INTERNATIONAL JOURNAL OF INDUSTRIAL MANAGEMENT (IJIM)
ISSN: 2289-9286 e-ISSN: 0127-564X
VOL. 16, ISSUE 1, 2022, 51 – 58
DOI: https://doi.org/10.15282/ijim.16.1.2022.9012

ORIGINAL ARTICLE

REVIEWING FOOD SECURITY ON PADDY PRODUCTION: A CONCEPTUAL PAPER

Syahmi Makhtar[1*], Irwan Shah Zainal Abidin[1], Rabiul Islam[2]

[1]School of Economic, Finance and Banking, College of Business, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia
[2]School of International Studies, College of Law, Government and International Studies, Universiti Utara Malaysia, 06010Sintok, Kedah, Malaysia

ABSTRACT – This study examines the literature on food security concerning paddy production, focusing on food security indicators to overcome food insecurity and lower paddy productivity. The purpose of this study is to perform a comprehensive review of the development of the conceptual framework for food security in paddy production and grasping the problems in paddy production and its impact on food security. The review indicates the flow from the national level to individuals may get information on food security challenges, with a particular emphasis on our staple foods, while also protecting the environment to achieve sustainable development. In addition, the key concerns and strategic initiatives of food security as a field and future research directions are discussed. Finally, the food security indicators for sustainable development goals were briefly reviewed.

ARTICLE HISTORY
Received: 15-10-2022
Revised: 10-11-2022
Accepted: 11-11-2022

KEYWORDS
Rice Production
Food Security
Conceptual Framework

INTRODUCTION

The concept of food security and the factors that influence it have been the subject of much research. The conceptual definition of food security and the determinants of food security at the individual, household, and national levels could be identified via a review of the relevant literature. The idea of food security first emerged in the middle of the 1970s. Since then, academicians and researchers have established a framework, refined, expanded, and varied the concept of food security (Giraldo et al., 2008). The Food and Agriculture Organization (FAO) defines food security as the condition in which everyone always has access to the food they need and wants to maintain an active and healthy lifestyle.

In addition, there is an increasing awareness of the need to bolster food security, yet, little is known about the elements that affect food security in Malaysia. Determining what factors contribute to food insecurity is critical for ensuring that academicians and policymakers in Malaysia can implement effective measures to address the issue. Because of that, this conceptual paper will discuss the food security framework that can help the Malaysian government craft effective policies by revealing whether or not all the factors influence food insecurity. Despite this, the four pillars for food security perspectives may help us develop a more complete conceptual framework for addressing food security, especially in paddy production.

This study contributes to the ongoing discussion of the best method to explore the flow of food security for paddy production to ensure a safe supply of rice in the future. This research aims to apply the theory and framework of food security toward paddy production. This paper will discuss and elaborate more on every food security indicator for the flow of paddy production. This paper developed a new expansion food security framework as a reference for other researchers and policymakers. We argue that the literature has yet to explain clearly the connections between the reality of paddy farmers that cause food insecurity for staple food and how it affects the production of paddy.

Furthermore, the Malaysian government also took additional steps to address the problem through both immediate and far-reaching policy changes. The National Food Security Policy and National Agro-Food Policy 2020-2030 (NAP 2.0) is one of the initiatives taken, and its goal is to boost rice production so that Malaysia can reach its Self-Sufficiency Level (SSL) target in the near future.

PURPOSE OF THIS STUDY

The purpose of this research is to undergo a comprehensive review of the development of the conceptual framework for food security in paddy production. This study also aims to investigate the problem happening in paddy production and its impact on food security. The scope of this paper is limited to food security issues in the paddy sector only.

LITERATURE REVIEW

An Overview of Food Security

There are four main components that determine a country's level of food security: (1) the amount of food available for consumption, (2) the ability to access the food, (3) how the food is used to feed people, and (4) how stable the food supply is in the face of shocks and cycles that are out of the ordinary. A population has a high degree of food security

*CORRESPONDING AUTHOR | S. Makhtar | ✉ syahmimakhtar97@gmail.com

when it can get sufficient food from a reliable, stable, and appropriate food supply at affordable costs to fulfil its consumption and nutritional demands (Sundaram & Tan, 2019).

Aside from that, the production and supply of food are not the only factors that determine food security. It is also impacted by social and economic issues, most of which have a generally negative impact on low-income individuals and farmers. Many different determinants for food security have been studied, from the national level down to the household and individual levels. Besides that, a nation is considered to have food security when its food supply and effective demand consistently and reliably meet the needs of its people. The country's food needs may be addressed by either domestic food production or access to food beyond what is produced domestically or through both factors (Food and Agriculture Organisation, 2006). Furthermore, domestic food production alone may be enough to meet needs in a closed economy. However, in an open economy, countries must rely on the international food market to satisfy their citizens' dietary requirements. This suggests that a country's internal and external factors influence the country's food security.

Therefore, food security is a critical problem in the more significant economics and agricultural development studies. Over the last four decades, Malaysia has been a net food importer. Most of its rice and other staple foods are imported. Domestic rice consumption per capita rose by 5.1 per cent annually between 2020 (73.9%) and 2021 (79%). On the other hand, rice production decreased from 2.35 million metric tons in 2019 to 2.34 million metric tons in 2020, which is a decrease of 1.2% per year (Zakaria & Ghani, 2022). There will be a disparity between production and demand. As a result, Malaysia's rice import cost went from RM1.5 billion in 2019 to RM2.5 billion in 2020 as the country raised its rice imports by 30-40 per cent during that period (Zakaria & Ghani, 2022). Malaysia mainly imports rice from Thailand, Vietnam, Pakistan, and India. However, rice's import increase year-by-year was explained by increasing imports from Thailand (55.3%), Pakistan (104%), and India (1.72%) (Department of Statistics Malaysia, 2020). Because of that, Malaysia will increase rice production to cover and fulfil the demand of all populations in Malaysia. According to Demeke et al., (2009), Malaysia released public or imported rice stock at subsidised prices and instituted retail price control.

Therefore, as mentioned earlier, individuals are facing food insecurity when they do not have adequate physical, social, or financial access to food.

Sustainable Development Goal

Referring to definition, each researcher has a different definition of sustainable development. Accordingly, it is very difficult to define sustainable development that is globally agreed upon. Therefore, this paper will use the definition of sustainable development of the World Commission on Environment and Development (1987) to address this restriction. Thus, sustainable development is defined as development that satisfies the demands of the present without affecting future generations' ability to satisfy their own needs.

Furthermore, sustainable development not only provides access to human knowledge but has also been a significant contributor to the drive against the present environmental, social, and economic crises, especially in overcoming the problems of poverty and food insecurity. Therefore, a sustainable food system guarantees food and nutrition security by promoting a more balanced, varied, and healthy diet. In addition, it centres the production, distribution, and consumption of food on the accessibility of food and the capacity to eat healthily. The food system can thus guarantee food security and ensure better nutrition for all through supply, demand, prices and incomes using food systems to achieve sustainable food policies. In addition, enabling conditions and a national food policy framework should be built to support Malaysia's commitment to achieving Sustainable Development Goals.

Table 1. Sustainable Development Goals

Goal 2	Zero hunger, provide adequate food, promote nutrition, and encourage sustainable farming.
Goal 3	Good Health, Keep everyone healthy and happy, regardless of age.
Goal 6	Clean Water, Ensure sustainable water and sanitation for everyone.
Goal 9	Support sustainable industrialization, innovation, and solid infrastructure.
Goal 12	Responsible to ensure sustainable consumption and production patterns

Sustainable Development Goal

Paddy is the main food crop in Malaysia. Other than that, the rice crop in Malaysia has already been for a long time and is heavily subsidised by the government. It has become more important for Malaysian government officials to focus on rice cultivation in light of the new global economic order. Increasing environmental competitiveness in today's globe has prompted Malaysia's government to be more attentive and aware of its developing population and rice production needs. Because of that, paddy and rice industry growth and national food security were the goals of the National Agricultural Policy (NAP) of 1984–1991, which established Malaysia's eight mainly granary paddy regions that can meet the country's rice needs and contribute to the country's overall food security (Firdaus et al., 2020).

Figure 1 below shows the average annual growth rate of paddy yield, rice production, and rice import from 1990 to 2020. During the period of NAP1 up to NAP3, the production performance of paddy crops showed an increase although there was a slight decrease in certain years. The rate of decline shown still shows that the country's rice production is still stable.

In addition, unstable yield rates and crop densities are included in main paddy granary areas, as well as increasing areas of fallow paddy land. The government has taken action which is by establishing paddy estates in irrigated regions

in the states of Kedah, Kelantan, Negeri Sembilan, Perak, and Penang to redevelop and rehabilitate the near areas of fallow land and assist farmers to boost their production (Economic Planning Unit, 1986). The year 2015 recorded an encouraging increase compared to 2010 including the effects of the use of quality and disease-resistant rice seeds as well as modern agricultural practices (Economic Planning Unit, 2015). Paddy was sown on a total area of 681,559 hectares in 2015, including paddy that was planted twice yearly.

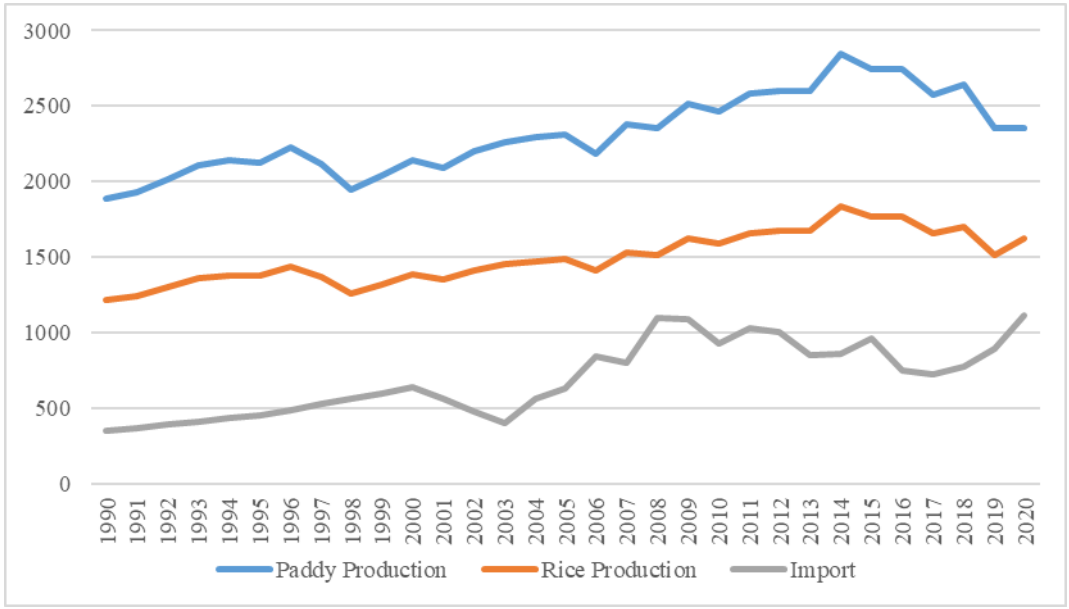

Figure 1. The Average Growth Paddy Yield, Rice Production, and Rice Import in Malaysia ('000 M/T).
Source: Ministry of Agricultural and Food Industry Malaysia (MAFI)

The Agriculture Policy that has been carried out is still not effective in ensuring food security for rice although rice is the main food source in Malaysia. To cover the insufficient source of rice in the country, imports had to be done from foreign countries. Therefore, to accomplish food self-sufficiency goals, the government implemented a new National Agro-food Policy 2021-2030 (NAP4).

CONCEPTUAL FRAMEWORK: FOOD SECURITY ON PADDY PRODUCTION

The conceptual framework places a focus on the combination and complexity of many elements that make up food security and rice productivity. In addition, the principle of food security is characterised by several types of research that emphasise the interconnections and effects between numerous variables of food availability, accessibility, utilise, and stability to satisfy their own demands. Figure 2 below shows how both macroeconomic circumstances and people have a role in producing and sustaining long-term sustainable food security. People are able to change the food they have access to into sufficient nutrition because of the way resources are distributed within households and because of the conversion factors of the individuals consuming the food.

According to the World Food Programme's Comprehensive Food Security and Vulnerability Study Guidelines (CFSVA), the extent to which individuals are able to provide for their own nutritional needs is determined by macroeconomic studies of food availability, household access, household utilities, and household stability. This serves as an introduction to the right to consume enough rice as well as the possibility to increase a farmer's revenue via the use of infrastructure while production is taking place. Aside from that, the status of paddy production is often impacted by the significant extent to which infrastructures, technologies, fertilisers, and seeds interact effectively.

Basically, food safety is mostly an individual concern. The main emphasis is on the nutritional status of each family member and the likelihood that it will not improve or worsen. Food security implies that everyone always has physical, social, and economic access to sufficient quantities of safe and nutritious food that meets their dietary needs and food choices to lead an active and healthy life. Therefore, the following framework will explain each variance in production flow indicators and fluctuations in rice output throughout time. At the same time, it may refer to any difficulty that arises.

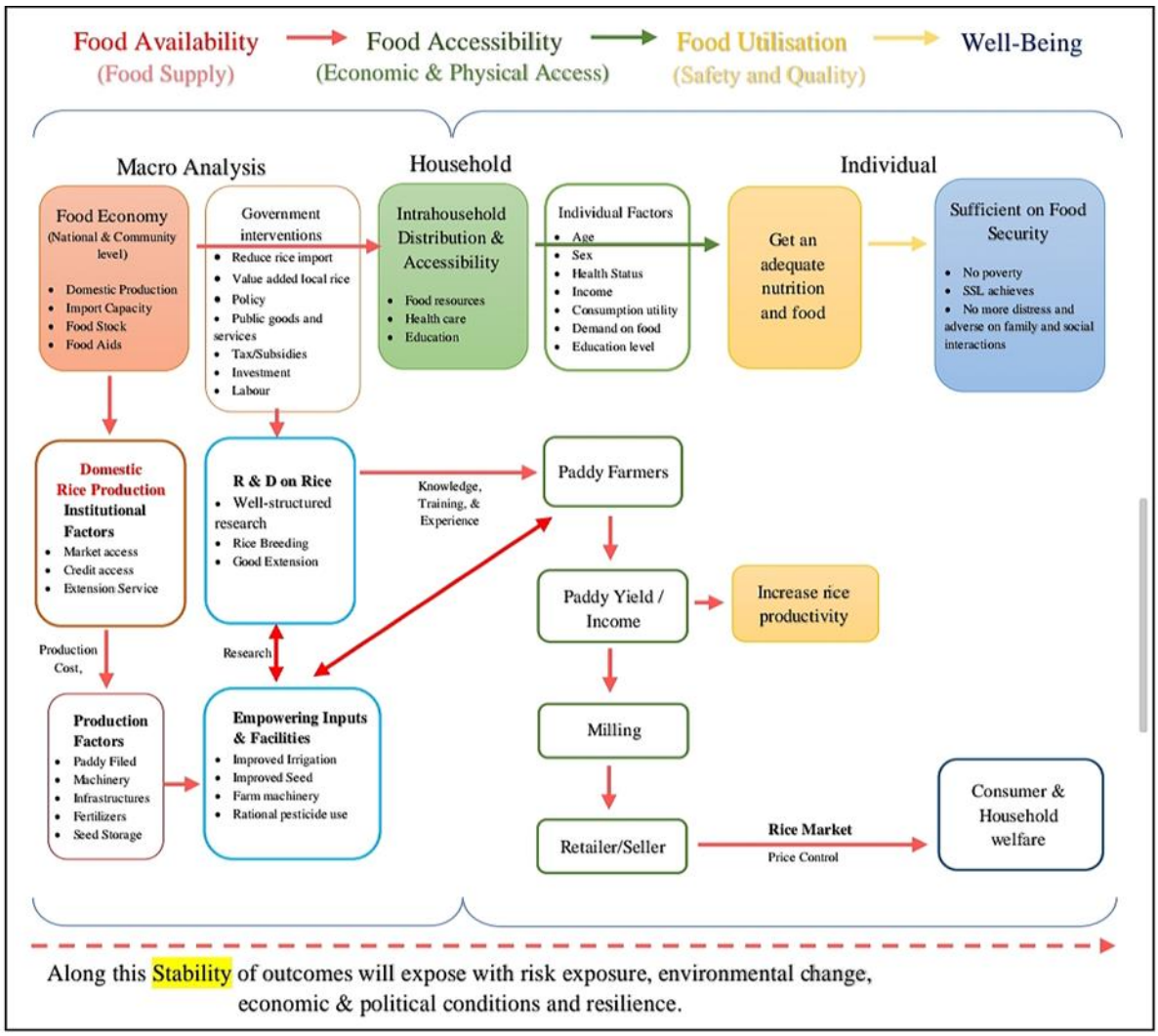

Figure 2. Conceptual Framework of Food Security and Rice Production
Source: Aurino, (2014); Lapina & Catelo, (2018); Lahlali & Boulif, (2021)

Besides, the framework depicts the factors that influence rice production and the chain of events that leads to rice reaching individual households. The next factor is the increase in output that comes from farmers' use of modern equipment and technology, allowing them to do things like boost their income and their capital to take advantage of a wider range of opportunities (Udin et al., 2014).

Availability

Food production, imports, exports, and food stocks may all be used to measure food availability. Raw material inputs for the food production sector, such as seeds, fertilizer, and insecticides, must be included. Furthermore, stored food stockpiles, as well as food decay and loss in production or storage, are a waste in consumption. The availability of adequate amounts of good quality food, provided by domestic production or imports, including food aids is a priority. Overall, ensuring enough food supply through local production, market imports, and agricultural inputs is simply one component of food security.

Macro analysis shows that food supply focuses primarily on the rice production sector, which includes domestic production, government interventions on import and export, and Research and Development (R&D) in the paddy industry. Rice is a crop that has high costs because it needs a lot of technology and machinery to grow. Expert and experienced farmers and good infrastructure are needed to generate a significant amount of income and harvest good quality rice. So, in order to start farming, every farmer needs capital. Most of them get loans from financial institutions and other organisations that offer agriculture loan incentives. This capital will be used to purchase farming tools, manage equipment, buy fertiliser and seeds, and fix up infrastructure.

Besides that, the granary area of land suitable for growing rice is decreasing as a result of urbanisation, industrialisation, and other economic issues. More urbanisation and industrialization will lead to a further decrease in the number of people working in agriculture, a rise in labour pay, a decrease in farm size, and a highly cost need for machinery. The majority of the rice granary sites have been transformed into industrial and residential areas, which has led to a decline in the proportion of total rice output. Harun (2017) explained that this proves that input costs are high in

Malaysia. As high-cost producers, rice farmers in Malaysia get help from the government. The average cost of producing rice in the granary is about RM30,241per hectare.

In Malaysia, water will become scarcer and harder to make proper irrigation because the granary area become residential areas for agricultural use. According to FAO, the ratio of water to rice, which is 5,000 litres of water for every kilogramme of rice, has stayed the same over the last 30 years. Nevertheless, the availability of rice in Asia has decreased by between 40 and 60 per cent. Besides, better use of fertilizers and water, as well as better agronomic management in paddy production, can help increase crop yields and help bridge the gap between production and consumption (Omar et al. 2019; Adnan et al. 2021). According to Ingrao et al. (2016), population and rapid economic and infrastructure development cause natural resources such as agricultural land, water, air, forests, and fossil fuels to become problematic and polluted. Therefore, resource recovery and conservation are also often given attention because rice production requires fresh water sources and unpolluted areas.

Therefore, the government has held a production support program such as a productive safety net, and subsidized fertilizer and seed program. In addition, an emphasis that has a good impact on young people is increasing rural food production, especially by small-scale farmers. The involvement of youth is very necessary but they do not have the experience, capital, and granary area to grow rice. Farmers often follow family traditions by growing crops for their personal use. Nevertheless, with the independence of Malaysia, agriculture became the main element of the economy (Mohamed & Damin 2010). Most of the time, young people who farm rice are carrying on a family tradition. They already have the right tools, knowledge from their parents, and a place to store grains. Thus, they do not have to spend a lot of money to get started. Since then, agriculture has grown rapidly and been passed down to new generations and is now one of the most important sectors in the Malaysian economy.

The development that the government needs to take seriously is increasing rice productivity by investing in rural infrastructure. Studies by Manjunath and Kannan (2017), Lokesha and Mahesha (2016), Lozano-Espitia and Ramírez-Villegas (2016), and Shaffril et al. (2018) looked at the effects of infrastructure, such as roads, communication, irrigation, electricity, farm size, fertiliser, education, storage, credit, and extension programmes, on agricultural production found that infrastructure and irrigation are very important for increasing crop productivity. The main purpose of the country's agricultural strategy is to develop technology and increase production while minimizing environmental impact (Tey 2013). Ali et al. (2018) stated that older farmers are more likely to have trouble adapting to new technologies. As a result, new technologies are often abandoned and hard to keep up with. Alam et al. (2010) mentioned that the average age of rice farmers in Malaysia is more than 46 years.

Accessibility

Household and individual access to sufficient resources to obtain food suitable for a high-nutrient diet are very important. In addition, the concept of household subsistence ensures that all family members have adequate access to food resources, whether this is achieved through daily expenditure or through agricultural subsistence. Another important component of food security is the availability of food with high nutrient content. To achieve this goal, adequate access to resources, such as productive and physical resources, appropriate wages for both producers and consumers, and the availability of food in its physical form is required.

Accessibility which is very important for farmers, requires education and practical experience in rice farming. According to Joao et al. (2015), Mannan et al. (2017), and Morais et al. (2018) found that the level of education, skills, and decision-making process, are all good indicators of the level of agricultural management. From the perspective of extension agriculture, the decision-making process and the elements that influence it are important to improve agricultural performance.

However, there are a handful of subsistence farmers who live in shacks in garden areas and rural areas that have less access to food. But in Malaysia at the moment, there are no significant challenges in this regard yet. According to Omar, Shaharudin, and Tumin (2019), the gap between rural and urban areas is getting closer indicating that the geographical location of an area is no longer the main factor in influencing the availability of food or the amount of food consumed.

In contrast, the majority of rural and urban residents across Malaysia now have physical access to food as a result of economic growth, full employment, retail sales of food commodities and food delivery, and government welfare initiatives. However, economic factors and disposable income have a more significant relationship with food availability. Farmers who have high yields can utilize their lives better. Therefore, better food security and higher crop yields and sales prices will result in higher yields for farmers (Adnan et al. 2019). Umar et al. (2016) agreed that increasing productivity and income through access to modern technology helps reduce poverty among Malaysian rice farmers. Despite that, strategies and policies may be created to better implement and support agricultural technologies in production and distribution.

Besides, the ability of individuals and families to purchase food is a critical factor in determining whether people who do not raise their own food can afford to buy suitable and healthy food from the market. Food costs and income are two examples of indicators that may help ensure this important component of food security. Apart from that, access to start-up capital and get good health care to continue the day job is also crucial.

Overall, strengthening rural institutions to assist farmers in securing land access and revitalising the rural financial system management is one of the ways that might be the best strategies. This method will simultaneously boost rice yield and enhance rice's self-sufficiency level. This is because more young farmers get to participate when granary land is made available. When the young generation finishes their agricultural courses, most new farmers cannot begin farming due to

a lack of land and funds. This is because the main issue is there are no new granary areas have been established, and granary places have been transformed into residential and industrial sectors.

Utilization

Individual nutritional status through the use of a nutrient dietary, clean water, adequate sanitation, and quality medical treatment to attain a state of nutritional well-being in which all of the body's physiologic expectations are fulfilled is fundamental. Besides, the food is utilized in a manner that takes into consideration the dietary and health requirements of each individual who lives in the household. This needs to highlight the significance of non-food inputs in food security. However, the emphasis should be placed more on utilization and satisfaction when deciding how to improve the quality of day-to-day living.

To boost the labour market, one of the aspects that have to be done is to encourage younger people to enter the agricultural sector by giving them financial resources, farmland, and agricultural equipment. This is one of the things that need to be done. Moreover, there is a requirement for reforms that distribute funds to promote youth engagement in agricultural education, assistance, and guidance for young farmers who want to develop their own strategic planning, lifelong professional learning, and, eventually, the use of innovative thinking to involve youths in rural development (Schrijver, et al., 2016).

This is due to the fact that every employment will generate income, which will allow the family to be able to purchase and satisfy daily requirements in a circumstance that is both healthy and adequate. According to Afroz et al. (2021), widespread poverty issues in the farming community may be traced back to a lack of farm income and the impact of poor agricultural education on farmers. A strategy to ensure the safety of food, particularly rice given its status as a primary dietary staple should be prioritize. Because of this, farmers need to raise and prepare the amount of emergency money to save for unexpected necessities.

Stability

When all of the previous processes have been completed, stability can be achieved. However, it is exposed to unsafety risks and requires a high level of resilience. To sustain an active and healthy lifestyle, all individuals must always have quick access to a cheap and sufficient amount of food that meets their specific dietary requirements and preferences (Lapina & Catelo, 2018). Stability is a multidimensional idea that means food is always readily available and there is enough to eat so that people do not have to worry about food shortages. To ensure food for the community, households or individuals must always have access to sufficient food, especially rice, which is the staple food of Malaysians.

Malaysia is a country that produces food domestically, but food insufficiency often occurs because the rate of food production is low compared to population growth. Malaysia's population is expanding faster than the country's rice production and Malaysia's rice output was just 67 per cent, and the rest came largely from Thailand, Vietnam, and Pakistan to meet Malaysian population demand (Omar et al., 2019). Therefore, Malaysia has to rely on imported food. Because of that, Malaysia is a country that produces its own food and should not be in a position of losing access to food due to unexpected shocks but it is possible that when an economic or climate disaster occurs, it causes a decrease in production, especially rice that is harvested according to the season (FAO, 2006). However, they should also not be at risk of losing access to food because of the usual cycle of seasonal food insecurity.

Lastly, the social and physical environment, as well as changes in politics and economics, all have an impact on the stability of the food supply. For example, there is often food insecurity in conflict zones, where frequent floods, pandemics, and climate change prevent people from getting food and food production is affected. Thus, it is the government's job to ensure that food is safe, and enough food can be supplied for sale, store and process, and import. Consequently, the concept of stability may be applicable to both the availability and access components of the food security concept.

CONCLUSION AND IMPLICATIONS

This paper aims to determine the elements of food security according to the flow of the rice production process so that it can benefit the population. Moreover, it is of utmost importance to consider the prosperity and well-being of rice farmers so that appropriate recommendations can be made. However, there are critical factors and issues that can be seen and need to be taken into account.

Along with that, it is clear that these factors will have a major influence on the choice of food security indicators, and they are also crucial in defining food security results in future. The framework shows that food security is not an end in itself but rather, it is an important component of a larger concept of human well-being as rice is a staple food and ensures that there is enough rice for everyone in Malaysia. With the use of framework indicators for rice production, we were able to investigate how food security concerns are affected by rice production and how this affects rice productivity.

Last but not least, the method of this study demonstrates how successful domestic rice cultivation may be at producing high yields and how easy farming in remote locations can be with advanced infrastructure. Whether looking at the situation in the short or long term, the food security analysis is a relatively consistent review of food supply and household commitment. It was essential to undertake a risk and vulnerability analysis for rural infrastructure in rice production to take a more proactive and future-oriented strategy for rice supply. It then considers paddy farmers' everyday decision-making and long-term response in light of the hazard they confront. When all aspects are considered, the study's result on the quantity of rice self-sufficiency can be further explained.

ACKNOWLEDGEMENT

The authors wish to express their gratitude to the Universiti Utara Malaysia and the Ministry of Higher Education, for funding this research under the Fundamental Research Grant Scheme (FRGS) (SO Code: 14395 and reference FRGS/1/2019/SS08/UUM/02/15).

REFERENCES

Adnan, N., & Nordin, S. M. (2021). How COVID 19 effect Malaysian paddy industry? Adoption of green fertilizer a potential resolution. Environment, Development and Sustainability, 23(6), 8089–812. https://doi.org/10.1007/s10668-020-00978-6

Adnan, N., Nordin, S. M., Bahruddin, M. A., & Tareq, A. H. (2019). A state-of-the-art review on facilitating sustainable agriculture through green fertiliser TechnologyAdoption: assessing farmers behavior. Trends in Food Science & Technology, 89, 439–452.

Afroz, R., Muhibbullah, M., & Rahman, M. Z. (2021). Poverty of Malaysian rice farmers in a changing climate - An empirical investigation in Kedah, Malaysia. IOP Conference Series: Earth and Environmental Science, 756(1). https://doi.org/10.1088/1755-1315/756/1/012012

Alam, M., Siwar, C., Murad, W., Molla, R. I., & Toriman, M. E. (2010). Socioeconomic profle of farmer in Malaysia: Study on integrated agricultural development area in North-West Selangor. Agricultural Economics and Rural Development, Institute of Agricultural Economics, 7(2), 249–265.

Ali, M., Man, N., Latif, I. A., Muharam, F. M., & Omar, S. Z. (2018). The use of information and communication technologies in agricultural risk management by the agricultural extension services in Malaysia. International Journal of Agriculture, Environment and Food Sciences, 2(1), 29–35.

Aurino, E. (2014). Selecting a Core Set of Indicators for Monitoring Global Food Security. ESS Working Paper for Food and Agriculture Organisation of the United States.

Joao, A. R. B., Luzardo, F., & Vanderson, T. X. (2015). An interdisciplinary framework to study farmers decisions on adoption of innovation: Insights from Expected Utility Theory and Theory of Planned Behavior. African Journal of Agricultural Research, 10(29), 2814–2825. https://doi.org/10.5897/ajar2015.9650

Demeke, M., Pangrazio, G., & Maetz, M. (2008). Country responses to the food security crisis: Nature and preliminary implications of the policies pursued . Food And Agriculture Organization Of The United Nations.

Economic Planning Unit Prime Minister's Department. (1986). Fifth Malaysia Plan 1986-1990. Kuala Lumpur: Percetakan Nasional Malaysia Berhad.

Economic Planning Unit Prime Minister's Department. (2015). Eleventh Malaysia Plan 2016-2020. Kuala Lumpur: Percetakan Nasional Malaysia Berhad.

FAO Agricultural and Development Economics Division. (2006). Food Security. FAO's Agriculture and Development Economics Division (ESA).

Firdaus, R., Tan , M. L., Rahmat, S. R., & Gunaratne, M. S. (2020). Paddy, Rice and food Security in Malaysia: A review of Climate Change Impacts. Cogents Social Sciences, 6(1), 1818373.

Giraldo, D.P., Betancur, M.J., & Arango, S. (2008). Food Security in Development Countries: A Systemic Perspective. Proceeding in System Dynamics Conference.

Harun, R. (2017). Policies and Economic Development. Economic and Technology Management Research Centre, MARDI.

Ingrao, C., Bacenetti, J., Bezama, A., Blok, V., Geldermann, J., Goglio, P., Koukios, E. G., Lindner, M., Nemecek, T., Siracusa, V., Zabaniotou, A., & Huisingh, D. (2016). Agricultural and forest biomass for food, materials and energy: bio-economy as the cornerstone to cleaner production and more sustainable consumption patterns for accelerating the transition towards equitable, sustainable, post fossil-carbon societies. Journal of Cleaner Production, 117, 4–6. https://doi.org/10.1016/j.jclepro.2015.12.066

Lahlali, R., & Boulif, M. (2021). A conceptual framework for achieving rice self-sufficiency in Sierra Leone. Moroccan Journal of Agricultural Sciences, 2(3), 130-137.

Lapiña, G., & Catelo, S. (2018). Knowledge and Information Gaps: Implications for Philippine Food Security. Journal of Economics, Management & Agricultural Development, 3(2), 55-74.

Lokesha, M. N., & Mahesha, M. (2016). Impact of road infrastructure on agricultural development and rural road infrastucture. International Journal of Humanities and Social Science Invention, 5(11), 1–7.

Lozano-Espitia, I., & Ramírez-Villegas, L. M. (2016). How productive is rural infrastructure? Evidence on some agricultural. Retrieved from http://www.banrep.gov.co/sites/default/files/publicaciones/archivos/be_948.pdf.

Mannan, S., Nordin, S. M., & Rafk-Galea, S. (2017). Innovation difusion attributes as predictors to adoption of green fertilizer technology among paddy farmers in Perak State. Global Business & Management Research, 9(1), 162.

Manjunath, S., & Kannan, E. (2017). Effects of Rural Infrastructure on Agricultural Development. Journal of Infrastructure Development, 9(2), 113–126. https://doi.org/10.1177/0974930617732258

Mohamed, A. M., & Damin, Z. A. . (2010). Industrialization and sustainable food security: New challenges for Malaysia. In Land and disaster management strategies in Asia. Springer, 67–80.

Morais, M., Borges, J. A. R., & Binotto, E. (2018). Using the reasoned action approach to understand Brazilian successors' intention to take over the farm. Land Use Policy, 71, 445–452. https://doi.org/10.1016/j.landusepol.2017.11.002

Omar, S. C., Shaharudin, A., & Tumin, S. A. (2019). The Status of the Paddy and Rice Industry in Malaysia. Kuala Lumpur: Khazanah Research Institute.

Shaffril, H. A. M., Krauss, S. E., & Samsuddin, S. F. (2018). A systematic review on Asian's farmers' adaptation practices towards climate change. In Science of the Total Environment, 644, 683–695. https://doi.org/10.1016/j.scitotenv.2018.06.349

Sundaram, J. K., & Tan, Z. G. (2019). Achieving Food Security for all Malaysians. Khazanah Research Institute.

Tey, Y. S. (2013). The adoption of sustainable agricultural practices: an integrative approach for Malaysian vegetable farmers. African Journal of Agricultural Research.

Umar, H. S., Abdullah, A. M., Shamsudin, M. N., & Mohamed. (2016). SOCIAL SCIENCES & HUMANITIES Implication of Fertiliser Subsidy Withdrawal on Societal Welfare, Rice Output and Imports in Malaysia's Rice Sector. Pertanika J. Soc. Sci. & Hum, 24(2), 777–794. http://www.pertanika.upm.edu.my/

Udin, F., Marimin, Sukardi, Buono, A., & Halid, H. (2014). A System Dynamics Simulation of Rice Agroindustry Development by Divestment Pattern for Increasing Rice Production and Farmer Income . Journal of Information Engineering and Applications, 4 (12), 82-94. www.iiste.org

Schrijver, Remco., & European Parliament. European Parliamentary Research Service. Scientific Foresight Unit. (2016). Precision agriculture and the future of farming in Europe: scientific foresight study.

Zakaria, M. B., & Nik Abdul Ghani, N. A. R. (2022). An Analysis of Rice Supply in Malaysia Post Covid-19 - From an Agriculture-Related Fiqh Perspective. International Journal of Academic Research in Accounting, Finance and Management Sciences, 12(2). https://doi.org/10.6007/ijarafms/v12-i2/12295.

CONFLICT OF INTEREST

The author(s), as noted, certify that they have NO affiliations with or involvement in any organisation or agency with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, jobs, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, expertise or beliefs) in the subject matter or materials addressed in this manuscript.