combining weather prediction and hydrological model to make better forecasting of soil moisture, water requirements for crops and efficient use of irrigation water (the use of real-time irrigation app and	Cole et al. (2018), Vågsholm et al., (2020); Roubik et al. (2022)

	soil water sensor); 3) Expanding aquaculture as food source; 4) Crop and livestock genetic improvement to fight against pest and diseases and enhance crop yields; 5) Minimising soil and water degradation by minimising the use of input and water in production; 6) Minimising climate change impact such as the adoption of methane inhibitors in livestock sector.	
Food insurance	Premiums paid to ensure access to nutritious food and prevent famine and food-borne illnesses.	Vågsholm et al. (2020).
Novel IT and AI solutions	The use of predictive models, machine learning, neural network and expert system to accurately forecast food demand. This is to help producers and retailers to prevent food wastage and stockout problem (inaccurate forecasting of sales due to price, weather, season, events and festivals, promotions and discounts, competitions, shelf life and number of customer fluctuations).	Vågsholm et al. (2020)
Intelligent labelling and sensors	The use of sensors for freshness, food packaging integrity, time-temperature indicators and identification tags such as RFID to reflect good foods for human consumption.	Vågsholm et al. (2020)
Diets rich in plant-based foods with fewer animal source food	Diets rich in plant-based foods with fewer animal source foods confer both health and environmental benefits.; better antibodies.	Vågsholm et al. (2020); Rubik et al. (2022)
Futuristic use of technology	Futuristic use of technology such as cryto-labelling in blockchain to ensure food traceability, transparency and authenticity especially in halal food production	Adekunle & Filson (2020)

Food Safety Assurance

Eating is considered a form of worship in Islam. Halal food is produced based on the Islamic dietary standard derived from Al-Quran and Hadith as well as the examples as shown by Prophet Muhammad SAW. In Islam, what is permitted is 'halal' and what is prohibited is 'haram'. To be considered halal, food must not break the Islamic dietary standards as the inclusion of prohibited animals and their byproducts. Animals must be slaughtered in a specific humane manner. The slaughtering process is a major component of halal meat and having halal food is one way to ensure only desirable meats are in the market. Other than ensuring the safety of the food, this requires the mass production to be significantly reduced (Adekunle & Filson, 2020). According to Al-Quran (Al-Baqarah: 168), "O mankind eat from whatever is on earth (that is) lawful and good and do not follow the footsteps of Satan. Indeed, he is to you a clear enemy". This brings to the 'halalan tayyiban' concept (Table 2) which has been repeated four times in Al-Quran including surah Al-Maidah verse 88, Al-Anfal verse 69 and al-Nahl verse 114. This concept is itself a standard (policy) and is applicable to all industries including food bank and food business operators.

Grains as Symbol of Good Deeds (Wealth Creation) and Human Civilisation

Al-Quran (Al-Baqarah: 261) mentioned: "The example of those who spend their wealth in the way of Allah is like a seed [of grain] which grows seven spikes; in each spike is a hundred grains. And Allah multiplies [His reward] for whom He wills. And Allah is all-Encompassing and Knowing". The Almighty has chosen grains (plants) among other things to represent good behaviour such as sharing and giving, from which one's wealth will grow based on the giving and sharing one has done, it is an assurance by Him. This symbolises how an individual can grow as a unified whole in healthy body, mind and spirit as exemplary characters to begin simply from what is consumed at the dining table (Guntur, 2021). This is probably one of the foundations that made up the civilised nations.

Limitation

There are limitations to this study especially in the aspect of article selection. The review on literature of food security involved only peer-reviewed journal articles while other sources of knowledge sharing that might exist in proceedings and reports are not considered due to the difficulty to access them and many of them are

unpublished. In addition, even though a few databases are used to search for the articles, only 18 articles were shortlisted for analysis due to time challenge. This constraint may reduce the access to the more recent articles for this study. Limitations are also related to the generalisation of the reviewed articles where the instruments used in the studies or the recommendations may not be suitable to be replicated in whole or without modification. Besides, current studies mostly focused on issues, problems, challenges and trends involving food security. However, other aspects of food security such as food co-operations and food distributions can be explored to give deeper understanding towards food security issues worldwide.

Conclusion and Future Direction

Through the analysis in this study, food security issues are becoming global concerns where many research activities were conducted to strengthen the understanding of this problem. Since Malaysians have never experienced any global food shortage previously, thus there is a need to learn from other countries' food insecurity experience especially after the COVID-19 pandemic. Nevertheless, it is important to understand that the main root of the problem may differ between countries and the solution that is effective in one country may not be feasible in another country. However, the food security dimension (Table 1) in this study was aimed for helping academics, regulators and authorities to understand the current issues and challenges in food security. Moreover, this study could help to encourage more research activities pertaining to food security in different contexts in order to fill in the gaps in the current literature.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM journal belongs to the authors.

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