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THE SUSTAINABILITY OF MALAYSIAN AGRICULTURE BASIC FOOD PRODUCTION BY 2030

Suzilah Ismail[1]* & Thanusha Palmira Thangarajah[2]

[1,2] Department of Mathematics and Statistics, School of Quantitative Sciences, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah

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Corresponding Author:
halizus@uum.edu.my

ABSTRACT

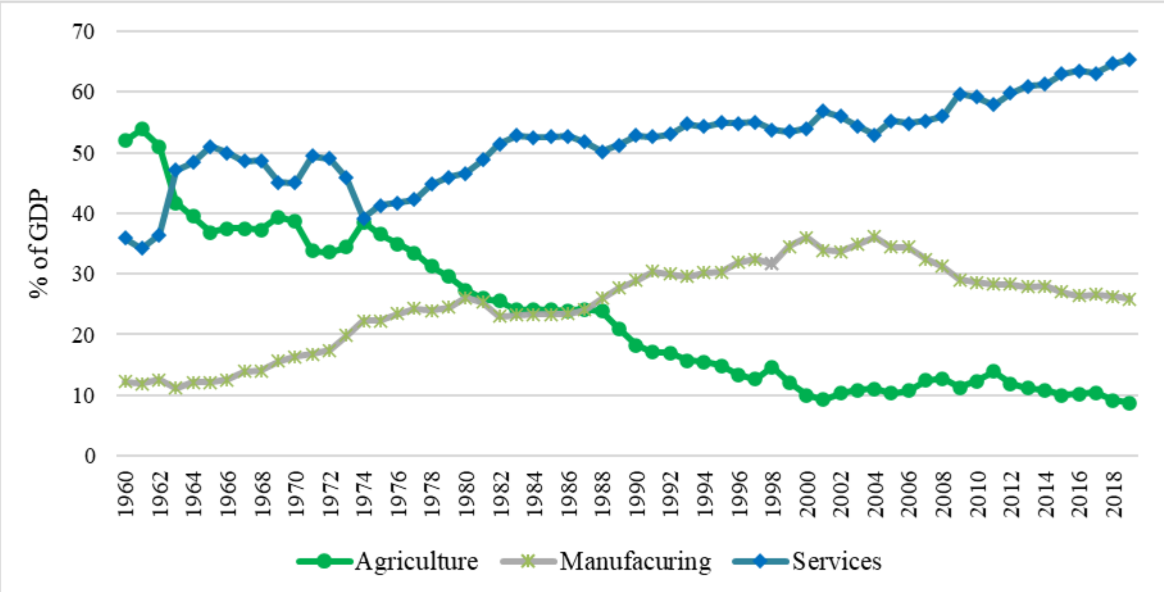
Agriculture is described as the art and science of developing the soil, growing crops, and raising livestock. Three main domains influence food production, which are crops, livestock, and fisheries. Food production plays a significant part in developing nations' economies and gives the population the fundamental wellspring of food, income, and job. Before independence and until the early '80s, Malaysia was an agricultural country. However, the scenario has changed due to the rapid development of the manufacturing and services sectors, which boosted the economy. Hence, the agriculture sector has been shrinking where the basic food production also has been affected. This is very alarming because the impact is very severe on our basic food production such as rice, beef, chicken, fish, etc. Relying too much on importing them would cause shortages in the future if the supplier (i.e., other countries) decided not to sell them or increase the prices. Therefore, this study aims to determine the sustainability of basic food production by 2030. The sustainability was determined by forecasting the supply of basic food productions and compare it with the population demand. Percentages were used in measuring the gap between demand and supply. The four forecasting techniques used were Double Exponential Smoothing, Holt's Exponential Smoothing, Autoregressive Integrated Moving Average (ARIMA), and Time Series Regression. The performances were evaluated based on three error measures (RMSE, GRMSE, and MAPE). The findings showed that the future supply of basic food production has failed to meet the demand, indicating the unsustainability of basic food production by 2030. Thus, drastic strategic agricultural policy planning needs to be established and implemented by incorporating modern smart farming technology. The

paradigm shift in basic food production is vital in self-sustaining basic food to ensure Malaysia's future food security.

1. Introduction

According to National Geographic (2021), "Agriculture is the art and science of cultivating the soil, growing crops, and raising livestock. It includes the preparation of plant and animal products for people to use and their distribution to markets". This indicates that agriculture can be a good food source and business that can contribute to a country's economy.

Malaysia was an agricultural country before independence until the early '80s (Mohamad Idham et al., 2015). During the British era, the big plantations were focused on rubber, oil palm, and cocoa. As for the basic food productions such as rice, fruits, vegetables and so forth, they were produced by smallholder who involved traditional farmers (Rozhan, 2015). However, the scenario has changed due to the rapid development of the manufacturing and services sectors, which boosted the economy. Figure 1 shows the shrinking of the agriculture sector as compared to manufacturing and servicing sectors from 1960 to 2019. At the beginning of the 1960s agriculture sector has the highest percentage of GDP with 51% and above but was overtaken by the services sector from 1964 onwards. Later, the manufacturing sector also bypassed the agriculture sector from 1988 onwards. Then the agriculture sector kept on decreasing to 8.8% in 2019.



Source: Department of Statistics Malaysia & World Bank
Figure 1. Agriculture shrinkage from 1960 to 2019

The shrinking of the agriculture sector has affected our basic food production. According to the Department of Statistics Malaysia (DOSM, 2019a), the self-sufficiency ratio (SSR, Figure 2) for rice was only 69%, and the Import Dependency Ratio (IDR) was more than 31%. This is because domestic rice production increased by only 0.8 percent per year (1980–2015), while consumption increased by 1.8 percent per year (Sidique and Shaharudin, 2019). Therefore, rice shortages were resolved by importing rice from Thailand, Vietnam, Myanmar, Cambodia, and India (World Bank Report, 2019). We also imported beef, chicken, and fish, where the IDR was 76.6%, 4.2% and 7.4%, respectively (DOSM, 2019a). Relying too much on importing them would cause shortages in the future if the supplier (i.e., other countries) decided not to sell them or increase the prices. This has happened to us recently when Vietnam has increased rice prices due to Covid-19 pandemic (The Star, 2021).

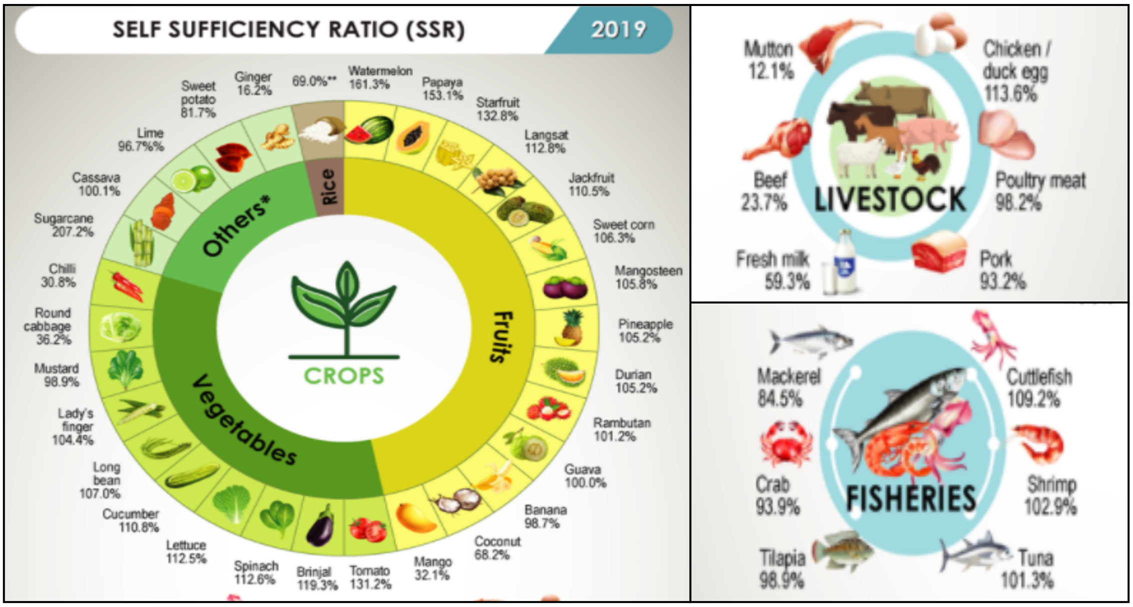


Figure 2. Self-sufficiency ratio of agriculture food production (DOSM 2019a)

Therefore, this study aims to forecast the agriculture basic food production for rice, beef, chicken and fishery by 2030 and determine their future sustainability in food security for Malaysia.

2. Methodology

The data of food production for rice, beef, chicken and fishery were obtained from Department of Statistics Malaysia. Table 1 displays the years of the data based on model estimation and evaluation. The first 35 years (rice), 15 years (beef and chicken) and 7 years (fishery) of the data was used for model estimation and the last 5 years (2015 to 2019) for model evaluation. In this study, we chose to have more in the estimation part because we were using ARIMA, which required a lot of data points due to the lags variables and transformation to make it stationary (differencing). This was to ensure we established a strong estimated model and evaluated recursively using another 5 years of data points.

Table 1
Summary of Data Partition: Estimation, Evaluation and Forecast

Food production	Estimation	Evaluation	Forecast
Rice	1980-2014	2015-2019	2020-2030
Beef	2000-2014	2015-2019	2020-2030
Chicken	2000-2014	2015-2019	2020-2030
Fishery	2008-2014	2015-2019	2020-2030

Four forecasting techniques were used: Double Exponential Smoothing, Holt's Exponential Smoothing, Autoregressive Integrated Moving Average (ARIMA) and Time Series Regression.

Double Exponential Smoothing

$$S_t = \alpha y_t + (1-\alpha)S_{t-1} \quad (1)$$
$$S'_t = \alpha S_t + (1-\alpha)S'_{t-1} \quad (2)$$
$$a_t = 2S_t - S'_t \quad (3)$$
$$b_t = \frac{\alpha}{1-\alpha}(S_t - S'_t) \quad (4)$$
$$F_{t+m} = a_t + b_t \times m \quad (5)$$

Holt's Exponential Smoothing

$$S_t = \alpha y_t + (1-\alpha)(S_{t-1} + T_{t-1}) \quad 0 \le \alpha \le 1 \quad (6)$$
$$T_t = \beta(S_t - S_{t-1}) + (1-\beta)T_{t-1} \quad 0 \le \beta \le 1 \quad (7)$$
$$F_{t+m} = S_t + T_t \times m \quad (8)$$

ARIMA

$$y'_t = c + \emptyset_1 y'_{t-1} + \cdots + \emptyset_p y'_{t-p} - \emptyset_1 \varepsilon_{t-1} - \emptyset_q \varepsilon_{t-q} + \varepsilon_t \quad (9)$$

Time Series Regression

$$y_t = TR + \varepsilon_t \quad (10)$$

The performances of the models were evaluated based on Root Mean Square Error (RMSE), Geometric Root Mean Square Error (GRMSE), and Mean Absolute Percentage Error (MAPE).

$$\boldsymbol{RMSE} = \sqrt{\frac{\sum_t^n e_t^2}{n}} \quad (11)$$
$$\boldsymbol{GRMSE} = \left(\prod_t^n e_t^2\right)^{\frac{1}{2n}} \quad (12)$$
$$\boldsymbol{MAPE} = \frac{100}{n}\sum_t^n \frac{|e_t|}{|Y_t|} \quad (13)$$

Several error measures were used to ensure the model's performance consistency where GRMSE is more robust than RMSE and MAPE when handling outliers (Mohd Alias Lazim, 2013). Forecasting technique that produces the smallest errors is considered as the best technique and would be used to forecast the basic food production (rice, beef, chicken and fishery) until 2030.

3. Results and Discussions

Table 2 displays the three error measures according to four forecasting techniques based on rice, beef, chicken, and fishery productions. The best forecasting techniques for rice are ARIMA (0,1,1) and double exponential smoothing for beef, chicken, and fishery.

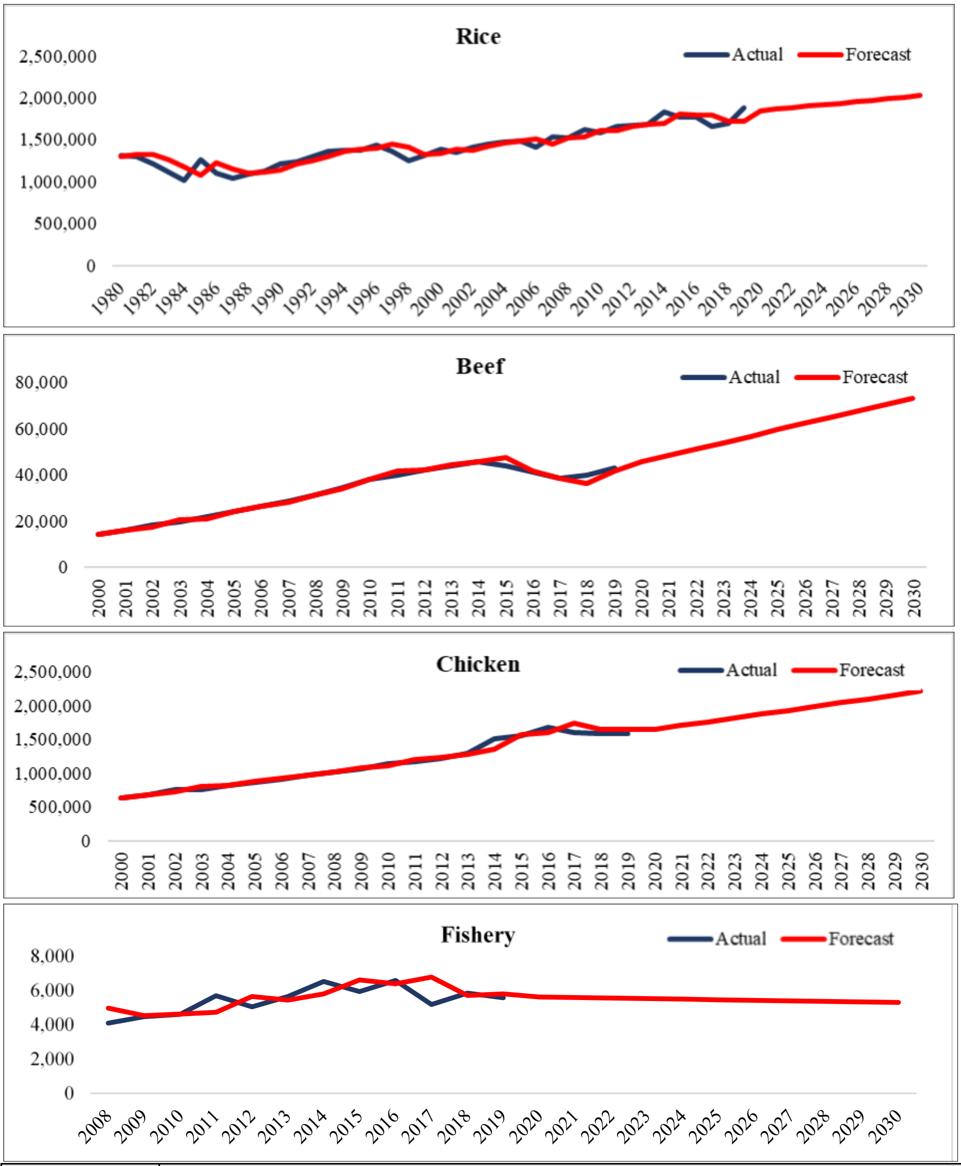
Table 2
Forecasting Techniques and Error Measures

Food Production	Forecasting Techniques	RMSE	GRMSE	MAPE	Total Rank	Rank
Rice	Double Exponential Smoothing	114193.8 (4)	63859.1 (3)	5.40 (3)	10	3
	Holt's Exponential Smoothing	97010.8 (1)	46068.3 (2)	4.31 (2)	5	2
	ARIMA (0,1,1)	97639. 9 (2)	37701.2 (1)	4.22 (1)	4	1
	Time Series Regression	10317.7 (3)	81614.0 (4)	5.43 (4)	11	4
Beef	Double Exponential Smoothing	2625.9 (1)	1011.8 (1)	5.00 (1)	3	1
	Holt's Exponential Smoothing	2860.5 (2)	1603.9 (3)	5.91 (2)	7	2
	ARIMA (0,2,1)	3283.1 (3)	1511.4 (2)	6.80 (3)	8	3
	Time Series Regression	3361.8 (4)	2929.1 (4)	7.62 (4)	12	4
Chicken	Double Exponential Smoothing	105911.8 (1)	41936.7 (1)	5.20 (1)	3	1
	Holt's Exponential Smoothing	106570.3 (2)	67336.9 (2)	5.51 (2)	6	2
	ARIMA (0,1,1)	277943.1 (4)	152089.2 (4)	13.1 (4)	12	4
	Time Series Regression	167577.9 (3)	111866.4 (3)	8.90 (3)	9	3
Fishery	Double Exponential Smoothing	938.7 (1)	334.8 (1)	12.4 (1)	3	1
	Holt's Exponential Smoothing	1135.6 (2)	943.4 (2)	19.2 (2)	6	2
	ARIMA (0,1,1)	1405.9 (3)	1082.7 (3)	23.0 (3)	9	3
	Time Series Regression	1822.2 (4)	1272.1 (4)	29.4 (4)	12	4

( ) - Rank

Figure 3 presents the forecast plots and values for rice, beef, chicken, and fishery productions from 2020 to 2030. The forecasts show an increment for rice, beef, and chicken but decrement in fishery by 2030. These increments are a good indicator showing that the basic food productions are increasing in the future except for fishery where it slightly drops. This is due to producers' belief that fishery has lower demand than beef and chicken (Azra et al., 2021), thus focusing more on beef and chicken production.

The forecast values reflect the future supply of each basic food production for rice, beef, chicken, and fishery. Figure 4 shows that the supply was compared with demand (% retrieve from FAO, 2018 and population, retrieve from DOSM, 2019b) of Malaysia to identify the sustainability of basic food production in the near future. Although the supply showed an increment for rice, beef, and chicken the demand is higher. On average, the percentage gap between demand and supply is 35% for rice, 79% for beef, 5% for chicken, and 97% for fishery.



FOOD PRODUCTION	FORECAST ('000 Tonne)										
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Rice	1841	1873	1884	1902	1911	1944	1953	1971	1992	2001	2023
Beef	45.5	48.3	51.1	53.9	56.6	59.4	62.1	64.9	67.7	70.4	73.2
Chicken	1641	1702	1761	1813	1871	1934	1992	2040	2101	2164	2221
Fishery	5.61	5.58	5.55	5.52	5.48	5.45	5.42	5.39	5.36	5.33	5.29

Figure 3. Forecast Plots and Values for Rice, Beef, Chicken and Fishery Production

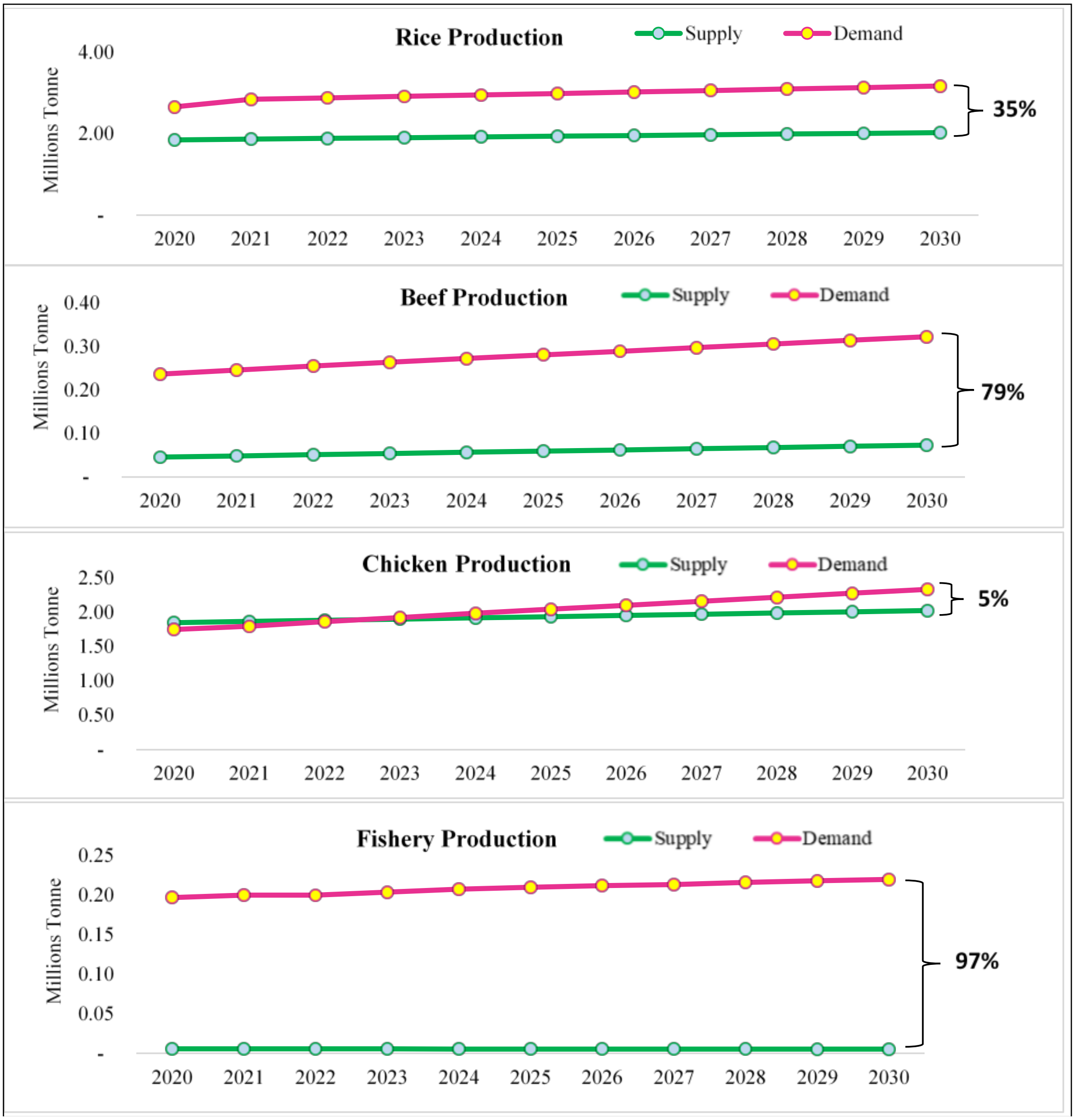


Figure 4. Future Demand and Supply of Basic Food Production (Rice, Beef, Chicken and Fishery) 2020 to 2030

Figure 4 indicates that Malaysia will be facing a serious challenge as the demand for food increases constantly over the year where the supply of the basic food production fails to meet the demand. It shows that demand is higher than local production. Thus, Malaysia could not sustain basic foods in the near future. The current Malaysian population is 32 million, and the projected population by 2030 is 38 million. This shows the increase in population will cause a rise in food demand. Notwithstanding expansion in basic food production, the higher demand from locals has prompted the issue of food insecurity in Malaysia.

Although importing them is a shortcut to addressing the agricultural problems, it will not secure our basic food in the future. Recently the Covid-19 pandemic has taught us a valuable lesson not to rely heavily on other countries. The impact is very severe where we must pay a higher price in getting the basic food. Realising this serious situation, the government has allocated RM4.97 billion in budget 2021 to empower the agricultural sector, and RM900 million was allocated for raising rice production to at least 75% soon through smart farming (The Star, 2020).

4. Conclusion

The shrinking of the agriculture sector is hazardous to our future basic food security. Thus, drastic strategic agricultural policy planning needs to be established and implemented by incorporating modern smart farming technology. The paradigm shift in the agriculture sector is vital in self-sustaining basic food production to ensure our future food security.

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Authors Contributions
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Conflict of Interest
No conflict of interest associated with this publication.

References

Azra, M. N., Kasan, N. A., Othman, R., Noor, G. A. G. R., Mazelan, S., Jamari, Z. Bin, Sarà, G., & Ikhwanuddin, M. (2021). Impact of COVID-19 on aquaculture sector in Malaysia: Findings from the first national survey. *Aquaculture Reports*, *19*. https://doi.org/10.1016/j.aqrep.2020.100568

DOSM (2019a). Supply and Utilization Accounts Selected Agricultural Commodities, Malaysia 2015-2019.

DOSM (2019b). Department of Statistics Malaysia. (2019). Monthly Statistical Bulletin, Malaysia. Retrieved from, https://newss.statistics.gov.my/newssportalx/ep/epFreeDownloadContentSearch.seam?cid=96693

FAO. (2018). Transforming the livestock sector through the Sustainable Development Goals. *Food* *and Agriculture Organization of the United Nations*. Rome. Retrieved from http://www.fao.org/3/CA1201EN/ca1201en.pdf

Mohamad Idham Md Razak, NorAzira, Noor Junaini Arwin Yaacob, Siti Nurul Aini Mohd Rodzi, Nurhikma Mohd Yusof, and Ridzuan Adli Azidin (2015). An Overview of Primary Sector in Malaysia. *International Journal of Economics, Commerce and Management* 3(2).

Mohd Alias Lazim (2013). Introductory Business Forecasting. A Practical Approach. 3rdED.Shah Alam: *Pusat Penerbitan Universiti, Universiti Teknologi Mara.*

National Geographic (2021). Agriculture. Download from https://www.nationalgeographic.org/encyclopedia/agriculture/ on 17 May 2021.

Rozhan Abu Dardak. (2015). Transformation of Agricultural Sector in Malaysia Through Agricultural Policy. FFTC Agricultural Policy Platform (FFTC-AP). *Food and Fertilizer Technology Center for the Asian and Pacific Region*. https://ap.fftc.org.tw/article/818

Sidique, Shaufique Fahmi, and Ashraf Shaharudin (2019). Malaysia's Agricultural Transformation: National Food Security. *Institute of Agricultural and Food Policy Studies*, Universiti Putra Malaysia.

The Star (2020). Malaysia aims to raise rice production.

The Star (2021). Vietnam to export 1,600 tonnes of rice at high price to Singapore and Malaysia.

World Bank Report (2019). Agricultural Transformation and Inclusive Growth: The Malaysian Experience.

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