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Factors affecting pineapple market supply in Johor, Malaysia

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Abstract

Pineapple (*Ananas comosus* L. Merr.) is a tropical and economic fruit with encouraging market potential in the global market. It is the first crop grown as a commodity crop in Malaysia and raised the country's position to a very significant level in the world between the late 60 s and early 70 s. However, Malaysian pineapple's contribution to the global market in the recent time has been experiencing downward trend, resulting to a set-back in its competitiveness. This study aimed to determine factors influencing pineapple market supply in Johor, Malaysia, with objectives of identifying factors affecting pineapple market supply and quantity supplied of pineapple to the market in the study area. Data were collected using a well-structured close ended questionnaire via face-to- face from 170 randomly selected pineapple farmers. The obtained data were analysed using descriptive analysis, exploratory factor analysis, and regression analysis. Six factors identi¬fied by exploratory factor analysis as the factors affecting pineapple supply are credit access, pineapple varieties, distance to the market, cost of input, price of pineapples and extension services. The result of regression analysis revealed that, quantity of pineapple supplied to the market was found affected by farming experience, farm size, credit access, pineapple varieties, cost of inputs, price of pineapples, and extension services at 5%, 1%, 1%, 5%, 1%, 5% and 5% significant level respectively. The study recommends the need for designing appropriate intervention mechanisms focusing on the aforementioned factors to improve industry's performance in the global market and uplift the status of smallholder pineapple farmers.

Introduction

Pineapple (*Ananas comosus* L. Merr) is an edible member of the family Bromeliaceae with over 2,000 species and the third most important tropical fruit after banana and citrus. It contributes to over 20% of the world's production of tropical fruits (Coveca, 2002; Bartholomew *et al*., 2003; UNCTAD, 2012). Pineapple is considered as economically important horticultural crop with great health benefits and encouraging market potential in the global market for foreign exchange earnings which in turn brings higher income for the farmers (Fawole, 2008; Joy, 2010; Fakayode *et al*., 2012).

In 2013, the global pineapple production was estimated at 24.78 million metric tons with Costa Rica, Brazil, Philippines, Thailand, and Indonesia as the top five pineapple producers in the world. They all produced about 10 million tons of pineapple. Other important producers include China, India, Nigeria, Mexico, and Colombia. Malaysia's contribution to the global pineapple production in 2013 was estimated at about 315.977 metric tons which ranked it nineteenth pineapple producing country in the world (FAO, 2013; Agrofood Statistics, 2013).

Pineapple, being the first crop grown as a commodity crop with high export potential in Malaysia has raised the country's position as one of the top three pineapple producers in the world between the late 60s and early 70s. However, the ability of the country to remain competitive has suffered a great hitch (Othman and Buang, 2010). This setback has been attributed to different factors among which is switching of pineapple farmers to other crop like palm oil which they believed to be more profitable and easier in terms of production activities. Pineapple industry in Malaysia has been experiencing shortage of land area for the pineapple production (Lin and Abdul Rahman, 2010). The decline in the pineapple plantation area is reported largely among the smallholder sector until 2007 when industry experienced increment (5,923 ha) in the plantation area. Notwithstanding, the reduction in the pineapple plantation area continued yearly till 2011 when the plantation area was 1,310ha.

Pineapple industry contributes significantly to the country's socio-economic development in terms of improving livelihoods of smallholder farmers

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through incomes generation. It contributes to the nation's economic development and growth of other supporting economic activities such as packaging, transportation, and other value addition activities, particularly in Johor. The state of Johor is known as the largest pineapple producer in 2011 with the quantity of production estimated at 80,389.22 metric tons (MPIB, 2011).

The rapid growth in the world's population and increase in the consumers' awareness towards the health benefits obtainable from fruits, had resulted to increase in the demand for fruits globally (Reid and Buisson, 2001; Sabbe *et al*., 2008). This development has provided a great opportunity for the expansion of the fruit sector's contribution to Gross national income (GNI) and elevation of rural incomes. Among all fruits, pineapple is a well-positioned fruit since its trade is oriented towards developed countries such as Japan, the USA and the European Community (Coveca, 2002).

In spite of ever growing global demand for pineapple fruit and Malaysia's tropical climate and strategic geographical location, its contribution to the world's pineapple market is quite low which is about 2% of the world production, compared to that of its counterparts such as Thailand and Philippines (FAO, 2013; Agrofood Statistics, 2013). Since the level of productivity of a country has a great influence on its competitiveness in the international market, it can be concluded that Malaysian pineapple's competitiveness in the international fruit market is experiencing a setback.

While the Malaysian agricultural development policies are designed to increase the productivity, competitiveness of the agricultural sector, sustainability of agro-food industry, and increase income of the producers for the significant contribution of the sector to the economic growth of the country, competitiveness of pineapple sector is considered important. In order to accomplish this, considering the economic importance of pineapple in the global market, it is important to examine the factors affecting pineapple market supply in the study area being known as largest pineapple producing area in Malaysia. Previous studies that dealt with pineapple sector in Malaysia examined mostly chemical aspects. Also there are few relevant studies on socioeconomic and marketing aspects of pineapple (Rajendran *et al*., 2012; Assis *et al*., 2014). This study aims to examine other dimensions related to the marketing side of the pineapple sector and make appropriate recommendations. Consequently, the investigation about the factors affecting pineapple marketable supply is worthwhile in order to uplift rural farmers' status, increase nation's contribution to the global market, contribute to the literature and serve as guideline for Malaysian Pineapple Industry Board and policy makers as well. Thus, this study aims to identify the factors influencing pineapple supply to the market and determine the most influencing factors affecting the quantity of marketable supply of pineapple in Johor, Malaysia.

Materials and Methods

The study was carried out in Johor, Malaysia. Johor was chosen due to its characteristic of largest pineapple planting area among other states in Malaysia (MPIB, 2013). Johor is the second largest state in Penisular Malaysia and second most populous state with a total land area of 19,210 km^2 (7,420 sq mi) which located in the southern part of the country between 1°20"N and 2°35"N latitudes. The climate of Johor is a tropical rainforest associated with monsoon rain from November until February, blowing from the South China Sea. The average annual rainfall is 1778 mm with average temperatures ranging between 25.5°C (78°F) and 27.8°C (82°F) and humidity of the state is between 82 and 86%.

The primary data used for this study were collected from one hundred and seventy (170) pineapple farmers selected randomly from the list of the registered pineapple farmers obtained from Malaysian Pineapple Industry Board (MPIB), using a well-structured close ended questionnaire via face-to face survey. The instrument used for data collection was consisted of questions regarding socio-demographic and farm profiles of the farmers, pineapple production and marketing activities, and 36 statements on possible factors affecting pineapple marketable supply using a five- point Likert scale where 1 is strongly disagree and 5 is strongly agree. To ensure validity of the instruments, each question was developed in the light of the objectives of the study, based on relevant past studies and finally taken to the expert at Malaysian Agriculture Research and Development Institute (MARDI) to establish its content and face validities. The instrument was pre-tested to detect weakness in design and a wide range of potential problems with the instrument. The results from pilot study were used to fine-tune the questionnaire for the final data collection. The data collection was accomplished with the help of enumerators who have been trained based on the objectives of the study and the contents of the research instrument.

Data analysis

The descriptive analysis, exploratory factor analysis (EFA) and multiple linear regression analysis were used to analyze the data using the Statistical Package for Social Science (SPSS) software version 22. Descriptive analysis was used to describe the socio-demographic characteristics of the farmers in terms of frequencies and percentages. Exploratory factor analysis using principal component analysis approach with orthogonal rotation (varimax) was used to identify the most important variables from the large number of variables in the data set that affect pineapple farmers' marketable supply. Varimax rotation attribute helps smoothen the components and reduces the level of convergence among the variables in each component (Hair *et al.*, 2009). Factor analysis is adopted from Kamarulzaman *et al.* (2013); Ibitoye *et al.* (2014) for summarizing a large number of items into much smaller number of variables or factors for better understanding of the data.

The 36 items considered for factor analysis in this study were subjected to reliability test to ensure the internal validity. According to George and Mallery (2003), the value of 0.8 is considered a good consistency in the instrument measurement showing that variables are consistent and reliable. The measure of sampling adequacy is determined by Keiser-Meyer-Olkin (KMO) and its value of at least 0.6 or higher with eigen-value greater than 1 is considered meaningful for factor analysis (Hair *et al*., 2009). The Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix that is all the variables are uncorrelated. If the significance value for this test is less than 0.05, this indicates that the test is significant, thus, factor analysis is suitable. In computing the factor analysis, the "option" tool in SPSS software was used to suppress the scores in order to only show results of those variables above 0.5. This was done to enable the easy identification of the significant variables in the components. Uncorrelated and standardized factor scores were also generated through the Anderson-Rubin method for further analysis.

Finally, the relationship between those identified factors together with some demographic characteristic variables and pineapple quantity supplied to the market by the farmers was determined using multiple regression analysis. Ordinary Least Square (OLS) regression has been employed to determine factors affecting market supply of agricultural commodities by different researchers such as (Kindie, 2007; Betelihem, 2013; Mahilet, 2013). Thus, the linear regression model was adapted from Mahlet *et al.* (2015) to analyze factors affecting the quantity of marketable supply of pineapple by the sampled farmers. The empirical model of the effects of a set of explanatory variables on the percentage quantity of pineapple supplied to the market is specified using the following relationship:

$$LnY = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + U$$

where,

LnY = Percentage quantity of pineapple supplied to the market

$\beta_1 \ldots\ldots \beta_{10}$ are the Regression Coefficients

X1 = Age (years)

X2 = Level of education (years spent in school)

X3 = Farming experience (years)

X4 = Farm size (hectares)

X5 = Credit access (score)

X6 = Pineapple variety (score)

X7 = Distance to the market (score)

X8 = Cost of inputs (score)

X9 = Price of pineapple (score)

X10 = Extension services (score)

U = Error term

In this model, the factor scores of each independent variables (credit access, pineapple varieties, distance to the market, cost of inputs, price of pineapple and extension services) and some socio-demographic characteristics of the producers such as age of producers, level of education, farming experience and farm size were used to predict value for dependent variable 'LnY' which is percentage quantity supplied of pineapple to the market. The data for dependent variable was transformed into natural logarithm using SPSS statistical package. The data transformation was due to the fact that the variable was difficult to be predicted with those explanatory variables unless it is transformed.

Before running the regression analysis, all the hypothesized explanatory variables were checked for the presence of multi-collinearity problem. Multicollinearity problem occurs due to a linear relationship among explanatory variables; and the separate effect of independent variables on the dependent variable becomes difficult to identify because there exists strong relationship among them (Gujarati, 2003). Multicollinearity diagnostic test was checked while computing regression analysis using SPSS software. Variance inflation factors (VIF) and tolerance values were used to check for the existence of multicollinearity among explanatory variables. As a rule of thumb, if the VIF of a variable exceeds 10 which occurs if R^2 exceeds 0.95, or the tolerance less

than 0.1 that variable is said to be highly collinear (Gujarati, 2003). The result showed that all the VIF values are less than 10 and the Tolerance values are greater than 0.1 (the lowest is 0.662), therefore, we can conclude that there is no violation of the assumption of multicollinearity in the data. Normality, linearity and heteroscedasticity of the data were also checked to avoid the violation of the assumption of all these tests. The result showed no systematic pattern in the residual plot, as the residuals were evenly spread indicating that the model is free from normality, linearity, and heteroscedasticity problems.

Results and Discussion

Respondents' socio-demographic profile

Table 1 shows the summary of the farmers' socio-demographic profile. The results showed that about one third (30.0%) of the pineapple farmers were in the age category between 51-60 years, 28.2% were between 41-50years, while few (3.5%) of the respondents were between 21-30 years. Majority of the respondents (87.6%) are males while the rest (12.4%) are females. This shows that there are more male pineapple farmers than female pineapple farmers in the study area. At the same time, majority (95.3%) of the sampled farmers are Malay, while (1.8%) and (2.9%) of the respondents are Chinese and other citizens. More than half (52.9%) of the respondents had secondary school education, 16.5% attained the level of education beyond secondary level, while only few (2.9%) did not attain any formal education.

In terms of experience, majority (75.9%) of the respondents had less than 10 years of farming experience, 12.4% of them had been farming for 10-20 years, while the rest (11.8%) had 21 years and above pineapple farming experience. Based on the area of farmland owned by the respondents, about 71.2% of the pineapple farmers cultivate less than 2 hectares of land, those that cultivate 2-3 and 4-5 hectares of land accounted for 12.9% and 13.5% respectively, while only few (2.4%) had farm size of 6 hectares and above. This indicates that majority of the pineapple farmers in the study area are operating on small-scale medium. Finally, based on the quantity of marketable supply of pineapple by the respondent farmers, majority (63.5%) of them supplied the quantity of pineapples ranging between 10,000 kg to 50,000 kg, 4.1% supplied the quantity less than 10,000 kg and more than 100,000 kg of pineapples respectively, while 28.2% reported the supply between 51,000 kg to 100,000 kg.

Table 1. Socio-demographic profile of the pineapple producers

Variables	Frequency (n=170)	Percentage (%)
Age		
21-30	6	3.5
31-40	32	18.8
41-50	48	28.2
51-60	51	30.0
61 and older	33	19.4
Gender		
male	149	87.6
female	21	12.4
Race		
Malay	162	95.3
Chinese	3	1.8
Others	5	2.9
Level of education		
No formal education	5	2.9
Primary school	47	27.6
Secondary school	90	52.9
Diploma	18	10.6
University	10	5.9
Years of Farming		
Less than 10	129	75.9
10-20	21	12.4
21 and above	20	11.8
Farm size (ha)		
Less than 2	121	71.2
2-3	22	12.9
4-5	23	13.5
6 and above	4	2.4
Quantity supply		
Less than 10,000kg	7	4.1
10,000kg - 50,000kg	108	63.5
51,000kg -100,000kg	48	28.2
More than 100,000kg	7	4.1

Source: Survey, 2015

Factors influencing pineapple supply to the market

Factor analysis was conducted on the items related to the factors influencing pineapple supply by the farmers using Varimax rotation method and Eigen values greater than one as a cut-off point for the number of factors extracted. The sampling adequacy and the factorability of the data were evaluated through the Kaiser-Meiyer-Olkin indicator (KMO), which is based on correlation and partial correlation varying from 0 to 1.0. In order to proceed with factor analysis, the overall KMO value should be at least

Table 2. Test of sampling adequacy

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.772
Bartlett's Test of Sphericity	
Approx. Chi-Square	1797.470
Degree of freedom	210
Significance	.000

Source: Survey, 2015

0.6 or higher (Hair *et al.*, 2009).

The value of KMO for this study was 0.772 as shown in Table 2 which is acceptable for conducting factor analysis. The Barlett's test of Sphericity showed that the overall correlation matrix is not an identity and it is significant at $p < 0.000$ indicating the appropriateness of extracted items for factor analysis. Furthermore, the anti-image correlation matrix revealed that the measures of sampling adequacy were well above the acceptable level of 0.5, confirming the suitability of the data for the factor analysis (Field, 2010).

The result shows that six factors comprising 21 items out of initial 36 items met Kaiser-Meiyer-Olkin's criterion having eigenvalues greater than 1 and are considered significant. These six factors collectively explained 71.181% of the total variation of the factors influencing pineapple supply as shown in Table 3 below together with the factor loadings, eigenvalues, percentage of variance, as well as Cronbach's alpha. Items in the six-factor solution had factor loadings ranging from 0.676 to 0.909. These factors are (1) Credit access, (2) Pineapple varieties, (3) Distance, (4) Cost of input, (5) Price of the product, and (6) Extension services. These factors are described and interpreted in turn below:

Factor 1: Credit access: This factor explained about 18.265 per cent of the total variance with eigenvalue of 3.836. The factor consists of five items with the factor loadings ranging from 0.684 to 0.909 (Cronbach's Alpha = 0.910). This result shows that credit access is one of the factors affecting pineapple market supply by the farmers. In support of this result, according to Matsane and Oyekale (2014) in their study, lack of access to credit has been found as one of the important factors affecting vegetables marketing among the small-scale farmers.

Factor 2: Pineapple varieties: This factor explained about 14.248 per cent of the total variance with eigenvalue of 2.992. There are four items in this factor with the factor loadings ranging from 0.708 to 0.869 (Cronbach's Alpha = 0.869). This result shows that varieties of pineapple produced by farmers influence the pineapple market supply by the farmers.

Factor 3: Distance: This factor explained about 10.598 per cent of the total variance with eigenvalue of 2.226. This factor had three items with the factor loadings ranging from 0.739 to 0.797 (Cronbach's Alpha = 0.787). This result indicates that distance is one of the factors influencing pineapple market supply by the farmers. Ayalew (2015) reported that distance to the market had influence on the market supply of fruits negatively.

Factor 4: Cost of inputs: This factor explained about 9.645 per cent of the total variance with eigenvalue of 2.025. There are three items under this factor with the factor loadings ranging from 0.762 to 0.850 (Cronbach's Alpha = 0.729). This result shows that cost of farm inputs can affect the pineapple market supply by the farmers.

Factor 5: Price of the product: This factor explained about 9.426 per cent of the total variance with eigenvalue of 1.979. This factor consists of three items with the factor loadings ranging from 0.770 to 0.809 (Cronbach's Alpha = 0.725). This result shows that price of the product is one of the factors affecting pineapple market supply by the farmers. This result is supported by Yimer (2015) that found out that market information on price affects market supply of fruits positively.

Factor 6: Extension services: This factor explained about 8.997 per cent of the total variance with eigenvalue of 1.889. Three items were found significant under this factor with the loading factors ranging from 0.715 to 0.839 (Cronbach's Alpha = 0.709). This result shows that access to extension services is one of the significant factors influencing pineapple market supply by the farmers. This finding is supported by Ayalew (2015) that the fruits market supply is influenced by the extension service.

The reliability test was conducted to confirm the internal validity of the items used for each of the factors obtained from factor analysis. According to George and Mallery (2003), the value of 0.8 is considered a good consistency in the instrument measurement showing that the variables are consistent and reliable. A Cronbach alpha value higher than 0.7 indicates consistency and reliability in the factor (Hair *et al*., 2009). As shown in Table 3 below, all the six (6) factors had the Cronbach's alpha values greater than 0.7 which is considered acceptable (George and Mallery, 2003).

Factors affecting quantity of pineapple supply to the market

Multiple regression analysis was employed to

Table 3. Summary of factor analysis on factors influencing pineapple supply

	Factor Loading					
Items	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**
Credit access						
Access to credit enhances acquisition of additional farm land	.909					
Access to credit enhances acquisition of production mechanization packages	.894					
Access to credit enhances my financial capability to buy farm inputs	.872					
Access to credit encourages the use of hired labors	.793					
Access to credit enhances my ability to acquire means of transportation	.676					
Pineapple varieties						
Cultivation of disease resistant varieties reduces the problem of inability to meet market demand		.869				
Planting of improved varieties gives me larger harvest		.847				
Type of pineapple requested determines my market supply		.833				
Planting of disease resistant varieties increases market supply		.708				
Distance						
Losses incurred through transportation increases due to far distance			.842			
Cost of production increases due to far distance			.839			
Short distance reduces the transport cost and time spent			.730			
Cost of inputs						
High cost of fertilizers discouraged me from using it				.850		
High cost of improved planting material made me stick to traditional planting material				.783		
I used family labor due to high cost of labor				.762		
Price of the product						
Price stability makes me increase my market supply					.809	
Increase in the price of pineapples made me increase my market supply					.808	
I increased my market supply due to high price offered in the previous year					.770	
Extension services						
Acquired training on the use of fertilizers and pesticides increases my productivity						.839
Adoption of new technology through extension workers increases my productivity						.729
Acquired training on pre and post-harvest handling of pineapple increases my market supply						.715
Eigenvalues	3.836	2.992	2.226	2.025	1.979	1.889
% of Variance	18.265	14.248	10.598	9.645	9.426	8.997
Cumulative %	18.265	32.514	43.112	52.757	62.183	71.181
Cronbach's Alpha	0.910	0.869	0.787	0.729	0.725	0.709

Source: Survey, 2015

[a]Extraction Method: Principal Component Analysis.

[b]Rotation Method: Varimax

Table 4. Regression analysis result

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	10.072	0.259	38.954	0.000
Age	0.002	0.004	0.617	0.538
Level of education	0.007	0.048	0.151	0.880
Farming experience	0.091	0.040	2.270	0.025
Farm size	0.268	0.043	6.285	0.000
Credit access	0.161	0.043	3.776	0.000
Pineapple varieties	0.078	0.033	2.369	0.019
Distance to the market	-0.011	0.037	-0.292	0.770
Cost of inputs	-0.176	0.043	-4.135	0.000
Price of pineapples	0.103	0.038	2.695	0.008
Extension services	0.101	0.041	2.448	0.015
R	0.757			
R Square	0.573			
Adjusted R Square	0.546			
Std. Error of the Estimate	0.463			

[a] Dependent Variable: Natural log of quantity supply
Source: Survey, 2015

determine the most influencing factors affecting market quantity of pineapple supplied by the farmers. Therefore, the independent variables are hypothesized to explain the variation in quantity of pineapples supplied to the market by the sampled farmers. The result of the regression analysis is shown below.

Based on the regression results, the coefficient of determination R^2 was 0.573 indicating that a combination of independent variables in the regression model explained 57.3% of the variation in the dependent variable (quantity of pineapples supplied by the sample farmers) with the remaining 42.7% is due to uncontrollable factors in the regression model.

Table 4 presents the result of regression analysis where ten explanatory variables were hypothesized to determine the quantity of pineapples supplied to the market by the sampled farmers. According to Gujarati (2003), the relevancy of a model greatly depends on correct specification of the model, correct expected signs of the predictors, and statistical significance of the regression coefficient. The model of this study is specified correctly and the results revealed that all the explanatory variables in this study have satisfied the expected signs.

Among ten (10) explanatory variables used to predict the quantity of pineapple supply in this study, seven (7) of them had statistically significant relationship with the quantity supplied of pineapples. They are pineapple farming experience (β=0.091, p = 0.025), farm size (β=0.268, p = 0.000), credit access (β=0.161, p = 0.000), pineapple variety (β=0.078, p = 0.019), cost of inputs (β= -0.176, p = 0.000), price of pineapples (β=0.103, p = 0.008) and extension services (β=0.101, p = 0.015).

The farmers' experience was significant ($p<0.05$) and had a positive relationship with the pineapple market quantity supplied as expected. The beta coefficient for farmers' experience (β=0.091, t=2.270) suggests that one year increase in the farmers' experience results in 9.1% increase in the quantity of pineapple supplied, holding other variables constant. This result is in line with the findings of studies conducted by Abay (2007); Abraham (2013); Mahlet *et al.* (2015) which revealed a significant and positive relationship between the farmers' farming experience and quantity of tomatoes and potatoes supplied to the market.

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=0.268, t=6.285) implies that on average, increase in the farmers' farm size by one hectare results in 26.8% increase in the quantity of pineapples supplied to market holding other variables constant. This result is in agreement with the finding of Bosena *et al.* (2011) that land size allocated for cotton is one of the factors affecting farm level marketable supply of cotton significantly. Also, the studies conducted by Martey *et al*. (2012); Leykun and Jemma (2014); Ataul and Elias (2015) revealed that the probability of being commercial farmer is positively significant by the farm size under cultivation while, cultivated land size positively determines the marketable supply from total production.

Another significant ($p<0.05$) variable is farmers'

access to credit and a positive relationship was found between this variable and the quantity of pineapple supplied. The beta coefficient for farmers' access to credit (β=0.161, t=3.776) indicates that on average, one unit increase in farmer's access to credit increases the quantity of pineapples supplied to the market by 16.1% holding other variables constant. This implies that the financial capability of the farmers who had access to credit would be enhanced to acquire the necessary farm inputs (such as improved varieties of planting materials, fertilizers, chemicals, and hormones etc.) that can bring about maximum production, thus quantity supplied to the market would also increase. This result is consistent with the findings of Bosena *et al.* (2011); Muhammed (2011); Bongiwe and Micah (2013); Tesfaw (2014); Mahlet *et al.* (2015), that access to credit had positive and significant relationship with volume of cotton, teff, cabbage, pepper and potatoes supplied to the market, respectively.

Pineapple varieties had a positive and significant ($p<0.05$) with the quantity of pineapple supplied. The beta coefficient for pineapple varieties (β=0.078, t=2.369) shows that on average, one unit increase in cultivation of improved varieties of pineapple by the farmers results to 7.8% increase in quantity of pineapple market supply, holding other variables constant. This result is consistent with the findings of Lin and Abdul Rahman (2010) that usage of technology by pineapple farmers gave higher productivity which in turn had positive effect on their returns. Birachi *et al*. (2011) also found a positive relationship between improved beans varieties and quantity of beans produced and marketed by small holder farmers.

Cost of inputs was found significant ($p<0.05$) and negatively influenced the quantity of pineapple supplied to the market as hypothesized. The beta coefficient for the variable cost of inputs (β= -0.176, t= -4.135) indicates that on average, one unit increase in the cost of inputs results to 17.6% reduction in the quantity of pineapple supplied to the market, holding other variables constant. This result follows the economic theory indicating that with an increase in the price of inputs the quantity supplied decreases due to reduction in quantity of production (David, 2012) (p. 12-17).

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=0.103, t=2.695) suggests that on average, one unit increase in the price of pineapple in the market results in 10.3% increase in the quantity of pineapple market supply by the farmers, holding other variables constant. This result is supported by the finding of Birachi *et al.* (2011) that revealed a relationship between the price of the beans and quantity supplied. This result is also supported by the economic theory of supply which implies that producers produce more of the product with a very high price, thus increase the marketable surplus, while they produce less of the product with a very low price (David, 2012) (p. 12-17).

Finally, access to extension services was significant ($p<0.05$) and had a positive relationship with the quantity of pineapple supplied as expected. The beta coefficient for the farmers' access to extension services (β=0.101, t =2.448) reveals that on average, one unit increase in farmers' access to extension services results to 10.1% increase in pineapple quantity supply, holding other variables constant. This result relates to the findings of Nkonya *et al.* (1997) that farm households' adoption of new technology is influenced by the farmers' contact with extension agents. Siziba *et al.* (2011); Rehima and Dawit (2012) also found a positive significant relationship between the extension contact and quantity supplied of cereals and pepper respectively.

Conclusion

Based on literature, marketable supply of the commodities has been recognized as a significant factor to income generation of smallholder farmers, profit made by farmers, hence improves farmers' livelihoods and economic development in general. The purpose of this study was to determine the factors affecting pineapple market supply in Johor, Malaysia. In addition to this, factors affecting the quantity of pineapple marketable supply in the study area were determined. The result of factor analysis in this study showed that credit access, pineapple varieties, distance to the market, cost of inputs, price of pineapples and extension services were identified as factors affecting pineapple supply. The regression analysis result revealed that, farming experience, farm size, credit access, pineapple varieties, cost of inputs, price of pineapples and extension services had significant ($p<0.05$) relationships with the percentage quantity of pineapple supplied to the market.

It can be concluded that all the factors identified in this study are very important factors to be given adequate attention for Malaysia to improve and sustain her competitiveness in the pineapple world market and to improve farmers' livelihoods. Particularly,

the factors such as farm size, credit access, cost of inputs and extension services are very crucial as they have direct effect upon the quantity and quality of farm produce. In view of the results, it is therefore recommended that, there should be improvement in the attention given the pineapple industry by focusing on those factors preventing the industry from contributing actively like her counterparts in the global market. The extension services should be also enhanced to educate and motivate farmers towards the productive and profitable farming practices. Research and development which is the basis of agricultural productivity should be strengthened for the maximum development of the pineapple industry.

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