Food Research 6 (Suppl. 1) : 101 - 111 (2022)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

FULL PAPER

Determinants of agricultural competitiveness: the case of pineapple production among smallholders in Johor, Malaysia

[1]Md Suhaimi, N.H., [1,*]Abdul Fatah, F., [2]Saili, A.R. and [3]Ali, R.

[1]*Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, Cawangan Melaka Kampus Jasin, 77300 Merlimau, Melaka, Malaysia*
[2]*Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, Cawangan Sarawak, Jalan Meranek, 94300 Kota Samarahan, Sarawak, Malaysia*
[3]*Market Intelligence and Agribusiness Centre (ES), Malaysian Agricultural Research and Development Institute (MARDI), Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia*

Article history:
Received: 12 October 2021
Received in revised form: 17 November 2021
Accepted: 20 November 2021
Available Online: 10 July 2022

Keywords:
Pineapple,
Profitability,
Smallholders,
Competitiveness,
Survey,
Regression

DOI:
https://doi.org/10.26656/fr.2017.6(S1).003

Abstract

Pineapple is a tropical fruit that contains great nutritional values and fine flavour with high export potential and provides income generation for many smallholders in Malaysia. In 2019, Malaysia exported pineapple-based products worth RM419 million. Therefore, this paper aimed to analyse the competitiveness of pineapple in Malaysia, which was relatively understudied in the literature, especially in Asia. In this study, the level of competitiveness of fresh pineapple production among smallholders at the farm level was evaluated using an extension to the Policy Analysis Matrix (PAM). The extension provides a disaggregate analysis that has allowed the development of the distribution of competitiveness scores for each pineapple production at individual farms, taking into consideration the drawbacks of the use of aggregated data. In the second stage of the analysis, the multiple regression method was used to examine the key determinants that affected the competitiveness of pineapple production. A sample of 191 smallholders was randomly selected in Johor. The results demonstrated that Malaysian smallholders particularly in Johor had strong comparative advantages in the production of pineapple. The findings showed the Social Cost Benefit (SCB) value was less than 1, which means at a social price, the average smallholders were socially profitable and internationally competitive. However, by using disaggregated data, the results proved that some smallholders were not producing social profits where 29% of them remained uncompetitive internationally. Apart from that, the results of regression analysis revealed that the competitiveness of pineapple production was significantly influenced by age, working experience, farm size and the variety of pineapple. To conclude, the study presented recommendations for the potential enhancement of viability and competitiveness of pineapple smallholders.

1. Introduction

The agricultural sector has been an important pillar of the Malaysian economy and has been a backbone of the Malaysian economy by producing agricultural products as major consumption and contributing more than 23% of total export earnings. Agriculture sectors contributed about 7% to the national Gross Domestic Product (GDP) and provides employment for almost 16% of the population in 2015 (Bakar, 2009).

In Malaysia, pineapple is one of the industrial crops and has been growing for nearly a century. In Malaysia, the planted area of pineapple was 15,611 hectares which ranked Malaysia 15th in the world out of 87 countries in the year 2012 (FAOSTAT, 2012). In 2017, the Department of Agriculture Malaysia or DoA reported that 340,722 Mt of pineapple has been produced throughout the year. Meanwhile, the production of pineapple in Peninsular Malaysia showed a decrement number from the previous year when it was recorded at 294, 161.01 Mt in 2015 (MPIB, 2014). In the year 2009, there were about 8,081 farmers registered in pineapple cultivation. Pineapple has become a main source of employment for many Malaysians (MPIB, 2010). The utilization of pineapple in Malaysia continued to gain further when in 2014. The average pineapple consumption increased up to 14.2 kg per year (Salim, 2016). Despite steady consumption and production

*Corresponding author.
Email: *fazleen5201@uitm.edu.my*

eISSN: 2550-2166
Published by Rynnye Lyan Resources

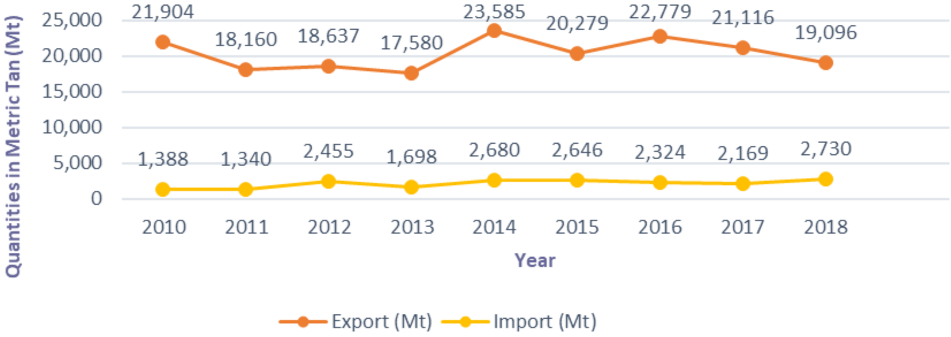

Figure 1. Trend in trade of fresh pineapple in Malaysia. Source: MPIB (2019)

growth rate, the industry's export value has shown a declining trend since 2008 (Figure 1). Malaysia's most important exports were reported in 2007, reaching 60,871 tons, before they declined to near sextuples in 2009, with a mere 10,313 tons, before they started to grow again by almost twice in 2010 (Figure 1).

Processed pineapples, pineapple juices or canned pineapples are among the activities in the downstream processing of fruits (MPIB, 2021). The pineapple fruit is listed in the main category of fruit in Malaysia. These major fruits are among the commodities that make a significant contribution to food production in many agricultural sub-sectors (DoA, 2017). One of the important factors that may determine the future of agriculture development in Malaysia is trade liberalization and globalization which would give an impact on agricultural growth in the country. The international trade agreements will have a huge effect on the course of agricultural activities (Bakar, 2009). Chubashini *et al.* (2011) mentioned that trade liberalization has a positive impact on tropical fruit trade and contributed to global competition. The technological advancement in post-harvest, storage and transportation in trade liberalization and globalization of the fruit trade had allowed for more accessibility to customers around the world. It provides an opportunity for Malaysia to globally market its fruits. Due to the market opening in trade liberalization, the global competition faced direct impacts as the increasing number of multilateral players serving the global tropical fruits market. One of the ways to overcome these binding international agreements is to develop win-win strategic coalitions and international agreements and conventions either bilaterally or with trading partners (Bakar, 2009).

Over the years, Malaysian tropical fruits including pineapple have faced greater competition from their major counterparts including Thailand, the Philippines and Indonesia as they produce and trade similar fruits and making them the closest competitors (Nik Mohd Masdek *et al.*, 2017). Although Malaysia has once been considered a top exporting country in pineapple production globally, its inefficient nature in production might be reflected in the inability to fully tap into the economic market potential and thus the competitiveness of the pineapple commodity has experienced a setback (Jaji *et al.,* 2018; Suhaimi and Abdul Fatah, 2021).

This problem has been attributed to different factors including the conversion of pineapple farmers to other lucrative crops such as oil palm that they believe would generate more profits and higher earnings (Jaji *et al.*, 2018). The pineapple industry in Malaysia has been experiencing a shortage of labour and ageing farmers for pineapple production (Suhaimi and Abdul Fatah, 2019). The decline in the pineapple plantation area is reported largely among the smallholder sector until 2007 when the industry experienced an increase of 5,923 ha in the plantation area and later continued to decline annually until 2011 (Jaji *et al.,* 2018).

Efforts to enhance pineapple production have been translated by Malaysian agricultural policies which aim to boost productivity and increase producers' incomes in particular for smallholder farmers. Over the years, the Malaysian government has shown apparent efforts toward the development of the pineapple industry. The aims of policies enforced by the government are to give significant strikes toward the self-sufficiency target, increase farmers' income, and achieve marketing efficiency. Among the policies developed by the government to raise the market potential of fruits, including pineapples, are The Economic Transformation Program (ETP), Agriculture National Key Economic Area (NKEA), Entry Point Projects (EPP 7), and The National Agro-Food Policy (DAN) 2011-2020.

The ETP was formulated in order to solve several economic challenges in Malaysia such as historical growth engines that were slowing down, the risk of being stuck in the middle, an unsustainable fiscal position and increasing global competition for markets, capital and talent. While, the NKEA aims at changing a conventional and small-scale production into a large-scale agribusiness industry, where the policy mainly focuses on selected sub-sectors that have high-growth potential that enables Malaysia to tap a large global market that is rapidly expanding. Aside from that, through the implementation of EPP 7, the government intends to improve the production of higher quality and better-quality fruits and vegetables accordingly to the nutritional safety standards, thereby enabling access to premium markets in the Middle East and Europe. While the DAN (2011-2020) and the recent DAN2.0 are among the approaches that will focus on improving the efficiency of the agro-food industry along the value chain to ensure the industry becomes more productive, competitive and knowledge-intensive.

Therefore, it is important to examine the factors affecting the competitiveness of the pineapple industry by considering the economic importance of pineapple in the local and global markets. Previous studies that dealt with the pineapple sector in Malaysia examined mostly marketing, socioeconomics, contract farming and supply chain issues mainly on a case studies basis, while very few studies have examined the degree of competitiveness on agricultural production in Malaysia at the farm level. As far as analytical studies on the profitability and competitiveness of the agricultural sector are concerned, voluminous studies emphasize the aggregate competitiveness or trade volume and its impact on economic growth for example using average data. These can have a false impression on the overall distribution competitiveness since results based on average or aggregate data may have significant implications on the policy decision making i.e., a policy may over support some farms or under support others. For this reason, this study aims to evaluate the competitiveness of pineapple production in Malaysia using farm-level survey data.

Is pineapple production in Malaysia competitive? Our approach to Policy Analysis Matrix proposed by Monke and Pearson (1989) is extended to generate new data. This extension allows us to take into consideration farm heterogeneity and to examine the distribution of competitiveness values for each pineapple farm. Consequently, this study aimed to develop and apply a more comprehensive framework of analysis to analyze the competitiveness performance of Malaysia's pineapple production and to measure the competitiveness of Malaysia's pineapple production at the farm level using the PAM extension.

2. Materials and methods

2.1 Policy Analysis Matrix model

The Policy Analysis Matrix (PAM) was coined by Monke and Pearson in 1989. PAM is commonly used as a tool to analyse the production system by comparing the private and social prices for inputs that are used in production as well as for the produced goods. According to Yao (1997), private prices are prices found in a current situation, while social prices adapt to the situation without any intervention from the government.

PAM is a double-entry bookkeeping analytical framework, which is widely applied to compute private and social profits for a variety of farming systems under different technological and institutional situations. PAM assists policymakers and analysts to comprehend the effects of policy on competitiveness as well as farm-level profits. PAM also helps to determine the impact of public investments on the efficiency of the agricultural system and the effects of agricultural research and development on economic efficiency and comparative advantage (Abdul Fatah and von Cramon-Taubadel, 2017).

PAM methodology is applied in this study to analyze the impact of policies on pineapple production in Malaysia. There are three purposes of the PAM, which are to allow a ranking of the competitiveness of pineapple systems at market prices and a ranking of the efficiency of pineapple production, as well as to measure the transfer effect of policies. The PAM model has two types of identities, which include profitability identity and divergences identity. Profitability identities define profit as the difference between revenues and costs, while divergences identities measure the effects of divergence because of a distorting policy that causes a private market price to diverge from efficient prices or because of underlying market or forces that have failed to provide an efficient price. The advantage of PAM is that it allows the disaggregation of the production activities and their costs (Hai and Heidhues, 2004). In practice, the PAM model presented in Table 1 contains costs and revenues in private and social prices. Total production costs are separated into tradable inputs and domestic factors to produce one unit of output. Tradable inputs are goods traded internationally. Domestic factors refer to land, labour and capital. The prices of domestic inputs are mainly determined by local markets. On the contrary, prices of tradable inputs are determined by international markets.

PAM also consists of three rows that define profitability as the difference between income and costs, private profitability, social profits and divergences. Private profitability (D) assesses the value of all outputs and inputs in private or actual prices. It can be calculated using revenues (A) minus total cost (B+C), where B and C are tradable and non-tradeable inputs (D = A-B-C). The first row shows the private profitability calculation which indicates whether the product is profitable or not from the individual farmer's views. In the second row, social profits (H) is the difference between revenues and costs which reflects the social opportunity cost and measures efficiency as well as a comparative advantage

Table 1. A structure of the Policy Analysis Matrix (PAM)

	Income	Cost		Profits
		Tradable inputs	Non-tradable input Domestic factors	
Private Prices	A	B	C	D = A-B-C
Social Prices	E	F	G	H = E-F-G
Effect of domestic divergences and efficiency–distorting policies	I = A-E	J = B-F	K = C-G	L = G-H = I-J-K

Source: Monke and Pearson (1989)

Table 2. A Policy Analysis Matrix Framework

A	Revenue based on private prices
B	Tradable input cost based on private price
C	Domestic input cost based on market price
D	Private profits
E	Revenue based on social price
F	Tradable input cost based on social price
G	Domestic input cost based on social price
H	Social profits
I	Output transfer
J	Input transfer
K	Factor transfer
L	Net transfer

(H = E-F-G). The third row measures the divergence which is the difference between observed private price and estimated social price. It is explained by the effects of policy or by the existence of market failure (Monke and Pearson, 1989).

Further explanation of PAM Table 1 is described in Table 2.

2.1.1 Data and assumptions

The farm-level data will be collected using a survey or interviews with the farmers and agricultural traders. These include comprehensive information, including input use output and corresponding prices. To complete the PAM, the private prices need to be converted to social prices, which are based on several data and assumptions.

The social price for agricultural produce is based either on the import or export parity price of the commodity equivalents at the farm gates.

As for the tradable inputs, the social prices of fertilizers, pesticides, seeds, fuel and lime are the respective import parity prices at the farm gate since Malaysia frequently import the inputs.

Social costs of machinery and other agricultural tractors are also assumed to equal the private costs considering that the owners determine the value of these packages and services.

Social costs are assumed to equal private costs of labour.

The need to determine the shadow exchange rate is important when conducting economic analysis, especially because it may affect all social values of tradable components and output.

Detailed information on the private and social inputs and output are summarized in Table 3.

To determine competitiveness level, the Domestic Cost Ratio (DRC) and Social Cost Benefit ratio (SCB) and other ratios are calculated from the PAM table above. These ratios indicate whether a farming system enjoys a comparative advantage vis-à-vis the international market. It also shows how competitiveness is affected by government policies.

The DRC is widely used as an indicator of

Table 3. Variable of interest and sources

Variables	Description	Sources of Data
Private input price	Prices for fertilizer, herbicide, equipment and planting materials.	Farmer and Traders
Private output price	Farm gate prices for pineapple, fertilizers and herbicide	Farmers
Private price for wages	The real price of agricultural wages	Farmers
Social output price	International price for Pineapple (Philippines)	International Trade Centre, World Bank and Market Intelligence
Social input price	Social price for fertilizer, herbicide, equipment and planting materials	Food and Agriculture Organizations of the United Nations Statistics Division (FAOSTAT)
Social price for wages	Social price for wages is assumed to be equal to the market wages	Department of Statistics Malaysia
Official exchange rate	Shadow exchange rate	Central Bank of Malaysia

eISSN: 2550-2166

competitiveness. The DRC measures the efficiency of utilization of domestic factors in the analyses of production system. The index calculated is a ratio of social costs for domestic factors to their value added. If the DRC<1, the production in a country is competitive. If the DRC>1 it indicates that the country is not competitive in production of the analyzed goods. The formula is as follows:

The Domestic Cost Ratio: $DRC = \frac{G}{(E-F)}$

The SCB is an alternative for DRC in measuring comparative advantage. The SCB is defined by the ratio of total resources cost to the revenue. The SCB offers a more precise ranking of alternatives' comparative advantages. If the SCB<1 it signifies that production in question is competitive while the SCB>1 indicates that production is not competitive. The formula of SCB is as follows:

The Social Cost Benefit: $SCB = \frac{(F+G)}{E}$

The nominal protection coefficient (NPC) is one of the most common methods to measure price distortions (Fang and Benghin, 2000). If NPCO < 1 indicates the presence of tax (tariff) on output, NPCO > 1 show the presence of subsidy and NPCO = 1 (in the absence of market failures) reveals the absence of intervention but NPCI < 1 implies subsidy, NPCI > 1 implies tax. The Effective Protection Coefficient (EPC) is defined as the ratio of value-added in private price to value-added in social prices (A-B-C) / (E-F-G) or D/H.

The PC measures the incentives effects of all policies or net policy transfers. A final incentive indicator is the subsidy ratio to producer (SRP) which the value is equal to the ratio of net divergences to social prices or SRP = L/E = (D-H)/E. Both the NPC and EPC ignore the transfer effect of factor market policies and thus do not provide a complete indicator of incentives (Monke and Pearson, 1989).

Besides that, the net private return to land (PNRL) and social net return to land are also calculated in this study. The PNRL is defined as A-B-C without the cost of land use and SNRL as E-F-G without the land use. This implied that the higher the PNRL (SNRL), the higher the private (social) profit per hectare of land employed in the production of the commodity (Abdul Fatah and von Cramon-Taubadel, 2017).

2.2 Extension to the policy analysis matrix

This study will be conducted based on farm-level data, which reveal farm-to-farm variability. Foundational to this is, that the disaggregated data that will be employed in this study will provide more comprehension and understanding to the policymakers and the government on results of the farms that are competitive or uncompetitive and how government policy might help to target support to those farms that need it most.

To achieve the goals, the study takes on a new extension of the Monke and Pearson (1989) Policy Analysis Matrix approach using data from farm surveys. Measuring competitiveness is often based on an average or aggregate data from farms in agriculture. Interpretations based on the aggregate measure may be misleading if the farms summarized in this manner are varied. This extension will enable to take into account farm heterogeneity and study the distribution of competitiveness as a way of coping with misrepresentative data or the details on each pineapple farm (Abdul Fatah, 2017). In doing so, a kernel distribution method which is a nonparametric representation of the probability density function of a random variable was used. The use of kernel distribution is when a parametric distribution cannot properly describe the data, or when to avoid making assumptions about the distribution of the data. A kernel distribution is defined by a smoothing function and a bandwidth value, which control the smoothness of the resulting density curve.

2.3 Multiple regression analysis

In a second stage of the analysis, a multiple regression was conducted to determine the factors that mostly influence the competitiveness of pineapple production among smallholders in Johor. Regression analysis is used in order to analyze how independent variables can be used to predict a dependent variable. Regression models with one dependent variable and more than one independent variable are referred to as multilinear regression (Uyanık and Güler, 2013). This form of standard regression analysis evaluates the fitness of the model developed for this research. The study shows how much of the overall variance in the dependent variable, which is the productivity of pineapple growers, can be explained by the independent variables of the underlying factors discussed in the literature review.

The Multiple Linear Regression model is depicted as follows:

$$SCB = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

where, C is the Social Cost Benefit ratio which represents the competitiveness level (dependent variable); α is constant; $\beta_1 \ldots\ldots \beta_6$ are the Coefficients to be estimated; X_1 is age (years); X_2 is education background (years of schooling); X_3 is working experience (years); X_4 is planting area (acre); X_5 is pineapple variety (1 = Josapine, 2 = Moris, 3 = MD2); X_6 is the price of pineapple (RM/pineapple) and ε is an error term.

3. Results and discussion

3.1 Policy Analysis Matrix results

This study provides a classification analysis that allows us to construct pineapple production and the distribution of SCB scores for individual pineapple farms. Therefore, by considering the distribution of competitiveness, the disadvantages of using average data or aggregated data could be avoided. SCB compares the total cost calculated at social prices with the social value of producing the unit of output. The SCB ratio is always greater than 0, and SCB greater than 1 indicates that production is not competitive, while an SCB ratio less than 1 indicates that the total input cost is lower than income and production is competitive.

The summary of both aggregate and disaggregated SCB and DRC analysis of pineapple farmers was reported in Table 4. The DRC indicates whether the use of the domestic factors is socially profitable (DRC<1) or not profitable (DRC>1). The results of the PAM table display results of SCB and DRC accordingly to the yield, farm size and pineapple varieties. By using aggregated data, the DRC value of pineapple production in Johor was 0.6288 which, the average smallholders in the sample were all competitive. Nevertheless, the results developed from disaggregated data reveal that only 71% of the farms from the total sample that produced pineapple were competitive. This means that the remaining 29% of the farms were not socially profitable, where the farmers had no comparative advantage in producing pineapple. This indicated that 29% of the sample smallholders used local resources at a higher value than the global or international resources.

In the context of farm yield, the result of aggregated data showed that 100% of farms competitively produced pineapple in which the DRC values were 0.6287. By using this average value, one would consider that regardless of farm size, on average, many smallholders were competitive at international prices and enjoyed comparative advantages in producing pineapples. However, when compared to disaggregated data, only 136 farms or 71% of the smallholders were eventually competitive while the remaining were uncompetitive (29%). The disaggregated SCB and DRC results are also depicted from the kernel density estimates as shown in Figures 2 and 3.

While for the farm size, the results show aggregated and disaggregated DRC values based on small and large farms. In this sample, the farm size is considered small if the pineapple smallholders owned landholding less or equal to 2.9 acres while the farm size is considered medium to big size if the smallholders owned landholding of more or equal to 3 acres. By using aggregated data, policymakers could interpret that 100%

Table 4. Summary of social cost benefit ratio and domestic cost ratio

		Aggregate		Disaggregate			
		SCB		SCB<1		SCB>1	
		Mean	Total farms/ Percent	Mean	Total farms/ Percent	Mean	Total farms/ Percent
SCB		0.6513	191 (100)	0.472	136 (71.2)	1.094	55 (28.8)
Yield		26610.52	191 (100)	31892.18	136 (71.2)	13550.44	55 (28.8)
Farm	≥3 acre	0.3236	60 (100)	0.3236	60 (100)	-	-
	≤2.9 acre	0.8013	131 (100)	0.5892	76 (58.0)	1.0944	55 (41.9)
Variety	Josapine	0.7403	150 (100)	0.5353	95 (63.3)	1.0944	55 (36.7)
	MD2	0.0166	6 (100)	0.0166	6 (100)	-	-
	Moris	0.3782	35 (100)	0.3782	35 (100)	-	-
		DRC		DRC<1		DRC>1	
		Mean	Total farms/ Percent	Mean	Total farms/ Percent	Mean	Total farms/ Percent
DRC		0.6288	191 (100)	0.186	136 (71.2)	1.7238	55 (28.8)
Yield		0.6287	191 (100)	31892.18	136 (71.2)	13550.44	55 (28.8)
Farm	≥3 acre	0.0983	60 (100)	0.0983	60 (100)	-	-
	≤2.9 acre	0.8716	131 (100)	0.255	76 (58.0)	1.7238	55 (41.9)
Variety	Josapine	0.7704	150 (100)	0.2184	95 (63.3)	1.7238	55 (36.6)
	MD2	0.0035	6 (100)	0.0035	6 (100)	-	-
	Moris	0.1289	35 (100)	0.1288	35 (100)	-	-

Source: Field Survey (2019)

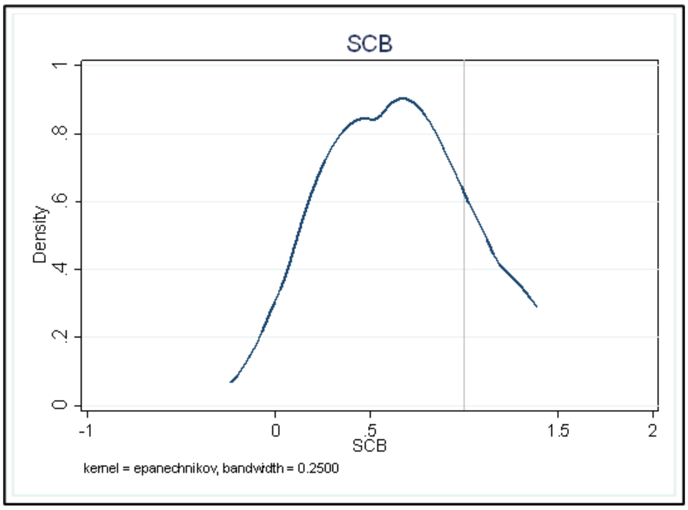

Figure 2. A SCB graph from kernel density estimate

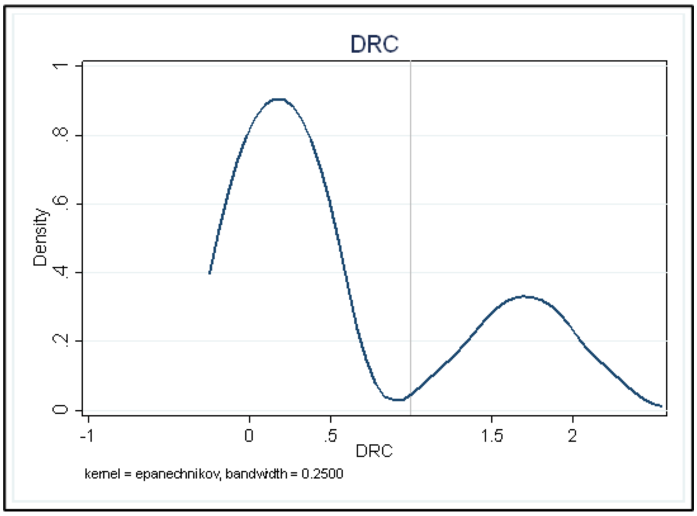

Figure 3. A DRC graph from kernel density estimate

of the total sample was competitive regardless of their farm size. Despite that, disaggregated data presented that only 58% of small landholding (76 farms from 131 total small landholdings) can be considered competitive with a 0.2550 DRC value, while the remaining 42% (55 farms from 131 total small landholdings) were not competitive (1.723 DRC value). This indicated that half of the smaller farms were competitive and these competitive farms account for a reasonably small share of pineapple production when using disaggregated data. While for large farms, all farms appeared to be 100% competitive (60 farms from the total sample) and enjoyed comparative advantages at international prices.

In terms of pineapple of varieties, the result evolved from aggregated data reveals that farms that produced varieties such as Josapine, Moris or MD2 were competitive. Nevertheless, using the disaggregated data, the results illustrated that only 63% of the farms (from 150 farms) that produced Josapine variety were competitive while the other 36% remained uncompetitive (1.723 DRC value). On the other hand, when compared to Moris and MD2, the result indicated that farms that produced either Moris or MD2 were 100% competitive at current prices.

A good alternative to the DRC is the social cost benefit (SCB) indicator, which accounts for all costs of production of the social prices or international prices. The results of SCB confirmed the DRC findings, where SCB values were all positive (100%) for all farms, which means all farms have comparative advantages and efficient use of resources in Johor. However, the results from disaggregated data revealed that 71% of the farms were competitive while the other 28% were uncompetitive internationally. This indicates that 55 farms out of the total sample have no comparative advantage and the waste of resources used.

In the framework of farm yield, for instance, the results of the aggregated data show that the SCB value of 100% competitive pineapple farms is 0.6512. It turns out that considering only aggregate data or average SCB may mask important differences across the farm. Per contra, when compared with disaggregated data, only 136 farms or 71% of the total sample are competitive, while the rest are not (29%). Facts have proved that many farmers are competitive. However, when using disaggregated data, these farms account for a quite number proportion of pineapple producers who were also uncompetitive.

In light of farm size, by using aggregated data, policymakers may explain that regardless of the size of their farms, 100% of the total sample is competitive. Nevertheless, the disaggregated data shows that only 58% of the small land (76 farms on 131 small land areas) are competitive with an SCB value of 0.5892, while the remaining 42% (55 farms on 131 small land) are not very socially competitive (1.094 SCB value). This shows that social income is not enough to pay for social value-added, which implies that a significant number of small farms are actually losing their international competitiveness, that is, they are not competitive. This post highlights the main advantage of using the disaggregate SCB distribution is to avoid the disadvantage of using average or aggregate data.

3.2 Determinants of competitiveness

Multiple regression was conducted to determine the factors that mostly influence pineapple production among smallholders in Johor. Because the DRC underestimates the competitiveness of activities that rely on large amounts of non-tradable inputs, this study uses the social cost-benefit ratio (SCB) indicator as an indicator to measure competitiveness. The results of multiple regression revealed that in the Malaysian pineapple industry particularly in Johor, from the growers' perspective, age, experience, farm size and pineapple varieties were determined as the most influential determinants in the competitiveness of

eISSN: 2550-2166

Table 5. Multiple regression output

Variables	Coefficients	Standard error	t-value	P>|t|
Age***	-0.0027	0.0004	-7.00	0.000
Education (years of schooling)	-0.0007	0.0024	-0.33	0.742
Working experience***	-0.0034	0.0005	6.79	0.000
Farm size***	-0.0099	0.0012	-8.38	0.000
Pineapple variety (1 = Moris; 0 = otherwise) ***	0.0208	0.0033	6.31	0.000
Pineapple variety (1 = MD2; 0 = otherwise)	-0.0029	0.0041	-0.72	0.472
Constant***	0.4846	0.0172	28.07	0.000

***Significant at p<0.05

pineapple production. The results of this study take into account the values of all regression statistics presented in Table 5. One of the most important parameters characterizing the quality of the model is the value of the determination coefficient (R^2) which lies in the range 0–1. The model goodness-of-fit is even better, once the value of R^2 is closer to one. The value of R^2 for this model is 0.7425, which fits all the data well.

Given the higher SCB score values (SCB>1), a positive coefficient predicted suggests that the explanatory variables in question enhance SCB scores and therefore negatively affect the competitiveness. Note that a lower SCB score value (SCB<1) indicates the negative coefficient of the prediction which explains that the explanatory variable in question will reduce the SCB score and thus have a positive impact on competitiveness.

The regression results as presented in Table 5 indicated that the farmers' age was significant (p<0.05) and had a negatively correlation with the value of SCB (β = -0.0027, p = 0.00). This suggests that one year older in the farmers' age results in decreasing SCB value by 0.2%, holding other variables constant. The decreasing SCB value (SCB<1) indicated that pineapple farms are competitive. The result is in line with the findings of studies conducted by Guo *et al*. (2015), that older farmers who do not plan to give up agriculture have higher agricultural output than other farmers. This is related to the farmer's experience because the farmer's age has been used to indicate the farmer's experience and the impact on market participation. Zanello (2012) concluded that compared with younger farmers, experience motivates older farmers to enter the market in Ghana. Therefore, old farmers are more eager for production input, and they have long-term production experience. These factors will lead to higher input and output levels and thus become more competitive.

The farmers' education background was found to be negatively correlated between this variable and the SCB value, however it is not statistically significant. The beta coefficient for farmers' education background ((β = -0.0007, p = 0.742) indicates that on average, one-unit decrease in farmers' education background increase the SCB values by 0.07% holding other variables constant. This shows that if the farmer has a lower education, then the farm is not competitive. Adinya, Afu and Ijoma (2010) in their study found that uneducated farmers that lack of education and training will affect their yield and production efficiency because they cannot read the instructions on the fertilizer bag. Some farmers with higher education levels use the recommended dosage fertilizer more often than those without education. According to Caswell *et al.* (2001 as cited in Gyimah, 2015), people think that education can reduce people's understanding of technology, thereby increasing the adaptability of technology, and thus more competitive.

The results displayed that farmers' experience was significant (P<0.05) and is negatively correlated to the value of SCB. The beta coefficient of farmer's experience (β = -0.003, p = 0.00) shows that a one-year decrease in farmer's experience will increase the SCB value by 0.3%, while other variables remain unchanged. The increasing in SCB value (SCB>1) indicates that pineapple farms are not competitive. This indicates that if farmers lack experience, farms will not be competitive. The result is in accordance with the findings of Akhilomen *et al*. (2015) that previously mentioned, farmers with many years of farming experience are expected to become more efficient and competitive. The experience of farmers leads to more effective combination of inputs, making labor a unit more effective. For young farmers who lack agricultural production experience, they will not have to worry about agricultural land and investment will also be insufficient (Guo et al., 2015).

Farm size had a significant (p<0.05) and negatively correlated with the SCB values. The beta coefficient for planting area (β = -0.009, p = 0.00) implies that on average, decrease in the farmers' planting area by one-acre results in 0.9% increase in the SCB values holding other variables constant. This shows that smaller farms have less output than larger farms. Many studies have shown that there is an inverse relationship between farm size and crop yield especially in the case of labor-intensive agriculture and low mechanization. Two factors behind the inverse relationship reversal: excessive land division may make some farms too small to operate efficiently, and the latest technological advances, including information and communication technology, may make it easier to monitor labor, thereby reducing the transaction costs of hiring labor. Another type of study found that the relationship between farm size and crop yield is U-shaped (Braun and Mirzabaev, 2015). The average farm size in most Asian is small, so 0.4 hectares to 0.8 hectares do not necessarily have any strong qualitative changes that may affect agricultural growth rate while passing from an average of 5-10 hectares to 20-25 hectares may have greater impact.

Morris variety had a positive correlation and significant ($p<0.05$) with the SCB values. The beta coefficient for Morris variety ($\beta = 0.020$, $p = 0.00$) shows that on average, one-unit increase in planting Morris variety results in 2% increase in SCB values, holding other variables constant. The increasing SCB value (SCB>1) indicated that pineapple farms are uncompetitive. This indicates that the Morris variety in this study has lower yields than other varieties such as Josapine. Pineapple has a wide range of applications and is used for a variety of purposes in various industries, such as the production of pineapple leaf fiber. It was discovered that the Josapine type is superior to Morris because it produces more fiber, is stronger, and is easier to extract (Mazalan and Yusof, 2017). Furthermore, the price of a Josapine fruit is higher than that of a Morris, making the Josapine type more suitable and popular for growing in Malaysia (Abdul Hamid and Ali, 2014) and thus more socially comparable.

However, MD2 variety had a negative correlation, and it was not statistically significant ($p>0.05$) with the SCB values. The beta coefficient for MD2 variety ($\beta = -0.002$, $p = 0.472$) indicates that on average, one-unit decrease in planting MD2 variety results in 0.2% increase in SCB values, holding other variables constant. This illustrates that the MD2 variety in this study has higher yield than other varieties. The pineapple variety MD2 is currently the most popular variety, and it is traded globally mainly because of its excellent taste, sweetness, attractive golden flesh and golden skin and its perfect cylindrical shape. However, each of planting materials of MD2 cost RM2.00 which is considered expensive. Therefore, the cost of planting materials for just one hectare of land can be as high as RM 80,000 (40,000 plants per hectare). The MD2 variety has encountered problems with the existing propagation technique. For example, although tissue culture can produce planting materials in large quantities, the cost of this technology lies in the initial cost of establishing laboratories, purchasing various chemicals, and developing technical skills, and the problem of somatic cell clonal mutation. At present, more than three-quarters of industry participants in the Malaysian pineapple industry are smallholder farmers. Hence, it is important to develop low-cost technology while still being able to mass-produce planting materials in a short period of time without somatic cells. In addition, local climate changes (such as droughts and prolonged rainy seasons) have also affected the existing production system of planting materials (Shafawi, Jamil, Aziz, Marzuki, Muhammad Noor, Nasarudin, Mustafa, Md Radzuan and Ying, 2018). All these reasons may explain insignificant results of this variety towards competitiveness of the farms in the study area.

4. Conclusion

Pineapples are among the commodities that make a significant contribution to food production in many agricultural sub-sectors in Malaysia. One of the important factors that may determine the future of agriculture development is trade liberalization which would give an impact on agricultural growth in the country and global competition. Therefore, research on the competitiveness of pineapple production will provide important evidence and data related to agricultural agency management or policymakers in order to plan a program to improve the private and social profits among the pineapple growers. An important contribution of this research lies in the analysis of disaggregated competitiveness at the farm level and the determinants of Malaysian pineapple competitiveness among pineapple smallholders in Johor, Malaysia. In this study, Social Cost Benefit (SCB) was used as an indicator to measure the competitiveness of Malaysian pineapple production. The results of the aggregated data showed that on average, pineapple farms in Johor were competitive. However, using disaggregated data, it was found that one -third of farmers remained uncompetitive in pineapple production. Therefore, the results revealed that a variation was present in the competitiveness of pineapple smallholding farms. Our findings also indicated that farmers' age, educational background, farmers' experience, farm size, and pineapple variety affect pineapple competitiveness among smallholder farmers in Johor, Malaysia. The application of the research findings provides several important considerations for future study. It is essential that the roles of the extension programmes will enhance agricultural revenues and productivity, improve food production and allow exports to other countries of the surplus food generated. For the optimum growth of the pineapple industry, research and development on which agricultural productivity is

eISSN: 2550-2166

highlighted should be upgraded through innovative technologies such as high yielding, new varieties or through mechanised and smart farming management of the farms. Lastly, future studies should consider sample data from the five largest pineapple-producing states in Malaysia in order to achieve better outcomes in the competitiveness study area in the country and to ensure future research is more compact and detailed.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

The authors would like to acknowledge the financial assistance received from Lestari Grant, UiTM (Grant No: 600-IRMI/DANA 5/3/GOT (001/2018) that was used in carrying out this study.

References

Abdul Fatah, F. (2017). Competitiveness and efficiency of rice production in Malaysia. Germany: University of Göttingen, PhD. Dissertation.

Abdul Fatah, F. and von Cramon-Taubadel, S. (2017). Profitability and competitiveness of rice farming in Malaysia: A Policy Analysis Matrix. *Asian Journal of Agriculture and Development*, 4(2), 31-48.

Abdul Hamid, M.J. and Ali, A.K. (2014). An assessment of the impact of technology on Josapine pineapple grown in Malaysia. Selangor, Malaysia: MARDI, Economics and Technology Management Research Centre.

Adinya, I.B., Afu, S.M. and Ijoma, J.U. (2010). Economic meltdown and decline in pineapple production: determinant of production inefficiency of pineapple-based alley cropping practices in Cross River State, Nigeria. *The Journal of Animal and Plant Sciences*, 20(2), 107-116.

Akhilomen, L.O., Bivan, G.M., Rahman, S.A. and Sanni, S.A. (2015). Economic efficiency analysis of pineapple production in Edo state, Nigeria: A stochastic frontier production approach. *American Journal of Experimental Agriculture*, 5(3), 267–280. https://doi.org/10.9734/AJEA/2015/13488

Bakar, B.B. (2009). The Malaysian agricultural industry in the new millennium: issues and challenges. In International Conference on Malaysia: Malaysia in Global Perspective, 27-28 September. Egypt: Cairo University.

Braun, J.V. and Mirzabaev, A. (2015). Small farms: changing structures and roles in economic development. *SSRN*, 2015, 2672900. https://doi.org/10.2139/ssrn.2672900

Chubashini, S., Tengku Ahmad, T.M.A., Ali, A.K.K.A., Rusli, R. and Ab Halim, N. (2011). Competitiveness of Malaysia's fruits in the global agricultural and selected export markets: Analyses of Revealed Comparative Advantage (RCA) and Comparative Export Performance (CEP). *Economic and Technology Management Review*, 6, 1-17.

DOA (Department of Agriculture). (2017). Fruit crops statistic. Putrajaya, Malaysia: Department of Agriculture.

Guo, G., Wen, Q. and Zhu, J. (2015). The impact of aging agricultural labor population on farmland output: from the perspective of farmer preference. *Mathematical Problems in Engineering*, 2015, 730618. https://doi.org/10.1155/2015/730618

Gyimah, K.A. (2015). Factors influencing pineapple productivity in the Akwapim South Municipal area. Ghana: University of Ghana.

Hai, N.M. and Heidhues, F. (2004). Comparative advantage of Vietnam's rice sector under different liberalization scenarios-a Policy Analysis Matrix (PAM) study. Germany: University of Hohenheim.

Hamid, M.J.A and Kassim, A. (2013). An assessment of the impact of technology on Josapine pineapple grown in Malaysia, p. 1-11. Selangor, Malaysia: MARDI, Economics and Technology Management Research Centre.

Jaji, K., Man, N. and Nawi, N.M. (2018). Factors affecting pineapple market supply in Johor, Malaysia. *International Food Research Journal*, 25 (1), 366–375.

Mazalan, M. and Yusof, Y. (2017). Natural pineapple leaf fibre extraction on Josapine and Morris. *MATEC Web of Conferences,* 135, 00043 (2017). https://doi.org/10.1051/matecconf/201713500043

MPIB. (2019). Pineapple introduction session and description of pineapple plant entrepreneur development program. KCCI Agro Seminar Program. Selangor, Malaysia.

MPIB. (2021). Canned pineapple processing. Retrieved on 3 February 2021 from https://www.mpib.gov.my/en/canned-pineapple-processing/

Monke, E. and Pearson, S. (1989). Policy analysis matrix for agricultural development. Cornell University Press, United States. Retrieved on 10 July 2020 from https://www.cepal.org/sites/default/files/courses/files/03_3_pambook.pdf

Nik Mohd Masdek, N.R., Chubashini, S. and Othman, M.F. (2017). Competitiveness of Malaysia's fruits in the global market: Revealed comparative advantage analysis. *Malaysian Journal of Mathematical*

Sciences, 11(S), 143–157.

Opata, P.I. and Ike, C.U. (2017). Drivers of farmers' marketable supply of pineapple in Southeast Nigeria. *Journal of Economics and Sustainable Development*, 8(22), 45–54.

Ruslan, N.A, Man, N., Nawi, N. and Ding, P. (2013). Factors that Influence the implementation of postharvest handling practices among fresh vegetable producers in selected states in Malaysia. *Journal of International Food and Agribusiness Marketing*, 25(Suppl. 1), 87-97. https://doi.org/10.1080/08974438.2013.800010

Salim, S. (2016). Transforming the Malaysian pineapple industry, presented at the 5th International Plantation Industry Conference and Exhibition (IPiCEx2016), 2 – 4 November. Johor, Malaysia.

Suhaimi, N.H. and Abdul Fatah, F. (2019). Profitability of Pineapple Production (Ananas comosus) among Smallholders in Malaysia. *International Journal of Recent Technology and Engineering,* 8(4) 4201-4207. https://doi.org/10.35940/ijrte.D7780.118419

Suhaimi, N.H. and Abdul Fatah, F. (2021). An assessment of comparative advantage of pineapple production (*Ananas comosus*) among smallholders in Johor, Malaysia. *IOP Conference Series: Earth and Environmental Science*, 757, 012012. https://doi.org/10.1088/1755-1315/757/1/012012

Shafawi, N.A., Jamil, R., Aziz, N.B., Marzuki, F.A., Muhammad Noor, A.A., Nasarudin, N.S., Mustafa, R., Md Radzuan, S. and Ying, J.C.L. (2018). New technology for mass propagation MD2 pineapple planting material in Malaysia. *International Journal of Agriculture, Forestry and Plantation*, 6, 33-36.

Uyanık, G.K. and Güler N. (2013). A study on multiple linear regression analysis. *Procedia Social and Behavioral Sciences*, 106, 234-240. https://doi.org/10.1016/j.sbspro.2013.12.027

Zanello, G. (2012). Mobile phone and radios: effects on transaction Costs and market participation for households in Northern Ghana. *Journal of Agricultural Economics,* 63(3), 694-714.

