Identification of Postharvest Loss Determinants of Small Scale Onion Farm Holders in Lode Hetosa District of Arsi Zone, Ethiopia as Basis for Appropriate Interventions

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Abstract

Onion has significant economic importance in Ethiopia. Although quantitative evidence is limited, postharvest loss in onion is considerably high. This study was aimed at identifying determinants of postharvest losses of onion at the farmer level and conducted from January to August 2014 in Lode Hetosa district of Arsi zone located in Oromia regional state, Ethiopia. Primary data were collected from smallholder onion farmers via household survey, focus group discussions and key informant interviews as well as field based observations. A total of 50 farmers were surveyed to collect primary data and postharvest losses were assessed at farm level. Data were analysed by descriptive statistics and multiple linear regression model. The total postharvest loss of onion at farmer level was found to be 25.4%, mainly because of poor cultural practices and disease attack during production and harvesting as well as poor handling practices, storage and transport. The higher proportion of losses (10%) was observed at transport to market level while the harvesting and storage levels' loss was 7.7% at each stage. The model regression results showed that gender of household head, level of education, time of harvest, use of ventilated storage facility, storage cooling system, and package capacity were significant determinants ($p < 0.05$) and

explained 57% (Adjusted $R^2 = 0.563$) of the variation in the onion loss at farm level. Storage before market and variety used were also found to determine onion loss at $p<0.1$ significance level. Generally, pre- and post-harvest management practices for enhancing shelf-life and marketability of onion, such as produce handling skills and use and management of storage facilities were lacking in the study area. The smallholder farmers in the study area need necessary support and complementary resources to reduce postharvest farm level onion losses. Onion farmers and development agents in the study area need capacity building interventions to improve skills in postharvest handling practices.

Key words: Postharvest onion handling, Farm level loss, Multiple linear regression model, Loss determinant factor

1. Introduction

More than 85% of the Ethiopian population, residing in the rural area, is engaged in agricultural production as a major means of livelihood. It accounts for 46% of GDP, 80% of export value, and about 73% of employment (Aklilu, 2015). Vegetable crops play an important role in contributing to the household food security and generating employment opportunities for the poor households. Recently, due to their high nutritional value vegetable do have ever rising demand both in local and foreign markets, and are classified among those export commodities' that generate considerable amount of foreign currency earnings to the country. The fresh onions, tomatoes, cabbage and potatoes that are mainly produced by small scale farmers are exported to Djibouti and from there to Saudi Arabia, Yemen and other Middle East countries (Selamawit and Tesfaye, 2019). As a matter of these

facts commercial farms in Ethiopia used to grow vegetables over a considerable land area for years (CSA, 2015). Major vegetable types produced in Arsi zone are onion, potato and tomato. In the zone, onion covered 23.36% of the root crop area and 39.71% of the production (Hunde, 2017).

Onion (*Allium cepa L.* var. cepa) is one of the important vegetable crops grown by farmers mainly for market purpose. In Ethiopia, onion is one of the most important vegetables for consumption. It is a vital complementary ingredient for cooking Ethiopian traditional sauce or wot, which is consumed together with *enjera*. It accounted for about 10.5 and 4.2 percent of area and quantity of root crops production, respectively (CSA, 2016). Onion covers about 17,980 ha with estimated annual production of 2.3 million quintals (MoARD, 2009).

Onion is the second most important; following pepper, in Ethiopia and Oromia is the most important production region (64%) (Bekele, 2010). The area under onion is increasing from time to time mainly due to its high profitability per unit area and ease of production, and the increase in small scale irrigation areas. Due to such an important contribution of onion to the country, some efforts have been made by both research and extension systems for its promotion. Between 2008 and 2014, the national production of onion grew from 148,855 to 221,846 tons or 21.3% growth per annum (CSA, 2002-2014). In 2018, the annual production reached 322,323 tons (FAOSTAT, 2019). Onion is produced and consumed all over the country. However, there are particular areas which contribute the lion's share to the national supply. As average production data for the period 2008 to 2014/15

indicates, Arsi zone made significant contribution (13.3%) to the national production (CSA, 2002-2014). Area in hectares and production in quintals were 4,120.14 and 163,061.89, respectively, in the zone (CSA, 2016).

Onion is highly produced with rainfall and highly the sources of income in Lude Hetosa, Sire and Hitosa districts. It is also produced under irrigation using traditional and modern type with pump or gravity irrigations. I sold in local, district and urban markets and transported to larger towns like Addis Ababa, Adama, Dire Dawa and Harer. The onion market chain extends up to Djibouti through Harar traders and the Harer traders also purchase it for Djibouti consumers. It is widely believed that Djibouti markets traders are relatively reliable. Similarly, the domestic use of onion is growing especially in urban centers, with the growth in restaurants, bars and hotels serving prepared food (JICA and OIDA, 2014).

Yet, existence of handling and storage related problems that require appropriate measures, with regard to vegetable marketing in the area were mentioned by JICA and OIDA (2014). Poor postharvest practices occur throughout the onion value chain, especially during farm level handling and storage. Onion lose can reach as much as 50% due to poor postharvest handling practices (Caleb, 2018). However, post-harvest technology has been given less emphasis both by concerned bodies and the public and there is information gap with regard to commodity specific technologies that minimize losses. Thus, whether the gain in onion crop yield in the study area is marginal or significant, it could be nullified because of inappropriate or unreliable post-harvest management. Consequently, appropriate handling techniques, packaging materials, proper storage facilities and transportation

that are specific to onion crop at the farmer level are required to minimize the above stated loss.

Moreover, proper post-harvest handling and storage also helps to ensure household and community food security until the next harvest and helps producers to avoid selling at low prices during the glut period that often follows harvest. Therefore, this survey result is important in order: to source for information (extent of such losses, mode of transporting it to retailers, the type of technologies used) on the postharvest challenges that onion farmers in the study area face yearly and to identify possible technological interventions for reducing them.

The aim of the study was to assess the level and causes of postharvest onion losses during field operations (i.e. harvesting, handling, storage, field packing and transportation to market) and identify determinant factors that influence postharvest farm level onion loss.

2. Methodology

2.1. Description of the Study Area

The survey was conducted from January to August 2014 in Lode Hetosa district, located in central part of Arsi zone, Oromia region, Ethiopia. The district is located about 164 km distance to the south east of Addis Ababa. The total area of the district was 510 Km^2 and divided into 16 administrative *Kebeles*, of which 13 are rural *kebeles* with a total of 17,928 households (CSA, 2007). Lode Hetosa district geographically located at an elevation of 1700-3036 meters above sea level. About 44% of the total area is highland, 51% mid-land and 5% is lowland within 6°59'and 8°49' latitude and 40°44'East longitude while the climatic condition of the area is

"Weynadega". The area receives an annual range of rain fall from 800-1400 millimeter and annual average humidity ranging from 40-56%. The annual temperature range is 10-22.6 degree Celsius. It has a daily maximum temperature that can reach up to 25 degree Celsius and minimum temperature of 10 degree Celsius (Yitna *et al.,* 2015). Main livelihood system is mixed agriculture with the main smallholder subsistence livestock are cattle, sheep, and donkey; crops are wheat, barley, and bean; and the principal smallholder cash crop is onion (Gil *et al*., 2010).

2.2. Sampling Procedure

In this survey a multi-stage sampling technique was employed. The first stage was purposive selection of onion growing *Kebeles*, followed by selection of sample households. The *Kebele* identification was made through reviewing secondary data on production and area coverage of the onion crop. Ten onion growing *Kebeles* were purposively selected as a sample out of the total 13 rural *kebeles* of the district.

The second stage involved random selection of six onion producing *kebeles* from a list of the onion producer *kebeles* in the district based on the intensity of onion production. In the third stage, 50 onion producer households were randomly selected from the total onion producer households after determined by using sample size determination formula (Yamane, 1967).

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

Where: n = is the sample size of onion producer households, N = is the total onion producer households in the district (N = 8000) and e = 0.139 is the

level of precision defined to determine the required sample size at 95% level of precision. Suitably accurate results can be obtained by accepting a larger margin of error and using resources more efficiently (Franklin and Walker, 2010).

After preparing fresh list of sampling frame, a total sample size of 50 households (Escalada, 2002) were determined based on probability proportional to size of total onion growing farmers in each *Kebele* as described in Franklin and Walker (2010). Sample households were selected following simple random sampling technique with the help of extension workers of the district. Probability proportional to size was used to determine sample sizes from each *kebele*.

2.3. Data Collection

The survey was conducted using the method of Investigative Survey Research Approach (ISRA) as described in Olayemi *et al.* (2010). Information was gathered from sample households with pre-tested interview schedule using structured questionnaire. A structured questionnaire was designed and used for the interview. The topics covered in the questionnaire included personal information like, age, family size, level of education and years of experience, stage and time of harvest of produce, percentage loss of produce during harvesting, storage and transportation, storage awareness, on-farm storage facilities utilized and for how long, mode of transportation and packaging materials utilized by the respondents were investigated.

The study has also taken some personal observation to get salient information that helped to identify problems faced by the farmers. Postharvest loss was estimated and quantified as a percentage based on total

harvested quantity. We carefully designed the questionnaire and elicited farmers' perception of postharvest losses at each stage of farm level onion value chains (*i.e.* harvest, storage and transport to market) through a visual exercise implemented by trained enumerator's proficient with local language (Afan Oromo).

Collection of primary qualitative information was managed through holding discussion with focus group and key informant interview. To ensure validity of the qualitative data, information was cross checked through conducting discussion with development agents and the district agricultural office staffs of the study area. Unstructured interview approach was used for key informants. It was conducted by talking to 10 development agents, 10 key farmers, and 2 district government officials who know the postharvest aspects of onion crop in the region.

2.4. Statistical Analysis

The collected data were coded and analysed using IBM statistics SPSS version 22 for windows package (IBM Corp, 2013) software tool. Data were analysed by descriptive statistics and multiple linear regression model.

Descriptive statistics such as frequency distribution, percentages and mean were used in analysing socio-demographic characteristics of respondents and quantity of onion lost at each farmer level field operation. Means, frequency distributions and percentages were used to compute the postharvest losses at three farm level stages. Development agents were trained to use physical "visual scale" samples of damaged onion. In this way, farmers could identify quality of onion throughout the farm level handling and more precisely estimate losses. The total postharvest losses were estimated as the sum of all

harvest, storage and transport to market level losses as perceived by the farmers.

Multiple linear regression analysis was employed to identify the determinants of the postharvest loss of onion at different farm level field operations as used by Adewumi *et al.* (2009). Multiple linear regression model was used to examine the relationship between postharvest loss of onion and explanatory variables. The general form of multiple linear regressions is:

$$Y = f(X1, X2, X3 \ldots Xk) \quad (1)$$

$$Y = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + \cdots + \beta kXk + \varepsilon i \quad (2)$$

Y represents postharvest loss, X1, X2, X3, X4…Xk represents independent or explanatory variables, βo is the intercept term, and εi is the error factor. The model used for farmer level onion loss was detailed in equation 3.

$$Y = 46.52 - 0.24^{*} X1 + 14.48^{*} X2 - 11.42^{*} X3 - 4.14^{*} X4 + 0.21^{*} X5 - 2.81^{*} X6 + 2.01^{*} X7 - 0.59^{*} X8 + 4.17^{*} X9 - 5.26^{*} X10 + 7.22^{*} X11 + 2.13^{*} X12 - 8.02^{*} X13 + 4.09^{*} X14 - 16.44^{*} X15 + 0.9^{*} X16 - 8.86^{*} X17 - 9.06^{*} X18 + \varepsilon \quad (3)$$

Where Y is total farm level postharvest onion loss per trip (%); *X1* is age of the household head; *X2* is gender of active labour force; *X3* is education; *X4* is marital status; *X5* is distance to nearest town; *X6* is onion farming experience; *X7* is distance from service giving institutions; *X8* is working persons; *X9* is land size covered by onion; *X10* is ever grown improved variety; *X11* is time of harvest; *X12* is grading/sorting; *X13* is storage facility; *X14* is storage before market; *X15* is cooling system; *X16* is place of

sale; *X17* is transport mode; *X18* is package capacity; *46.52* is the constant term (intercept); and ε is error term.

3. Results and Discussion

3.1. Socio-demographic characteristics of respondents

According to Table 1, middle age households were more participating in onion production. The average total farm land size for farmers in the district was 2.48 ha whereas the land being used for onion production was 0.65 ha on average. The average distance to nearest town of sample respondents was 7.5 km away.

Table 1. Socio-demographic characteristics, market factors and farm specific characteristics (continuous variables) of the sampled respondents

Variables	N	Mean	Std. Deviation
Age	50	42.04	8.29
Distance to nearest town (Km)	50	7.51	6.53
Family size	50	6.00	2.37
Working persons	50	3.91	2.28
Total crop land (ha)	50	2.48	1.63
Total irrigable area (ha)	50	0.72	0.32
Land size covered by onion (ha)	50	0.65	0.30

Analysis of the socio-demographic characteristics of respondents revealed the dominance of males (Table 2). About 95.66% of the sampled respondents were males whereas the remaining were females. This finding indicates that

male-headed households were more participating in onion production and marketing. The education status of the households indicates that there were 6.52% with no formal education, less than or equal to grade 6 were 17.40%, grade 7-12 complete were 73.91% and completed diploma were found to be 2.18%. Major means of income with respect to agricultural production were cereal and pulses production (89.13%) and vegetable production (10.88%). The results of the responses as to how the farmers have been in the farming business of fresh onion production shows 3%, 16%, 18%, 13% of them have been handling the produce for over 30, 20, 10 and less than 10 years, respectively.

Table 2. Socio-demographic characteristics, access to services and market outlet of farmers (categorical variables) of sampled respondents

Variable		No of Respondent	% respondents
Gender status	Male	46	95.66
	Female	4	4.34
Marital status	Married	46	95.66
	Unmarried	4	4.34
Educational status	No formal education	4	6.52
	≤6	9	17.40
	7-12 grade	35	73.91
	Diploma	2	2.18
Major means of income	Cereal and pulses production	43	89.13
	Vegetable production	7	10.88

Onion farming experience (Year)	Less than 10	13	26.09
	10 -20	18	36.96
	20-30	16	32.60
	30-40	3	4.34
Main occupation	Farming	33	69.57
	Farming and artisan	8	15.21
	Farming and petty trading	7	13.04
	Other	2	2.18
Distance from service giving institutions	5 min. - 1 Hr	31	63.04
	1:30 – 2 Hrs	19	36.96
Onion variety	Improved	14	28.28
	Local/improved	17	34.10
	Local	18	38.63
Place of sale	Farm gate	2	2.18
	Farm gate/market	2	2.18
	Market	46	95.66
To whom	Retailer	22	45.66
	Whole seller	26	52. 18
	Whole seller/direct consumer	2	2.18
Price condition	Good	3	6.46
	Medium	26	77.41
	Poor	6	16.12

Intention to expand onion production	Yes	50	100
	No	-	-

More than 63% of respondents had service giving institution in their vicinity while those using improved onion variety were less than 28%. It is also revealed that majority of the respondents (95.7%) were married and their main livelihood (69.6%) was farming. Majority of the respondents (95.6%) sell their produce at market for wholesalers (52%) and most of them (77.4%) perceive the market price as average. Farmers seem to have good experience and motivation to expand onion production system.

3.2. Farm level onion handling practices

Majority of the farmers (50%) responded that harvesting is conducted at any time of a day and it is based on bulb maturity (75.56%). They also practice bulb grading (97.8%) before storage mainly using human labor (93.33%) as a means of grading and bulb ripeness stage (55.56%) as main grading criteria (Table 3).

Table 3. Stage and time of harvest, grading, sorting, and curing methods practiced by respondents

Variable		**No of Respondent**	**% respondents**
Time of harvest	Anytime	24	50.00
	Morning	11	21.73
	Afternoon	6	10.88
	Evening	9	17.40
Stage of harvest	Matured	36	75.56

	Leaf shading and color change to yellow	14	24.44
Grading/sorting	Yes	47	97.82
	No	3	2.18
Means of grading/sorting	Hand operated onion grader	5	6.67
	Human labor	44	93.33
Grading criteria	Color	6	11.11
	Defect	8	15.56
	Ripeness	26	55.56
	Uniformity	2	2.22
	Ripeness, color, defect, size, uniformity	8	15.56
Curing	Yes	47	97.78
	No	3	2.22
Means of curing	Field curing	50	100
	Other	-	-

Onion is highly perishable if the outer skin is not dried out properly. Most of the producers in the district cure their harvested bulbs using field curing method to get a quality product (Table 3). One of the simplest and most effective ways to reduce water loss and decay during postharvest storage of root, tuber and bulb crops is curing after harvest.

Table 4 presented respondents' onion handling practices and types of defects the bulbs face during storage. About 73.33% of the farmers do not use on-farm structure to store it and they simply store it in a room with soil floor. The remaining respondents use ventilated structure (9.9%) and on-farm shades (17.78%). Only 13% of the respondents practice atmospheric storage management using simple humidification technique. As a result only half of the respondents were able to store their produce for more than 4 days before marketing (Table 4). In line with this finding, limited availability of storage facilities was the major factor that compelled onion producers to sell all their produce immediately after harvest, risking much lower prices than would be under normal market conditions (Tekeste *et al.*, 2013).

Table 4. Storage facilities utilized, atmospheric storage management (ASM) used, storage period, defects occurring during storage, and cooling method used by respondents

		No of Respondent	**% respondents**
Storage structure type	No farm structure	34	73.33
	On field side	2	2.22
	Under the tree	8	15.56
	Ventilated farm structure	6	9.89
Use of ASM	Yes	8	13.04
	No	42	86.96
Type of ASM	No	42	87
	Humidity	8	13

Storage before market	2 days	12	23.91
	3-4 days	14	26.09
	More than 4 days	24	50.00
Defects	Yes	43	89.13
	No	7	10.87
Type of defects	Bruises	2	2.43
	Decay	3	4.88
	Fungal attack	28	58.66
	Defects on skin due to sunburn/rubbing	2	2.43
	Bruises, Decay, Insect injury, Fungal attack, Defect on skin, Green sprout foliage	15	36.59
Extent of defects	Major	11	24.40
	Minor	23	51.22
	Serious	11	24.40
Cooling system	Air ventilation	7	15.00
	On field ventilation/Air and sun	30	55.00
	Room cooling	13	30.00

Most of stored bulb is subjected to defects and fungal disease was the major cause of spoilage in the study area causing yield losses (Table 4). The absence of cooling system in storage also exposed bulbs to high temperature and then spoilage. The only cooling activity that the majority (55%) of the

farmers practices during storing their onion bulbs was on field ventilation prior to room storage. About 30% of the farmers apply room cooling to their bulbs while the remaining 15% store their bulbs in air ventilated rooms. Maintaining appropriate storage conditions for onion bulbs can slow down respiration rate, reduce re-growth or sprouting, prolong shelf-life, and inhibit the development of decay-causing pathogens. Lack of storage facilities had forced onion farmers to sell the produce even if the prices are low. Knowing this lack of ability and facilities to store onion for long, wholesalers put pressure on producers to sell at low prices (Emana *et al.*, 2017).

The majority of producers (95%) sell their produce at local markets for whole sellers (52%), retailers (45%) and direct consumers (3%). The rest 5% was sold at farm gates to middle men/brokers. The primary mode of transportation of onion bulbs in the study area to the local markets was by loading it on back of animals like donkeys and horses (Table 5). Wholesalers are the major buyers of onion as they buy at least a truck load of onion at a time from farmers. They mostly purchase from farmers and local collectors. The farmers are price takers and the price paid is decided by the wholesalers. Usually price is set by wholesalers after bargaining with local collectors. This result was similar to the findings of Hailu *et al*. (2017), who conducted onion value chain analysis in Ejere district and reported that farmers hardly negotiate the price due to fear of post-harvest loss, in case the product is not sold and brokers tend to set prices and make extra benefits from the process.

Table 5. Mode of transportation and packaging materials utilized by respondents

Variable		No of Respondent	% respondents
Transport mode/type	Bagged onion is loaded on Donkey/Horse back	47	97.82
	Open Lorry	3	2.18
Packaging material during transport	Juts	50	100
	Plastic crates	-	-
Package capacity	70-100	40	82.60
	110-140	10	17.40

3.3. Loss during farm level postharvest handling practices

Estimation of the extent of losses in this study, like many others studies, is based on respondents' self-reported perceptions of the postharvest losses occurring at each farm level postharvest value chain stage. The total postharvest loss of onion at farmer level was found to be 17% (Table 6). This result was in line with the survey study by Emana *et al*. (2017) on postharvest losses of onion in Bora and Dugda districts in Oromia, Ethiopia and they reported that over 30% postharvest losses were registered for onion mainly because of poor cultural practices and disease attack during production and harvesting as well as poor handling practices, storage and transport. The higher proportion of losses (6.9%) was observed at storage level. Fumen *et al*. (2017) also reported similar result that poor storage structure contributes to much of postharvest onion loss.

Table 6. Mean percent onion loss during harvest, storage and transportation to market by respondents as a consequence of pre-harvest and postharvest practice

Produce loss	No of Respondent	% loss
Harvesting	50	6.1
Storage	50	6.9
Transport to market	50	4.1
Total loss		17.0

The higher percentage loss at the transport stage could be accounted for the cumulative effect of improper handling from harvest to market level. Similar to this, Emana *et al*. (2017) reported that postharvest loss which occurred at the farm level extends to the other stages in the chain increasing the loss further due to poor handling, transporting, storage and ambient temperature which deteriorates the overall product quality. They stated that it is a continuum of disease and pest attack and limited pre-harvest crop management; and lack of access to appropriate tools and skills during harvesting; lack of a market to sell the products immediately after harvest, which is severe during the rainy season, and lack of appropriate storage facility.

3.4. Analysis of postharvest farm level onion loss determinants

Postharvest onion quantity losses during harvesting, storage, and transport to market were assessed. The results of the determinants of postharvest losses for farm level onion value chain are presented in Table 7. Signs of parameter estimates and statistical significance of the coefficients from the multiple

linear regression model estimation indicate the direction of the response associated with the presence or level of a particular variable. For example, positive parameter estimate of a given variable indicates that the probability of a farm level onion loss in the study area increases with the presence or level of that variable while a negative parameter estimate has the opposite effect.

Table 7. Determinants of farm level postharvest onion loss

Variables	**Coefficients**	**Standard error**	**Pr > |t|**
Intercept	46.52	17.21	0.01
Age (N)	-0.24	0.18	0.18
Gender (1=male, 0=female)	14.48	6.59	0.04
Education (1= formal education, 0 = no education)	-11.43	5.24	0.04
Marital status (1=married, 0= otherwise)	-4.15	5.57	0.46
Distance to nearest town (Km)	0.22	0.24	0.36
Onion farming experience (1= >10, 0 = <=10)	-2.82	2.68	0.30
Distance from service giving institutions (Km)	2.01	2.37	0.40
working persons (N)	-0.59	0.61	0.34
land size covered by onion (ha)	4.17	3.81	0.28
Variety (1 = improved, 0 = local)	-5.26*	2.70	0.06
Time of harvest (1=any time, 0= morning)	7.23	2.95	0.02
Grading/sorting (1 = yes, 0 = no)	2.13	6.69	0.75
Storage facility (1= no farm structure, 0 = ventilated farm structure)	-8.02	2.73	0.01
Storage before market (1= >4 days, 0 = <= 4 days)	4.10*	2.35	0.09

Cooling system (1=ventilated shelf cooling, 0 = air/sun/room floor storage)	-16.45	2.69	0.00
place of sale (1= farm gate, 0 = market)	0.91	5.54	0.87
Transport mode (1 = open lorry, 0 = animal)	-8.85	6.90	0.21
Package capacity (1= <=100, 0= >100)	-9.05	3.46	0.01

Regression coefficient *, **, *** = significant at 10%, 5% and 1%, respectively.

Out of 18 considered variables, 6 variables were found to determine farm level postharvest loss of onion in the study area at $p<0.05$ level (Table 7). The model regression results showed that gender of household head, level of education, time of harvest, use of ventilated storage facility, storage cooling system, and package capacity were significant determinants ($p < 0.05$) and explained 57% (Adjusted $R^2 = 0.563$) of the variation in the onion loss at farm level. Storage before market and variety used were also found to determine onion loss at $p<0.1$ significance level. The result also showed that those farmers with more experience tend to have lower levels of postharvest losses. With more years, farmers seem to be good in managing their farm and handling harvests, hence the less the postharvest loss.

Similarly, the probability of experiencing loss is low for farmers who harvest their produce in the morning. This is in line with the expectations that harvesting at the lower temperature day time helps to reduce the rate of senescence. The result also revealed that farmers who use storage facility and were near to service giving institutions had lower probability of experiencing onion loss.

The regression result of sex indicated that the variable had positive relationship with postharvest loss. This implies that female-headed households are likely to experience less postharvest losses for these crops as compared to the male-headed households. Experience had negative effect on farm level onion loss. The negative relationship between quantity lost and farm experience indicated that the increase in farm experience resulted in a decrease in quantity lost. Family size of working age, as expected, had a negative effect on quantity lost.

Distance to nearest market had positive effect on onion postharvest farm level loss. The positive relationship indicates that the farther is a household from the market, farmers forced to transport or store their product and it leads to onion loss.

Qualitative data obtained from survey respondents and key informants interview discovers that the onion production in the study area have mainly constrained by lack of stable seed supply system, lack of appropriate pre and post-harvest handling technologies, lack of appropriate storage facility, and weak market linkage at farmer level. They suggested that there is a need for improved seed, less size packaging, domestic and export market linkage, additional income generation means, fertilizer price reduction and chemical treatments/fungicides for disease management. The farmers further suggested that training be given on pre-harvest management and postharvest handling technology to improve productivity of onion. Besides, in the focus group discussions, it was stressed that the lack of knowledge lack of appropriate pre and post-harvest handling technologies and limited market linkage at farmer level. On the other hand, the study discovers that there is

cheap labor for onion production, suitable farm land and motivated farmers to produce and market.

Generally, onion produce handling skills and storage facilities such as cooling facilities are lacking in the study area. This is in accordance with JICA and OIDA (2014) report that lack of sustainable markets for vegetables, interruption of broker in price setting, fluctuation of selling prices, weak management capacity and corruption of cooperatives committee, high costs of pesticide chemicals, lack of quality vegetable seeds, product perishability, absence of adequate preservation physical facilities and lack of transit stores were mentioned as some of the problems in vegetable marketing in the study area. Similarly, a survey conducted by Tekeste *et al*. (2013) on post-harvest handling practices in onion production in four districts (Adama, Merti, Dugda Bora and Adamitulu-Jiddokombolcha) in the Central Rift Valley Region of Ethiopia, which is close to the current study area, revealed that farmers did not subject harvested onion bulbs to any post-harvest management practices for enhancing shelf-life and marketability of the crop.

4. Conclusion and Recommendations

Lack of understanding of the extent and location of losses and associated factors within the postharvest fresh produce field handling operations is a major challenge to design appropriate postharvest loss reduction interventions at small holders' level. The survey results were in line with personal field observation results that identified the need for improved postharvest technology, improved variety seed, technical support, improved storage structure during glut and market linkage, training in handling and

storage techniques and irrigable water source. The smallholder farmers in the study area need necessary support and complementary resources to reduce postharvest farm level onion losses. They need capacity building interventions to improve skills in postharvest handling practices.

The following recommendations are made as to be considered based on the producers' survey result analysis of onion handling in Lode Hetosa district:

- Training on farmers' postharvest handling skills that can help reduce farm level onion losses has to be given to producers and development agents so as to improve the shelf life of onion that can generate a better income to producers.
- Provision of trainings on construction of improved small scale farm structures and ventilated storage facilities to avoid market glut and make onion available off season.
- Introduction of improved/appropriate size packaging materials.

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