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Determinants of Onion Storage Losses Among Farmers In Selec* 1 Local Government Areas In Sokoto State

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Abstract: This study evaluated onion storage losses among farmers in selected Local Government Areas (LGAs) in Sokoto State. The four LGAs were purposively selected for the study. From the LGAs, 80 farmers were randomly selected from 16 purposively selected villages. Data on onion storage losses were collected fortnightly between December 2002 and September 2003. Descriptive statistics and multiple regression analysis were used for data analysis. *Rudu*, room, *dabi* and *bukka/kutubi* were the storage structures commonly used by respondents. An average of 4, 389.2 kg were stored for a duration of between one to five months. Rotting, dehydration and sprouting were the major causes of storage losses. Results of the multiple regression analysis revealed that quantity of onion stored and duration of storage had significant ($P<0.01$) influence on storage losses. To reduce the level of storage losses, farmers should be educated on the general storage procedure for onion. Research efforts should be intensified so that better and more efficient storage methods could be developed, the use of *bukka/kutubi* storage by farmer should be encouraged for it gave the least storage losses and the establishment of onion dehydration plants buy the private sector be encouraged to process onion into more durable products.

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Introduction

Onion (*Allium cepa L.*) is second only to tomato (*Lycopersicum lycopersicum*) as the most important vegetable world wide (Grubben, 1977). It is a vegetable crop that is eaten in almost the same quantity throughout the year (Regmi, 1994). It is also a vegetable crop that can be stored for months. This is possible because onion as a storage organ respires at much slower rate and will therefore remain fresh for much longer period than other vegetables (Fordham and Biggs, 1995). However, poor or inadequate storage facilities and methods common with the traditional practices have resulted in heavy losses to stored crops. Poor storage life of bulbs was identified as one of the major onion storage problems in the tropics where ambient storage temperature is almost universally used (Currah and Proctor, 1990). Sprouting, rotting, loss in weight and post harvest chemical and biochemical changes were reported by Ogbadu (1983) as serious problems of onion storage. Bednarz and Kadams (1986) asserted that losses caused by rotting and sprouting increased with larger bulb size. Curah and Proctor (1990) cautioned that, onion storage under ambient conditions may become a problem for the producer, who has to balance the cost of storage, the loss in weight incurred during the drying process and the likely losses through deterioration in store, against the possible rise in price if marketing the crop is deferred for some weeks or months.

The main reasons for storage losses especially in developing countries is the inadequacy of storage facilities (Boumans, 1985). Currah and Proctor (1990) identified four main onion handling groups: farmers, middlemen, retailers and government and that more bulb onion are stored by farmers than any other grouping. It could thus be assumed that the number of farmers' stores significantly outnumber other types of stores. Currah and Proctor (1990) further reported the use of different storage methods ranging from bags and sacks, losses storage, layering with alternate layers of sand or straw to crates or boxes.

In Nigeria, commercial onion production is mainly in the north (Ayodele, 1996). The crop is cultivated in two marked seasons, namely rainy season (April to August/September) and dry season (September/December to April) (Awurum, 1999). In Sokoto State, northwestern Nigeria, it is the dry season crop that is cultivated. Since cultivation is limited to a specific season of the year and consumer demand is all year round, there is need to store onion successfully with minimal loss. This paper evaluated determinants of onion storage losses among farmers in selected LGAs in Sokoto State.

Findings of the study may serve as a guide to farmers and traders who practice storage of onion as well as a reference material for researchers and the agricultural extension service.

Methodology

Sokoto State in northwest Nigeria lies within latitude $11^0 30^1$-$13^0 55^1$N and longitude $4^0 07^1$-$6^0 56^1$E (Singh, 2000). The state is divided into 23 LGAs with a population of 2, 359, 533 according to the 1991 provisional census figure (SOSG, 1999). The area falls within the semi-arid sub-Saharan region where long (October-May dry and short (June-September) rainy season prevail. The former consists of a cold dry spell (November-January), the harmattan period and a hot dry spell (February-May). Annual rainfall (400-700 mm) is frequently erratic with a characteristic single peak which reaches its maximum in August and the precipitation drops sharply in October. Vegetation is largely the Sudan savanna type with the northern part of the state approaching the Sahel Savanna (Shaib et al., 1997).

Farming is the major occupation of the inhabitants of the state. Crops cultivated include both food and cash crops, such as millet, sorghum, rice, groundnut, cowpea, cassava and sweet potatoes. Vegetables, such as onion, tomatoes, sweet and hot peppers are also grown during the dry season under irrigation (Anon, 1993).

Data on onion storage and storage losses were collected fortnightly between December 2002 and September 2003. Four LGAs namely Gada, Goronyo, Wurno and Kware were purposively selected for the study. From each of the selected LGAs, four villages were also purposively selected. The purposive selection was based on the intensity of onion production/storage. From each of the selected villages, five farmers were randomly selected, giving a total of 80 farmers selected from 16b villages. However, (58.75%) of the sampled farms stored onion for various duration using different storage methods. Storage data for the study were therefore collected from the respondents who practiced onion storage. Data were analysed using descriptive statistics and multiple regression analysis. The multiple regression model used is represented implicitly as:

$Y = f(X^1, X^2, X^3, D^1, D^2, D^3)$ ....(1)

Where:

Y = Quantity of onion lost in storage (kg)
X^1 = Quantity of onion stored (kg)
X^2 = Duration of onion storage (Months)
X^3 = Experience in onion storage (Years)
D^1 = Dummy variable for room storage (= 1 if onion is stored in room)
= 0 otherwise)
D^2 = 1 if onion is stored in *rudu*
= 0 otherwise
D^3 = 1 if onion is stored in *dabi*
= 0 otherwise

The model was analysed using the linear, Cobb-Douglas, quadratic and semi-log functional forms.

The explicit form of the linear function is represented as

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_1 D_4 + \beta_5 D_2 + \beta_1 D_3 + U$ .... (2)

Where Y, $X_1, \ldots X_3$, $\beta_1 \ldots \beta_6$, $D \ldots D_3$, α and u are as earlier defined

α = Constant term
β_1- β_6 = Parameters estimated
u = Error term

Cobb-Douglas Functional form

$Y = \alpha + X_1^{b1} X_2^{b2} X_3^{b3} D_4^{b4} D_5^{b5} D_6^{b6} eu$ ....(3)

The logarithmic transformation of the model is

$\text{Log } Y = \alpha + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 D_1 + \beta_5 D_2 \beta_6 D_3 + u$.... (4)

Where Y, $X_1 \ldots X_3$, $\beta_1 \ldots \beta_6$, $D_1 \ldots D_3$, a and u are as earlier defined.

The quadratic functional form:

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 D_1 + \beta_5 D_2 + \beta_6 D_3 \; \beta_7 X_1^2 + \beta_5 X_2^2 + \beta_9 X_3^2 + \beta_{10} D_1^2 + \beta_{11} D_2^2 + \beta_{12} D_3^2 + \beta_{13} X_1 X_2 X_3 D_1 D_2 D_3 + u$ ....(5)

Where Y, $X_1 \ldots X_3$, $\beta_1 \ldots \beta_6$, $D_1 \ldots D_3$, α and u are as earlier defined.

The semi-log functional form:

$Y = \alpha + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 D_1 + \beta_5 D_2 + \beta_6 D_3 \div u$........... (6)

Where Y, $X_1, \ldots X_3$, $\beta_1 \ldots \beta_6$, $D_1 \ldots D_3$, α and u are as earlier defined.

The *bukka/kutubi* storage was treated as the base category in the assignment of dummy variables. The intercept therefore reflect the intercept of this category. The intercepts β, β_5 and

β_6 tell by how much the intercepts of the other three categories differ from the intercept of the base category.

In the preceding model, β_4, β_5, and β_6 tell by how much onion storage loss when room, *rudu* and *dabi* storage are used differ from onion storage loss when *kutubi/bukka* storage is used. A negative coefficient indicates that the category made less contribution of the base category while a positive coefficient indicates that the category made more contribution to storage loss compared to the contribution of the base category.

The functional forms of the model used in the analysis include linear, Cobb-Douglas, quadratic and semi-log functional forms. The Cobb-Douglas functional form was selected as the lead equation for it gave the best fit.

Result and Discussion

Onion storage practices commonly used by farmers in the area include room, *rudu*, *dabi* and *bukka/kutubi* methods. It was also found that some farmers used more than one storage method at a time (Table 1). The distribution of respondents according to methods of storage used is presented in Table 1.

Table 1: Distribution of respondents according to methods of storage used.

Storage method	Frequency	Percentage
Rudu	23	48.93
Dabi	10	2127
Bukka/kutubi	8	17.02
Room	8	17.02
Total	49*	

* Greater than sample size (47) because some respondents used more than one method.
Source: Field Survey, 2002/2003.

Findings of the study revealed that 48.93% of the respondents used *rudu*, 21.27% of the respondents used *dabi* whereas 17.02% of the respondents each used *bukka/kutubi* and room storage (Table 1). Majority of the respondents (91.48%) had their stores located near their homes whereas the remaining 8.52% had their stores on the farm.

Room storage involves the use of living rooms for onion storage. The *rudu* (Fig. 1) is a storage structure resting on wooden poles and constructed with sticks, sorghum stalks, grass mat and thatch. Usually constructed near the dwelling houses, the *rudu* has a narrow gate through which onion is loaded in or evacuated. The structure can last for more than one year and the capacity varies with size.

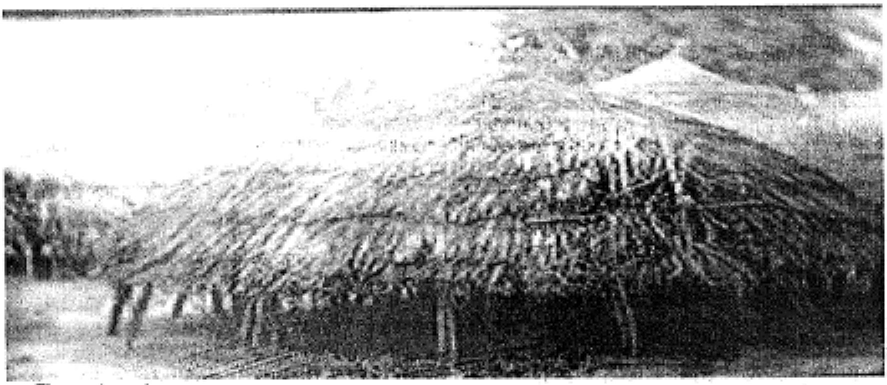

Figure 1: *rudu*

The *dabi* (Fig. 2) is a rectangular storage structure constructed with wooden poles, sorghum stalks and thatch. Shorter poles and sorghum stalks are used to construct a platform in the structure. It is on the platform that the onion is placed to prevent it from having direct contact with the ground. The *dabi* is also constructed close to dwelling houses. It is a bigger structure compared to the *rudu* and can contain more onion than either the *rudu* or *bukka/kutubi*. The structure can last for more than one year.

Figure 2: The *dabi*

The *bukka/kutubi* (Fig. 3) cone shaped is a storage structure constructed with sorghum stalks and thatch or with thatch only. When the onion is to be removed before the beginning of the rainy season, it is usually placed on the ground and covered with the structure. However, when the onion is to remain in store for some weeks or months into the rainy season, a structure is erected using sorghum stalks and stones to raise the onion above the ground level. The *bukka/kutubi* is a smaller storage structure compared to either the *dabi* or *rudu*. It may be constructed in the field where there is no danger of theft and when the onion is to be removed before the rains otherwise it is constructed near the dwelling houses. The structure last for only one storage season.

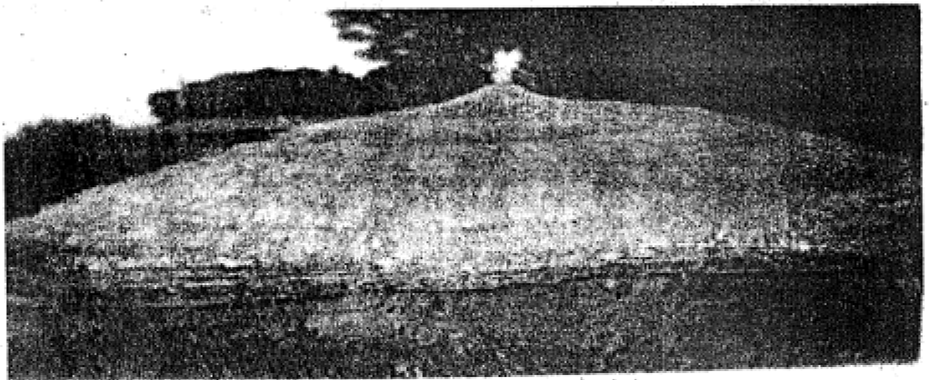

Figure 3: The *bukka/kutubi*

Duration of Onion Storage

An average of 4,387.2 kg of onion was stored by the respondents. The distribution of respondents according to the duration of storage is presented in Table 2.

Table 2: Distribution of respondents according to the duration of storage.

Duration of storage (month)	Frequency	Percentage
1-2	7	14.89
3-4	32	68.09
5 and above	8	17.02
Total	47	100

Source: Field Survey, 2002/2003

Results of the study revealed that majority (68.09%) of the respondents store their onion for a period of between three and four months (Table 2). Onion was stored for five months or more by 17.02% of the respondents.

Onion Storage Losses

A total of 3,916 kg representing 19.35% of the total quantity stored or an average of 849 kg of onion was lost in storage. The distribution of respondents according to storage loss (Table 3) shows that between 251 and 500 kg was lost in storage by 25.53% of the respondents, 23.4% of the respondents lost over 1000 kg while only 8.51% of the respondents lost 250 kg or less.

Table 3: Distribution of respondents according to storage loss

Storage loss (kg)	Frequency	Percentage
Less than 250	4	8.5
251-500	12	25.53
501-750	10	21.28
751-1000	10	21.28
Over 1000	11	23.40
Total	47	100

Source: Field Survey, 2002/2003.

Onion storage in the area of study is undertaking during the hottest season of the year (March, July/August). The heat coupled with the use of poorly ventilated traditional storage structures, could be responsible for the high level of losses recorded. The quantity lost is however, within the range of 15-20% estimated by Karikari (1989). He attributed the losses recorded in his study to poor post harvest handling including storage.

Causes of Onion Storage Loss

Major causes of storage loss were identified as rotting, dehydration and sprouting. Asked to estimate the quantity lost to each of the three causes, it was realised that rotting accounted for 11.92%, dehydration 7.15% and sprouting 0.28% of the total quantity stored (Table 4). However, all the respondents experienced loss from more than one cause of storage loss. Loss caused by rotting and dehydration were reported by 87.23% of respondents whereas the remaining 12.27% reported storage loss caused by rotting, dehydration and sprouting. Ogbadu (1983) reported sprouting, rotting, loss in weight and post harvest chemical and biochemical changes as serious problems of onion storage.

Table 4: Quantity of onion lost in storage by causes.

Storage method	Frequency	Percentage
Sprouting	591.31	0.28
Rotting	24,584.37	11.92
Dehydration	14,739.93	7.15
Total	39,916.6	19.35

Source: Field Survey, 2002/2003.

Determinants of Onion Storage Losses

Multiple regression analysis was used to estimate the relationship between the dependent variable (onion storage loss) and the independent variable. The independent variable consists of three quantitative explanatory variables, namely; quantity of onion stored (X_1), duration of storage (X_2) and years of experience in onion storage (X_3). The qualitative (dummy) variable, method of storage, had four categories. The first category *kutubi/bukka* storage was used as the base category, and the other categories were room storage (D_1), *rudu* storage (D_2) and *dabi* storage (D_3).

The functional forms of the multiple regression model used for the estimation were the linear, Cobb-Douglas, semi-log, exponential and the quadratic forms. Results of the Cobb-Douglas function were reported for it gave the best fit in terms of high R^2 value, number and magnitude of significant variables and appropriate signing of the coefficients. Results of the Cobb-Douglas function are presented in Table 1.

Table 5: Relationship between onion storage loss and its determinants.

Variables	Regression coefficient	Standard error	t-value
Constant ( )	-1.960	1.269	-1.544
Quantity stored (X_1)	0.821	0.151	5.427***
Duration of storage (X_2)	1.194	0.205	5.812***
Experience in storage (X_3)	-0.028	0.117	-0.240
Room storage (D_1)	0.698	0.295	2.363**
Rudu storage (D_2)	0.216	0.239	0.902^{ns}
Dabi storage (D_3)	0.250	0.241	1.037^{ns}
R^2 = 0.752, Adjusted R^2 = 0.715			
F-value = 20.204***			

*** = significant at P<0.01
** = significant at P<0.055
^{ns} = Not significant
Source: Field Survey, 2002/2003

The F-value is a measure of the joint significance of all the explanatory variables included in the model. The F-value of 20.204 is highly significant (P<0.01). The adjusted coefficient of determination (adjusted R^2) is 0.715, implying that 71.5% of the variation in onion storage loss among the respondents was accounted for by the explanatory variables included in the model. The regression coefficients for quantity stored (X_1) and duration of storage (X_2) are positive and significant (P<0.01). Years of experience in onion storage (X_3) had negative but significant relationship with storage loss. All the dummy variables had positive regression coefficients indicating that they made positive contribution to onion storage losses. However, only the coefficient with respect to room storage was significant at (P<0.05).

Results of the study (Table 5) show that one percent increase in the quantity of onion stored (X_1) by the respondents, accounted for 0.821% increase in onion storage loss. Therefore, as more onion is stored, higher storage losses should be expected. Similarly, one percent increase in the duration of storage accounted for 1.194% increase in onion storage losses. However, the regression coefficient for experience in onion storage (X_3) had negative regression coefficient, implying a decrease in the quantity of onion loss in storage, with increase in the years of experience in onion storage. The results further indicate that for one percent increase in onion storage experience, there was a decrease of 0.02792% in storage loss. Thus as the years of experience in storage increases, the farmer is expected to acquire additional skills in the storage practice. This will enable him to improve on his storage practices, leading to a decrease in storage loss.

Room storage (D_1), *rudu* storage (D_2) and *dabi* storage (D_3) all had positive regression coefficients. This implies that storing onions in these structures instead of *bukka/kutubi* increased storage losses. Storage in room, *rudu* and *dabi* instead of *bukka/kutubi* would increase storage loss by 0.81%, 0.21% and 0.09% respectively. Less onion storage loss should therefore, be expected as more farmers use *bukka/kutubi* compared to the other methods. The *bukka/kutubi* method is a smaller structure, contains less onion and therefore less weight is exerted on the bulbs underneath, thus allowing for better aeration. The structure can also be easily inspected for damage or rotten bulbs. Which are removed thereby preventing the infection of other bulbs. These qualities help in improving the keeping quality and thus decrease the magnitude of storage losses.

Conclusion and Recommendations

Onion storage losses were evaluated. Findings of the study revealed that room, *dabi*, *rudu* and *bukka/kutubi* were the structures used for onion storage in the study area. Onion storage losses were high, causes of which were identified as rotting, dehydration and sprouting. Quantity of onion stored and the duration of storage significantly influenced storage losses. The use of room, *rudu* and *dabi* methods of storage increased losses compared to the base category (*bukka/kutubi* storage).

Government should explore the possibility of inviting or encouraging the private sector to establish onion dehydration plant(s). Processing of onion into more durable products will assist in reducing the level of storage losses in addition to preparing the product for introduction into the international market. It is also suggested that research efforts in the area of storage, be intensified, so that better and more efficient methods could be developed. Farmers should also be educated on the general storage procedure for onion and the need to avoid practices that are known to encourage losses. The use of *bukka/kutubi* method by farmers should be encouraged since less onion storage loss is recorded when this method is used compared to other methods.

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References

Awurum, A.N. (1999) evaluation of onion (*Allium cepa* L) cultivars under rainfed and irrigated conditions in the humid tropics. *Journal of Sustainable Agriculture and Environment* 1:56-60.

Anon (1993). *Geographical Location and Climate of Sokoto.* Government printer, Sokoto P.1.

Ayodele V.I. (1996) Onion *Allium cepa L.* and *Allium cepa L.* Var *aggregation* production in Ibadan, southwest Nigeria; prospects and limitation. Paper presented at the 11th Annual Conference of the Horticultural Society of Nigeria. Ogun State University, Ago Iwoye, 1-4 April.

Bednarz, F. and A. Kadams (1986). Onion storage as influenced by variety and bulb size. Paper Presented at the Horticultural Society of Nigeria 8th Annual Conference/10th Anniversary of NIHORT, Ibadan, Nov. 10-14. 11 Pp.

Boumans, g. (1985) *Grain handling and Storage.* Amsterdam: Elsevier Science Publishers.

Currah L. and F. J. Proctor (1990) onion in tropical regions. *National Resources Institute Bulletin* No. 35, 232 pp

Fordham R. and A.G. Biggs (1985) *Principles of Vegetable Crops Production.* London Collins. P 154-184.

Grubben, G.J.H (1977) *Tropical Vegetables and their Genetic Resource.* Rome, F.A.O. 197pp.

Karikari, S.K. (1989) Harvesting, Landing and storage of major *fadama* vegetable crops. *Proceedings of the National Workshop on Fadama and Irrigation Development.* Zaranda Hotel, Bauchi Nigeria 23-25 October. Pp 149-172.

Ogbadu G.H. (1983) "Preliminary study on the preservation of onions by gamma irradiation. *Noma News Magazine* 1 (1): 24-25.

Shaib, B.A Aliyu and J.S. Bakshi (eds). *Nigeria National Agricultural Research Strategy Plan:* 1996-2010. Department of Agricultural Science, Federal Ministry of Agriculture and National resources, Abuja, Nigeria. 335pp.

Singh, B.R. (2000). Quality of irrigation water in *fadama* lands of northwestern Nigeria II. Tubewell waters Zamfara State. *Nigerian Journal of Basic and Applied Science* 9: 191-202