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CAN MALAYSIA FEED ITSELF? FOOD SECURITY ISSUES IN MALAYSIA©Σ

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ABSTRACT

The COVID-19 pandemic has shown that access to food supply may be a future problem if Malaysia is unable to ensure that food supplies are adequate, of better quality, edible, healthy, nutritious, and at affordable prices. The study examines the level of food security using four dimensions, namely food availability, accessibility, utilisation, and stability. Based on interviews with policymakers and policy document analysis, a framework for food security was created. The results show that if the majority of food products can be produced locally, they may be able to reduce the dependency on imported goods. This increase in *availability* affects *accessibility* through lowering prices. The use of biotechnology may further improve food *utilisation* and *stability*. These have implications for food production and self-sufficiency levels (SSL). Study shows that achieving high SSL is more about empowering the agriculture sector (to ensure food security) even when food import activities are present. These four dimensions also contribute not only to the food security of the country but also to overall security.

Keywords: biotechnology, agricultural Biotechnology, food security, four dimensions of food security, food self-sufficiency.

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BOLEHKAH MALAYSIA MENAMPUNG KEPERLUAN MAKANAN SENDIRI? ISU-ISU KESELAMATAN MAKANAN DI MALAYSIA

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ABSTRAK

Pandemik COVID-19 telah menunjukkan bahawa akses kepada bekalan makanan mungkin menjadi masalah masa depan jika Malaysia tidak dapat memastikan bekalan makanan mencukupi, berkualiti, boleh dimakan, sihat dan berkhasiat, dan pada harga yang berpatutan. Kajian ini mengkaji tahap keselamatan makanan menggunakan empat dimensi iaitu ketersediaan makanan, kebolehcapaian, penggunaan, dan kestabilan. Berdasarkan data temu bual, dan analisis dasar sesebuah negara, kerangka kajian yang membentuk keselamatan makanan negara telah dihasilkan. Keputusan kajian menunjukkan bahawa jika majoriti produk makanan boleh dihasilkan di dalam negara, ini mungkin dapat mengurangkan kebergantungan barangan yang diimport. Peningkatan ketersediaan ini memberi impak kepada kebolehcapaian melalui penurunan harga. Penggunaan bioteknologi seterusnya meningkatkan lagi penggunaan dan kestabilan makanan. Ini mempunyai implikasi terhadap pengeluaran makanan dan tahap sara diri (SSL). Kajian menunjukkan bahawa untuk mencapai tahap SSL yang tinggi, perlunya memperkasakan sektor pertanian (untuk memastikan keselamatan makanan) walaupun aktiviti import makanan masih berjalan. Empat dimensi ini juga menyumbang bukan sahaja kepada keselamatan makanan negara tetapi juga keselamatan keseluruhan.

Kata kunci: *bioteknologi, bioteknologi pertanian, keselamatan makanan, empat dimensi keselamatan makanan, sara diri makanan.*

Introduction

When energy and prices fluctuated greatly in the 1970s, food security changed from addressing the issue of ensuring the stability of primary foods production to assuring the stability of prices. The concept of food security was later refined at the World Food Conference in 1974 as the availability at all times of the world's food supply of adequate basic food to maintain a stable expansion of food consumption and offset the fluctuations in production and prices. This idea underscores the need for further growth, as the deficiency in protein-energy was thought to affect more than 25% of the world's population in 1970 (Wen Peng and Elliot 2018).

The 1996 World Food Summit (FAO 1996) further defined food security as a situation ‘when everyone, at all times, has physical and economic access to adequate, safe and nutritious foods to meet their nutritional needs and food choices for an active and healthy life’. These fundamental principles have later led the Food and Agriculture Organization of the United Nations (FAO 2008) to define the four major dimensions of food security which were widely used to date: first, *food availability* where there is an ample supply of food, either by local production or imports. Second, *food accessibility* refers to people's ability to obtain food from outlets such as markets or farms. The third dimension is the *utilisation of food*, which means that it is cooked in a nutritionally sound manner, and the final dimension is always the *stability of food* supply and accessibility (Marie 2015).

The food industry faces a great challenge as the world population grows and there has been a greater demand for healthy food. For food security, biotechnology open to numerous opportunities. Among others, the focus on the utilisation of biotechnological techniques can help to reduce the quality and number of unhealthy food ingredients, as well as to degrade allergenic substances. In agriculture, genomic research and targeted breeding also greatly facilitate quality advancement. Therefore, the scientific field of *food biotechnology* has the potential to enhance at least four aspects key aspects of food security: i) to protect our food security and sustainably, ii) to improve the quality and effectiveness of our key food production systems, thus reducing waste during food processing, and improving traceability, iii) improving access to food markets through better transportation and marketing systems. This includes lowering food prices, and iv) strengthening consumer purchasing power, especially in developing countries. All the above can help improve the food supply for global consumers (Kevan and Jill 2018).

The level of food security also has implications for political stability. For example, in 2008, Haiti's government collapsed when senators fired the prime minister after more than a week of protests over food prices, despite the president's proposal to reduce rice prices. In another incident, thousands of people left their homes in Mali because agriculture, food supplies, and distribution were destroyed by its regional war (Joseph and Jim 2008). The above-mentioned examples indicate how food security can impact government stability, which in return impacts national security. The Covid-19 pandemic also put Malaysia's immediate and long-term food security plan in the spotlight. Images of people buying massive quantities of food that circulated widely at the start of the

Movement Control Order (MCO) sparked widespread concern about Malaysia's food supply.

This is because the pandemic has created disruptions in the food value chains. Some countries even stopped exporting food in fear of scarcity and shortages. Disruptions in value chains affect prices which in turn affects availability, accessibility, utilization, and stability which are important dimensions of food security. While the food crisis may be temporal and transitory, the pandemic has shown that access to food supply will be a future problem if the current food production model is not sustainable. It is therefore important to understand the need for Malaysia to strengthen its domestic food production, to ensure that food supplies are adequate, of better quality, edible, healthy and nutritious, and at affordable prices. Hence reducing the over-reliance on the global food value chains forms the preliminary motivation of the study.

This is also a crucial issue for the country because Malaysian food production can only meet between 20% and 70% of local consumer demand. Currently, the country is unable to produce enough food to feed its population, resulting in increasing food imports. In 2019, Malaysia produced 70% of its rice, 74% of its vegetables, 78% f its fruit, 86% of its fish, 32% of its beef, 23% of its goats, and 18% of its milk (Rozhan 2020). Due to increased demand and limited domestic production, the country relies heavily on the importation of many agricultural products, including rice, sugar, wheat, beef, goats, and dairy products. As a result, food imports are increasing year after year.

The study aims to assess the level of food security in Malaysia by examining the contributions of the four dimensions of food security. The variables of interest will be the determinants of food security, with biotechnology policy as an intervening variable to ensure food security in the country. The final objective of the study is to identify key issues and challenges facing the country in achieving food security. The research question of the study hence asks, 'what determines the level of food security in Malaysia?' Second section will provide a literature background on the subject matter and identify the research framework. Third section will explain the methodology, and Section 4 will discuss the findings. The paper concludes with policy implications.

Literature Review and background of Malaysia

Past literature on security in Malaysia follows three common themes: First will be the definitions and dimensions of food security; second, the role of biotechnology, and finally, the sustainability of food security and food production. The discussions in this literature review section will be based on these themes. Since Malaysia is the country of interest, country-specific literature will be prioritized as well.

In the early 1970s, during a period of worldwide food scarcity, the notion of food security was first centred on maintaining food availability and price stability for fundamental foods. Food security was defined during the 1974 World Food Conference as 'the continuous availability of sufficient world food supplies of fundamental commodities to sustain steady growth in food consumption and to compensate for changes in production and pricing' (Wen Peng and Elliot 2018). The World Food Summit of 1996 further 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' (WHO 2005). This definition is based on Chapter 14.6 of Agenda 21 (UNDESA 1992), adopted at the United Nations Conference on Environment and Development (UNCED) in 1992, which states: 'The major thrust of food security is to bring about a significant increase in agricultural production in a sustainable manner and to achieve a substantial improvement in population' (WHO 2005).

It was further refined in 2009 at the World Summit, where the phrase 'four pillars of food security' was first coined to refer to the four dimensions of food security, namely (1) *Availability***.** The availability of both domestically produced and imported food. (2) *Accessibility*. Food can be delivered to the client (transportation infrastructure), provided the latter has the financial means to purchase it. Socio-cultural access is added to physical and economic access to guarantee that food is culturally acceptable and that social safety nets protect the less fortunate. (3) *Utilization*. To live a healthy and complete life and maximise one's potential, one must be able to consume a suitable quantity and quality of food. Due to the importance of food and water safety and cleanliness, this level also includes proper water and sanitation. A person's physical health must be in good condition to absorb and use the food they consume. (4) *Stability*. Stability refers to a nation's, community's, or individual's capacity to tolerate shocks to the food chain system, whether natural (climate, earthquakes) or manufactured (wars, economic crises) (Wen Peng and Elliot 2018). In any country's quest to ensure food security, all four of these factors must be present.

The Role of Biotechnology

The Introduction of the National Biotechnology Policy (NBP) in 2005, was the country's most significant boost to the biotechnology industry (Mahaletchumy & Muthu 2018). The Malaysian government's emphasis on the agriculture sector can be seen in the NBP, where it is assigned as the first thrust of the policy. Kevin, Thomas, and Rekha (1999) state that biotechnology applications are extensive, and the benefits are incredibly significant that this technology is used by almost every industry. The role of biotechnology, according to them, provides powerful techniques to resolve food safety issues. This is even more important in developing countries as low crop production is widely regarded as the primary cause of global hunger and food insecurity, specifically in rural areas (Mohammad and Byong 2014). In general, literature has shown that the role of biotechnology is to: first, increase crop yield by introducing high-yielding varieties that are resistant to biotic and abiotic pressure; second, improve crop yield by introducing high-yielding varieties that are resistant to biotic and abiotic pressure. Third, reducing pest-related losses, and fourth, increasing the nutritional values of food, which is particularly important in rural areas and developing countries.

Literature does not always point to the positive aspect of biotechnology. While there are benefits of biotechnology, WHO (2005) also highlighted potential problems of biotechnology on human health and development. Plants, animals, and microbes can be genetically modified (GM) with novel features using recombinant gene technology, the most well-known modern biotechnology. In addition to genetic alteration, procedures like cloning, tissue culture, and marker-assisted breeding are typically viewed as modern biotechnologies. This suggests science has to go against the norms and certain ethics and challenge the notion of biological nature itself. Nevertheless, when being used with prudence, the merits of biotechnology can be significant. For example, the People's Republic of China (PRC) has managed to increase at least 500,000 ha of insect-resistant

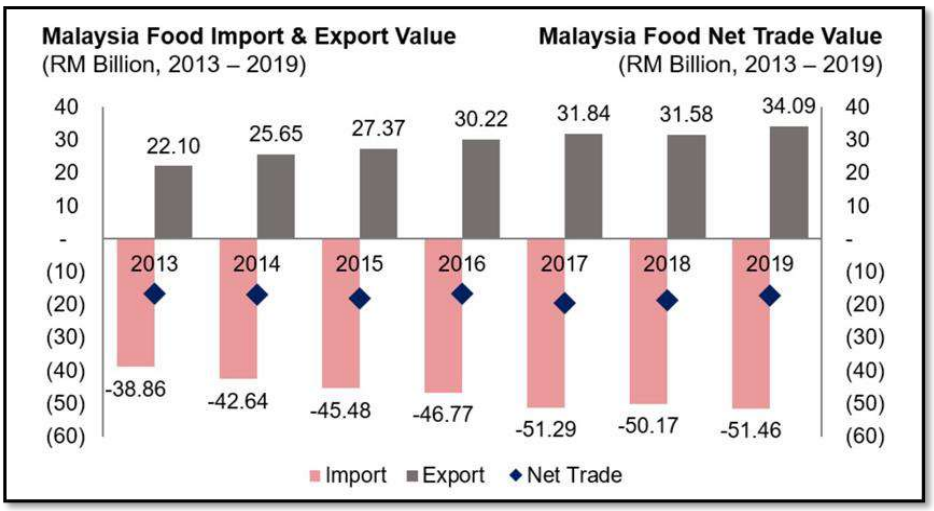
transgenic cotton and soybeans GM crops for commercial production (World Bank 2019). This was done by reducing losses due to diseases and pests while minimising pesticide use.

The Sustainability of Food Security and Food Production

Past literature suggests that a country with a "high" food security level can obtain sufficient food from a reliable, stable, and plentiful food supply at a reasonable price to meet its consumption and nutritional requirements (Jomo and Tan Zhai 2019). This concept of *self-sufficiency* is described as "needing no outside assistance to meet one's basic needs, particularly in terms of food production." The most common indicator used to identify its level is the Self-Sufficient Ratio (SSR) (Refer to Appendix 1 for further descriptions).

The SSR is used to determine the percentage of food consumed and produced in the country. It establishes if a country's agricultural production is sufficient to meet domestic demand. The higher the ratio, the more self-sufficient one is. According to the Ministry of Agriculture and Food Industry (MAFI), Malaysia's food imports have increased from RM 38.9 billion in 2013 to RM 51.5 billion in 2019. Figure 1 below shows the statistics of Malaysia's food import and export values from 2013 until 2019 (Ivan 2020). Based on the data, there have been trade deficits year by year since 2013. This is one of the many indicators that show our food security is in an increasingly vulnerable position.

Figure 1: Malaysian Food Import and Export Value from 2013 to 2019



Source: (Ivan 2020).

Malaysia's population is now around 33.42 million and is expected to cross 45 million by 2050. Population growth will lead to an increased demand for food. Food security concerns arise due to the growing population's need for more food, whereas the country may risk being unable to produce enough for itself. According to Malaysia's SSR of selected crops in 2019, as shown in Figure 2 below, 24 of the 42 most used agricultural products have an SSR of more than 100% (Ivan 2020). However, the main categories of

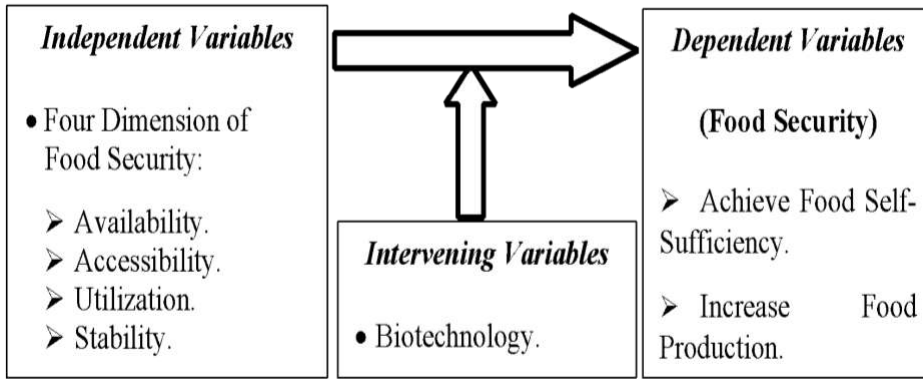
staple agricultural food products such as rice, beef, mutton, chilli, coconut, and milk have fallen below 100% SSR. This means that Malaysia may encounter self-insufficiency in food supply to meet its food needs. These demands rely on imports to meet domestic consumption, which may put Malaysia at a high import dependence risk. A caveat is that, although SSR is an important indicator, it should not be taken as an absolute target of a country. This means it should be based on the comparative advantage of the country and should not take precedence over efficiency. This is to ensure that *food imports* will not be viewed with negative connotations, as for some countries, importing foods may be more efficient than producing locally due to numerous factors, e.g., costs, land conditions, etc.

Another important indicator of sustainability is the Global Food Safety Index (GFSI). It is an index that measures food safety drivers across nations and periods. The Economic Intelligence Unit (EIU), in collaboration with a panel of worldwide food safety experts has maintained the index. The GFSI model incorporates four important dimensions: availability, affordability, quality, and safety, in addition to natural resources and resilience (Sarena, Ashar and Siti 2019). Each dimension is further subdivided into several indicators that assess the numerous programs, policies, and practices that are universally recognised as critical food security drivers by global experts.

Methodology

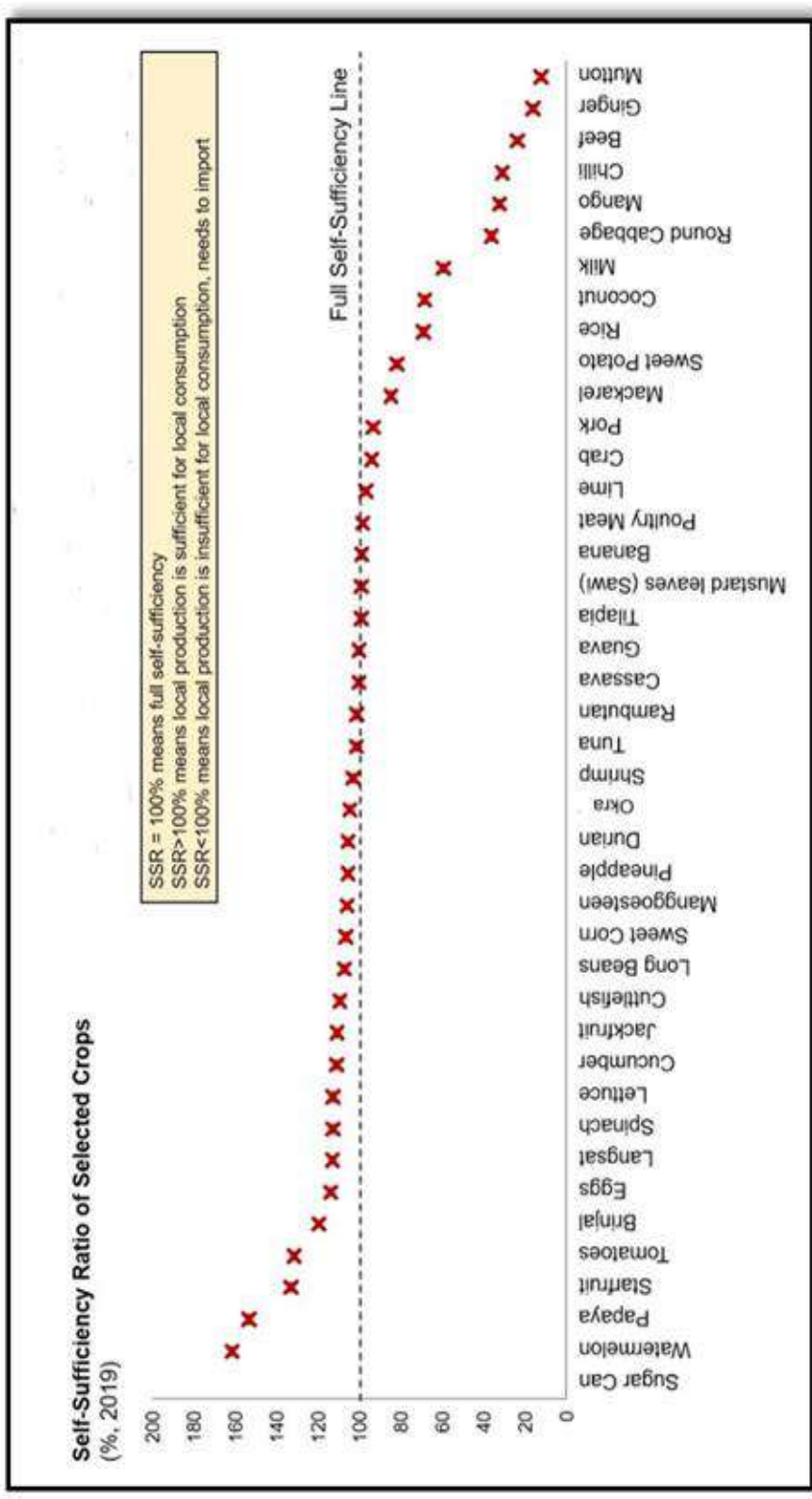
More specifically, the paper examines how the four dimensions of food security impact two key indicators of food security in Malaysia, namely food production and self-sufficiency levels in the country. Biotechnology plays an intervening role in the process. The study will also identify the government's agro-industry initiatives to cater to sufficient food supply while considering the growing population in the coming years. Based on the literature review, the research framework is shown in Figure 3 below.

Figure 3: Analytical Framework for Explaining Relationship between Dependent, Independent, and Intervening Variables



Source: Compiled and created by Authors.

Figure 2: Malaysia's Self-Sufficiency Ratio (SSR) in 2019



Source: (Ivan 2020)

The identified Independent Variables (IV) are the dimensions of Food Security as proposed by FAO (2008): food availability, accessibility, utilisation, and stability. The first is the availability of food. There is an adequate food supply, either from domestic production or from imports. Secondly, food access refers to the ability of people to get food from shops such as markets or farms. The third dimension is the consumption of food, which means that it is cooked in a way that sounds nutritional, and the last dimension is always the stability of food supply and access. Evaluation of SSL will be important as a benchmark to determine food safety without relying solely on food imports to overcome food deficits, especially staple foods such as rice, vegetables, fruits, meats, and dairy products.

Biotechnology policies will be the catalyst (or intervening variable) that links all four dimensions with food security in Malaysia. Biotechnology can improve the quality, nutritional value, and variety of food available for human consumption, as well as improve food production, distribution, and waste management performance. The dependent variable is food security. It is important to note that food security indirectly affects national security. The identified outcome of the study will lead to policy suggestions on the means of achieving food security. This research utilizes qualitative methods.

The collection of data is mainly from primary and secondary sources. Discussions were conducted with the members of the Ministry of Agriculture and Food Industries in the formation of the analytical framework as well as the verification of the results. The key data sources, however, are the Malaysia Plans (7^{th} to 12^{th}), the National Agrofood Policies (2011-2020), National Agrofood Policy 2.0 (2021-2030), the National Agriculture Policies (1991-2020), and the National Biotechnology Policies (2005-2020). The study also analysed other national biotechnology initiatives such as Bioeconomy Transformation Programs (2012 – current), and other secondary sources such as books, newspaper articles, academic journals, and annual reports to further link the dimensions of food security on Malaysian national food policies.

Findings

The findings of the study nexus between four dimensions of food security on food production, SSR, and food security are in Table 1 (next page). The discussions will follow the framework suggested in Figure 3.

Independent Variable

Food Security

Food availability refers to the capacity of a household to receive an acceptable quantity and quality of food. In the study, our finding, food availability is linked to food production due to the need to address issues of population growth. Issues of food availability also affect the food industry by forcing the sector to be productive using biotechnology and the efficiency in the usage of land and labour.

Table 1: The Impact of IVs on Food Production, SSR, Identifying Food Security Nexus

Dimensions of Food Security	Impact on Food Prutilises	Impact on Food Self-Sufficiency	Food Security Nexus
1. Availability	1. Population growth 2. Food demand 3. Food industry 4. Agricultural productivity 5. Agrobiotechnology 6. Land and Labour	1. Food import 2. Food stocks 3. Food production	1. SSR affected 2. Food production affected 3. The policy affected
2. Accessibility	1. Income and purchasing power 2. Food price 3. Infrastructure and food system	1. food consumption 2. low productivity	1. SSR affected 2. Food production affected
3. Utilization	1. Nutrition status 2. Food safety		1. Mechanism to ensure safe food affected.
4. Stability	1. Climate change 2. Natural disaster 3. Conflict 4. Political factor 5. Economic factor	1. Climate change 2. Natural disaster 3. Conflict 4. Political factor 5. Economic factor	1. SSR affected 2. Food production affected 3. Policy affected 4. Bioeconomy affected

Source: Compiled and created by Authors.

Malaysia is experiencing mild availability issues where, on average, Malaysian producers can only meet about 20% to 70% of the needs of local consumers. Malaysia produced 70% of its rice, 74% of its vegetables, 78% of its fruits, 86% of its fish, 32% of its beef, 23% of its mutton, and 23% of its milk in 2019 (Rozhan 2020). The rising demand from worldwide markets enables entrepreneurs to export their products, which has resulted in a reduction in the availability of food products on the market. As a result, food imports continue to increase from year to year, from RM38.9 billion in 2013 to RM51.5 billion in 2019. Table 2 below shows Malaysia's food import and export values from 2013 to 2019.

The findings suggest that the yearly increase in trade deficit implies Malaysia is increasingly dependent on imports to supplement its food supply, thus showing the potential fragility of our food security. Therefore, the study concludes the need for high local production of essential foods to mitigate the need to import and thus will increase the SSR of the food category. It ensures sufficient food supplies can be exported or be used as input for the production of other goods (i.e., processed food, animal feed, etc.). Findings show that food availability positively affects food security (high SSR) and allows for economic. It also allows for more policy space for food-related innovation. High food availability also reduces prices, which affects the affordability of food, which in return affects the accessibility of food, which will be explained below.

Table 2: Malaysia's Food Import & Export Value from 2013 – 2019 (RM Billion)

Year	2013	2014	2015	2016	2017	2018	2019
Export (RM/Bn)	22.10	25.65	27.37	30.22	31.84	31.58	34.09
Import (RM/Bn)	38.86	42.64	45.48	46.77	51.29	50.17	51.42
Trade Deficit	-16.76	-16.99	-18.11	-16.55	-19.45	-18.59	-17.33

Source: Ivan 2020

Food Accessibility

Access to food is related to the price, availability, and preference for high-quality food. Food accessibility refers to household access to sufficient resources (rights) to obtain nutritious food. In terms of determinants of household food expenditure, this study found that total household income is a key indicator for predicting household spending patterns. With a population of 33.4 million, Malaysia has a purchasing power of about RM44,686 per capita in 2019, and the average household spends RM726 on food per month or 18% of the average monthly household income. Food prices have risen faster than other goods.

This is shown in Malaysia's consumer price index (CPI), which increased by 15% between January 2010 and October 2015, while the food index increased by 23%, outpacing the CPI by 8%. Since 2003, the CPI has increased by 69 per cent, compared to a 42 per cent increase in the overall CPI (Rozhan 2020). This means that food prices have risen faster than overall prices. This affects food accessibility because soaring prices

coupled with increased demand for food and insufficient local production to meet demand may only mean the food is only accessible to higher income groups in the society. Thus, larger food price increases will also affect mostly low-income consumers and exacerbate issues of income inequality.

The link between availability and accessibility is as follows: If local food production can exceed its SSR, the scale effect will enable food to be purchased at lower prices. However, this should also come with improvements in transportation, market infrastructure, and food distribution networks because most agricultural and animal activities take place in rural areas. Thus, NBP calls for an increase in agricultural and livestock production to increase food production. Increased food productivity can benefit farmers and the country's food production, which can reduce dependence on imports. The results of this study show that to improve food products, agricultural development needs to be accelerated according to food demand and supply. In addition, the use of agricultural biotechnology supports the potential to increase the production and productivity of agriculture, livestock, and fisheries.

Food Utilisation

Food utilisation refers to the ability of a household to obtain adequate nutrients through food intake and health care to meet its physiological needs. Therefore, food consumption also depends on the benefits of acceptable food consumption, which may be related to its nutritional quality. Proper food intake can result in improved health and well-being of an individual or household. Food availability and accessibility both affect food utilisation whereby according to a 2018 UNICEF study of urban households and low-income children in Malaysia, more than one in ten children receives less than three meals a day. 97 percent of parents attribute high food prices as the main cause of difficulty in providing nutritious food for their children. Individuals or households who face insecurity in terms of food availability, accessibility, or consumption are more vulnerable to nutrient deficiencies in these conditions.

This study concludes that the agricultural industry needs entrepreneurs capable of commercialising biotechnology and high-tech food production to develop food production that meets nutritional criteria. The food-manufacturing sector in the present era must be developed and transformed into a modern, competitive, and economically viable sector. In addition, malnutrition is exacerbated by low economic conditions, inadequate public health infrastructure, and the absence of social welfare programs.

Food Stability

Food stability refers to households that have access to sufficient food consistently. Thus, food stability is inextricably linked to issues of availability, accessibility, and consumption of food. To ensure household food security, it is necessary to face unforeseen hazards such as crises, climate change, natural disasters, economic crises, and political instability. Any political conflict has an impact on all facets of food security. For example, civil wars and political instability can devastate food security by destroying agriculture, disrupting food production, and disrupting food distribution.

Additionally, climate change and natural disasters are complicated environmental challenges that directly affect the economy, notably agriculture. It has the potential to have a detrimental effect on the sustainability of agricultural output, freshwater supply, and the survival of indigenous species and ecosystems. In this context, the study discovered that Malaysia was in a precarious position, as food demand continued to rise

year after year while domestic agriculture was unable to meet demand. Thus, the risk of civil wars, economic crises, natural or manufactured calamities, and health-related epidemics (such as COVID-19 illness) can all result in uncertainty in agricultural and food markets, resulting in food instability.

Conflict and food crises are significant contributors to food insecurity and malnutrition. They stifle food production, impair access to food and health care, and erode social protection systems. The conflict has characterised every famine in the modern age. This has not yet occurred in Malaysia, however during MCO, there were disputes in the food value chain delivery. This is a result of the numerous issues and regulations imposed by the authorities during MCO. This rule affects many vegetable vendors and delivery truck drivers in Cameron Highland who are unable to sell and deliver crop produce to market due to market closures or operating time restrictions. The disruption of logistic services, particularly the supply of vegetables from Cameron Highland, continues, possibly affecting the economy of farmers as well as affecting the stability of the food supply.

As a result, existing policies must ensure that the country's food output increases while simultaneously reducing its rising reliance on food imports. This policy must encompass a comprehensive action plan for enhancing and ensuring national food security. Thus, boosting food production and self-sufficiency is the primary strategy for ensuring Malaysia's food security.

Role of the Intervening Variable: Development of Biotechnology in Malaysia

Malaysia's biotechnology initiatives began in the mid-1990s when the government gave considerable resources, time, and effort to make the country an international biotechnology hub. The biotechnology agenda was created to transform Malaysia's rich natural resources and biodiversity into bio business and wealth. In this regard, Malaysia launched its first National Biotechnology Policy (NBP) in 2005, and the 9th Malaysia Development Plan strengthened support for the development of this sector. Within the plan, agricultural biotechnology was given due attention as biotechnology techniques can be applied to various existing agricultural activities in the country.

Agricultural Biotechnology Links to Food Security

Agriculture contributes significantly to national income and export earnings, as well as job generation, and hence plays an essential part in the national economy. The Malaysian government recognizes that modern biotechnology procedures such as genetic engineering have the potential to boost agricultural production and productivity. These will ensure that the *availability* and *accessibility* dimensions of food security are covered. This is evident as the use agricultural biotechnology sector focuses on the development of new crops, livestock, aquaculture, and marine areas, which can increase food supply to achieve food availability and accessibility. This is consistent with the direction of Malaysia's biotechnology development policies, where five corridors were announced in the Ninth Plan's Mid-Term Review to attract companies seeking new growth potential in agricultural biotechnology and its applications.

As for food utility, plant breeding is used to increase and stabilise yields, increase tolerance to pests, diseases, and abiotic conditions such as drought and cold, and increase the nutritional value of food. As early as the 1970s, the government launched the 1972 Applied Food and Nutrition Program intending to increase nutrition and reduce hunger

in Malaysia. Its goal is also to increase the production of nutritious foods and to promote supplementary nutrition to pregnant and breastfeeding women, newborns, and school-aged children. Improving the health and nutritional well-being of Malaysians continues to be one of the strategic thrusts of the 12th Malaysia Plan (2021-2025).

To ensure food stability, high-impact agriculture projects (HIPs) such as The Permanent Food Production Park (TPKM) were proposed during the Ninth Malaysia Plan, 2006-2010 to ensure food stability through value-added biotechnology approaches and advanced plant management systems. The initiatives continued as in 2022, the Pahang government has approved 90 hectares of land in Tanjung Putus, Kuala Kuantan, to set up a permanent food production park (TKPM) with the participants selected from among the youth and B40 group. This further ensures that the country has a stable production of food as well as ensures the supply and accessibility of food to lower-income groups within the country.

Impact on Dependent Variables: Food Production and Food Self-Sufficiency

The final part of the *findings* section examines the nexus between the four dimensions and the overall food security - which is proxy by food production and food self-sufficiency. While the summary of the relationship is noted in Table 1, this section provides further discussions.

Food Production

Food production is a strategic issue for all governments because it includes population security, or "survival." Food production, especially in the agricultural sector, is a high priority on Malaysia's national agenda. Malaysia is in a demanding situation as the *food availability* and *accessibility* dimensions – in the form of consumption, continue to rise yearly, and the supply of food produced on domestic farmlands is insufficient to fulfil demands. By and large, food production can cover only between 20% to 70% of the needs of local consumers (Rozhan 2020). For instance, Table 4 illustrates that food production versus demand for several major food items increased between 2010 and 2015, and 2020, while local food production fell short of satisfying demand. Malaysia needs to rely on food imports from a range of countries to meet this demand. As a result, Malaysia's food trade balance has been negative (Yap 2019).

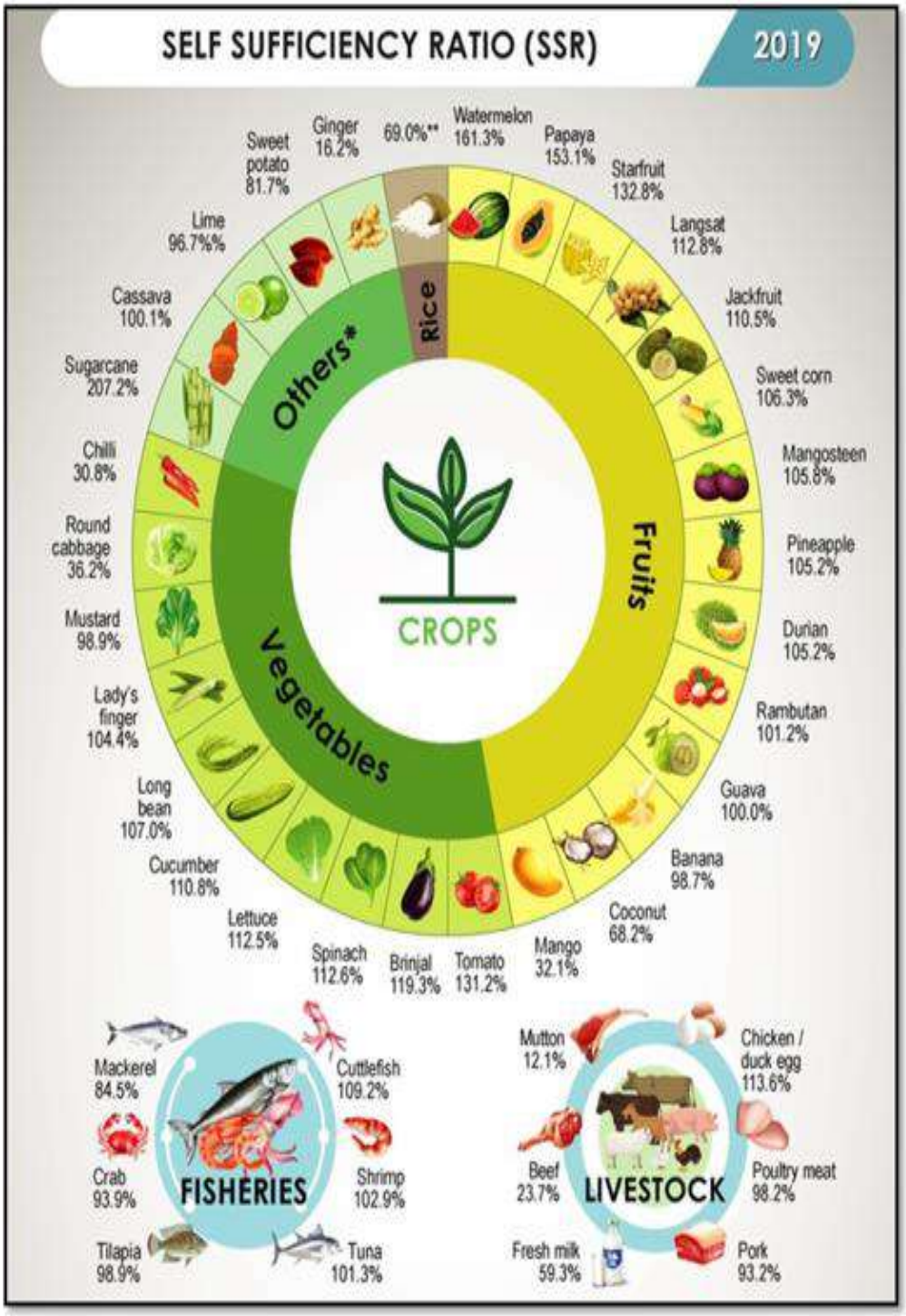
Rice production serves as a proxy for food insecurity. Additionally, it serves as a critical indication of food security and serves as the foundation for food policy planning. Malaysians consume rice daily, either directly or indirectly through rice flour. Malaysians consume approximately 80 kg of rice per person per day, which accounts for approximately 26% of total calorie intake per day, at an average monthly cost of RM44 per household (Sarena, Ashraf, and Siti 2019). Rice consumption, according to Rozhan (2020), is approximately 2.5 million tons. Malaysia, on the other hand, is only capable of producing 70% of domestic demand, necessitating the import of rice from a variety of countries. Thailand, Vietnam, Cambodia, India, and Pakistan were the primary sources of rice imports in 2018. According to the data in Table 4, demand for rice is increasing faster than supply.

Table 4: Food Production Versus Demand for Major Food Commodities, 2010-2020

Commodity	2010			2015			2020		
	Production	Demand	Deficit/ Surplus	Production	Demand	Deficit/ Surplus	Production	Demand	Deficit/ Surplus
	'000 metric tonnes (MT)								
Crops	**4,061**	**6,569**	**(2,508)**	**4,929**	**7,395**	**(2,466)**	**6,102**	**8,504**	**(2,402)**
Rice	1,642	2,300	(658)	1,785	2,495	(710)	1,875	2,685	(810)
Fruit	1,768	2,689	(921)	2,115	2,993	(878)	2,569	3,365	(796)
Vegetables	651	1,580	(929)	1,029	1,907	(878)	1,658	2,454	(796)
Livestock	**2,186**	**3,269**	**(1,083)**	**2,540**	**3,806**	**(1,266)**	**2,956**	**4,368**	**(1,412)**
Beef	47	162	(115)	59	194	(135)	76	232	(156)
Mutton	2	23	(21)	5	30	(25)	12	39	(27)
Poultry	1,296	1,013	283	1,505	1,163	342	1,746	1,327	419
Pork	234	230	4	231	242	(11)	231	248	(17)
Eggs	540	468	72	651	553	98	773	649	124
Milk	67	1,373	(1,306)	89	1,624	(1,535)	118	1,873	(1,755)
Food fish	**1,338**	**1,315**	**23**	**1,626**	**1,593**	**33**	**2,117**	**1,918**	**199**
TOTAL	**7,585**	**11,153**	**(3,568)**	**9,095**	**12,794**	**(3,699)**	**11,175**	**14,790**	**(3,615)**

Source: (Yap 2019)

Figure 4: Malaysian Food SSR 2020



Source: (Uzir 2020)

Domestic food production is critical in this situation to ensure that the country always has an adequate food supply, even during disasters like the COVID-19 pandemic. Apart from food *availability* and *accessibility*, food security issues have been focused more on *utilisation* issues because it is increasingly important to stay healthy during the pandemic. Also, the sustainable flow of foods during a crisis further invoked concerns about food *stability*. This trend will persist in the future as nations start living with the pandemic.

While increasing food production is necessary to ensure food security and avoid reliance on imported agricultural products, empowering domestic production rather than an inward-looking stance is much more favourable. By creating an adequate supply of locally produced agro-food, consumers are assured of food's availability, accessibility, utilisation, and stability. With biotechnology as a catalyst for platform technologies such as genetic engineering, functional genomics, and proteomics, the development of agro-biotechnology products may increase plant and livestock productivity (Rozhan 2019). Genetic engineering has the potential to improve the quality, nutritional value, and diversity of foods that are accessible for human consumption (Mohammad and Byong 2014).

Food Self-sufficiency

Among the 42 most used agricultural products, 24 have an SSR of more than 100%. However, the major agricultural food categories, such as rice, beef, mutton, and fresh milk, have dropped below the 100 per cent SSR level. Because these foods rely on imports to supply domestic demand, they have a high rate of import reliance. As illustrated in Figure 5, in 2019, the SSR of key foods such as rice is 69 per cent, vegetables at 46.6 per cent, key proteins such as beef at 23.9 per cent, mutton at 11.2 per cent, fresh milk at 61.3 per cent, dairy products at 5%, and fruits at 79 per cent. This has also resulted in a rising trade imbalance year after year (Uzir 2020).

All of these data indicate that Malaysia's food self-sufficiency levels stemmed from *availability* and *accessibility* issues within the country. If the majority of these food products are *available* locally (meaning can be farmed and produced locally), they may be able to reduce the dependency on imported goods. If biotechnology is used to empower local farmers, they will improve the quality of their produce and thus improve earnings and crops yield. This increases their *accessibility* to food as prices may lower due to an increase in food availability. More important, it also increases farmers' accessibility to higher quality and disease-resistant seeds. The seeds imbued with biotechnology techniques produce further improves nutritional values, which further improves the *utilization* of food. In the long term, the food chain may stabilise as more foods with higher quality are made available to consumers.

To reiterate, the idea of achieving high SSL is more about empowering the agriculture sector (to ensure food security) even when food import activities are present. Improving SSL is therefore interpreted in this study, as improving the level of agricultural production capacity, productivity, and capacity of the country. Improvements in agricultural productivity, workforce skills, land utilisation, and standards compliance are more important than import substitution efforts to raise SSL.

Conclusion

Food production is a strategic issue for all governments because it includes population security, or "survival." UN's Food and Agriculture Organization (FAO) refers to food security as a condition in which all levels of the food supply are sufficient, safe, and nutritious to suit the demands and desires of an active life and a healthy lifestyle. According to the FAO, while measuring a country's food security, four factors or indicators must be identified: availability, accessibility, utilization, and stability.

First, food availability for consumers can be improved by increasing the efficiency of major food production systems and reducing waste during food processing. Second, trade actions improve access to food supply through better supply management and marketing systems to reduce food costs and increase consumer purchasing power. Third, food intake can also be enhanced by improving the nutrient status of food choices, such as vitamin supplements through biofortification. Finally, increasing physical access to food supplies at affordable prices will help stabilise the food system.

These four dimensions also contribute not only to the food security of the country but also to overall security. It can be said that food security is an important aspect in determining the stability and strength of a country in addition to other factors such as economic strength, military, political and social stability. Ensuring adequate food supply at affordable prices by the population, will indirectly eliminate various security risks in the country. A healthier population also ensures that the human capital of the country is preserved, and thus strengthens the country against various security risks.

With the world economy shifting to an ever dynamic and competitive landscape, amid global pandemic pressures that have and in turn disrupted economic activities as well as individual sources of income, food security is now one of the key areas of focus that can affect national security. The Covid-19 pandemic has become a call for Malaysian food security where food security is important to ensure that the community has access to nutritious basic food without having to deal with food shortages or having to pay exorbitant prices. The downside of the lack of food supply is the problem of hunger and starvation.

Policy Implications

1. Agriculture is Malaysia's primary source of food. This encourages the government to expand agricultural programs to boost domestic production. Good strategic plans and good government policies determine the development of the agricultural sector. Thus, the Malaysian government recognises that biotechnology processes such as genetic engineering have the potential to increase agricultural productivity. The use of new agricultural technologies and agricultural biotechnology can aid in the resolution of agricultural production issues, as has been demonstrated in other countries. As a result, the use of biotechnology in agriculture has benefited farmers, producers, and consumers.

2. The Ministry of Agriculture and Food Industries (MAFI) has identified six important target areas for improving food production for Malaysia to achieve self-sufficiency in terms of food security. These included expanding the use of recent technologies such as smart agricultural mechanisation and automation,

as well as developing integrated data systems following the Industrial Revolution 4.0. (IR4.0). Additionally, the Ministry emphasises the importance of optimising agricultural land use to boost productivity, which includes developing underutilised land, consolidating land management, and integrating farms (Kiandee 2021).

3. The latest National Agrofood Policy (NAP), NAP2.0 (2021-2030) (DAN2.0 - *Dasar Agromakanan Negara* 2021-2030), will further strengthen efforts toward improving the production levels of farmers and entrepreneurs through the application of modern technology, sustainable resource management, and a more efficient supply chain, as well as target increased self-sufficiency (SSL) of key food commodities by 2030.

Results from this study, therefore, suggest that the policy direction of the country focus on three pillars: ensuring food production, high SSL, and food security. It can be implemented by (1) increasing food production through land optimisation, sustainable agricultural expansion, and large-scale food cultivation; (2) improving and expanding access to food through the availability of marketing and promotional infrastructure; and (3) ensuring affordable food prices. Additionally, biotechnology can be utilized to encourage more technologically advanced agricultural practices, such as enhanced seed consumption, animal husbandry, and fishing technology, all of which contribute to increased productivity.

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SINERGI 2, no. 1: 6-27

Appendix 1: Definition of SSR

Self-Sufficiency Ratio (SSR) is used to calculate the extent to which the supply of agricultural commodities in the country meet the domestic needs of the country.

$$\text{SSR} = \frac{Production}{(Production + imports \pm Stok) - Exports} \times 100\%$$

SSR is measured in percentage (%)

If SSR < 100% it implies the supply of agricultural commodities in the country is still not sufficient to meet the domestic needs of the country

If SSR > 100% it implies the supply of agricultural commodities in the country is sufficient to meet the domestic needs of the country

The capacity of home production, particularly of staple food crops, to meet local consumption is measured in the Food Self-Sufficiency Ratio (SSR). SSR in food will conserve foreign exchange that can be utilised to acquire other agricultural goods that are not produced locally. Such food crops are produced and grown within a country, with a minimum reliance on the foreign market, to ensure that sufficient food is available to feed the local people (Nur Marina & Normaz 2019).