

Socio-economic determinants of onion post-harvest losses in Wamakko LGA of Sokoto State, Nigeria

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ABSTRACT: The objective of this research is to identify the socio-economic characteristics of onion farmers, the causes of onions' post-harvest losses, and indigenous technologies used for onion storage in the study area. The purposive sampling method was used to administer a structured questionnaire that encompasses both open and closed-ended questions. Data for the study were generated from a sample population of 240 farmers in four major onion-producing areas. The primary data for the study were obtained from onion farmers using a pre-test structured questionnaire. Descriptive statistical analysis and multiple regression were used to analyse the data. The study reveals that the most important factor in onion storage is inadequate storage facilities, and storage structure is achieved by using local storage (rumbu and dabi) and spreading on a mud floor in a room and under tree shade. These resulted in devastating loss of the products before reaching the market for sale. The study recommends that the government and private organisations should assist farmers with modern storage structures to forestall economic loss of onions.

Keywords: Farmers, post-harvest losses, onions, Wamakko.

INTRODUCTION

Onion (*Allium cepa* L.) is a herbaceous biennial plant belonging to the family *Amaryllidaceae* and genus *Allium* (Grubben *et al.*, 2004). Bulb onion, also known as common onion, is grown globally as a commercial crop and is used widely either as a vegetable in the form of a salad or as a component in a meal preparation. Onion is a source of vitamin C, vitamin B6, potassium, magnesium, polyphenols, and its medicinal value is highly acclaimed (Rodrigues *et al.*, 2003; Hänninen *et al.*, 2000; Verma and Singh, 2004).

Onion is grown globally in about 170 countries. China ranks first with over 18 million tons of bulb onion produced, followed by India (11 million) and the USA (about 3.2 million) tons of annual production (Hanci, 2018). Nigeria is the largest producer of onions in West Africa, with a total production of slightly above 1.1 million tonnes. Onions are mostly produced in Northern Nigeria. The dominant states involved in the production of onions are Sokoto, Kaduna, and Kano States (CBI, 2021).

In the meantime, while the number of food-insecure population remains unacceptably high, each year and

worldwide, massive quantities of food are lost due to spoilage and infestations on the journey to customers (FAO, 2010). In some African countries like Nigeria, where tropical weather and poorly developed infrastructure contribute to the problem, post-harvest loss can regularly be as high as 40-50% (FAO *et al.*, 2012). Obviously, one of the strengthening food qualities and quantity is by reducing these losses.

Annually, farmers produce a lot to boost the economy, but most are lost at the post-harvest stages. Thus, outputs of all agricultural commodities produced in the field have to undergo a series of operations such as threshing, transportation, processing, storage and exchange before reaching the final consumer, and there are appreciable losses of outputs during the stages of handling (Basavaraja *et al.*, 2006). The sum quantity of outputs lost in these stages is referred to as post-harvest loss. The post-harvest scenario in vegetables (onions) presents a dismal picture and is mostly composed of traditional techniques practised by growers, traders, resulting in a

considerable deterioration of physical and nutritional qualities of the harvested crop (Oni and Obiakor, 2002; Sablani *et al.*, 2002; Alidu *et al.*, 2016). Mbuk *et al.* (2011) and Olayemi *et al.* (2012) pointed out that the quality and nutritional worth of the fresh foods are affected by post-harvest handling and storage conditions that eventually cause post-harvest losses. Mrema and Rolle (2002) also stated that post-harvest losses of onions range between 20-40%, because harvesting, processing/storage techniques are inefficient, as a result, supply is unstable. In perishable crops like onions, proper and scientific storage, packaging, transport, and handling technologies are not adequate, and hence, a considerable amount of produce is wasted. The moisture content of the onion is inherently more liable for deterioration in quality and quantity, especially under tropical conditions. Moreover, they are biologically active and carry out transpiration, respiration, and other biochemical activities that contribute to the deterioration in quality of the produce. Thus, post-harvest losses in onions during post-harvest operations due to improper handling and storage are enormous. Basavaraja *et al.* (2006) reported that in underdeveloped and developing tropical countries, both quantitative and qualitative losses of agricultural products occur at all stages along the post-harvest value chain, from harvesting, through handling, storage, processing, packaging, transportation and marketing until crops are delivered to final consumers.

Post-harvest losses in onions can be caused by a wide variety of factors/determinants ranging from poor sources of planting seeds/seedlings, growing conditions, to handling at a farm level. Not only are losses clearly a waste of food, but they also represent a similar waste of human efforts, farm inputs, livelihoods, investments and scarce resources such as water (Olayemi *et al.*, 2012).

In Wamakko Local Government Area of Sokoto State, where onions are grown in large quantities mostly during the dry season, with inadequate storage capacities that are mostly traditional and unscientific. As a result, during this period, prices fell very low due to a glut situation. Thereafter, the rise in prices is quite rapid and sometimes wide fluctuations occur, leading to dissatisfaction amongst the producers as well as consumers. During this bulk production period, onion growers either sell their produce at a low price in fear of high storage loss or store for a few days using traditional methods under ambient conditions. In both cases, dealers have more control of onion price in favour of the growers because of poor or unavailability of storage facilities, such as cold storage, and where they are available, they are beyond the reach of smallholder farmers. These necessitate most of the farmers in Wamakko Local Government Area to bring their onions directly to the market after harvest in order to avoid post-harvest loss. Mrema and Rolle (2002) posited that about 20-40% of onions are lost after post-harvest due to inefficient storage techniques. This is similar to Halliru *et al.* (2019), who stated that 31% or above onion loss occurred as a result of inadequate and local storage

techniques.

This research intends to identify the causes of onions' post-harvest losses incurred by the farmers and indigenous technologies used for onion storage with the view to finding possible solutions and recommendations for the post-harvest losses incurred by the onion farmers. Thus, this study will focus on the socio-economic determinants of post-harvest losses of onion farmers in Wamakko Local Government Area of Sokoto State, Nigeria.

METHODOLOGY

Study area

The study was carried out in Wamakko Local Government Area of Sokoto State, Nigeria, which lies between latitude 12° N and 13° 58' N and longitude 04° 8' E and 6° 54' E (Figure 1). Wamakko was estimated to have an area of 697 km² and a population of 209,204 (National Population Census, 2015). Wamakko Local Government Area was described by the presence of hills, sandy savannah, in addition to numerous rivers, streams and dams. The annual rainfall is about 50 mm, with the highest peak in August. The predominant tribe in Wamakko is Hausa. The residents were mainly farmers and fishermen (Kabiru *et al.*, 2013).

Method of data collection

Data for the study were generated from both primary and secondary sources. The primary data for the study were obtained from onion farmers by using a pre-test structured questionnaire. The data collected include the socio-economic characteristics of the respondents (sex, age, levels of education, farm size), causes of onion losses, and the indigenous onion storage methods used. The questionnaires were administered through face-to-face interviews with farmers.

Sampling method

The population of the study consist of the Onion farmers in the four (4) major onion production communities of Wamakko Local Government area, such as Asari, Lokobi Mana, Gidan Kaduna and Fanari village. In each location, 60 farmers were selected using a simple random sampling technique. A total of 240 farmers were randomly selected purposively for the study.

Analytical tool

The data obtained from the questionnaires were analysed using descriptive statistics with the help of Microsoft Excel, and the results were expressed as frequencies and

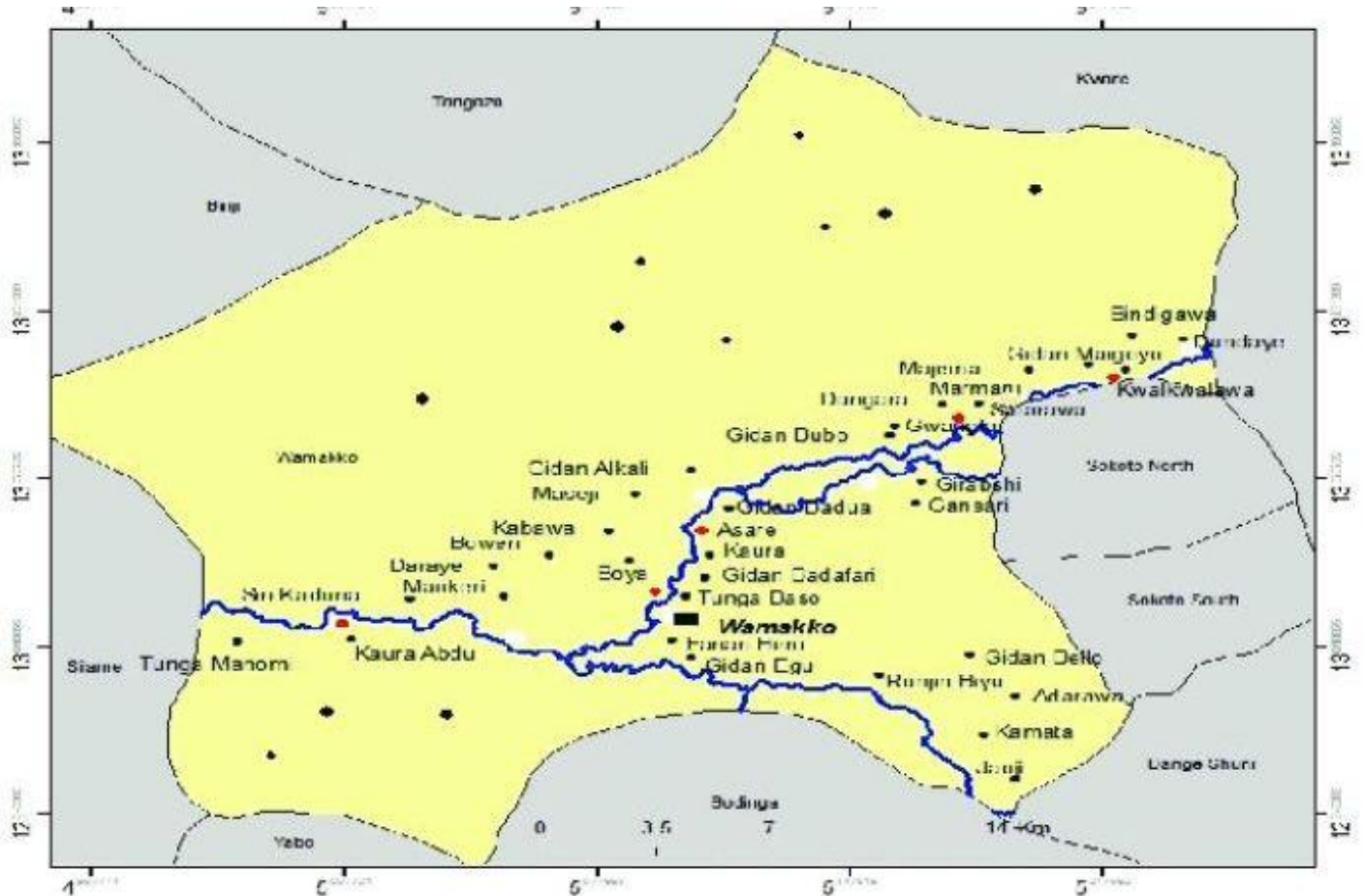


Figure 1. Map of Wamakko Local Government Area, Sokoto State.

percentages in tables. Logistic regression analysis was employed to determine factors influencing postharvest losses of onion at the farmer's level. This model will be selected because of its simplicity and practicability (Mary, 2021). The specification for the regression functional form can be implicitly represented as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8)$$

Where Y = postharvest losses (kg/ha) and X_s are the independent variables, X_1 = Age (Number of years), X_2 = Level of education (number of years), X_3 = family size (number of persons), X_4 = farming experience (number of years), X_5 = Farm size (Ha), X_6 = Output (kg), X_7 = Distance to market (km), and X_8 = Length of storage after harvest (months).

The explicit form of the function can be represented as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + u$$

Where Y , X_1 X_8 are as earlier defined, β_0 = constant

term, β_1 - β_n = parameters to be estimated, and u = error term.

RESULTS AND DISCUSSIONS

Socio-economic characteristics of onion farmers in the study area

The demographic characteristics of a population, including age, sex, farm size and education level (Tables 1 to 5), may affect agriculture negatively or positively. Results indicated that the majority of respondents interviewed were males (90%). Similar findings have been reported in Northern Nigeria in research conducted by Halliru *et al.* (2019), where the majority of respondents involved in onion production were males.

The results indicated that the average age of onion farmers in the four study sites was 41 years, with 67.5 per cent respectively (Table 1). This was contrary to the average age of Kenyan farmers of 60 years in 2018, as was reported by Gathambiri *et al.* (2021). Onion enterprise requires intensive labour (Dogondaji, 2005); therefore,

Table 1. Sex of the onion farmers in the study area.

Sex	Asari	%	Lokobi mana	%	Gidan Kaduna	%	Fanari	%	Total	%
Male	57	95	54	90	54	90	51	85	216	90
Female	3	5	6	10	6	10	9	15	24	10
Total	60	100	60	100	60	100	60	100	240	100

Field Survey; 2024.

Table 2. Age of the respondents in the study area.

Age	Asari	%	Lokobi Mana	%	Gidan Kaduna	%	Fanari	%	Total	%
21-30	18	30	12	20	6	10	8	13.3	44	18.3
31-40	36	60	42	70	42	70	42	70	162	67.5
41-60	6	10	6	10	12	20	10	16.6	34	14.16
Total	60	100	60	100	60	100	60	100	240	100

Field Survey.2024.

Table 3. Level of education of onion farmers in the study area.

Level of education	Asari	%	Lokobi Mana	%	Gidan Kaduna	%	Fanari	%	Total	%
Informal	17	28.3	33	55	7	11.6	31	88	36.6	
Primary	22	36.6	15	25	26	43.3	15	78	32.5	
Secondary	18	30	12	20	22	36.6	12	64	26.6	
Tertiary	3	5	Nil	Nil	5	8.3	2	10	4.16	
Total	60	100	60	100	60	100	60	240	100	

Field survey; 2024.

Table 4. Onion farm size of the respondents in the study area.

Farm size (Ha)	Asari	%	Lokobi Mana	%	Gidan Kaduna	%	Fanari	%	Total	%
0.5	24	40	30	50	30	50	24	40	108	45
0.51-1.0	18	30	12	20	6	10	12	20	48	20
1.10-1.50	12	20	6	10	12	20	12	20	42	17.5
1.51-2.0	6	10	6	10	6	10	6	10	24	10
2.00	Nil	Nil	6	10	6	10	6	10	18	7.5
Total	60	100	60	100	60	100	60	100	240	100

Field survey; 2024.

farmers aged 41 years of age who are in their productive age were involved in the onion production.

About thirty-three per cent (3%) of the respondents had attained primary education level, 59.1% were educated up to secondary level, and 4.2% had tertiary level of education, while the rest had informal education (36.6%). Education level influenced postharvest losses incurred at the farm level (Table 3). Secondary and tertiary level of education enhances farmers' ability to access postharvest management knowledge and skills, especially during

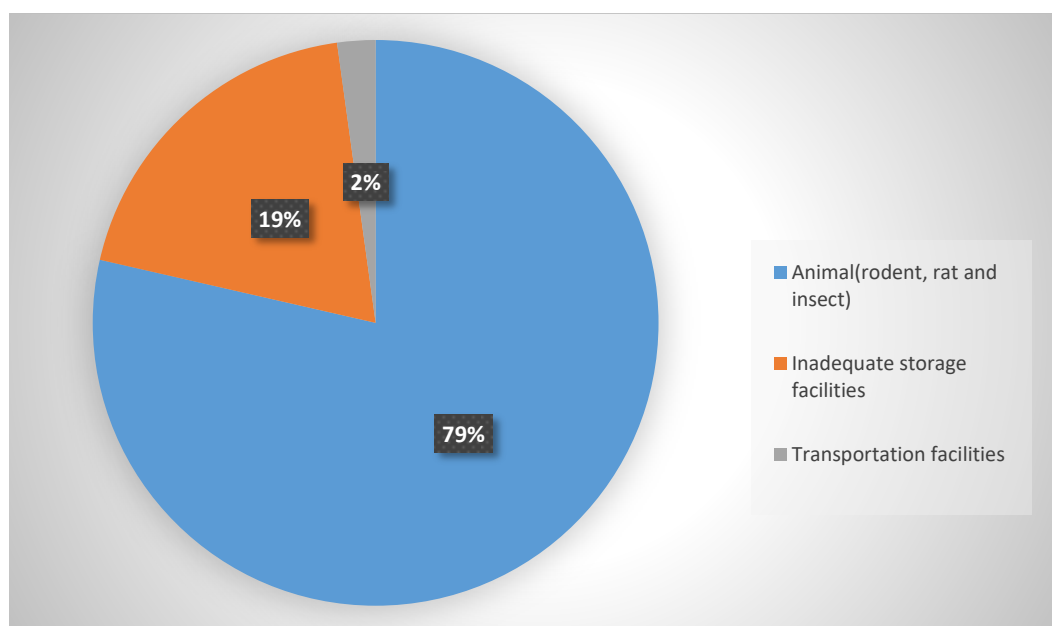
training. This enables the farmers to employ appropriate postharvest management techniques, thus influencing postharvest losses negatively.

The average farm size owned by the respondents was 1.2 ha, with 0.75 ha under onion production (Table 4). In the developing world, two-thirds of the population live in rural areas with about 475 million farmers of smallholder farms who own about two hectares (Gathambiri *et al.*, 2021). In Nigeria, farmers owned an average farm size of 1.2 ha (Halliru *et al.*, 2019). However, the results established

Table 5. Farmers experiences in post-harvest losses.

Parameters	Asari	%	Lokobi Mana	%	Gidan Kaduna	%	Fanari	%	Total	%
Yes	60	100	60	100	60	100	60	100	240	100
No	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	60		60		60		60		240	100

Field Survey; 2024.

**Figure 2.** Factors responsible for post harvest loss in the study area.

that bulb onion producers in Asari, Lokobi mana, Gidan kaduna and Fanari villages owned an average of 1.2 ha with 0.75 ha under onion production. Onion production in Nigeria has gained popularity over the years due to high demand in domestic markets. This resulted in farmers opening up vast areas previously not engaged in onion production to meet market demand.

Causes of post-harvest loss

The result from the data obtained on the causes of post-harvest loss in the study area indicated that all the onion farmers experience post-harvest loss (Table 5). The most important factors that are responsible for post-harvest loss are animals (rodents, rats and insects) (19.24%), inadequate storage facilities (78.58%) and negligible contributions of inappropriate transportation facilities (2.18%), as indicated in Figure 2. Inadequate storage facilities were recorded to be the highest cause of post-harvest loss in the area. This incident makes the farmers incur losses in economic terms. Some of the respondents revealed that, out of a hundred (100) bags of onion stored

after harvesting is hard to get thirty (40) bags in a year. This necessitates some farmers to sell their products immediately after harvesting at the farm point or to market directly.

Indigenous method of onion storage facility

The onion farmers in the study area adopt various methods of storing the onion, such as local store (Rumbu), Local store (Dabi), spreading on the mud floor inside rooms and spreading under trees in order to avoid post-harvest losses. And each method used depends on the ability and capability of the individual farmer, as indicated in Table 2. The majority of the respondents (52.91%) in the study area use local stores (Rumbu) as a means of storing their onion product (Table 6). This method indicates a lower risk of post-harvest loss and is therefore a highly adopted indigenous method of storing onion products in the study area. The rate of onion loss incurs at storage duration as indicated by farmers between 31% and above of the total

Table 6. Indigenous (local) method of used for onion storage in the study area.

Parameters	Asari	%	Lokobi Mana	%	Gidan Kaduna	%	Fanari	%	Total	%
Local store (Rumbu)	32	53	30	50	30	50	35	58	127	52.91
Local store (Dabi)	18	30	25	41.6	20	33.3	15	25	78	32.5
Spreading on the mud floor inside room	7	11.66	3	5	5	8.33	5	8.3	20	8.33
Spreading under tree	3	5	2	3.33	5	8.33	5	8.3	15	6.25
Total	60	100	60	100	60	100	60	100	240	100

Field survey; 2024.

Table 7. Rate of onion loss incur at storage in the study area.

Rate	Asari	%	Lokobi Mana	%	Gidan Kaduna	%	Fanari	%	Total	%
1-10%	0	00.00	0	0.00	0	0.00	0	0.00	0	0.00
11-20%	9	15	3	5	12	20	6	10	30	12.5
21-30%	18	30	12	20	24	40	9	15	63	26.25
31% and above	33	55	45	75	24	40	45	75	147	61.25
Total	60	100	60	100	60	100	60	100	240	100

Field survey; 2024.

onion produce by farmers is (61.25%) in all the sampled areas of the study area with the exception of very few farmers (12.5%) that experiences about 1-10% loss of the onion (Table 7) as a results of unscientific method of storage facilities used as spreading on a mud inside the room and spreading under the tree shade.

Determinants of post-harvest loss in onion

The coefficient of multiple determination (R^2) is 0.6854, implying that the explanatory variables in the model explain about 69% of the total variation in the postharvest loss in onion production (Table 8). The results reveal that the significant factors influencing postharvest loss in onion production in the study area were age, educational level, family size, distance to market, farm size, output, and length of storage after harvest. The age of a farmer was significant ($p < 0.05$) and positively related to postharvest loss in onion production. This suggests that older farmers are likely to incur more postharvest loss than young ones. This may be due to the fact that the older a farmer is, the less innovative or energetic he is likely to become (Falola *et al.*, 2022). Young farmers are likely to have the required physical strength to carry out postharvest management, thereby minimising postharvest loss than their older counterparts. Also, the young farmers are usually more innovative and more likely to adopt improved postharvest management practices than their older counterparts (Falola *et al.*, 2017).

The level of education of the respondents was very highly significant ($p < 0.01$) and negatively related to

postharvest loss. This implies that well-educated farmers have lower post-harvest losses than those with less education. Education has been reported to enhance the ability of an individual to make better, meaningful and more accurate decisions (Alidu *et al.*, 2016). It can also enhance the adoption and use of improved technologies that may guide against postharvest loss. This result is in line with many similar studies (Salisu *et al.*, 2019). The family size of the respondents was significant ($p < 0.01$) and negatively affected postharvest losses in onion production. This suggests that farmers with large family sizes tend to incur less postharvest loss. This could be due to the relatively high availability of family labour to such farmers, which makes postharvest management practices much faster and more efficient. Halliru *et al.* (2019) reported a similar finding that household size influenced postharvest loss in tomato production. The results also show that the larger the farm area put under cultivation, the more postharvest loss and vice versa. This could be due to the low level of modern storage facilities for storing and preserving the harvested onions. Similarly, an increase in the output of onions also increased postharvest loss. This may also result from a lack of proper storage due to poor storage facilities. It may also be due to the high labour requirement needed to carry out the harvesting on time, which may be lacking or not within the reach of the farmer. The same explanation may be responsible for the significant positive influence of the length of storage on postharvest loss in the study area. Distance to market also influenced postharvest loss in onion production positively ($p < 0.05$). This implies that the longer the distance covered from the farm to the market,

Table 8. Determinants of postharvest loss in onion.

Variables	Coefficients	Standard error	t-value	p-value
Age	0.0557**	0.0282	1.9762	0.042
Level of Education	-1.0500 ***	0.1455	-7.2142	0.000
Family size	-0.2650***	0.0930	-2.8513	0.005
Farming experience	0.0823	0.7843	0.1049	0.295
Farm size	0.3801***	0.0907	4.1900	0.000
Output	0.1180***	0.0189	6.2463	0.000
Distant to market	0.2187***	0.1102	1.9853	0.038
Length of storage after harvest	0.0635***	0.0318	1.9967	0.043
Constant	13.9243	1.1657	11.9449	0.000
R ²	0.6854			
Adjusted R ²	0.6531			
F- value	17.02			

***, **, *Signifiant at 1%, 5%, and 10% respectively (Source: Authors computation, 2024).

the higher the postharvest loss in onion production. This could be a result of poor road networks in the rural areas, which contributed to and/or resulted in the postharvest loss.

Conclusion

The study revealed that most onion farmers in the study area were male, with an average age of forty-one years. Post-harvest losses were mainly caused by inadequate storage facilities, animal infestation, and poor transportation, with inadequate storage being the most significant factor. These losses often force farmers to sell their produce immediately after harvest, resulting in reduced income. To mitigate this, farmers adopted various storage methods such as local stores (rumbu and dabi), spreading on mud floors, and drying under trees, with local stores proving most effective in minimising losses. However, the continued use of unscientific storage practices contributes to high loss rates. Factors such as age, farm size, output, market distance, and storage duration were found to increase post-harvest losses, while education level and family size reduced them. Overall, most losses occur during off-farm handling and storage stages.

Recommendations

Following the findings of the study, it was recommended that;

1. There is a need for the government and private organisations to assist the farmers in building modern onion storage facilities to forestall economic loss of onions.
2. Considering the nutritional value of onion, there is a

need for the government and private organisations/ individuals to provide onion processing plant that can be used for different purposes apart from food.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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