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Supply Chain Analysis of Avocado and Mango Fruits in Gedeo Zone

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Abstract
Agriculture plays a great role in reducing the cost of living in urban areas by supplying surplus products from the rural areas to the urban areas and also it reduces the cost of living in the urban areas as a result of abundant supply of food. This reduces the upward pressure on wages, which implies a reduction in the cost of production. The country is endowed with diverse natural resources and had a capacity to grow different fruit types. But the farmers are not getting enough benefit from the resources. This study was carried out to determine the supply chain of mango and fruits. From the Gedeo zone two woredas were selected purposively and two kebeles from each worerdas were selected based on the presence of fruit production. Data was collected from 114 mango and banana producing households, 13 local collectors and 17 retailers through structured interview, focus group discussion, key informant interviews, market assessment as well as field observation. Multiple linear regression model was used to analyze factors that affects mango and avocado fruits supply of the producers in the area. Producers, rural collectors, retailers, and consumers were identified as the actors who were participating in mango and avocado fruit supply. Four variables were identified as the significant variables which affects the supply of both mango and avocado fruits. These variables were the price, quantity produced, access to market information and distance from the market. Distance from the market was significantly and negatively related with the supply of both fruits where as the remaining three variables where found to be significantly and positively related with the supply of mango and avocado fruits. Four supply channels were identified as the important channels in the mango and avocado fruit supply chain. Producer-retailer-consumer channel was identified as the first important supply channel in which the greater proportion of fruits were transacted in the area. While the producer-local collector-consumer channel was identified as the least supply channel in terms of volumes of each fruits transacted. Since the quantity produced of each fruits is positively and negatively related with the supply of each fruits in the area, the governmental as well as nongovernmental organizations should supply the improved varieties for each type of fruits for the farmers and give training for the farmers on how to increase the production and also productivity for each type of fruits. In addition to this the infrastructural problems should be taken in to consideration so as the farmers can supply their fruits to the market easily and get better price for their products.
Keywords: Supply Chain Analysis, Structure, Conduct and Performance

1. INTRODUCTION

1.1. Background

Most of the rural people`s life of Ethiopia are largely dependent on agriculture. Agriculture is known to supply the country with food grains, cash crops, milk and dairy products, and meat products among other things. Besides, a productive agricultural sector provides relatively abundant food and raw materials to the increasing industry–based urban population. Agriculture plays a great role in reducing the cost of living in urban areas by supplying surplus products from the rural areas to the urban areas. It reduces the cost of living in the urban areas as a result of abundant supply of food. This reduces the upward pressure on wages, which implies a reduction in the cost of production. This reduction in the cost of production makes industrial profit higher. Increasing the supply of cheap raw material for industrial sector reduces the cost of raw materials.

Ethiopia is implementing some important strategies to achieve food security which includes diversification of crops, increasing the availability of food production, and encouraging the production of early maturing and high yielding crops in different agro-ecologies of the country (CSA, 2009). Food security is one of the most important problems for the rural population of Ethiopia, whose life is almost entirely dependent on agricultural products.

A variety of fruit crops has been growing in different agro ecological Zones by small farmers, for subsistence and income generation. About 61,972.60 hectares of land is under fruit crops in Ethiopia. Bananas take the largest proportion of the total production followed by avocado and mango fruits. From the total hectare of the land which is covered by all fruit types 58.11% of the fruit crop area is covered by banana fruits followed by avocados and mangoes that contributed 14.42% and 14.21% of the area respectively. From this total hectare of land more than 4,793,360.64 quintals of fruits was produced in the country. Bananas, Mangoes, Papayas, Oranges and Avocados took up 63.11%, 14.55%, 8.07%, 7.46% and 5.35% of the fruit production, respectively (CSA, 2012).

1.2. Statement of the Problem

There are different types of fruits which are producing in Gedeo zone and the zone is endowed with diverse natural resources and has the capacity to produce different fruits types. The production of these fruits in the zone is for marketing purpose as well as for home consumption. Peoples in the zone are producing different types of fruits but they are not getting better price for their fruits and also not getting enough benefit from the resources (GZADD, 2014). This shows that there are certain factors that hinder the producers not to get better price and also better profit for their resources. Therefore, the focus of this study is to identify those factors that discourages the farmers not get enough benefit for their resources and also to identify the actors and their functions in Avocado and Mango supply chain, by analyzing the supply channels mainly for Avocado and Mango fruits in the zone.

1.3. Objectives

1.3.1. General Objective

Analyzing the supply chain for avocado and mango fruits and to examine the factors that affect the supply of fruits in Gedeo Zone

1.3.2. Specific Objectives

The specific objectives were

- To identify different actors who are participating in the supply of avocado and mango fruits.
- To analyze the supply channels for avocado and mango fruits
- To investigate the factors that affects the supply of avocado and mango fruits

1.4. Research Questions

The following questions were addressed in this research:

- Who are the actors which are participating in the supply of avocado and mango fruits?
- What are the supply channels for each type of fruits?
- What are the factors that affect the supply of avocado and mango fruits?

2. RESEARCH METHODOLOGY

Description of the study area

The Gedeo live between 5 and 7 degrees North latitude and 38 and 40 degrees East longitude in the escarpments of the South eastern Ethiopian highlands overlooking the Rift Valley, in the narrow strip of land running from North (Sidama zone) to South (Oromiya region). In altitude the area ranges from 1200 m a.s.l in the vicinity of Lake Abaya to 2993m a.s.l at *Haro Wolabu* Pond, Bule woreda (Ethiopian Mapping Authority, 1988).

Geographically, the Gedeo Zone lies in the inter-tropical convergence zone (Lundgren, 1971). As a result, the Gedeo highlands benefit from both equatorials and the monsoons, the two most important trade winds in the region. Thus, the climate of Gedeo Zone is characterized as warm humid temperate. Mean annual temperature ranges between 17 º C and 22.4º C and mean annual rainfall between 1200 and 1800 mm. The Gedeo Zone is thus endowed with two rainy seasons, from March to May and from July to December, with interruptions of 3 to 4 dry months. However, the truly dry months are only January and February; others count with intermittent rain showers. The climate is suitable for abundant forest cover (Ethiopian Mapping Authority, 1988).

Sources of Data

In order to address the objective of the study both primary and secondary sources of data were employed. Primary data was collected through a structured questionnaire, focused group discussions, key informant interviews, field observation and market assessment. It was collected using two types of interview schedule (one for farmers and the other for traders). The primary data which was collected from fruit producing farmers include factors affecting the supply of avocado and mango fruits, socioeconomic characteristics of the households, price setting strategies and terms of payment. The interview schedule for traders include, types of traders (retailers, local collectors, wholesalers etc.), buying and selling strategies, experience of traders on fruit trading, access to market information and socioeconomic characteristics of the traders. Secondary data was collected from different sources, such as: government institutions, the Zone`s Agricultural Development Department, bulletins and websites.

Method of Sampling and Sample Size

A three-stage sampling technique was used to draw sample fruit producer farmers. First, from Gedeo Zone two woredas were selected purposively. During the selection, the woreda`s potential for fruit production was taken in to consideration. In the second stage, two kebele`s were selected from each woreda`s purposively due to more production of fruits in the area. In the third stage, using the population list of fruit producer farmers from sampled kebele`s, the intended sample size was determined proportionally to population size of fruit producer farmers using random sampling method. Accordingly, in this study sample size selection was based on the rule of thumb $N \geq 50+8m$, where, N, is sample size and `m` is the number of explanatory variables (Xi) where i=1, 2…8. Based

on this rule the researcher will take a total sample of 114 respondents from the Gedeo Zone.

Method of Data Analysis

In this study two types of data analysis methods were used. These include descriptive and econometric analyses.

Descriptive statistics

Descriptive statistics like mean, min, max, standard deviation, percentages and frequencies were used to examine and understand the socioeconomic characteristics of sampled respondents and structure, conduct and performance of fruit market. The data collected was analyzed using Statistical Package for Social Science (SPSS) version 20 and Excel 2007 after editing, coding and arranging the raw data collected from survey.

Market structure, conduct and performance analysis (S-C-P)

a. Market Structure

Market structure is analyzed based on the degree of market transparency (market information) and the degree of market concentration.

Market transparency: It refers to the reliability and timeliness of market information that the traders have for their marketing decision. The existence of a large number of buyers and sellers does not guarantee competition and efficiency of the market unless the traders and producers have a proper knowledge of the functioning of the market. In a transparent market, participants have adequate information about their competitors regarding their source of supply and buying prices for better decisions.

***Market concentration*:** Concentration ratio is expressed in terms of CRx which stands for the percentage of the market sector controlled by the biggest X firms. Four firms (CR_4) concentration ration is the most typical concentration ratio for judging the market structure.

The concentration ratio is given as:

$C=\sum_{i=1}^{r} Si$ i=1, 2, 3, 4……r

Where, C= concentration ratio

Si= the percentage market share of the i^{th} firm

r= the number of relatively larger firms for which the ratio is going to be calculated

b. Market conduct

It is a systematic way to detect indication of unfair price setting practices and the conditions under which practices are likely to prevail. Conduct is pattern of behaviour which enterprises follow in adopting or adjusting to the market in which they sell or buy, in other words the strategies of the actors operating in the market.

c. Market performance

Market performance is analyzed using the marketing margin. Marketing margin is the difference between the value of a product or a group of products at one stage in the marketing process and the value of an equivalent product or a group of products at another stage. The term market margin is most commonly used to refer to the difference between producer prices of an equivalent quantity and quality of a commodity. However, it may also describe price differences between other points in the marketing chain; for example, between producer and wholesale, or wholesale and retail, prices. Marketing margin is calculated taking the difference between producers and retail prices. The total marketing margin is the difference between what the consumer pays and what the producer/farmer receives for his product. In other words, it is the difference between retail price and farm price. The producers' share is the commonly employed ratio calculated mathematically as, the ratio of producers' price to consumers' price (retail).

Mathematically, producers' share can be expressed as:

$$PS=P_X/P_r$$

Where: PS = Producers' share

Px= Producers' price

P_r = Retail price

Total gross marketing margin (TGMM) is the final price of the produce paid by the end consumer minus farmers' price divided by consumers' price and expressed as a percentage. The TGMM is useful to calculate 'producer's gross margin' (GMMp) which is the portion of the price paid by the consumer that goes to the producer.

The total marketing margin is given by the formula shown below

$TGMM = \text{Retailer price} - \text{Farmer price})/(\text{Retailer Price})*100$

$GMM_{a=} \text{Assembler price} - \text{Farmer price})/(\text{Retailer Price})*100$

$GMMr= (\text{Retailer Price} - \text{Assembler Price})/(\text{Retailer Price})* 100$

GMMp= 100%-TGMM

Where: TGMM is the total gross marketing margin

GMMp is the producer participation margin

GMMr is the percentage of the total gross marketing margin received by the retailer

GMMa is the percentage of the total gross marketing margin received by the retailer

Econometric analysis

For the econometric analysis multiple linear regression model was used to determine the factors that affect the supply of mango and avocado fruits since there are more than one independent variables. Since the dependent variable, the supply of fruit is a continuous variable, OLS model was used and the OLS regression is specified as:

$$Y_i = \alpha_i + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots\ldots + \beta_i X_i + U_i$$

Where: Y_i = quantity of avocado supplied to market

α_i = Intercept

β_i=Coefficient of the i^{th} explanatory/independent variable

X_i = Vector of explanatory variables

U_i = disturbance term

Hence, the equation for the quantity of avocado supplied is:

Quantity of Avocado Supplied = $\alpha_i + \beta_1$Sex + β_2 Edu + β_3Distance + β_4Quantity produced + β_5Price +β_6Extension + β_7Market Information + β_8 credit + U_i

Multiple Regression Model: - The purpose of using a multiple linear regression model when there are two or more independent variables, as in the present study, is to estimate how the included variables are related. The estimated coefficients indicate the effect of a change in the independent variables on the dependent variable. Multiple Linear Regression (MLR) analysis in this study was used to identify factors affecting the supply of fruits in the study area.

Test for Multicollinearity: It is important to check multicollinearity problem for continuous and dummy variables before running the model. Multicollinearity is a high degree of correlation among several independent variables. It commonly occurs when a large number of independent variables are incorporated in a regression model that may measure the same phenomena (Jeeshim and KUCC, 2002). More specifically, Multicollinearity refers to a situation where it becomes difficult to disentangle the separate effects of independent variables on the dependent variable because of strong relationships among them (Maddalla, 1992).

There are two measures that are often suggested to test the existence of multicollinearity. These are Variance Inflation Factor (VIF) for association among the continuous explanatory variables and Contingency Coefficient (CC) for dummy variables. Variance Inflation Factor (VIF) is used to test the existence of multicollinearity for association among the continuous variables. As R_j^2 increase towards unity, that is, as the collinearity of X_j with the other regressors increase, VIF increases. As a rule of thumb, if the VIF greater than 10, which will happen if Rj^2 is greater than 0.90, that variable is said to be highly collinear. Multicollinearity of continuous variables can also be checked using Tolerance. Tolerance is one if X_j is not correlated with the other explanatory variable, where as it is zero if it is perfectly correlated with other explanatory variables (Gujarati, 2003).

$$VIF(X) = (1 - R_j^2)^{-1}$$

$$TOL = \frac{1}{VIF}$$

Where, R_j^2 refers to coefficient of determination between explanatory variables

VIF refers to variance inflation factor

TOL refers to tolerance

Contingency coefficient is used to check multicollinearity or association between discrete variables. It measures the relation between the row and column variables of a cross tabulation. The value ranges between 0 and 1, with 0 indicating no association between the variables and value close to 1 indicating a high degree of association between the variables.

Test for heteroscedasticity: One of the assumptions of the classical linear regression analysis is that for given X's, the variance of ε_i (error term) is constant or homoscedasticity among the explanatory variables. That means, the variance of the unobservable error term, conditional on the ''X's,'' is constant, i.e. $Var(\varepsilon/x) = \delta^{2}$. The Violation of homoscedasticity assumption is known as heteroscedasticity. It is important to check heteroscedasticity problem before presenting, interpreting and discussion of the result of regression. In this study Breusch-Pagan Test approach will be used.

Heteroscedasticity is tested using Breusch-Pagan test based on the following procedure.

1. The original equation was estimated by using OLS method and the least square residuals were obtained .i.e. $y = \beta 0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \text{------} \beta_{11} X_{11} + \varepsilon_i$,
2. Then the least square residuals were regressed on all the independent variables. i.e.

   $\varepsilon^2 = \delta 0 + \delta_1 X_1 + \ldots \delta_{11} X_{11} + u$ where, δi=parameters

   $\hat{e}^2$ is independent variable
3. The R-square of this regression was obtained.

➢ The null of no heteroscedasticity is then:

$H_0 = \delta_1 = \delta_2 = \delta_k$
$H_1 : = \delta_{1\#}\ \delta_{2\#}\ \delta_k$

$$F = \frac{R2\tilde{\varepsilon}2/K}{(1-R2\tilde{\varepsilon}2)/(n-k-1)}$$

If F-calculated is less than F-tabulated, the null hypothesis is accepted which says there is homoscedasticity in the model.

3. Results and Discussion

Market Structure

Actors and their functions in fruit markets

Producers: These are smallholder farmers who produce different types of fruits and supply to different agents.
Local collectors: They collect fruit from producers or farmers and in turn sell it to retailers and consumers.
Retailers: They buy fruits either directly from producers or local collectors and deliver to consumers.
Consumers: These are the last actors in the fruit supply chain. They are individuals or households who buy various fruits from fruit producers, local collectors and retailers for their own consumption only.
Processors: Avocado and mango processing in the study area is apparently limited to juice making where cafes, restaurants and juice houses takes the leads in cuisine preparation.

Supply channels

i. Mango supply channel

For mango fruits eight supply channels were identified in the zone. These channels were producer–consumer channel, producer-retailer-consumer channel, producer-retailer-processor-consumer channel, producer-local-collector-consumer channel, producer-local collector-retailer-consumer channel, producer-local collector-processor-consumer channel, producer-local collector-retailer-processor-consumer channel and producer-processor-consumer channel. Among the channels producer-retailer-consumer market channel shared the largest volume which is 42% of the total volume of mango fruits supplied to the market while producer-processor-consumer channels take the least share of the total supply of mango fruits to the market which was about a total of 11% of supply of mango fruits to the market.

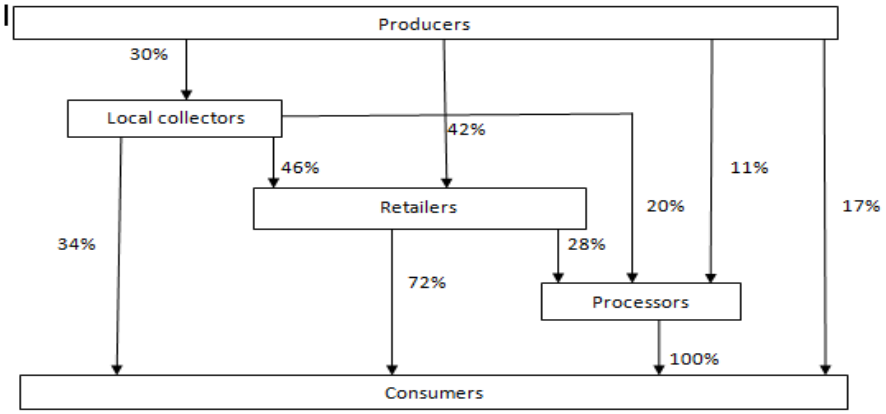

Figure 1 *Supply channel of mango*

ii. Avocado supply channel

Eight supply channels were identified for avocado fruit which was supplied to the market. Among the eight supply channels, producer-retailer-consumer supply channel shared the largest volume avocado fruits supplied to the market which was about a total percentage of 39% of avocado fruits transacted while the least share was undertaken by producer-processor-consumer channel which shared 14% of the total volume of avocado fruits transacted.

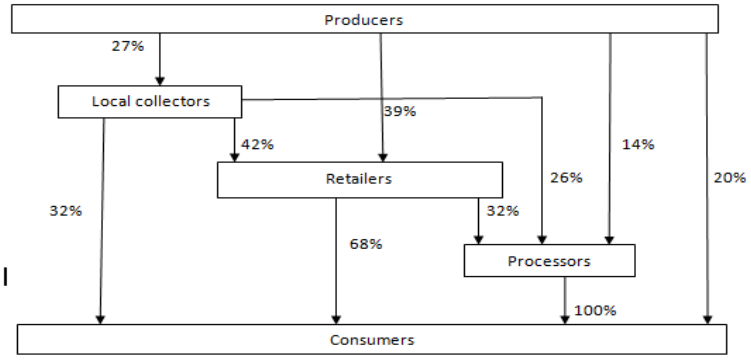

Figure 2. *Supply channel of avocado*

Degree of market concentration

Concentration ratio is expressed in terms of CRx which stands for the percentage of the market sector controlled by the biggest X firms. Four firms (CR_4) concentration ratio is the most typical concentration ratio for judging the market structure. A CR_4 of over 50% is generally considered a tight oligopoly; CR_4 between 25% and 50% is generally considered a lose oligopoly, and a CR_4 of fewer than 25% is competitive.

i. Concentration ratio for avocado

Concentration ratio for avocado market was calculated by taking the annually purchased volume of avocado by market participants in quintal. The degree of market concentration was measured using the common measures of market concentration that is Concentration Ratio (CR_4).

Number of traders (A)	**Cumulative frequency of traders (B)**	**% of traders ($C=\frac{A}{20}$)**	**Cumulative % of traders (D)**	**Quantity purchased in kg (E)**	**Total quantity purchased in kg F=A*E**	**% share of purchase ($Si=\frac{F}{62000}$)**	**% cumulative purchase ($C=\sum_{i=1}^{r} Si$)**
2	2	6.66	6.66	3950	7900	12.74	12.74
2	4	6.66	13.33	3750	7500	12.09	24.83
1	5	3.33	16.66	3500	3500	5.65	30.48
1	6	3.33	20.00	3300	3300	5.32	35.8
9	15	30	50.00	2500	22500	36.29	72.09
1	16	3.33	53.33	2450	2450	3.95	76.04
3	19	10	63.33	2100	6300	10.16	86.2
2	21	6.66	70.00	2050	4100	6.61	92.81
1	22	3.33	73.33	2000	2000	3.23	96.05
8	30	26.67	100	306.25	2450	3.95	100
		100			8195	100	

Source: own computation (2015)

The result in table 1 shows that the concentration ratio for avocado is 24.83%. This indicates that avocado fruit markets in the districts were characterized by having a greater number of buyers and suppliers. Following the market structure criteria suggested by Kohls and Uhl (2002) the nature of avocado market in the area has a competitive nature because its concentration ratio for the biggest four firms (CR_4) was 24.83%. The result does not coincide by Assefa (2009) who found out that the oligopolistic nature of the market due to limited number of traders. But the study was concise with the study which was undertaken by Nega, *et al.,* (2014) who found that the competitive nature mango market in Tembaro Woreda.

ii. Concentration ratio for mango

The result in table 2 shows that the market concentration for mango is 23.05%. This indicates that avocado markets in the districts were characterized by the prevalence of large number of buyers and sellers. Therefore, following the market structure criteria suggested by Kohls and Uhl (2002) mango market showed competitive nature with CR_4 of 23.05%.

Table 2 Concentration ratio of mango market in Gedeo zone

Number of traders (A)	Cumulative frequency of traders (B)	% of traders (C=$\frac{A}{20}$)	Cumulative % of Traders (D)	Quantity purchased in qt (E)	Total quantity purchased in qt F=A*E	% share of purchase (Si=$\frac{F}{41000}$)	% cumulative purchase (C=$\sum_{i=1}^{r} Si$)
1	1	3.33	3.33	2500	2500	6.10	6.10
2	3	6.67	10	2350	4700	11.46	17.56
1	4	3.33	13.33	2250	2250	5.49	23.05
7	11	23.33	36.66	1450	10150	24.76	47.81
9	20	30	66.66	1250	11250	27.44	75.25
6	26	20	86.66	1200	7200	17.56	92.81
1	27	3.33	90	1150	1150	2.80	95.61
3	30	10	100	600	1800	4.39	100
		100			41000		

Source: own computation (2015)

Market conduct

***a.* Conduct of producers and traders**

Price setting and Terms of payment

In the study area more than 95% the price of the fruits was set by market demand and supply. This means that buyers and sellers negotiate in the process and finally agree to exchange the products with the agreed up on price. The selling strategy of the respondent farmers is open to any buyer. This is in line with Ayelech (2011) and Nega *et al*., (2014) who stated that the greater proportion of price for avocado and mango was set by demand and supply interaction and the selling strategy of the respondent farmers was open to any buyer. Regarding the terms of payments almost all producers of the fruits practiced cash in hand system and they take the price of the products as soon as they sold the fruits to traders. This is in line with the findings of Adugna (2009) who explained that large proportion of the fruit producers practiced cash in hand system and take the price as soon as they sell the fruits.

Market performance

i. Market performance of Avocado

The farmer's share of the total consumer price was 100% in channel I, 80 %, 44.4% and 85.7%, 80.8%, 45.7%, 44.8%,50%in channel II, III and IV, V, VI,VII and VIII respectively. This implies that 20% of the total consumer price in channel II, 55.6% of the total consumer price in channel III, 14.3% of the total consumer price in channel IV, 19.2% of the total consumer price in channel V, 54.3% of the total consumer price in channel VI, 55.2% of the total consumer price in channel VII and 50% of the total consumer price in channel VIII results from marketing activities by traders. Without considering channel I (producers sell directly to consumer) the total gross marketing margin (TGMM) is the highest in channel III which is about 55.6% and lowest in channel IV which is about 14.3 %. Producer's share (GMMp) is highest (85.7%) from the total consumers' price in channel IV and lowest in channel III (44.4%).

Table 3: Market performance of Avocado in terms of marketing margin with respect to the share of actors in each channel

Actors	Price in birr	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Producer	Selling price	250	200	200	210	210	215	215	230
	Farmers share%	100	80	44.4	85.7	80.8	45.7	44.8	50
	TGMM%		20	55.6	14.3	19.2	54.3	55.2	50
Local collector	Selling price				245	235	260	250	
	Margin				35	25	45	35	
	Marketing margin%				100	10.6	17.3	13.5	
TCMM%					100				
Retailer	Selling price		250	250		260		280	
	Margin		50	50		25		30	
	Marketing margin%		20	44.4		9.6		10.7	
TCMM%			100						
Processor	Selling price			450			470	480	460
	Margin			200			210	200	
	Marketing margin%			100			44.6	41.7	
TCMM%									100
Final consumer price		250	250	450	245		470	480	
TCMM			50	250	35	50	255	265	230

Source, Survey result (2015)

ii. Market performance of mango

The farmer's share of the total consumer price was 100% in channel I, 86.8%, 48.3% and 90.4%, 85.5%, 51.1%,

48.9% and 49% in channel II, III and IV, V, VI,VII and VIII respectively. This implies that 13.2% of the total consumer price in channel II, 51.7% of the total consumer price in channel III, 9.6% of the total consumer price in channel IV, 14.5% of the total consumer price in channel V, 48.9% of the total consumer price in channel VI, 51.1% of the total consumer price in channel VII and 51% of the total consumer price in channel VIII results from marketing activities by traders. Without considering channel I (producers sell directly to consumer) the total gross marketing margin (TGMM) is the highest in channel III which is about 51.7% and lowest in channel IV which is about 9.6 %. Producer's share (GMMp) is highest (90.4%) from the total consumers' price in channel IV and lowest in channel III (48.3%). Retailers have got relatively higher marketing margin which is 9.6% whereas local collectors have got lower marketing margin which is 5.8%.

Table 4: Market performance of Mango in terms of marketing margin with respect to the share of actors in each channel

Actors	Price in birr	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Producer	Selling price	235	220	215	235	235	225	220	230
	Farmers share%	100	86.8	48.3	90.4	85.5	51.1	48.9	49
	TGMM%		13.2	51.7	9.6	14.5	48.9	51.1	51
Local collector	Selling price				260	250	260	260	
	Margin				25	15	35	40	
	Marketing margin%				9.6	6	13.5	15.4	
TCMM%									
Retailer	Selling price		255	245		275		270	
	Margin		35	30		25		50	
	Marketing margin%		20	12.2		9		18.5	
TCMM%									
Processor	Selling price			445			440	450	470
	Margin			200			180	200	
	Marketing margin%			100			40.9	43.5	
TCMM%									100
Final consumer price		235	265	445	260	275	440	450	
TCMM				230	25	40	215	230	240

Source, Survey result (2015)

Determinants of the Supply of Mango Fruit

The econometric result in table 3 shows among the eleven hypothesized determinants of market supply of mango five variables were found significant. These were quantity of mango produced, price of mango, access to market information, access to extension service and distance from the market. The coefficient of multiple determinations (R^2) was estimated 0.876 and adjusted R^2 value was 0.846. This means that 87.6% of the variation in the dependent variable is explained by the explanatory variables included in the model. Furthermore, the adjusted R^2 of 84.6% which is significant has further consolidated the goodness of the model, hence, its econometrics significance and reliability.

Table 3. *Determinants of quantity of mango supplied to the market.*

Variables	Coefficients	Std. Err.	T	P-value
Constant)	0.004	0.097	0.038	0.970
Distance from the market	-0.122**	0.199	2.620	0.011
Access to extension service	0.002	0.027	0.091	0.928
Quantity produced in quintal	0.232***	0.024	30.825	000
Education level of hh	0.033	0.186	.178	0.895
Access to market information	0.054**	0.042	2.26	0.026
Price of mango	0.0550**	0.225	2.444	0.016
Sex of hh	0.011	0.078	0.134	0.893
Access to credit service	0.012	0.028	0.445	0.658
R^2 0.834				
Adjusted R^2 0.812				

**, ***indicates significance at 10%, 5% and 1% respectively.

From the eight variables which were expected to affect the supply of mango fruit to the market, four were found to be significantly related with the supply of mango fruit to the market. These variables are distance from the market, quantity of mango fruit produced in quintal, access to market information and the price of mango fruit.

Distance from the market is negatively and significantly related with the supply of mango fruit to the market at the significant level of 5%. The coefficient in the multiple linear regressions indicates that as the distance from the market place increases by one kilometer, then the quantity supplied to the market decreases by 0.122 quintal *ceteris paribus*. This finding is related with the findings Bosena (2008) and Nega *et al.,* (2014*)* for whom

the quantity of fruits supplied to the market deceases as there is an increase in the distance from the market place.

As the result in table 3 indicates that the quantity of mango fruit produced positively and significantly related with supply of mango fruit to the market at the significant level of 1%. The coefficient indicates that as the quantity of mango fruit produced increases, every things remains constant, the supply of mango fruit to the market increases by 0.232 quintal. The result coincides with Wolday (1994) and Rehima (2007) who identified an increase in quantity of agricultural products increase the supply of products.

The third variable which was significantly related with the supply of mango to the market is the price of mango fruit. As the price for mango fruit to the market increases and every things remains constant, then the supply of mango fruit to the market increases by 0.055 quintal. It is significant at the significant level of 5%. The result coincides with the findings of Wolelaw (2005) and Nega *et al*., (2014) who concluded that the increase in the price for a product encourages the producers to supply more products to the market.

The last but not the least variable which was related significantly to the supply of mango fruit to the market is access to market information. Market information is positively and significantly related with the market supply of mango fruit at a significance level of 5%. Households who have access to market information can supply 0.054qt more than those who do not have access to market information, *other things remaining constant*. This is in line with Mohammed (2011) who found that access to market information is related to the marketable supply of products significantly and positively.

Determinants of the Supply of Avocado Fruit

Four variables were found to be significant related with respect to supply of avocado fruit to the market. These are distance from the market, quantity of avocado produced, price of avocado and access to market information. Quantity of avocado produced access to market information and price of avocado fruits are positively and significantly related with the supply of avocado at the significant level of 1%, 1% and 5% respectively where as distance from the market is negatively and significantly related with supply of avocado fruits to the market. For the explanation of the variables see the explanations given for the variables which are significantly related with the supply of mango fruits to the market. The coefficient of multiple determinations (R^2) was estimated 0.878 and adjusted R^2 value was 0.862. This means that 87.8% of the variation in the dependent variable is explained by the explanatory variables included in the model. Furthermore, the adjusted R^2 of 86.2% which is significant has further consolidated the goodness of the model, hence, its econometrics significance and reliability.

Table 4 Determinants of quantity of avocado supplied to the market.

Variables	Coefficients	Std. Err.	T	P-value
(Constant)	0 .025	0.212	0.120	0.904
Quantity produced in quintal	0.740***	0.035	21.372	000
Access to extension service	0.328	0.198	.178	0.895
Education level of HHH	0.034	0.076	0.451	0.653
Access to market information	0.044***	0.238	2.669	0.009
Distance from the market	-0.211***	0.060	-2.820	0.006
Access to credit service	0.141	0.069	0.038	0.970
Sex of HHH	0 .001	0.012	0.098	0.922
Price of avocado	0.189**	0.106	2.26	0.026
R^2 0.845				
Adjusted R^2 0.821				

and * represents the level of significance at 5% and 1% respectively.

4. Conclusion and Recommendation

Conclusion

The study was conducted at Gedeo zone, to analyze the mango and avocado supply chain and investigating the factors that influence the supply of fruits. The actors who are participating in production and marketing services of fruits in the study area include producer, local collectors, retailers and consumers. Four marketing channels are identified for transaction of each fruits and among the channels producer-retailer-consumer marketing channel shared the largest volume of transaction while producer-local collector-consumer marketing channel shared the least volume of each fruits in terms of transaction.

Mango and avocado fruit marketing in the area is characterized by having large number of buyers and sellers, free entry and exit and the majority of fruit price is set by demand and supply of the fruits in the market. The marketing structure of fruit in the study area is competitive market.

Out of the eight variables which are expected to affect the supply of fruits in the area four were found to be significantly related with the supply of the fruits to the market. Quantity produced in quintal of the fruits, price of the fruits and access to the market information are related significantly and positively with the supply of the

fruits to the market where as distance from the market is significantly and negatively related with the supply of the fruits to the market.

Recommendation

- The concerned bodies should focus on increasing production and productivity of the fruits by supplying improved varieties of fruits for producers because quantity of mango and avocado produced is one of the determinant factors that affect the amount of mango and avocado fruits supplied to the market positively and significantly.
- The intervention of governmental and non-governmental organizations (NGO) is needed to improve the rural communities' infrastructure service in order to encourage the communities to exchange their products effectively and efficiently. Because distance from the market is a critical issue which affects the supply of fruits negatively and significantly.

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