Determinants of Head Cabbage Marketed Surplus Among Smallholder Farmers in Kofale and Kore Districts, Oromia Region, Ethiopia

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Abstract

Fruits and vegetables are highly perishable agricultural produces and their post-harvest loss is great in amount. Producers suffer a huge economic loss due to lack of proper understanding about causes and nature of losses, preservation methods, and transportation and marketing. Cabbage, which is highly nutritious vegetable, is an economically important vegetable in Ethiopia and one of the most widely cultivated vegetables in West Arsi zone especially at Kofale and Kore districts. This study was aimed at analyzing factors determining the volume of head cabbage supplied to the market by smallholder farmers in Kofale and Kore districts, west Arsi zone. Data were collected from both primary and secondary sources. Primary data for this study were collected from 120 randomly selected farmers by using semi-structured questionnaire. A multi-stage random sampling procedure was used to select 120 sample respondents using probability proportional to size. Descriptive statistics and econometric model were used to analyze data. From total quantity of head cabbage produced only 33.48% supplied to the market in the study area. Ordinary least square regression model results showed that seven variables such as Education, head cabbage farming experience, land allocated for head cabbage, head cabbage market price, livestock holding, market information access, and participation in off/non-farm income activities significantly affects the volume of head cabbage supplied to the market. Policy implications drawn from the study findings include the need to improve farmers' knowledge and experience on head cabbage production and marketing, encouraging adult education through extension service, improving land allocated for head cabbage, and improving market information access to increase volume of head cabbage supplied to the market in the study area.

Keywords: Volume of supply, Head cabbage, Ordinary least square model, Kofale and Kore districts.

1. Introduction

Agriculture is the most important sector in Ethiopia; it accounts for 46% of GDP, 80% of export value, and about 73% of employment. The sector still remains largely dominated by rain-fed subsistence farming by smallholders who cultivate an average land holding of less than a hectare. Although agriculture has a long history in the country's economy, development of the sector has been hampered by a range of constrains which include land degradation, low technological inputs, weak institutions, and lack of appropriate and effective agricultural policies and strategies (Aklilu, 2015).

As other leafy vegetables, cabbage is highly nutritious vegetable and has so many health benefits. It is rich in phyto-nutrient anti-oxidants that are powerful oxidants and known to help protect against breast, colon, and prostate cancers and help reduce LDL or "bad cholesterol" levels in the blood. Moreover, fresh cabbage is an excellent source of natural antioxidant, vitamin C that helps the body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals (Umesh Rudrappa, 2014).

Vegetable production is becoming an increasingly important activity in the agricultural sector of the country mainly due to increased emphasis of the government on the commercialization of smallholder farmers (Hailegiorgis and Hagos, 2016). Integrating vegetable production into a farming system has contributes substantially to the Ethiopia's economy in terms of food and nutrition security as the vegetables complement stable foods for a balanced diet by providing vitamins and minerals (Bezabih *et al*., 2015). Head cabbage is one of economically important vegetables in the country which grows best under cool conditions. According to CSA (2014), annual head cabbage production (in quintal) and area under production (in hectare) has increased by about 16 and 30 percent, respectively, from 2012/13 to 2013/14. Report from Office of Agriculture and Rural Development of respective districts (OoARD, 2013a;OoARD, 2013b) shows that head cabbage is widely produced and marketed in Kofale and Kore districts of West Arsi Zone, Oromia Regional State. The significantly increasing vegetable production in general and head cabbage in particular indicates that smallholders may have better surplus for market.

Despite the increasing importance of vegetables in the country as well as in the study area, the development of horticulture in general and vegetable production and marketing in Ethiopia in particular is constrained by a number of factors: Policy implementation gap, inadequate vegetable seed regulatory frameworks, inadequate quality control and certification mechanisms, limited public institutional capacity and capability supporting efficient and regular vegetable seed supply, inefficient seed importation and distribution system, high post-

harvest losses, high incidence of diseases and insect pests, poor vegetable marketing and value chain development and weak linkage and integration among stakeholders (Bezabih *et al.*, 2014).

According to Bezabih and Hadera (2007), production of horticultural crops is seasonal and price is inversely related to supply. During the peak supply period, prices decline and vice versa. The situation is worsened by the perishability of the products and poor storage facilities. Thus, 25% of the product is spoiled along the marketing channel. Despite the production potentials and importance of head cabbage crop for the country as well as the study area, there has been limited performance of farmers in head cabbage marketing. The factors governing head cabbage producers supply to the market are not well studied and appropriate policy options need to get location-specific information to solve inherent problems. This study tries to fill the gap by providing location-specific and timely information on smallholder farmers' head cabbage supply to the markets.

1.1. Objective of the Study
- To describe the status of smallholder farmers head cabbage supply to the market
- To identify the determinants of quantity of head cabbage supplied to the market in the study area

2. Research Methodology
2.1. Description of the study area
This study was carried out in Kofale and Kore districts of West Arsi Zone, Oromia Regional State. West Arsi Zone is one of the 18 administrative zones under Oromia Regional State (the region accounting for about 34 percent of the country's total area) and it is divided into 12 districts (Fig. 1). Of the districts located in the zone, Kofale and Kore districts cover for about 5.3 (663 square kilometer) and 4.2 percent (533 square kilometer), respectively, of the zone's total area. According to CSA's (2013) population projection of the country, total population of these districts, respectively, is estimated to be 216,159 and 124,556 in 2014 with most population residing in rural areas.

According to the traditional classification system of climatic zones of Ethiopia cited in Deressa *et al.* (2010), agro-ecology of the study areas is dominantly highlands with altitude ranges from 2550 to 3150meter above sea level (masl). The annual rainfall ranges between 1800 and 2700 mm with bi-modal rainfall distribution. The main rainy season, *Ganna* extends from June to September/October and short rainy season, *arfasa*, covers the time between March/April and May (OoARD, 2013a; OoARD, 2013b). The average daily minimum and maximum temperatures of both districts are 17 - 19^{0}C and 22 - 23^{0}C, respectively.

The study districts are characterized by crop-livestock mixed farming system dominated by smallholders who integrate rain-fed crop cultivation and low input-output livestock production. Baseline information from Offices of Agriculture and Rural Development (OoARD, 2013a; OoARD, 2013b) indicates that agriculture, both crop and livestock production, is the major source of livelihood for most households (65 and 77 percent, respectively, in Kofale and Kore) followed by non-farm and off-farm activities. Crops including barley, wheat, maize, faba bean, pea and linseed are grown in these districts. Potato and head cabbage are also vegetables grown in the study areas for household consumption and income generation.
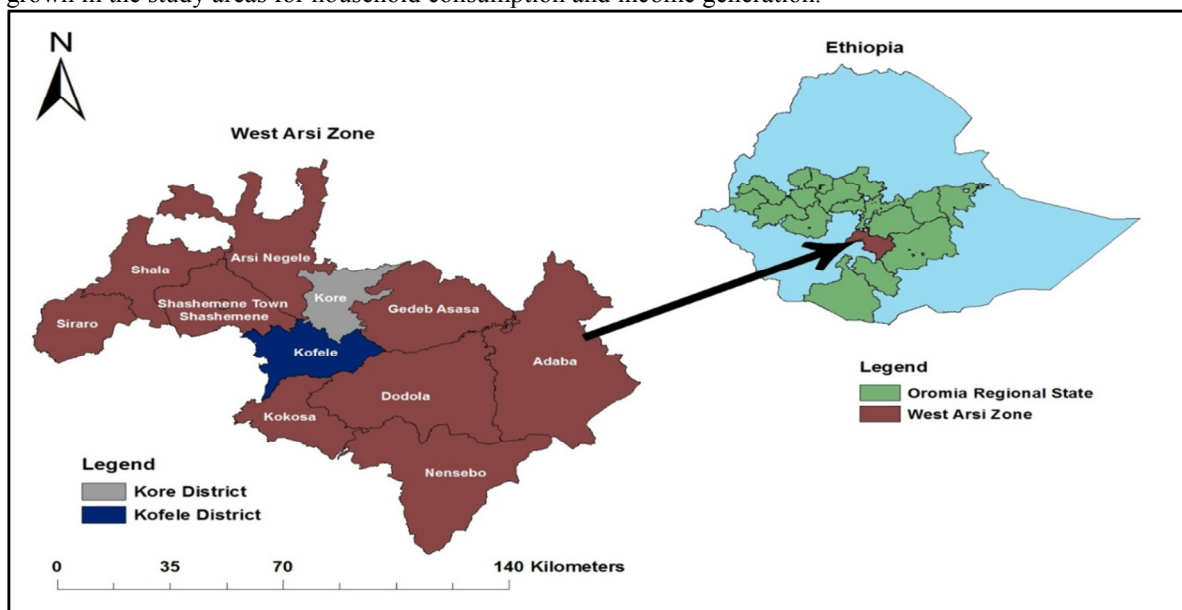

Figure 1. Map of the study area

2.2. Sampling Procedure

A multi-stage sampling procedure was used to identify sample households for data collection. In the first stage, head cabbage producer *kebeles* were purposively identified in collaboration with concerned experts from district office of agriculture and development agents based on the intensity of head cabbage production and markets. The second stage involved random selection of three head cabbage producing *kebeles* from a list of the head cabbage producer kebeles in the districts namely, Shire kombolcha, Bole Hilensaa and Doda Dayu from Kore district and Wamagn Alkaso, Koma Bitacha and Germama from Kofale District. In the third stage, 120 head cabbage producer households were randomly selected from the total head cabbage producer households in the districts using Yamane (1967) sample size determination.

$$n = \frac{N}{1 + N(e)^2}$$

Where**,** n = is the sample size of head cabbage producer households, N= total number of households producing head cabbage in the districts, e= margin of errors at 10% non-response rate.

Table 1: Sampling frame and sample size of Head Cabbage producers

No	Kebeles	Total number of head cabbage producers (N=10,000 both districts)	Number of sampled households
1	Shire Kombolcha	1667	20
2	Bolo Hinlensa	1667	20
3	Doda Dayu	1667	20
4	Wamagn Alkaso	1667	20
5	Koma Bitacha	1582	19
6	Germama	1750	21
	Total	**10,000**	**120**

2.3. Method of data collection

Data were gathered from both primary and secondary sources. Primary data were gathered from selected households using pre-tested questionnaires and checklists. Secondary data which is relevant for the present study were also collected from Offices of Agriculture and Rural Development (OoARD), the Central Statistical Agency (CSA), and from published and unpublished sources.

2.4. Method of data analysis

Both descriptive statistics and econometric model were used for analyzing the data. Descriptive statistics was applied to the basic characteristics of the sample households to assess differences or similarities among the households. The descriptive statistics such as mean, standard deviations, minimum and maximum values, frequencies, and percentages were used to describe the households.

2.5. Econometric model

This part of the analysis deals with the understanding of the determinants of volume of head cabbage supplied to market. Quantity Supplied to the Market is a continuous variable that represents the actual supply of head cabbage by individual households to the market during the survey year, measured in quintals (100kg). Multiple linear regression model (OLS) was appropriate to analyze factors affecting volume sales because all sampled households producing head cabbage participated in marketing. However, when some of the assumptions of the Classical Linear Regression (CLR) model are violated, the parameter estimates of the above model may not be Best Linear Unbiased Estimator (BLUE). Thus, it is important to check the presence of heteroscedasticity, multicollinearity and endogeniety problem before fitting important variables into the regression models for analysis.

Yi = b0 + biXi + *μ*i   **(1)**

Where

Y = volume of head cabbage supplied to the market, Xi= explanatory variable included in the model and μi =Error term

3. Results and Discussion

3.1. Descriptive analysis

Descriptive statistics of variables used in the regression analysis are given in Table 1 and 2. As the study result revealed that from total quantity of the head cabbage produced only 33.48% proportion supplied to the market indicating low level of commercialization in the study area. This means the mean percentage of head cabbage harvested which was taken to the market for sale by the respondents in rural area was 33.48%.

The average age of the sample respondents was found to be 37.33 years having head cabbage farming

experience of 5.78 years. This range of households' ages implies most of them were within their productive age bracket. About 12.5% of households in the sample are female headed. The average household size is about 8.67, with family labour supply of 4.4 persons per household, figures which are which is larger than the national average 4.6 persons per household (CSA, 2014b). Livestock owned 7.25 TLU. A household on average operates about 2.56 ha land of which 0.42ha is allocated for head cabbage production, perhaps due to the availability of more arable farmland in the area. Almost 82.5% of household heads are literate, a figure which has shown significant rise in recent years. The extension services reached out 68.3% of the farm households, while the credit service extended only credit about 30%. Though all the respondents in this survey are primarily engaged in crop production and livestock rearing, 56% of them are also participated in off/non-farm activities to generate additional income. Off/non-farm activities refers both to self-employments in non-farm sectors such as petty trade, craft work/carpentry, blacksmith, and off-farm employment such as cash/food for work (safety net), daily labor, and guard.

Table 2: Descriptive statistics of selected variables used in the empirical analyses

Variables (Continues)	Mean		Std. Dev.
Age	37.33		10.55
Family size	8.67		3.34
Farming experience	5.78		3.84
Livestock holding	7.25		3.45
Farm size	2.56		1.49
Land allocated for head cabbage	0.42		0.32
Distance from nearest market center	1.55		1.34
Variables (Dummy)		Frequency	Percentage
Participation in non/off-farm income activities	Yes	67	55.83
	No	53	44.17
Sex	Male	105	87.5
	Female	15	12.5
Education	Literate	99	82.5
	Illiterate	21	17.5
Credit services	Yes	36	30.0
	No	84	70.0
Extension services	Yes	82	68.3
	No	38	31.7
Market information	Yes	82	68.33
	No	38	31.67

3.2. Regression Analysis

In this section, the selected explanatory variables were used to understand the determinants of volume of head cabbage supplied to market.

Analysis of determinants affecting farm level volume supply of head cabbage was found to be important to identify factors constraining head cabbage supply to market. Prior to fitting multiple linear regressions, the hypothesized explanatory variables were checked for existence of multicollinearity, heteroscedasticity and endogeniety problem. The problem of endogeniety occurs when an explanatory variable is correlated with the error term in the population data generating process, which causes, the ordinary least squares estimators of the relevant model parameters to be biased and inconsistent. The source of endogeniety could be omitted variables, measurement error and simultaneity (Maddala, 2001). Both Hausman test and Durbin-Wu-Hausman (DWH) test were applied to check the presence of endogeniety. In case of this study, there is no endogeniety problem from the explanatory variables included in the model that could cause endogeniety bias if OLS is applied. The VIF results indicate that, there was no serious multicollinearity problem among the explanatory variables included in the model because all VIF values are less than 10. If there is presence of multicollinearity between independent variables, it is impossible to separate the effect of each parameter estimate in the dependent variables. It is thus, important to test multicollinearity between explanatory variables. Furthermore, all the variables were tested for the problem of heteroscedasticity using the Breuch-Pagan test and there was no heteroscedasticity problem. So since there is no heteroscedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables are BLUE. Also, the model specification was carried out using the Ramsey-reset test, and the results revealed that there were no omitted variables in the model. Therefore, OLS method was used to identify factors affecting the volume of head cabbage sold to the market (farm level marketed surplus of head cabbage) by head cabbage farmers in the study area since all assumption was fulfilled.

Table 3: Determinants of volume of head cabbage supplied to the market (OLS estimates)

Variable	Coef.	Std. Err.	P>t
Constant	1.404*	0.790	0.079
Age	0.002	0.007	0.774
Sex	0.219	0.226	0.335
Education	0.350*	0.200	0.083
Head cabbage farm experience	0.243**	0.101	0.017
Family size	0.026	0.023	0.257
Land allocated for head cabbage	73.65***	5.836	0.000
Head cabbage market Price	11.087***	2.102	0.000
Livestock holdings [a]	6.840**	3.592	0.050
Market information	0.604**	0.261	0.021
Distance to the nearest market	-0.017	0.033	0.614
Access to extension service	0.206	0.146	0.180
Access to credit service	0.104	0.153	0.498
Participation in off-farm income activities	-0.146**	0.073	0.045
Number of Observation		120	
$F_{(13, 106)}$		32.23	
Prob>F		0.0000***	
R-Squared		0.780	

Note: Dependent variable is quantity of head cabbage supplied to market in quintal in 2013.

***, ** and * are Significant at 1%, 5% and 10% level of probability, respectively.

As depicted in Table 3, the model was statistically significant at 1% probability level indicating the goodness of fit of the model to explain the relationships of the hypothesized variables. Coefficient of multiple determinations (R^2) was used to check goodness of fit for the regression model. Hence, R^2 indicates that 78 percent of the variation in the quantity of head cabbage supplied to market was explained by the variables included in the model. The explanation on the effect of the significant explanatory variables is discussed below.

The result shows that land allocated for head cabbage has significant effect on volume of head cabbage supplied to the market at 1% significant level with expected positive sign. The positive sign of the coefficient implies that the larger the land size allocated for head cabbage production the larger the quantity produce and thereby increasing the quantity of produce available for sale. Thus, the per unit production costs will be lower due to the economics of scale. Increase in the size of one hectare of land allocated for head cabbage increases volume of sales of head cabbage by 73.65 quintal, keeping other factors constant. In support of the finding here, Wubshet (2010), Alemnew (2011), and Toyiba *et al*. (2014) indicated that the area of land allocated for coffee, red pepper and papaya production affected farm level marketed supply of each commodity significantly and positively. Households with larger land size are relatively better off because it allows the household to have a surplus production above subsistence needs and enable them to sell products for market. An increase in farm size naturally implies an increase in output which leads to increase marketed surplus.

Education has showed positive effect on head cabbage quantity supplied to market with significance level at 10%. The survey results revealed that, if head cabbage producer gets educated, the amount of head cabbage supplied to the market increases by 0.35 quintal, keeping other factors constant. This may be because majority of the farmers in the study area have minimum education requirements to make them market oriented and thus enable them to have better skills and better access to information to supply more head cabbage to market. This is also in line with previous studies conducted by Astewel (2010) and Ayelech (2011), who found that if paddy and avocado producer gets educated, the amount of paddy and avocado supplied to the market increases, respectively. Amare (2013) also reported that education level of farmers exhibited a significant and positive effect on the marketed surplus of pepper.

Head cabbage farming experience of households has significant effect at 5% significant level for head cabbage quantity sold with expected positive sign. Thus, the result implied that, as farmers experience increase by one year, the head cabbage supplied to market increased by 0.243 quintal, keeping others factors constant. This means that the farmers with more experience in head cabbage production and marketing have higher ability to sell more head cabbage produces in the market than less experience because they have more marketing network and information. This is in line with finding of Ayelech (2011), and Ele *et al*. (2013) who illustrated as farmers experience increased the volume of tomato, avocado and crops supplied to the market has increased, respectively.

Market price of head cabbage influenced the volume of sale positively at 1% level of statistical significance with expected positive sign. This result shows that one ETB increase in head cabbage price increase the volume

of head cabbage supplied to the market by 11.087 quintal, keeping other factors constant. This suggested that farmers are more response to higher prices because they get higher incomes from their produce. This result is in line with the findings of (Sebatta *et al.,* 2014; Sigei *et al.*, 2014).

Owning more number of livestock had a positive influence on the level of head cabbage sale at 5% level of statistical significance. This implies that an additional of livestock in TLU would increase the extent of head cabbage sells by 6.84 quintals, keeping other factors constant. Households with higher livestock possession would lead to higher probability of getting excess livestock for selling to purchase inputs for production, particularly the owner of more oxen have an ability of ploughing more land on time, thereby achieving crop yields which increase the marketable surpluses. Some livestock (donkey and horse) also used for transporting head cabbage products to market which reduces transportation costs. This result is in line with the findings of (Solomon *et al.,* 2010; Aman *et al.,* 2013).

Access to market information had a positive impact on the extent of head cabbage sells at 1% significance level. This indicated that the more households' access to market information the extent of head cabbage offered for sells would increase by 0.604 quintals, *ceterus peribus*. This result implies that market information availability motivated households to sell more head cabbage produces since it informs the farmers about market. This result is in line with the findings of (Jari and Fraser, 2009; Gani and Adeoti, 2011).

Participation in off/non-farm activities had a negative impact on the volume of head cabbage supplied to the market at 5% level of statistical significance. This implies that the respondents' involvement in off/non-farm activities would decrease the extent of head cabbage sells by about 0.146 quintals, keeping other factors constant. The probable reason was that the respondents' engagement in off/non-farm activities share more labor and time allocated for growing head cabbage which results in low head cabbage production and possibly leads to smaller quantities of head cabbage sold. This result is in line with the finding of (Sebatta *et al.,* 2014).

Production and marketing of Head Cabbage
Of their total land holdings, respondents in the study areas had been allocated 0.42 hectares of land for head cabbage production. Respondent farmers indicated that the mean yield of head cabbage production was 149.9 quintal per hectare. Shortage of quality seed, high cost of inputs, poor seed germination, limited knowledge on recommended agronomic practice, diseases and pest attacks, lack of storage and high perishability nature of product are the main production constraints of head cabbage whereas, suitable climatic conditions & fertile land and enabling policy environment & support from public organization & NGOs are the main opportunity for head cabbage production in the study area. The price of the produce greatly varies monthly, yearly and varies with quality.

Market factors are external factors that affected the demand for or the price of a good or service (Sigei *et al.*, 2014). It includes distance from market, access to road, market information, and price of outputs. The respondents are travelled on average about 2 and 2 and half hours per trip to reach the main commercial town i.e. Kofele and kore town respectively but in the study area are on average about 1.55 km away from nearest market center for both districts. In the study area, farmers set head cabbage sell price before marketing the products based on the received market information and also expected better incentives from the supplied head cabbage products. However, the majority (90%) of sample respondents are sold head cabbages less than the price they set due to head cabbages market price fluctuation and brokers interferences. Farmers sold one kilo of head cabbage by the mean price of ETB 2 in 2013/14 by directly negotiating with buyers and also through brokers. According to the information obtained from the farmers the average selling price of cabbage per kg dropped from 2.5 birr at the beginning of the cabbage production in January to 1.5 birr in March 2013 (the survey time). This was because of the quality reduction of the produce due to heavy rain and increased farmers' cabbage production. The average price per kilo of cabbage at the wholesaling area was found to be 3.0 birr and at the retailer's level, it was 6.0 birr. However, this price varies from time to time depending on the supply and quality of the produce. Cabbage is a highly seasonal crop with an oversupply during the dry seasons (winter and spring seasons) which are production peaks and undersupply during lean season (summer season) resulting in highly fluctuating prices. During the summer season, farmers have power to decide on the price, whereas during the dry season, price fluctuation is mostly on the hand of wholesalers and intermediaries. Market information is playing an important role in supplying agricultural commodities for market through informing the farmers about market condition (Jari and Fraser, 2009; Adenegan *et al.,* 2012). This study result showed that 68.33% of the sampled households have access to market information when they want to supply head cabbage to the market. Neighbor farmers (46.3%), brokers (42.3%), and friends (39.8%) are the major sources of market information that market participants received about market in study area.

4. Conclusion and Recommendation
This study was aimed at analyzing factors determining head cabbage volume supplied to the market by smallholder farmers in Kofale and Kore districts of Oromia region. The specific objectives of the study include

describing the status of smallholder farmers head cabbage supply to the market and identifying factors affecting volume of head cabbage supplied to the market of farm households. A multi-stage sampling procedure was used to select 120 sampled households for data collection. The data were generated from both primary and secondary sources. The primary data were collected from individual interview using pre-tested semi-structured questionnaire and checklist. The analysis was made using descriptive statistics and econometric model using STATA software. Multiple linear regression model (OLS) was applied to analyze factors affecting volume of head cabbage supplied to the market by smallholder farmers in the study areas. The findings of this study are summarized as follows;-

From total quantity of the head cabbage produced only 33.48% supplied to the market by farmers where as the remained consumed at home and damaged due to its high nature of perishability. Of the 120 interviewed head cabbage producing households, 87.5% were male headed households. The average ages of the sampled respondents were 37.33 years having 5.78 years of head cabbage farming experience. The average family size was 8.67 with family labour supply of 4.4 persons per household. Livestock owned 7.25 TLU. A household on average operates about 2.56 ha land of which 0.42ha is allocated for head cabbage production, perhaps due to the availability of more arable farmland in the area. Almost 83% of household heads are literate. Households in the study area on average 1.55 km away from nearest market center. The extension services reached out 68.3% of the farm households, while the credit service extended only credit about 30%. Of the 120 interviewed head cabbage producing households, 68.3% have access to market information and 55.83% participated in non/off-farm income activities in the study area.

Econometric result of the linear regression model (OLS) indicated that education, head cabbage farming experience, land area allocated for head cabbage, head cabbage market price, livestock holding, market information access and participation in off/non-farm income activities are significantly determining the quantity of head cabbage supplied to the market. Therefore, these variables require special attention if farmers quantity of head cabbage supplied to the market is to be increased.

To increase volume of head cabbage supplied to the market policy makers should focus more on;-

✓ Upgrading the knowledge of the households through education, experience sharing and trainings (market related),

✓ Strengthening the existing livestock production through providing improved health services, better livestock feed (forage), targeted credit and adopting agro-ecologically based high-yielding breeds and disseminating through artificial insemination in the area as livestock provides manures for the farm, means of transportation of their products to the market, and provide financial liquidity,

✓ Interventions in the form of establishing new farmers cooperatives/groups and improves the existing farmers cooperatives/groups to collect head cabbage products and link farmers cooperatives/groups with output markets are required to reduce broker interferences and transportation costs and also sustain farmers benefits from their products,

✓ Delivering proper and adequate market information through strengthening market information delivery network and also link farmers cooperatives/groups with proper sources of market information to enhance head cabbage producers farmer regular access to information on market dynamics.

✓ Increasing land size area allocated for head cabbage production, this issue calls for implementing an appropriate land lease and tenure systems, which provide an opportunity for leasing-in more land or owning increased farm size for head cabbage production.

Acknowledgements

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