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Profitability of Pineapple Production (Ananas comosus) among Smallholders in Malaysia

Nurul Hidayah Md Suhaimi, Fazleen Abdul Fatah

Abstract*: Pineapple is a tropical fruit with high nutritive value and fine flavour. It has been an encouraging potential of commercial crop for income and export earnings in Malaysia. Despite its popularity, there are little empirical data on the costs and profitability of its production in Malaysia. Therefore, this study attempts to determine profitability of pineapple production in Johor which focuses on calculation of the production costs incurred, the income earned, as well as analyse the feasibility of growing pineapples among smallholders. A simple random sampling technique was used to obtain information from 191 respondents using random sampling. Data from interviews were then analysed using descriptive statistics and budgetary technique. Results indicated that majority of the farmers were males, middle aged, engaged full time in pineapple production, possessed small scale farm and had a background in pineapple farming for at least twenty years. Most respondents cultivated Josapine variety and grew pineapple on a peat soil. The result showed that the pineapple production business is profitable and returning more to the farmer than the original investment in terms of purchased inputs as indicated by benefit cost ratio of 1.72. Additionally, the result of regression analysis revealed pineapple production was significantly affected by working experience, planting area, pineapple variety, pineapple price and cost of inputs.

Keywords: Cost Benefit Ratio, Malaysia, Multiple Regression, Pineapple, Production, Profitability

I. INTRODUCTION

In Malaysia, pineapple is one of the most promising demand of fruit in the local and export markets (Nazri & Pebrian, 2017). Out of 100 per cent pineapple produced, seventy per cent of it consumed as a fresh fruit in the country of origin (Bartholomew et al., 2003). It originated from warm climates in the Americas, being the main producers: Thailand, Brazil, Philipines, India and China (Maia, Maia, Lima, Aspiazu, & Pegoraro, 2012). Pineapple belongs to the bromeliad family, which consist of 50 genera and about 2,500 knows species (Sanewski, 2009). *Ananas comosus* is the most familiar species that exploited for commercial purposes (UNCTAD, 2016). The expansion of pineapple plantations was commenced from canned pineapples industry that showed in London from Singapore in year 1886 by J.F. Nicholson. From the moments, the canneries establishment expended in Penang, Johor and Selangor (Thalip, Tong, & Ng, 2015).

Malaysia's pineapple industry started with the intercropping system in 1888. Pineapple become an intercrop plant that is crucial to coconuts, areca nuts, rubber and other fruits trees. The expansion of rubber plantations stimulating pineapple industry as an intercrop plant thus increasing the importance, such that fluctuating world prices for canned pineapple lauded the enactment of the Pineapple Industry Ordinance in 1934. To control the progress of the industry, the rules and regulations were set up which encouraged greater interest towards the industry as expressed with the beginning of pineapple monocropping in Johor (Haruna, Mohd Hanif, Abd Rahim & Musa 2013).

Pineapple is the first crop grown as a commodity crop in Malaysia with high export potential (Jaji, Man and Nawi, 2018). Pineapple from family Bromeliaceae is considered as an important tropical fruit. After bananas, pineapple was recognized by the United Nations Conference on Trade and Development (UNCTAD) in the ranking of commercial tropical fruits for production on a worldwide basis. Pineapple has been an important industrial or commodity crop with greater benefits. Pineapple contained numerous nutritional, medical and industrial value which promoting and enhancing well-being of mankind.

The popular pineapple varieties in Malaysia are MD2, Moris, Josapine, N36 and Sarawak and typically planted in Johor, Sarawak, Sabah, Kedah, Selangor, Negeri Sembilan, Pahang and Terengganu. Johor ranks first in term of production accounting for more than 16% of total production (Salim, 2016). The MD2 has been identified as a key crop under the National Key Economic Area (NKEA) of the Economic Transformation Program (ETP). This variety also has been identified as EPP7's catalyst for the premium fruit market. Compared to other varieties, MD2 is better in several qualities. Among them are: uniform bright colour, sweeter taste, four times vitamin C content, lower fiber, lower acidity, thinner skin, smaller fruits at an average of 1.5kg each, and no longer shelf life (Thalip et al., 2015).

II. LITERATURE REVIEW

A. Production of Pineapple in Malaysia

In Malaysia, pineapple is one of the former industrial crops and has an existence for nearly a century.

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* Correspondence Author
Fazleen Abdul Fatah *, Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, Jasin Campus, 77300 Merlimau, Jasin, Malacca, Malaysia.
Nurul Hidayah Md Suhaimi, Centre of Postgraduate Studies, Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

Pineapple cultivation offers lucrative income for growers especially with the establishment of high planting density in farm and the use of cultivar that provide a stable yield and high resistance towards disease. In 2015, Department of Agriculture (DoA) reported that 272,570 Mt of pineapple have been produced throughout the year. The details of planted area, production and value of production from pineapple are presented in Table 1.

Table 1: Planted area and harvested area, production and value of production of pineapple in Malaysia, 2015-2017

Year	Planted Area (Ha)	Harvested Area (Ha)	Percentage of Harvested Area (%)	Production (Mt)	Value of Production (RM)	Average yield (Mt/Ha)	Potential Production (Mt/Ha)
2015	10,847.0	8,975.3	82.7	272,570.0	386,140,884	30.4	62.0
2016	13,148.9	10,354.1	78.7	391,714.4	515,248.7	37.8	62.0
2017	12,898.44	10,130.76	78.54	340,721.95	668,666.83	33.63	62.0

Source: DoA (2017)

Meanwhile, Table 2 represents specific numbers of production of pineapple according to the states in Malaysia 2015. Production of pineapple in Peninsular Malaysia shows the decrement number from year 2014 to 2015 which is 294, 161.01 MT was recorded (MPIB, 2014).

Table 2: Hectarage, Production and Value of Production of Pineapple by State, Malaysia, 2015

State	Hectarage (Ha)	Harvested Area (Ha)	Production (Mt)	Value of Production (RM)
Johor	6,357.3	5,384.5	199,773.4	278,762,333
Kedah	469.8	388.5	6,611.6	9,366,395
Kelantan	259.5	195.0	4,365.3	6,184,229
Melaka	8.8	7.3	57.9	81,992
Negeri Sembilan	177.5	172.4	6,195.2	8,776,464
Pahang	112.0	88.2	2,168.0	3,071,329
Perak	65.3	62.2	2,142.5	3,035,202
Perlis	-	-	-	-
Pulau Pinang	303.5	213.5	6,937.1	9,827,558
Selangor	385.5	316.1	5,150.9	7,297,056
Terengganu	41.4	41.0	709.6	1,005,309
Peninsular Malaysia	**8,180.6**	**6,868.6**	**231,111.4**	**327,407,867**
Sabah	941.8	760.7	14,952.0	21,182,000
Sarawak	1,724.6	1,346.0	26,506.6	37,551,017
W.P. Labuan	-	-	-	-
MALAYSIA	**10,847.0**	**8,975.3**	**272,570.0**	**386,140,884**

Source: DoA (2015)

B. The Pineapple Market in Malaysia

In order to improve the livelihoods of small farmers through income generating, the pineapple industry contributes greatly to the socioeconomic development of the country. It helps to promote economic development in the nation and the growth of other economic support activities, like packaging, transport and other value-added activities in Johor in particular (Jaji et al., 2018). Johor is known to be the biggest producer of pineapple in 2017 with an estimated volume of production of 274,284 metric tons (Table 3) (DoA, 2018).

Table 3: **Top producing state in Malaysia for pineapple production, 2017**

State	Hectarage (Ha)	Production (Mt)
Johor	8,112	274,284
Sarawak	1,767	25,664
Sabah	972	11,155

Source: Booklet Statistik Tanaman (Sub-Sektor Tanaman Makanan), (DoA, 2018)

Raziah (2009) claims that the fall of the Malaysian pineapple industry has been due to many factors. The impairment of the quality of peat soil resulting from prolonged use for production of pineapples has been believed to impair crop productivity. Diminished peat soil yield was most likely caused by the Paratylenchus species nematode (Nik Masdek, 2007 as cited in Raziah, 2009). Detailed studies of the populations of nematodes in the soil and root of pineapple plants showed a high population of Paratylenchus species during various stages of growth in several affected commercial farms.

Peat soils bring huge economic advantages to their regions. For use as horticultural compost, peat is extracted. The high-water retaining capacity and airflow are very popular in commercial horticulture. Peat is also used to produce electricity for fuel. It is available in cold climates as briquettes for heating homes. Peat soil are drained and used for farming applications (pasture and crop production) and forestry (Efretuei, 2016).

Shah (2018) reported that in order to meet the demand of domestic and overseas markets, Malaysia will need at least 3,000 ha of land to grow MD2 pineapples. Minister of Agriculture and Agrobased Industry, Datuk Salahuddin Ayub, said to The Star Online, that currently there are only 2000 hectares of land used in Johor for the growing of pineapples. The export of MD2 pineapples is to more than 13 countries including Oman, Iran, the UAE, Turkey, Singapore and South Korea. Kuwait and China are the latest on the list of exporting countries in the near future and in discussions with various European countries in order to export the fruit for them.

C. Cost-Benefit Analysis (CBA)

Assessment of the cost benefit (CBA) shows the value of an asset by contrasting the costs involved with the benefits. It is used to assess proposals economically and calculate the project's financial viability. The financial ratios used for cost benefit analysis according to Gittinger (1982 as cited in Oduro, 2015) include the benefit cost ratio (BCR). According Gittinger (1982), the Benefit Cost Ratio is defined as the value today of all benefits divided by the value today of all costs (Oduro, 2015).

Machiraju (2011 as stated in Asante & Kuwornu, 2014) mentioned that the cost-benefit analysis included the review of a plan from the point of view of optimizing the net benefit. Ross et al (2001) mentioned that profitability can be calculated on an annual basis or over or the lifetime of an asset while the calculation of lifespan profitability is used to allow the decision to allocate resources.

Return on sales, profit margin and capital return are also well-known indicators of productivity (Asante et al, 2014).

The hypothesis is based on the financial analysis using the cost-benefit analysis method, which uses discounted project-value indicators such as the benefit-cost ratio (BCR). Economic analysis has been used as both production and input costs have been considered. Seed, fertilizer and other equipment for processing are included in the price of input. Production consisted only the production of pineapple produced during the season. The Benefit Cost Ratio is defined according to Gittinger (1982 as cited in Oduro, 2015) by the value of every benefit divided by the value of all costs today. The decision rule states that if the Benefit Cost Ratio (BCR) is greater than 1, then the projected is said to be financially viable hence it can be accepted (Oduro, 2015).

D. Factors affecting pineapple production

Factors affecting agriculture competitiveness have received some attention in recent literature. In this study, these factors have been recognized as credit access, cost of inputs, pineapple varieties, and farm size.

1) Credit access

Investment and production decisions of farmers are closely affected by access to financial instruments. In the absence of suitable risk mitigating products, or in the case of financial instruments available that do not meet the needs of farmers, farmers may be discouraged from adopting better technologies or purchasing agricultural inputs or taking other decisions that may improve their business efficiency. Enhanced access to finance can improve the investment choices of farmers and provide more effective risk management instruments (Karlan and others 2012a, Cai and others 2009 as cited in Ruiz, 2014).

2) Cost of inputs

Agriculture inputs such as cultivated area, seed, manpower, chemical fertilizer, manure and insecticide should be optimally used in farming activities. However, Yusi (2016) found in his study that agriculture inputs have not been used timely and desirable. These usage inputs ought to be increased. Between these eight input factors, cultivated area has the biggest impact on pineapple production. It was also noted that a change in the volume of total pineapple outputs results could take place with every increase and decrease from the production factors. This would therefore justify that pineapple farming conditions in South Sumatera are increasing returns to scale that indicates the number of the result can be improved if the production factors used are maximum.

3) Pineapple varieties

Based on the study in Indonesia, pineapple farming faced a quite challenge as reflected in the harvested area and shifting production. The reasons behind this occasion are the failure to develop the use of greater varieties, use least cultivation method and improper techniques for post-harvest by farmers (Yusi, 2016).

4) Farm Size

Small farms give higher profit margin due to the facts that large farms produce lower unit cost and lower per unit return per hectare in contrast small farms. Subsequently, the per hectare values of all production inputs are normally higher for small farms. Small size farms have a tendency to be more productive than large farms. This is likely gives acceptance to the reasons of why majority of farmers choose small farms for their production (Ayagiba, 2002).

III. METHODOLOGY

A. Study area

DoA (2018) reported that Kluang district in Johor is the most productive pineapple region in Malaysia and follows by Maradong in Sarawak and Tuaran in Sabah in the Plant Statistics Booklet (Food Crop Substation) (Table 4). The pineapple industry is distinctive in Malaysia because it is cultivated 90% on peat soil and the rest on mineral soil (Chan, 2000 as cited in Raziah, 2010). Pineapple growing technology had a positive effect on farmers ' incomes in peat soil. However, there is a growing interest in planting fresh fruit varieties on mineral soil, as it seems to be better than the ones grown on peat soil (Raziah, 2010).

The largest area of fruit cultivation was found to be Johor in 2015, with 15,263 ha. There are three reasons for the cultivation of high fruit in Johor: 1) land accessibility; 2) favorable soil condition; 3) appropriate environment. Johor is Malaysia's leading pineapple cultivation area. The pineapples in Johor are mainly grown in Pontian, Kluang and Muar districts. (Nik Mohd Masdek, Chubashini, and Othman, 2015; Shanmugam, Yassin & Khalid 2019a, 2019b).

Table 4: **Top producing state and district in Malaysia for pineapple production, 2017**

State	District	Production (Mt)
Johor	Kluang	175,142
Sarawak	Maradong	4,680
Sabah	Tuaran	8,213

Source: Booklet Statistik Tanaman (Sub-Sektor Tanaman Makanan), (DoA, 2018)

It stated by The National Compendium on Agro-statistics that Johor ranking among Malaysia's most important states in 2015 with a wide range of crops and animals. Geoffrey (2018) proposed that each Johor district dedicates considerable amounts of land to agricultural production including Kulai and Johor Bahru, which are relatively established districts. However, today's lead is Kluang, Segamat, Batu Pahat and Kota Tinggi. In other words, the west, central and east parts of the state tended to contain the largest agricultural fields.

Reflecting on recent trends in growth since 2000, state planners are projecting that Johor's agricultural footprint could increase until 2030, in areas that are considered to be less affected by urban expansion, namely Kota Tinggi, Batu Pahat, Kluang, and Tangkak, the majority of new cultivations will take place. Table 5 presented the hectarage, production and value of production of pineapple in each district in Johor by year 2017.

Table 5: Hectarage, Production and Value of Production of pineapple by district in Johor, 2017

District	Hectarage (Ha)	Harvested Area (Ha)	Production (Mt)	Value of Production (RM)
Batu Pahat	1,499.2	1,124.4	28,108.7	55,163.4
Johor Bahru	152.0	150.0	4.375.8	8,587.6
Kluang	3,912.3	3.111.0	175,142	343,715,7
Kota Tinggi	38.0	15.2	67.9	133.2
Kulai	3.8	2.6	64.4	126.4
Mersing	10.0	6.0	60.0	117.8
Muar	306.7	301.7	14,408.3	28,276.3
Pontian	2,047.7	1,602.5	21,801.7	101,660.8
Segamat	142.4	142.2	255.8	501.9
Tangkak	-	-	-	-
TOTAL	8,112.1	6,455.5	274,284.4	538,283.1

Source: Fruit Crops Statistics (DoA, 2017)

The pineapple is a popular non-seasonal fruit and is commonly grown on peat soil in Johor, Malaysia. According to Raziah (2009), over the years, the size of land for pineapple cultivation has declined. During RMK-3 (1976-1980), the average acreage area was 12,700 ha, but during RMK-8 (2001-2005), it decreased by nearly 50% approximately 6,700 ha. However, there was an evidence that the field cultivated with pineapple with the average area grown during the period in the early years of RMK-9 (2006-2010) increased to 10,000 hectares.

Particularly in Johor, the acreage of pineapple had been experiencing fluctuations. Referring to the Table 6, the hectarage of pineapple planted area was declining by 0.95% with the increasing number of productions up to 43% from year 2013 until 2014. However, in year 2015, there was indication of improvement in the area cultivated with pineapple up to 46%. But then again, the hectarage of pineapple cultivated area experiencing deteriorating in year 2016 until 2017.

Table 6: Hectarage of pineapple in Johor, 2013-2017

Year	Hectarage (Ha)	Production (Mt)
2013	5,099.09	139,922.50
2014	5,003.71	245,544.37
2015	9,676.00	329,954.00
2016	8,934.53	273,949.46
2017	8,112.06	274,284.36

Source: Fruit Crops Statistics (DoA, 2017)

B. Sampling and data used

There are several strategies for determining the sample size. These include using a census for small populations, imitating a sample size of similar studies, using published tables, and applying formulas to calculate a sample size (Israel, 1992).

Table 7: The total population of pineapple farmers in research area

Area	Number of people
Batu Pahat	85
Kluang	122
Kulaijaya	6
Muar	99
Pontian	70
TOTAL	382

Source: MPIB (2019)

Table 7 above showed the total population of pineapple farmers in Johor. According to Sekaran (2003), the suggested sample size for given population of 382 is approximately 196 respondents. This sampling design is used to samples respondent for researcher-structured questionnaires, which is a tool in this effectiveness of survey to determine this problem statement. The target population for this questionnaire involve small-scale pineapple growers. A population sample from an accessible population will be selected in this study. Smallholder has been choosing in this research due to the greater impact of the competitiveness and efficiency of activities such as cost of input, output price and profit margin compared to large-scale growers.

The present study was conducted in five districts in Johor viz., Batu Pahat, Kluang, Kulaijaya, Muar and Pontian. The primary data were collected from the respondents through personal interview method guided by well-structured questionnaire. Johor was selected as an area study due to its high productivity throughout Malaysia. Total 191 smallholder's pineapple growers were selected randomly. For analysis of data, budgeting techniques and cost concepts (establishment cost, fixed cost, variable cost and total cost) and Benefit-Cost Ratio were used in this study.

C. Method of analysis

1) Budgetary approach

Simple budgetary approach was used to calculate the total cost, total revenue and net return.

TC = TFC = TVC

Where TC denotes total Cost, TFC denotes total fixed Cost, TVC denotes total variables Cost, TR denoted total revenue, TR denotes selling price per pineapple x total output.

Net Profit = TR – TC

2) Benefit Cost Ratio

The benefit cost (BCR) ratio was used in this study. The decision rule is that we accept the project if the BCR ≥ 1 and when the cost and benefit streams are discounted at the opportunity cost of capital. Thus, is BCR > 1 it implies that pineapple production is profitable, if BCR < 1 it implies not profitable and if BCR =1, the investment break even.

$$\text{Benefit Cost Ratio} = \sum_{t=0}^{n} \frac{B_t/(1+r)^t}{C_t/(1+r)^t}$$

Where B_1 denotes benefit in year t, C_t denotes cost in year t; r denotes cost of capital; t denotes number of years. The decision rule is that we accept the project if BCR ≥ 1 when the cost and benefit streams are discounted at the opportunity cost of capital. Thus, if BCR > 1 it implies that pineapple production is profitable, if BCR < 1 it implies not profitable and if BCR = 1, the investment break even.

3) Multiple regression

The analysis of the data is conducted using the Social science statistic system (SPSS) version 20 through the descriptive analysis and multiple linear regression analysis. In terms of frequencies and percentages, quantitative research was used to identify farmers' socio-demographic characteristics.

Multiple regression analysis was used to evaluate the relationship between these identified factors and certain demographic characteristic variables and pineapple production. Mahlet et al. (2015 as cited in Jaji et al, 2018) adapted the linear regression model to analyse factors affecting pineapple production. The empirical model of the effects on pineapple production of a set of explanatory variables is defined using the following relation:

$$C = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon$$

Where, C = Pineapple production
α = Constant
$\beta 1 \ldots\ldots \beta 8$ are the Coefficients to be estimated
X1 = Age
X2 = Level of education
X3 = Farming experience
X4 = Farm size
X5 = Price of pineapple
X6 = Cost of inputs
X7 = Credit access
X8 = Pineapple varieties
ε = Error term

The values of each independent variable (credit access, cost of inputs and pineapple price) and some socio-demographic features of producers such as age of farmers, level of education, farming and agricultural size were used in this model to forecast value for the dependent "C" factor, i.e. pineapple production.

IV. RESULT AND DISCUSSION

A. Socio-economic Characteristics of Respondents

Table 8 and 9 shows the socio-economic characteristics of the respondents by frequency and mean respectively. These included ages, gender, race, education background, working experience, pineapple variety, type of soil and type of incentives. Majority (51.8%) of the farmers were Male and their mean age were 51 years old and most of them were 55 years old. Race of respondents are presented in Table 8 also indicated that 157 of them were Malay (82.1%) and the remaining is Chinese. Considering the age of the respondents, most of the respondents (22%) never getting any formal education and had 20 years of working experience. Josapine was the variety that are mostly planted (78.5%) in Johor that use peat soil (96.8%) as a medium. Respondents also received herbicides (96.8%) from the government as incentives. The total planting area of pineapple (acre) was 2.40 acres, most of which belonged to 1.0 acres of pineapple. For a period of 13-14 months, they received RM 49, 273.58 revenue. The average production of pineapple was 33, 668.72.

Table 8: Socio-economic Characteristics of Respondents (by Frequency)

Socio-economic characteristic	Frequency	Percentage (%)
Gender		
Female	33	10.8
Male	158	51.8
Race		
Chinese	34	17.8
Malay	157	82.1
Education Background		
No formal education	67	22.0
PMR/STP	30	9.8
SPM/STPM	41	13.4
STPM/Diploma	36	11.8
Ijazah/Sarjana	17	5.6
Pineapple Variety		
Josapine	150	78.5
MD2	6	3.1
Moris	35	18.3
Type of Soil		
Mineral	6	3.15
Peat Soil	185	96.85
Type of Incentive		
Herbicides	185	96.85
Planting Material	6	3.15

Source: Survey, 2019

Table 9: Socio-economic Characteristics of Respondents (by Mean)

Socio-economic characteristic	Mean	Median	Mode
Age	51.52	53.00	55
Working Experience (Years)	20.32	22.00	25
Planting Area (Acre)	2.40	2.0	1.0
Income (RM)	49, 273.58	37,800.00	18,900.00
Production (pineapple)	33,668.72	27,000.00	13,500.00

Source: Survey, 2019

B. Cost Analysis

1) Cost Benefit Analysis

Table 10 indicates the average of input cost and labour cost for the pineapple planting in Johor for the period of 14 months from 191 respondents. This included site cleaning cost, weeding cost, fertilizing cost, hormone cost, protection hat cost and labour cost. Gross margin derived from total acre and the farm gate price gained by farmers. The decision rule states that if the Benefit Cost Ratio (BCR) is greater than 1then the projected is said to be financially viable hence it can be accepted. The gross margin for pineapple planting in Johor for the period of 14 months from 191 respondents are as follows:

Table 10: Input cost and labour cost incurred in pineapple production in Johor

Benefit Cost Ratio (BCR)	Cost (RM)
Gross Margin	**57,202.04**
Site cleaning cost	395.95
Weeding cost	728.70
Fertilizer cost	8,350.45
Hormone cost	144.77
Hat cost	1,131.48
Planting Material cost	2,211.33
Labour cost	8,065.34
(-) Total Cost	**21,028.04**
NET PROFITS	**36,174.01**
Benefit Cost Ratio (BCR)	**1.72**

The Benefit-Cost Ratio (BCR) analyses results revealed that pineapple production is viable. The BCR for pineapple production is 1.72.

2) Factors affecting quantity of pineapple supply to the market

Table 10: Regression analysis result

	Coefficients	Std. Error	t-ratio	p-value
(Constant)	-27642.921	5013.501	-5.514	0.000
Age	3.161	25.371	0.125	0.901
Education Background	-231.650	270.443	-0.857	0.393
Working Experience	90.886	13.561	6.702	0.000
Planting Area	10667.426	630.185	16.927	0.000
Pineapple Variety	2994.006	418.293	7.158	0.000
Price of Pineapple	8299.812	793.940	10.454	0.000
Cost of inputs	0.192	0.073	2.641	0.009
Credit access	316.832	190.017	1.667	0.097
R square	0.995			
Adjusted R square	0.990			
Std. Error of the Estimate	2395.79773			
Total respondents	191			

[a] Dependent Variable: Pineapple Production

Source: Survey, 2019

The most significant factors in pineapple production among smallholder farmers was analyzed with multiple regression analysis. The independent variables are therefore hypothesized to explain the difference in the quantity of the pineapples given by the tested farmers on the market. Below is the product of the regression analysis.

Drawing from the regression results, the determination factor R2 was 0.990 suggesting that 99.0 percent of the variance in the dependent variable (pineapple production) with the remainder of 1 percent was due to the combination of independent variables within the regression model because of uncontrollable factors in the regression model.

The outcome of the regression analysis is shown in Table 11, which indicates the development of pineapple was determined by eight explanatory variables. The validity of a model depends greatly on a valid model description, correct anticipated signs of the predictor and the empirical significance of the regression coefficient, according to Gujarati (2003 as cited in Jaji *et al*, 2018). The model of this study is correctly defined, and the results show that the predicted signs have been met by all the explanatory variables of this analysis.

Among eight (8) explaining variables used in this study for the forecast of pineapple production, five (5) had a statistically significant connection with the pineapple supply. They are working experience (β=0.051, p = 0.000), planting area (β=0.793, p = 0.000), pineapple variety (β=0.063, p = 0.000), pineapple price (β=0.95, p = 0.000) and cost of inputs (β= 0.131, p = 0.009).

The farmers' experience was significant ($p<0.05$) and had a positive relationship with the pineapple production as expected. The beta coefficient for farmers' experience (β=0.051, t=6.702) suggests that more experienced farmers results in 5.1% increase in the pineapple production, holding other variables constant. Farm size had a significant ($p<0.05$) and positive relationship with the quantity of pineapple supplied as it confirms a priori expectation. The beta coefficient for farm size (β=0.793, t=16.927) implies that on average, increase in the farmers' farm size by one-acre results in 79.3% increase in the pineapples productivity supplied to market holding other variables constant.

Pineapple varieties had a positive and significant ($p<0.05$) with the pineapple production. The beta coefficient for pineapple varieties (β=0.063, t=7.158) shows that on average, one-unit increase in cultivation of improved varieties of pineapple by the farmers results to 6.3% increase in quantity of pineapple market supply, holding other variables constant.

Cost of inputs was found significant ($p<0.05$) and positively influenced the pineapple production to the market as hypothesized. The beta coefficient for the variable cost of inputs (β=-0.131, t=-2.641) indicates that on average, an increase in the cost of inputs (RM) results to 13.1% increase in the pineapple production, holding other variables constant.

Price of the product is a sensitive factor with a great effect on both demand and supply of any product. Following the hypothesis, a positive and significant ($p<0.05$) relationship were found between the price of the pineapple and quantity supplied of the product. The beta coefficient for the price of the pineapple (β=0.095, t=10.45) suggests that on average, an increase in the price of pineapple (RM) in the market results in increase 9.5% in the quantity of pineapple market supply by the farmers, holding other variables constant.

V. CONCLUSION

The empirical results reveal that pineapple production had a Benefit-Cost Ratio of 1.72 which implies that pineapple production is profitable while the result of regression analysis revealed pineapple production was significantly affected by working experience, planting area, pineapple variety, pineapple price and cost of inputs.

The pineapple sector is one of the products that can contribute greatly to the nation's revenue. Pineapple growers have varied social histories, including male domination, low levels of education and limited access to credit. Pineapple are primarily grown and manufactured by smallholders with the rest focused on farming. Farming is deemed lucrative but also costly. After all, the factors listed in this study are very significant factors that Malaysia needs to focus on improving its competitiveness on the world pineapple market and improving farmers' livelihoods.

In general, considerations such as farm size, access to credit, input costs and type of variety are very important as they directly influence the quantity and quality of agricultural production. In light of these results, the pineapple production sector should therefore be given greater consideration by concentrating on conditions that discourage it from successfully exporting to the global market, as its counterparts. The extension facilities should also be improved, in order to educate and empower farmers in the output and competitiveness of farming practices, and for maximum growth in pineapple industry research and development, which are the foundation for agricultural productivity, should be enhanced.

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