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Determinants of Pineapple Market Supply in Bureti Sub County, Kericho County, Kenya

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Abstract: **Supply of agricultural produce is directly influenced by production and productivity. Therefore factors that affect agricultural production also affect supply. This study analyses the determinants of pineapple market supply in Bureti Sub County, Kericho County, Kenya. Multi stage sampling was used to select 133 farmers for the study using structured interview schedules. This was supplemented by secondary data collected using content analysis from different published and unpublished sources. Econometric analysis using Ordinary Least Square (OLS) was used to analyse the collected data. Results of the findings revealed that area of land under pineapples and quantity of pineapple produced affected the quantities of pineapples supplied to the market significantly and positively at ($p < 0.01$) by a factor of ($r = 0.908$) and ($r = 0.667$) respectively. The other factors that affected quantities supplied to the market positively at ($p < 0.05$) were years in pineapple production ($r = 0.296$), education level ($r = 0.204$), total land holding ($r = 0.284$) and price at the nearest market($r = 0.305$). Production seasonality and distance to the nearest market affected quantities supplied to the market at ($p < 0.1$) by a factor of ($r = - 0.371$) and ($r = 0.448$) respectively. Based on the findings the study concludes that factors that affect market supply can either be positive or negative thus results into an increase or a reduction in the quantities supplied to the market. The study therefore recommends training of farmers on modern production techniques, input usage and marketing. It further recommends introduction of new high yielding pineapple varieties like MD2 and improvement of rural roads.**

Keywords: **Bureti, Kericho, market supply, pineapples.**

1. INTRODUCTION

Pineapple is the second most important tropical fruit in the world after banana. It contributes over 20% of the total world production of tropical fruits (UNCTAD, 2012). Pineapple is an important dessert fruit for millions of people across the world as source of vitamins, calcium, magnesium, potassium and iron. It is a delicious fruit with fine flavor and high health, and nutritive value (Hossain et al., 2015). Statista (2013) indicates that most of the pineapples harvested are consumed as fresh fruit in the countries of production. The main producers of pineapples worldwide are Brazil, Thailand, the Philippines, Costa Rica, China, India, Nigeria, Kenya, Mexico and Indonesia. Other producers include United States, Belgium, the Netherlands, Germany, Italy, Ecuador, Ivory Coast, Belgium, Malaysia, Australia and South Africa (UNCTAD, 2012; Ndungu, 2014). The most commonly grown pineapple varieties which command over 80% of the global pineapple trade include smooth cayenne, queen and MD2 (Ndungu, 2014).

In Kenya pineapple is produced by both small, medium and large scale producers. The large scale producers which accounts for 90% of the total production include Delmonte Company in Thika, Kakuzi Limited based in Muranga and Ndemo Farm based in Kilgoris. While small and medium scale producers which accounts for 10% of the total production takes place in Homabay, Migori, Kericho, Kisii, Kilifi, North of Malindi and Kiambu counties. Pineapple is produced for

both local and export markets as fresh and processed (sliced and frozen/vacuum packed rings/cubes, juices (HCDA and USAID, 2012).The main variety grown in Kenya is smooth cayenne which accounts for 80% of the total production (Koech et al., 2013). Pineapple production and marketing in Kenya is constrained by unavailability of quality planting material, insect pests' especially mealy bugs and nematodes, poor agronomic practices among smallholders, limited cottage industry to process pineapple into diverse range of products, lack of access to physical market, inappropriate pre-harvest and post-harvest handling and informally organized and hygienic fresh pineapple markets (HCDA, 2012).

In Bureti Sub County, pineapple production is one of the major source of income and livelihood after tea and dairy. In 2014, the total production was 98,000MT out of 1,960 hectares of pineapples with an estimated value of 1.24 Billion. The average production per acre was 50MT per hectare compared to a potential yield of 80MT. In theory, increased productivity per unit area would result into increased supply to the market. A report by Department of Agriculture, Bureti Sub County (2014), indicates that production and marketing of pineapples in Bureti Sub County is characterized by seasonality in production leading to fluctuation in prices, poor agronomic practices, poor post-harvest handling and under-developed pineapple cottage industry.

Supply of agricultural produce is known to strongly influence production. For instance perishable agricultural produce like pineapples may sometimes not be channelled to the market due to spoilage while non-perishable agricultural produce may be stored and released to the market at a much later date. The quantity supplied to the market informs the marketing costs, function and services offered to transfer the produce/product to the point of consumption (Adesiyan, 2012). The decision to supply the market is often taken once the produce is at hand and if made earlier several factors have to be taken into consideration. Such factors according to Shah (2013), include type of crop, size of farm, size of family, price of crop output, level of production, availability of inputs, credit access, availability of marketing facilities, distance to the market, transport facilities, production of other crops, nature of crop grown, storage and personal and family consumption.

Similarly, Abay (2010) found that the size of output, production experience, access to market and family size had affected market supply of food grain. Similarly in a market chain study of Teff and Wheat production in Woreda, Southern Ethiopia. Urgessa (2011) found that sex of the household head, quantity of produced, access to market information and access to extension services significantly and positively affected market supply. Besides, Kayitesi (2011) in a study of small scale pineapple production in Ngoma District of Rwanda, observed that inadequate planting materials, unhealthy (diseased) planting materials and poor farming practices, little access to credits, high transport costs and poor routes from the farms to the main highways and lack of adequate market information are constraints to small-scale pineapple production. Yimer (2014) further demonstrated that quantity of fruit produced, education level of the household Head, market information, distance to the market, and extension service significantly influenced the supply of fruits to the market. Sigei et al. (2014) conducted a study on the determinants of pineapple market participation while Koech et al. (2014) conducted a study on allocative efficiency of small scale pineapple production in Bureti Sub County. None of the past studies on pineapples in Bureti Sub County had focused on the household pineapple supply to the market. In order to improve pineapples supply to the market, improve the livelihood of pineapple household and improve market efficiency, factors that affect supply of pineapple to the market need to be identified, analysed and addressed. This study analysed the determinants of pineapple market supply in Bureti Sub County using ordinary least square regression model.

2. METHODOLOGY

Research Design:

Descriptive research design was used in this reseach with quantiattive and qualitative approaches in data collection and analysis. The design was preferred because it makes enough provision for protection against bias and maximizes reliability as stated in Onen and Oso (2005).

Study Area:

Bureti Sub-County is one of the 6 Sub-Counties in Kericho County South Rift of Kenya. The total land area is 321.1 km², of which 83% or 272 km² is arable. The Sub-County is administratively divided into 7 Wards which include Techoget, Kapakatet, Litein, Cheboin, Chemosot, Tebesonik and Kisiara (IEBC, 2013). The estimated population is 167,469 while the farm households are 33,530 (KNBS, 2009). The annual average rainfall range is 1500 - 1900mm and an altitude range of 1800-3000 meters above sea level while the temperature range is 16 – 20 ^{o}C. Pineapple is one of the major enterprises

after Tea and dairy. Its production is however concentrated in four wards out of the seven wards.

Target population:

The study targeted 5,149 pineapple farmers in 4 wards of Bureti Sub County where pineapple production is concentrated. The wards included Kisiara, Tebesonik, Chemosot, and Cheboin (Department of Agriculture report, Bureti Sub County, 2015)

Sampling design and procedure:

Multi stage sampling procedure was used in selecting specific pineapple producers for this study. First purposive sampling was used to select four wards in Bureti Sub County based on pineapple production concentration namely Kisiara, Chemosot, Cheboin and Tebesonik wards. Then proportionate sampling was applied to determine the sample size of pineapple producers for this study in each ward. Sample size formula by Kothari (2004) was used in this study to determine farmers sample size.

$$n = \frac{z^2 . p . q . N}{e^2 (N-1) + z^2 . q . p}$$

Where

n = Sample size

N = Population (5,149)

z = Level of significance (0.05)

e = Precision level (allowable error)

p = Proportion of population containing the major interest (0.15)

q = 1 – p (proportion in the target population)

Table 1. Sample size of pineapple farmers in Bureti, 2016

Wards	Pineapple farmers	Proportion	Sample size
Kisiara	2,650	0.50	66
Tebesonik	1,750	0.32	43
Chemosot	790	0.06	16
Cheboin	370	0.12	8
Total	**5,149**	**1.00**	**133**

Data collection instruments and procedure:

Structured pineapple producers interview schedule was used to collect primary data through face to face interviews while content analysis was used to collect secondary data from diferent published and unpublished sources including government institutions, journals, working papers and the Internet sources . A research permit was obtained from Kenya National Commision of Science and Technology(NACOSTI) before data collection.

Data Analysis and Presentation:

Primary data was collected from pineapple farmers through the use of structured interview schedules was collated, cleaned, and coded for electronic entry and analysis. The Statistical Package for Social Science (SPSS version 20) was used to process the data for analysis. Secondary data gathered using content analysis was also analyzed. The analyzed data was presented inform of tables. Econometric analysis was applied to analyze the determinant of household pineapple market supply. In particular, Linear Ordinary Least Square (OLS) regression model was used.

The model was specified as follows (Gujarati, 2004)

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$Y = \alpha i + ßiX_i + U_i$

Where

Y = Quantity Supplied (Explained/Dependent variable)

αi = Intercept

ßi = Coefficient of i^{th} explanatory variable

Xi = Vector of explanatory/Independent variables and i is 1, 2, 3 . . .n

Ui = disturbance or error term

Before performing regressions, all hypothesized explanatory variables were checked for the existence of the statistical multicollinearity problems. Variance Inflation Factor (VIF) for association among the continuous explanatory variables and Contingency Coefficients (CC) for dummy variables.

Variance Inflation Factor (VIF) defined as:

$$VIF = \frac{1}{1 - R_j^2}$$

Where R_j^2 is the multiple correlation coefficients between explanatory variables

As a rule of thumb, Gujarati (2004) states that if the *VIF* value of a variable exceeds 10, which will happen if R_j^2 (explained variation) exceeds 0.90, then, that variable is said to be highly collinear.

The formula for contingency coefficient (CC) is as follows:

$$CC = \sqrt{\frac{\chi^2}{n + \chi^2}}$$

The decision criterion with the contingency coefficient is that if the value of CC is greater than 0.75, the variables are said to be collinear (CC > 0.75).

Definition of Variable:

Dependent Variable: Quantity of pineapples supplied to the market was the dependent variable in the multiple linear regression model measured in kilograms**.**

Independent Variables: Thirteen variables (9 continuous and 4 dummy) were hypothesized and tested using OLS regression model (detailed description presented in Table 3.3).

Table 2. Summary of independent variables used in the OLS Model

Independent Variable	Definition	Type of variable	Hypothesized impact on variable
Age of Respondent	No. of years	Continuous	±
Education Level of Respondent	Illiterate ,read and write	Dummy	±
Family Size	Number	Continuous	±
Total Land holding	Acres	Continuous	+
Area of land under pineapples	Acres	Continuous	+
Years in pineapple production	No. of years	Continuous	+
Access extension services	1=Yes,2=No	Dummy	+
Production seasonality	1=Yes, 2=No	Dummy	±
Access to market information	1=Yes,2=No	Dummy	+
Distance to the nearest market	Kilometers	Continuous	-
Quantity of Pineapples produced	Kilograms	Continuous	+
Price at the nearest market	Kshs/Kg	Continuous	±
Farm Gate Price	Kshs/Kg	Continuous	±
Note: *OLS= Ordinary Least Squares or Linear Least Squares; ± (either positive or negative effect on dependent variable) ; - (negatively effect on dependent variable); + (positive effect on dependent variable)*			

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3. RESULTS AND DISCUSSIONS

3.1 Farmer Demographic characteristics:

Demographic characteristics have significant implications on how the household behaves in production and marketing.The interaction of these variables can influence negatively or positively, the level of output in the farms (Moshi, 2013). The demographic characteristics considered in this study included sex, age, education level, family size and years in pineapple production (Table 3). From the findings 67.7% of the respondents were male and 32.3% female. This could mean that men play a crucial role in ensuring pineapple supply to the market since they have a role in the allocation of land for the various enterprises. As regards age, most farmers were below 60 years of age, 25.5% were below 36 years indication that they were energetic and therefore able to produce. As stated by Williams et al. (2012) young farmers have greater ability to produce rationally, participate wisely on marketing and other economic related activities thereby ensuring increased supply to the market.

Likewise majority (52.6%) of pineapple farmers had been in pineapple production for between 5 and 10 years suggesting that they had vast experience in pineapple production and therefore were able to handle the challenges in pineapple production and marketing thus greater efficiency in production and higher productivity. Tadesse (2011) also found that households with better experience in avocado and mango farming produced more amounts of avocado and mango than the one with only less experience in Gomma Woreda, Ethiopia. In addition most (60.9%) pineapple farmers had family size of less than 6 persons. This could be an indication of low retention of pineapple for household consumption and therefore higher quantities of pineapples supplied to the market and vice versa. This is comparative to Adenuga et al. (2013) who argued that large household size were most likely consume a higher proportion of the vegetables before reaching the market reducing their marketable surplus as compared with families with smaller household size.

Majority (84.2%) of farmers had some basic education. It is therefore highly probable that they are able access to information on improved production practises and therefore able to make informed decision on technology adoption. According to Abraham (2013), education is believed to broaden farmers' intelligence and enables them to perform the farming activities intelligently, accurately and efficiently. As a matter of fact, better educated farmers tend to be more innovative and are therefore more likely to adopt the marketing systems.

Table 3. Demographic characteristics of pineapple farmers

Variables	Attributes	Frequency(N=133)	Percent
Sex	Male	90	67.7
	Female	43	32.3
Age of Respondent	< 36 years	34	25.6
	36 -60 years	70	52.6
	> 60 years	29	21.8
Education Level	No Formal Education	21	15.8
	Primary Level	60	45.1
	Secondary Level	39	29.3
	Tertiary Level	13	9.8
Family Size	< 6 Persons	81	60.9
	6 -10 persons	42	31.6
	> 10 persons	10	7.5
Farming Experience	< 5 years	23	17.3
	5-10 years	70	52.6
	> 10 years	40	30.1

3.2 Results of OLS regression model:

The relationship between the independent variables and the dependent variable was analysed using ordinary linear square regression model and the results result expressed as shown below.

$\mathbf{Y}= -2.322 + 0.204X_1 + 0.284X_2 + 0.908X_3 + 0.296X_4 + 0.448X_5 - 0.371X_6 + 0.305X_7 + 0.677X_8$

The model was then subjected to statistical test and results presented in Table 4. The result shows that the coefficient of determination(R) was 0.725 which means that the predictors (education level of respondent, total land holding, area of land under pineapples, years in pineapple production, production seasonality, distance to the nearest market, price at the nearest market and quantity of pineapples produced) of the model have a correlation of 72.5% with the dependent variable (quantity of pineapples supplied to the market). The coefficient of determination (R2) of 0.526 indicates that the model explains 52.6% of the variations in quantity of pineapple supplied to the market. This means that other factors not studied in this research contributes 47.4% of the variance in the dependent variable.

Table 4: model Summery –Goodness of fit

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.725[a]	.526	.460	.853

a. Predictors: (Constant), age of respondent, education level of respondent, family size, total land holding, area of land under pineapples, years in pineapple production, access to extension services, production seasonality, access to market information, distance to the nearest market, farm gate price, price at the nearest market, quantity of pineapples produced

b. Dependent Variable: Quantity of pineapples supplied to the market

Likewise, from the OLS regression results, out of the thirteen variables entered in the model, eight variable namely education level, years in pineapple production, total land holding, area of land under pineapples, quantity of pineapples produced, seasonality in production, distance to the nearest market and price at the nearest market were found to significantly affect the quantities of pineapples supplied to the market at $p < 0.1$, $p < 0.05$ and $p < 0.01$ (Table 5).

Table 5. OLS estimates of factors affecting pineapple market supply

Variables	Coefficients	Std. Error	t	P –value
(Constant)	-2.322**	1.113	-2.085	0.039
Age of Respondent	-0.052	0.095	-0.550	0.583
Education Level of Respondent	0.204**	0.096	2.120	0.036
Family Size	0.058	0.141	0.406	0.685
Total Land holding	0.284**	0.134	2.109	0.037
Area of land under pineapples	0.908***	0.187	4.860	0.000
Years in pineapple production	0.296**	0.125	2.361	0.020
Access extension services	0.210	0.184	1.137	0.258
Production seasonality	0.448*	0.269	1.662	0.099
Access to market information	0.188	0.172	1.090	0.278
Distance to the nearest market	-0.371**	0.157	-2.368	0.020
Farm Gate Price	-0.079	0.196	-0.402	0.688
Price at the nearest market	0.305*	0.181	1.682	0.095
Quantity of Pineapples produced	0.677***	0.103	6.586	0.000
R^2 = 0.526 , Adjusted R^2 =0.460, Number of observations , N=133 , *, **, *** *indicates significance at p < 0.1, p < 0.05 and p < 0.01 respectively.*; R^2 = 0.526 *means that the model explains 52.6% variations; OLS is Ordinary Least Squares or Linear Least Squares model*				

Area of land under pineapples: The variable had a significant and positive at influence on the quantity of pineapple supplied to the market at (p< 0.01).The coefficient of the variable was 0.908 indicating that a unit increase in the area land under pineapple would lead to an increase in the quantity of pineapple supplied to the market by factors of 0.908. This is similar to the finding by Abraham (2013) in a value chain analysis study of vegetables in Ethiopia, who found that the area of land under vegetables had a positive and significant influence on the quantity supplied to the market

Quantity of pineapples produced: This variable affected the quantity of pineapple supplied to the market significantly and positively at (p< 0.01). The coefficient was 0.677 implying that a unit increase in the quantity of pineapples produced would lead to increases in the quantity of pineapple supplied to the market by a factor of 0.677. In other words as the quantity of pineapples produced increases, the quantity supplied to the market also increases. This comparative to findings by Tesfaw (2014) that the amount of pepper produced significantly and positively affected the quantity of pepper sold by a factor of 0.907 at (p< 0.01).

Education level: The variable had a positive coefficient of 0.204, this meant that as in education level increases, the quantity of pineapple supplied to the market also increases by factors of 0.204 at ($p< 0.01$). Zechaias et al. (2012) in a study of market chains of forest coffee in South West of Ethiopia, found that education improves the ability of the farmers to acquire new idea in relation to market information and production techniques, which in turn enhanced productivity and thereby increased marketable supply. In another study tomatoes in Kwara State of Nigeria, Adenuga et al. (2013) found that education had a positive and significant influence on the production, productivity and quantities of tomato supplied to the market.

Total land holding: The total land holding had a positive relationship with the quantity of pineapple supplied to the market. Results show thata unit increase in total land holding would lead to an increase in the quantity of pineapple supplied to the market by factors of 0.284 at ($p < 0.05$. This could have been because if a farmer owns more land, the probability of allocating land for pineapple crop would increase. Producers with large area of land under pineapple can produce more than a producers who own less area and thus to supply more to the market. The finding is not different to Gebre (2015) who found that total land owned has a significant and positive effect to the amount of potatoes supplied to the market.

Years in pineapple production: As Teddese (2011), households with better experience in production of a specific commodity produces more that commodity compared to households without experience. This variable had a positive effect on the quantity of pineapples supplied to the market with a coefficient of 0.296at ($p < 0.05$). The findings points to the fact that, a unit increase in the years in pineapple production by the famer would lead to an increase in the quantity of pineapple supplied to the market because of the experience gained as a result of continued production. This is because experience increases production efficiency hence productivity and therefore quantity supplied to the market. This is confirmed by Adenuga et al. (2013) in a previous study of the economics and technical efficiency of dry season tomatoes in Kwara State of Nigeria, that most farmers were experienced in their enterprises because of the many years in production and were therefore ale to produce and supply more tomatoes to the market.

Production seasonality: Seasonality is a major factor in agricultural production as Welch et al. (2015) states that seasonality is a phenomenon that causes crops prices to behave in a relatively predictable manner year in year round and is related to calendar such as months and was usually based on changes of demand and supply and of the harvest highs and lows. The change in change in seasonality was found to either increase or reduce the quantity of pineapple supplied to the market by a factor of 0.448 at ($p < 0.1$).At the peak seasons in resulted into increased supply to the market while in the lean seasons it resulted into reduced supply of pineapples to the market.

Nearest market price: This variable positively affected the quantity of pineapples supplied to the market at ($p < 0.1$). The coefficient was 0.305 indicating that a unit increase in the nearest market price would lead to an increase in the quantity of pineapple supplied to the market by a factor of 0.305. This could be because prices stimulate production, and thus market supply. The finding is similar to Tadesse (2011) who found a positive relationship between the price of avocado and the quantity of avocado supplied to market in Goma Woreda, Ethiopia.

Distance to the nearest: As hypothesized, the variable had a negative effect on the quantity of pineapples supplied to the market. A unit increase in the distance to the nearest market lead to a decrease in the quantity of pineapples supplied to the market by a factor of 0.371 at ($p <0.05$). This is because if farmers are nearer to the market they are likely to supply their produce to the market because of the reduced transportation cost and vice versa. The finding is comparable to previous finding by Mohammed (2012) that market distance affected quantities of coffee supplied to the market negatively. On the contrary, Sebatta et al. (2014) found that distance to the nearest town had a positive and significant effect on potato farmers' decision to participate in the market in Uganda.

4. CONCLUSION AND RECOMMENDATIONS

Based on the findings on farmers, this study concluded that demographic variables was significant to the pineapple production quantities and the ultimate supply to the market given the fact that the interaction of demographic variable can positively or negatively affect the levels of output in the farm and hence supply to the market. Similarly based on the ordinary least square (OLS) regression results which revealed that area of land under pineapples ($r = 0.908$, $p < 0.01$), quantity of pineapple produced ($r = 0.667$, $p < 0.01$), years in pineapple production($r = 0.296$, $p < 0.05$), education level(r

= 0.204, p < 0.05), total land holding(r = 0.284, p < 0.05), price at the nearest market (r = 0.305, p < 0.05), production seasonality(r = 0.448, p < 0.1) and distance to the nearest market (r = - 0.371, p < 0.05) significantly affected the quantities of pineapples supplied to the market. This study colcludes that factors that affect the quantities of pineapples supplied to the market can either be positive and result into increase in quantities supplied to the market or negative and result in a reduction in the quantities supplied to the market

The study recommends training of farmers on modern production techniques like flower induction and proper use of imputs. This would ensure increased production and productivity and minimize the quantity reduction due to seasonality thereby increasing quantities of pineapples supplied to the market and stabilising prices. Farmers can also be trained on pineapple marketing so as to enhance there skills in harvesting, transportation, storage and packaging. This would ensure better quality pineapple fruits supplied to the market and high returns to the farmer. The study also recommends introduction of new high yielding pineapple varieties like MD2 in the area to enhance productivity per unit area of land thus increased supply of pineapples to the market. The study further recommends improvement of rural access roads to enhance accessibility to the nearest markets

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