# Assessment of Postharvest Practices of Groundnuts in Northern Ghana Based on the Participatory Rural Appraisal Technique

**D. Oppong-Sekyere[1*], R. Akromah[2], E. Y. Nyamah[3], A. D. Ninfaa[1], M. M. Braimah[4], M. M. Akpalu[1] and A. R. S. Salifu[1]**

[1]*Department of Ecological Agriculture, Bolgatanga Polytechnic, P.O.Box 767, Bolgatanga, Ghana.*
[2]*Department of Crop and Soil Sciences, KNUST-Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*
[3]*Sichuan Agricultural University, School of Economics, 211 Huimin Rd. Wenjiang 611130, Chengdu, China.*
[4]*Department of Agricultural Engineering, School of Engineering, Bolgatanga Polytechnic, P.O.Box 767, Bolgatanga, Upper East Region, Ghana.*

***Authors' contributions***

*This work was carried out in collaboration between all authors. Authors DOS and RA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors EYN, ADN, MMB, MMA and ARSS managed the analyses of the study. Author ADN managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

A postharvest evaluation study of groundnuts (*Arachis hypogaea* L.) was undertaken in a total of thirty (30) districts selected from the three Northern Regions of Ghana, namely, Upper West, Upper East and Northern, by employing the Participatory Rural Appraisal (P.R.A.) procedure. Ten (10) randomly selected, predominant groundnut growing districts were sampled in each case; interviews and focal group discussions were held which involved 600 individual key informants in all, 20 from

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*\*Corresponding author: Email: danieloppongsekyere@yahoo.com;*

each district/community and thirty (30) focal group discussions. Interviews were conducted using both open and close-ended questionnaires. The main aim of the research was to solicit general information on the postharvest activities and marketing of groundnuts as it pertains in Northern Ghana. The Statistical Package for the Social Scientists (SPSS version 17.0) and Microsoft Excel were used to analyze data obtained from the questionnaire; Results were summarized into means, using standard error, and percentages, where necessary. The association between storage structures and duration of groundnuts in storage was tested by the Chi-Square statistic method. Results obtained from the study shows that 'China' local groundnut variety was the most cultivated (76.5%, 99.5%, 96.5%) in all three regions (N/R, U/E and U/W respectively). Reason for choice of variety was high yielding (73.33%) and ease of harvesting and drought tolerance (32.67%). Most efficient Storage structure of groundnut was Jute sack (93%). Average length of storage was 5-6 months (74.45%). Most common storage pests were Grain weevils (57; 9.50%) and *Cercospora* Spp. (28; 4.67%). Most common storage diseases were Aflatoxin (78; 13%) and *Aspegillus* Spp. (21; 3.50%). Improvement of the storage structures has a higher likelihood of increasing the duration of groundnut in storage. The major end use of groundnut according to the study was groundnut paste (50%). Groundnuts have ready market (489; 81.50%) according to farmers. Relay of information was mostly by colleague farmers (39.33%) and MoFA (31.33%), NGOs (13.83%). The scale of measurement used was common for bowls and 100 kg bag. Average market price of a 100 kg bag and a bowl were Ghs136.55%, Ghs3.43 respectively.

## 1. INTRODUCTION

Agriculture is the mainstay of more than half of Africans. Though the most thriving and significant enterprise that propels economic development of the continent, food insecurity among arid and semi-arid African countries is a key challenge amongst global trends [1,2]. Enhancing food security is significant and consistent with increasing agricultural productivity and reducing pre- and post-harvest crop losses. Agricultural production in Africa is basically and significantly traditional, and among all the crop groupings, cereals and legumes come across as the majority in terms of food production [2]. Among the cereals and legumes, maize, sorghum, rice, wheat and millet, cowpea, groundnut, common bean, soybean, chickpea, Bambara groundnut, pigeon pea, and green gram are most common. Notwithstanding, the most dominant crops vary from one country to the other [3].

The seasonality of agricultural production in Africa demands that agricultural commodities are distributed thoroughly across the year to ensure success. Storing agricultural produce and/or products is a method of keeping and indeed saving same for future use. This is done repeatedly in the agricultural business chain during the transport of agricultural produce from producers to processors and same or its products from processors to consumers who are the end users [4,5].

According to [6], the main objective of storage of agricultural produce by small scale farmers is to ensure household food supplies or reserves as well as seeds for planting in the subsequent growing year. Cereals and legumes are stored from one harvest to the next so as to guarantee their constant supply all year round and also to ensure its quality is preserved until it is needed for use. During off-season or lean periods, the stored crop is released gradually to the market, which has an advantage of stabilizing seasonal prices [7]. According to [3], in the dry Sahelian countries in Africa, crop storage is a function of subsistence and survival [5].

The Northern Regions of Ghana (Upper East, Upper West and Northern), which doubles as the main breadbasket of Ghana, is bedeviled with low agricultural productivity, malnutrition and poverty, affecting particularly the majority of rural households [8,9,5]. Major factors militating against crop production in the regions are poor soil fertility, unavailability of quality, certified planting seeds, and unreliable rainfall [10]. In view of this, most households are unable to produce enough food to feed themselves for a major part of the year. This occurrence contributes significantly to malnutrition, as caused by a lack of protein, oil and vitamins in a largely cereal-based diet; over half of the populations in the regions live below the poverty line. Thus, families are left with no other option but to purchase additional food to supplement the family diet, or better still, depend on external

inputs to improve crop productivity, which is almost impossible for the average household [8,9,5].

Groundnuts have the ability to fix atmospheric nitrogen; and also survive in low nitrogen soils. Groundnuts also have the advantage of improving soil fertility for the subsequent crop [11].

The crop is highly nutritious, with high amounts of protein (12 - 36%), and oils (36-54%), therefore, has the potential of minimizing the problems of malnutrition. Groundnuts thrive under low rainfall conditions and can be grown with low capital investment [12]. Groundnut is a popular commodity that is widely traded in local, regional and international markets, and qualifies as an important source of income, particularly for women farmers, who, according to [13], are the main cultivators [5].

Participatory Rural Appraisal (PRA) is an approach in research that was born from Rapid Rural Appraisal (developed in the 1970s and 1980s). It is a set of informal techniques that was used by development practitioners, particularly, in rural areas to obtain, analyze and evaluate data. As an antidote to the supposed challenge of researchers and other non-community members missing and miscommunicating with local and community members in the area and context of community work, as well in agricultural and rural development projects and programmes even when conventional methods or research appeared to have proved unsuccessful [14,15]. PRA is a technique or method of research that ensures that, collection and analysis of research data are conducted by local community people; Researchers or people of their category only serve as facilitators rather than controllers of the process. Further, [14] expanded PRA as "a growing family of approaches, methods, attitudes and behaviours to enable and also empower people to share, analyze and enhance their knowledge of life and circumstances and environments and above all plan, act, monitor, evaluate and reflect on their actions" [16].

Researchers act and lean together with the villagers or community members, in a collaborative fashion, meant to assist scientists design, test and recommend new technologies in view of information gathered about farmers' criteria for usefulness of the innovation or intervention [17]. Once farmers and community members are directly involved in PRA, it is the aim that research would come up with technologies and innovations that farmers could play a key part in the dissemination of such research outcomes [18], the intended result being a more productive, stable, equitable and sustainable agricultural systems and schemes [17,5].

Notwithstanding, the current study sought to evaluate the postharvest practices and management of groundnuts as it pertains in the three northern regions of Ghana, which come across as the major producers.

## 2. MATERIALS AND METHODS

### 2.1 Location, Study Area and Sampling Procedures for PRA

A total of thirty (30) districts were chosen, by the simple sampling procedure, from the three Northern Regions of Ghana (Upper West, Upper East and Northern), by employing the PRA procedure. Ten (10) randomly selected, predominant groundnut growing districts were sampled in each case; interviews and focal group discussions were held which involved 600 individual key informants in all with 20 from each district/community, and thirty (30) focal group discussions. Interviews were conducted using both open and close-ended questionnaires. Selection of districts/communities was based on the information of quantity of groundnuts produced [19,5].

#### 2.1.1 Field visits to districts/Communities and group discussions

Visits were made to the chosen districts and/or communities by the researcher and staff of the Ministry of Food and Agriculture (MoFA) in the respective selected districts, which objective was for same to familiarize themselves with the key sites, establish a good relationship with the local people and have a first-hand experience of the study areas. The community heads and the extension officers were tasked to mobilize farmers (both male and female) for focus group discussions, Dates, time and venue were agreed on. Checklists were developed with input from field officers and used to guide discussions with farmers groups and individual key informants (opinion leaders, farmer-group/based organizations (FBOs), Agricultural Extension Agents and Chiefs from the study areas) [11].

A discussion was initiated between the researcher, farmers and extension officers, to explain the objectives of the research and also outline the role and communication processes of the various actors in the study. The most common and familiar language of communication was employed by farmers, and where necessary, the services of an interpreter was used. Farmers formed discussion groups to ensure focus and consensus building, taking into consideration, sex and age of each group [11,5].

## 2.2 Analysis of Research Data

Statistical Package for the Social Scientists (SPSS version 17.0) and Microsoft Excel were used to analyze data collected from the questionnaire, and same summarized into percentages and means; while Standard errors were used to separate means where necessary. The Chi-Square statistic method was used to test the association between storage structures and duration of groundnuts in storage.

### 2.2.1 Procedure for chi-square test

The Chi-Square statistic was used to test whether the classification variables were associated or not. With regards to the test of independence, we seek to test the following hypothesis at level α.

H$_0$: Classification criteria are independent
H$_A$: Classification criteria are not independent

The test statistic in this case is

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{\left(O_{ij} - e_{ij}\right)^2}{e_{ij}}$$

If the null hypothesis (H$_0$) is true, the value of $\chi^2$ should be small, since the observed values and the expected values will be close. The null hypothesis would be rejected if the $\chi^2$ statistic is larger than $\chi^2{}_{\alpha,(r-1)(c-1)}$.

The Chi-Square distribution is 'continuous', however the values calculated in the chi square test are not from a continuous scale but a discrete one. This is because observed frequencies vary in discrete units. The LR Chi-Square test was applied instead since the assumption of Chi-Square that no more than 20% of the expected counts were less than 5 and

all individual expected counts were 1 or greater was not met,

$$G = 2 \sum f \cdot \ln\left(\frac{f}{f_i}\right)$$

Where $f$ is the observed frequency and $f_i$ is the expected frequency.

## 3. RESULTS

## 3.1 Variety of Groundnuts

According to Fig. 1, 'China' variety was the most cultivated by the farmers in the Northern region, being cultivated by more than two-thirds, (76.5%) of the farmers, followed by 'Agric' (20%),'Oboolo' (1.5%) and 'Otuhia' (0.5%) varieties. Similar trend was observed in the Upper East region but generally with higher percentage figures; 'China' (99.5%), 'Agric' (74%) and 'Oboolo' (22%). For Upper West region, 'China' variety recorded the most cultivated groundnut variety (96.5%) followed rather by 'Oboolo' (4.5%) and 'Agric' varieties with a small percentage (0.5%), which incidentally runs through all the other varieties. Varieties, 'Obooshie' and 'Yenyawoso' were not cultivated in the Northern region.

## 3.2 Some Popular Groundnut Varieties Grown and Reasons

Majority (73.33%) of groundnut farmers interviewed, mentioned 'high yield', followed by 'ease of harvesting', (46.5%) and drought tolerance (32.67%), among others, as their reasons for choosing a particular type of groundnut variety. 'Disease tolerance' and 'Oil content' recorded 18.83% respectively whereas 'Storability' came across as the least (2.83%) reason for choice of a variety (Fig. 2). 'China variety was mostly planted by majority (76.5%) of the groundnut farmers, followed by 'Agric' (20%), 'Oboolo' (1.5%) and 'Otuhia' (0.5%) varieties.

## 3.3 Harvesting of Groundnuts and Other Activities

### 3.3.1 Harvesting

From Table 1, a vast majority of the interviewed groundnut farmers, 581 (96.83%) harvested their produce only when groundnut leaves turned yellow; and employed manual harvesting using a hoe, 375 (62.50%), employing about thirteen (13) or more workers, 176 (29.33%). This was

followed by 1 to 4 workers, 164 (27.33%) who were hired to work on farmers' groundnut farms. 'Others' and 'missing' as indicated in the statistical analysis, represent groundnut farmers who did not form part of either of the options provided (or answered by farmers) or did not provide any answer at all or had their response missing. This is therefore treated as missing data.

### 3.4 Yields of Groundnut (Shelled and Unshelled)

Yields of shelled groundnuts were generally low as 218 (36.33%) of the farmers in the study area had yields ranging from 2 to 3 bags/acre (Table 2). This was closely followed by yields of 1 to 2 bags per acre of 177 (29.50%). Only a small 87 (14.50%) of the farmers obtained yields of 6 to 7 bags/acre. Among the regions, Northern region was highest, 128 (64.00%) for 2 to 3 bags per every acre.

According to the farmers, yields of Unshelled groundnut was highest, 252 (42.00%) for 4 to 5 bags per acre of production. This figure was not too different from that recorded for 6 to 7 bags per acre, 184 (30.67%). Upper West region was highest, 116 (58.00%) for the yield range of 4 to 5 per acres of unshelled groundnut produce. 'Others' and 'missing' as indicated in the statistical analysis, represent groundnut farmers who did not form part of either of the options

provided (or answered by farmers) or did not provide any answer at all or had their response missing. This is therefore treated as missing data.

Two-thirds of the groundnut farmers, representing (426, 71.00%) indicated their worst yield for the last five years was 1 to 2 bags/acre, whereas a little above one percent, 9 (1.50%) said their worst yield was in the range of 6 to 7 bags per every acre of production (Table 2).

### 3.5 Handling and Storage

Majority of groundnut farmers (93.47%) in the Upper West region carried their groundnut produce home on head. This is followed by Upper East region, with 87.5% who stored their groundnut produce at home. In the Northern region, 84.26% of groundnut farmers stored their produce at home while a small 14.21% stored the produce on the farm (Fig. 3).

Results from the study areas in the three northern regions of Ghana, in Fig. 4 shows that, Jute sack was the most commonly used storage structure, recording figures as much as 93.00%, 69.04% and 66.67% for Upper West, Upper East and Northern regions respectively. Pot/brick bins as storage structure recorded appreciable percentages of 20.2% and 16.75% for Upper East and Northern regions respectively.
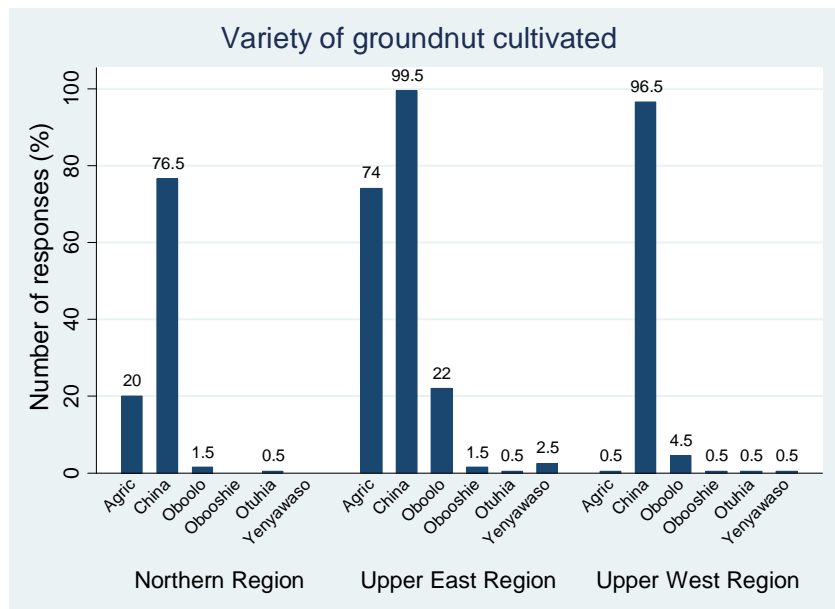


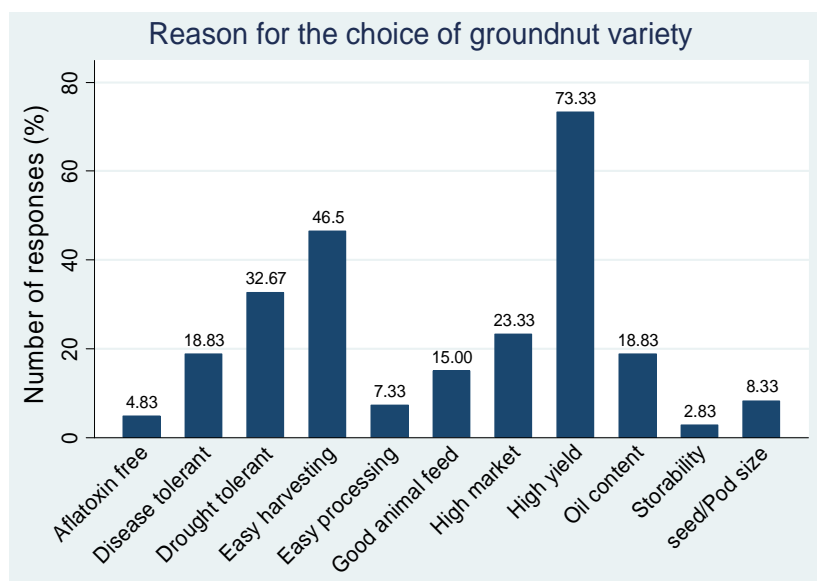**Fig. 1. Variety of Groundnut cultivated by farmers**

## Reason for the choice of groundnut variety



**Fig. 2. Reasons for the choice of Groundnut varieties by farmers**
*Source: Field survey*

**Table 1. Harvesting**

|  | UER | UWR | NR | Total |
|---|---|---|---|---|
|  | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| **Time of harvesting** |  |  |  |  |
| When leaves turn yellow | 196 (98.00) | 195 (97.50) | 190 (95.00) | 581 (96.83) |
| When leaves are still green | 3 (1.50) | - | 4 (2.00) | 7 (1.17) |
| Others | - | 4 (2.00) | 1 (0.50) | 5 (0.83) |
| Missing | 1 (0.50) | 1 (0.50) | 5 (2.50) | 7 (1.17) |
| **Mode of harvesting** |  |  |  |  |
| Manually with hoe | 175 (87.50) | 100 (50.00) | 100 (50.00) | 375 (62.50) |
| Mechanically with harvester | 4 (2.00) | 2 (1.00) | 2 (1.00) | 8 (1.33) |
| Others | 21 (10.50) | 85 (42.50) | 95 (47.50) | 201 (33.50) |
| Missing | - | 13 (6.50) | 3 (1.50) | 16 (2.67) |
| **Number of workers employed** |  |  |  |  |
| 1 – 4 workers | 77 (38.50) | 16 (8.00) | 71 (35.50) | 164 (27.33) |
| 5 – 8 workers | 60 (30.00) | 40 (20.00) | 61 (30.50) | 161 (26.83) |
| 9 – 12 workers | 25 (12.50) | 41 (20.50) | 29 (14.50) | 95 (15.83) |
| 13 or more workers | 38 (19.00) | 101 (50.50) | 37 (18.50) | 176 (29.33) |
| Missing | - | 2 (1.00) | 2 (1.00) | 4 (0.67) |

*UER: Upper East Region, UWW: Upper West Region, NR: Northern Region*

Majority of the groundnut farmers, 554 (92.33%) stored their groundnut in the Unshelled form. This figure was highest, in percentage, for Upper West region, 190 (95.00%). Only a small percentage of 9 (1.50%) stored their produce in the shelled form (Table 3).

Majority, 205 (34.17%) of the groundnut farmers stored their groundnut produce for 5 to 6 months.

This was closely followed by 191 (31.33%) who stored their produce for 3 to 4 months only (Table 3). 'Others' and 'missing' as indicated in the statistical analysis, represent groundnut farmers who did not form part of either of the options provided (or answered by farmers) or did not provide any response at all. This is therefore treated as missing data.

**Table 2. Crop yield**

| | UER | UWR | NR | Total |
|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| **Yield of shelled groundnut (per acre)** | | | | |
| 1 – 2 bags | 83 (41.50) | 53 (26.50) | 41 (20.50) | 177 (29.50) |
| 2 – 3 bags | 42 (21.00) | 48 (24.00) | 128 (64.00) | 218 (36.33) |
| 4 – 5 bags | 18 (9.00) | 3 (1.50) | 29 (14.50) | 50 (8.33) |
| 6 -7 bags | 1 (0.50) | 85 (42.50) | 1 (0.50) | 87 (14.50) |
| Others | 53 (26.50) | 11 (5.50) | 1 (0.50) | 64 (10.67) |
| Missing | 3 (1.50) | - | - | 4 (0.67) |
| **Yield of unshelled groundnut per acre** | | | | |
| 1 – 2 bags | 59 (29.50) | 4 (2.00) | 1 (0.50) | 64 (10.67) |
| 2 – 3 bags | 38 (19.00) | 31 (15.50) | 8 (4.00) | 77 (12.83) |
| 4 – 5 bags | 54 (27.00) | 116 (58.00) | 82 (41.00) | 252 (42.00) |
| 6 -7 bags | 41 (20.50) | 46 (23.00) | 97 (48.50) | 184 (30.67) |
| Others | 6 (3.00) | 3 (1.50) | 8 (4.00) | 17 (2.83) |
| Missing | 2 (1.00) | - | 4 (2.00) | 6 (1.00) |
| **Best yield in the last five years** | | | | |
| 1 – 2 bags | 17 (8.50) | 2 (1.00) | 8 (4.000) | 27 (4.50) |
| 2 – 3 bags | 30 (15.00) | 7 (3.50) | 5 (2.50) | 42 (7.00) |
| 4 – 5 bags | 74 (37.00) | 37 (18.50) | 11 (5.50) | 122 (20.33) |
| 6 -7 bags | 54 (27.00) | 144 (72.00) | 100 (50.00) | 298 (49.67) |
| Others | 22 (11.00) | 8 (4.00) | 64 (32.00) | 94 (15.67) |
| Missing | 3 (1.50) | 2 (1.00) | 12 (6.00) | 17 (2.83) |
| **Worst yield in the last five years** | | | | |
| 1 – 2 bags | 159 (79.50) | 122 (61.00) | 145 (72.50) | 426 (71.00) |
| 2 – 3 bags | 20 (10.00) | 65 (32.50) | 26 (13.00) | 111 (18.50) |
| 4 – 5 bags | 16 (8.00) | 5 (2.50) | 2 (1.00) | 23 (3.83) |
| 6 -7 bags | 2 (1.00) | 2 (1.00) | 5 (2.50) | 9 (1.50) |
| Others | 1 (0.50) | 4 (2.00) | 15 (7.50) | 20 (3.33) |
| Missing | 2 (1.00) | 2 (1.00) | 7 (3.50) | 11 (1.83) |

*UER: Upper East Region, UWW: Upper West Region, NR: Northern Region*

From the results in of the study in Fig. 5, more than two-thirds of the groundnut farmers (72.45%) suggested Jute sack was the most efficient storage structure for groundnuts.

## 3.6 Type of Storage Pest and Disease

From the results of the study in Table 4, most of the farmers, 242 (40.33%) did not experience storage pests on their stored groundnut produce, though Grain weevils, 57 (9.50%), *Cercospora spp*, 28 (4.67%), Bruchids, 23 (3.83%) and Grain moth, 11 (1.83%) were found to be present in farmers' stored groundnut produce.

Among the storage diseases identified by groundnut farmers, *Aflatoxin*, 78 (13.00%), *Aspergillus* spp, 21 (3.50%), *Penicillium* spp, 15 (2.50%) and *Fusarium* spp, 8 (1.33%) were among those present, even though majority, 369 (61.50%) of them did not experience storage disease challenges. 'Others' and 'missing' as

indicated in the statistical analysis, represent groundnut farmers who did not form part of either of the options provided (or answered by farmers) or did not provide any response at all.

From the study (Fig. 6), groundnut farmers mentioned chemical application (35.36%) as the most commonly used method of controlling storage pests, followed by manual (hand picking) with 26.62%. Application of wood ash was the least (1.90%) commonly used method by groundnut farmers. A little above twenty- two percent (22.43%) did not apply any form of control measure(s) for pests and diseases.

## 3.7 Processing, Uses and Marketing

Table 5 gives a description of the marketing of groundnuts by farmers. Over 489 (81.50%) indicated they had ready market for their groundnut produce. About forty percent, 239

(39.83%) of the farmers said they sold their groundnut produce at the market, whereas 82 (13.67%) sold their groundnut at home.

Less than four percent, 23 (3.83%) of the farmers said they sold all their groundnut produce after harvest while majority, 167 (27.83%) indicated they only sold 75% of their groundnut produce. About 20% of the farmers sold one-third (25%)

and half (50%) of their groundnut produce respectively.

A little above fifty percent, 315 (52.50%) used 'bowls' as the scale of measurement. This was followed by 138 (23.00%) who used the 100 kg bag as the scale of measurement, and a small 4 (0.67%), on the 50 kg bag scale (Table 5).

**Table 3. Form and duration of groundnut in storage**

| | UER | UWR | NR | Total |
|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| **Form of storage of produce** | | | | |
| Shelled | 2 (1.00) | 2 (1.00) | 5 (2.50) | 9 (1.50) |
| Unshelled | 183 (91.50) | 190 (95.00) | 181 (90.50) | 554 (92.33) |
| Both forms | 10 (5.00) | 4 (2.00) | 8 (4.00) | 22 (3.67) |
| Others | 4 (2.00) | - | - | 4 (0.67) |
| Missing | 1 (0.50) | 4 (2.00) | 6 (3.00) | 11 (1.83) |
| **Duration of groundnut in storage** | | | | |
| 1 – 2 months | 6 (3.00) | - | 33 (16.50) | 39 (6.50) |
| 3 – 4 months | 50 (25.00) | 93 (46.50) | 48 (24.00) | 191 (31.33) |
| 5 – 6 months | 99 (49.50) | 13 (6.50) | 93 (46.50) | 205 (34.17) |
| 7+ months | 42 (21.00) | 87 (43.50) | 6 (3.00) | 135 (22.50) |
| Others | - | 1 (0.50) | 5 (2.50) | 6 (1.00) |
| Missing | 3 (1.50) | 6 (3.00) | 15 (7.50) | 24 (4.00) |

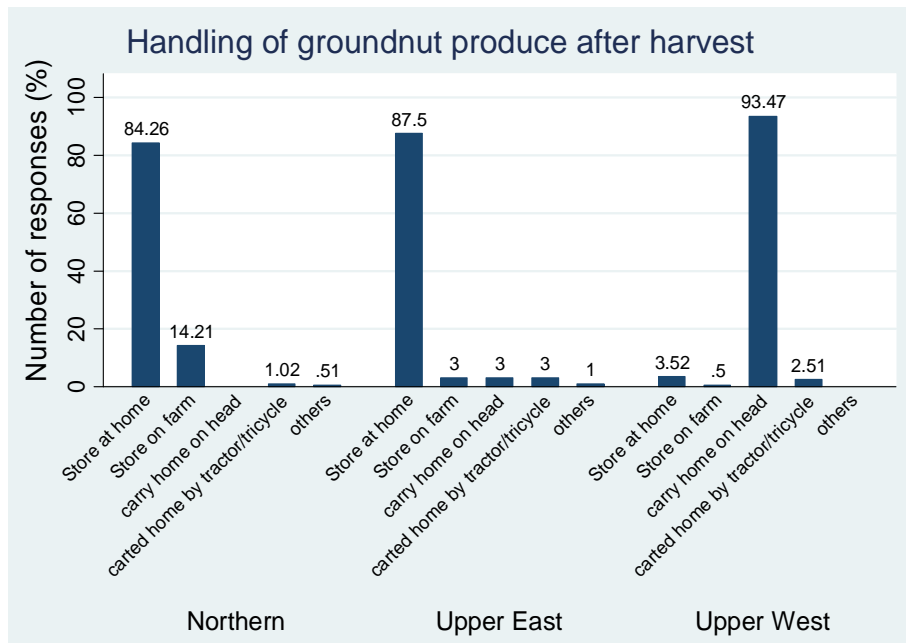*UER: Upper East Region, UWW: Upper West Region, NR: Northern Region*



**Fig. 3. Postharvest handling of Groundnut produce by farmers**
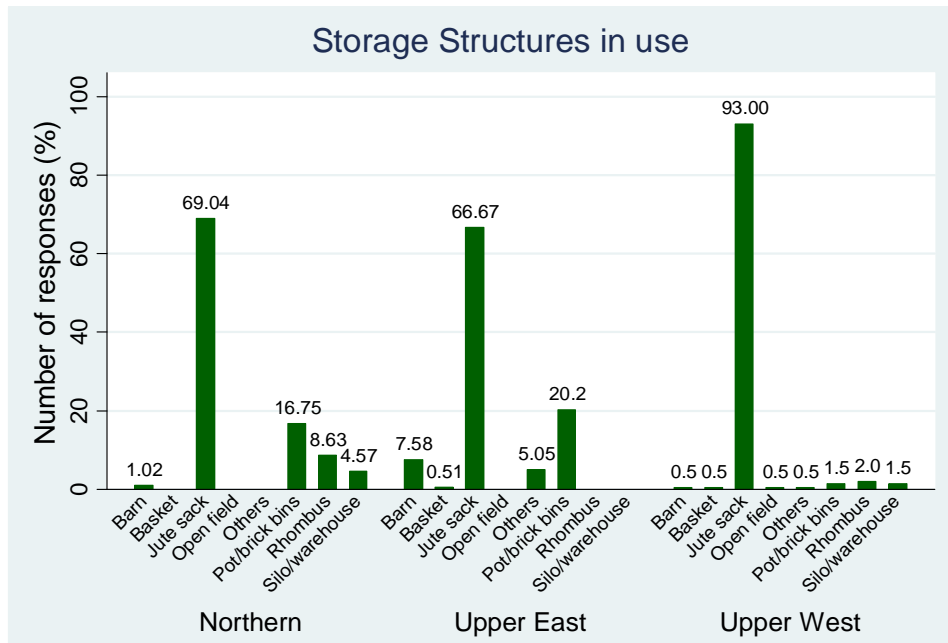*Source: Field survey*

## Storage Structures in use



**Fig. 4. Type of storage structures used by farmers**
*Source: Field survey*

## Farmer's opinion on the efficiency of storage structures
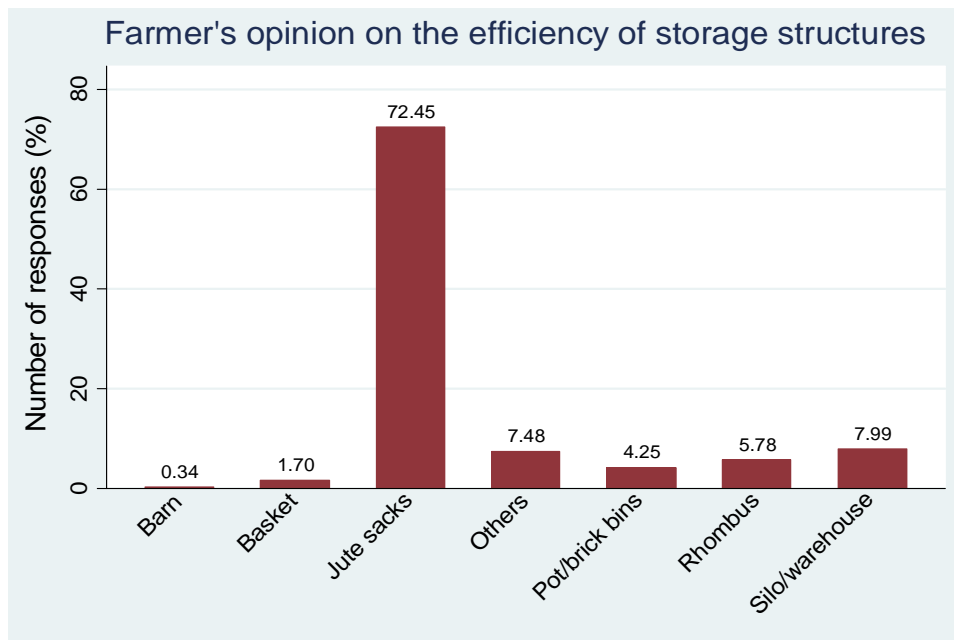


**Fig. 5. Opinion of farmers on the efficiency of storage structures**
*Source: Field survey*

Results of the study (Table 6) indicate that the average price of 100kg bag of groundnut sold for Ghs136.55 and that for 50kg bag of groundnut (at lean season was) sold at Ghs137.21. A bowl of groundnut, according to the groundnut farmers interviewed was sold at Ghs 3.24.

The study revealed that, 'China' groundnut variety had the highest market value, according to (81.5%) of the farmers interviewed. This was followed by 'Agric' (11.67%), with 'Oboolo' variety recording the least with less than one percent (0.17%).

Results of the study show that, the cost of hiring labour for land preparation per every acre of land stood at GHs 2, 805. The highest cost was recorded for planting (Ghs 9,042) followed by production (cultural practices), Ghs 6,530 and storage, Ghs 3,020. Harvesting and Processing cost the least with Ghs 2, 000 per every acre of activity (Table 7).

**Table 4. Disease and pest attack during storage**

|  | UER | UWR | NR | Total |
|---|---|---|---|---|
|  | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| **Type of storage pest** |  |  |  |  |
| None | 35 (17.50) | 186 (93.00) | 21 (10.50) | 242 (40.33) |
| Grain weevils | 7 (3.50) | 5 (2.50) | 45 (22.50) | 57 (9.50) |
| Grain moth | 7 (3.50) | 2 (1.00) | 2 (1.00) | 11 (1.83) |
| Bruchids | 19 (9.50) | - | 4 (2.00) | 23 (3.83) |
| *Cercospora* sp. | 10 (5.00) | - | 18 (9.00) | 28 (4.67) |
| Others | 81 (40.50) | 1 (0.50) | 66 (33.00) | 148 (24.67) |
| Missing | 41 (20.00) | 6 (3.00) | 44 (22.00) | 91 (15.17) |
| **Type of storage disease** |  |  |  |  |
| None | 102 (51.00) | 172 (86.00) | 95 (47.50) | 369 (61.50) |
| *Aspergillus* | 5 (2.50) | 1 (0.50) | 15 (7.50) | 21 (3.50) |
| *Fusarium* | 3 (1.50) | - | 5 (2.50) | 8 (1.33) |
| *Penicillium* spp | - | - | 15 (7.50) | 15 (2.50) |
| Aflatoxin | 47 (23.50) | 4 (2.00) | 27 (13.50) | 78 (13.00) |
| Others | 4 (2.00) | 1 (0.50) | 2 (1.00) | 7 (1.17) |
| Missing | 39 (19.50) | 22 (11.00) | 41 (20.50) | 102 (17.00) |

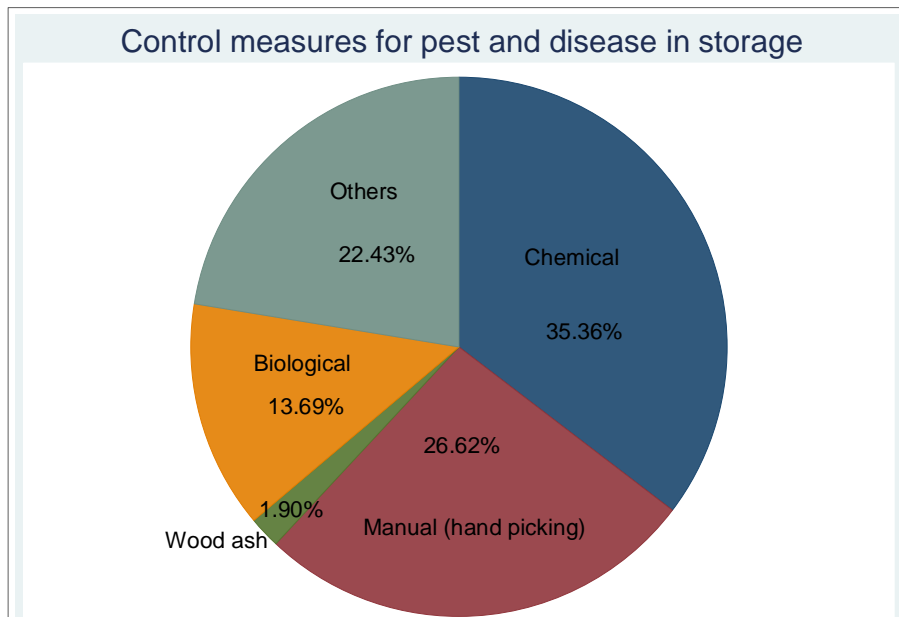*UER: Upper East Region, UWW: Upper West Region, NR: Northern Region*



**Fig. 6. Control measures employed by farmers for pests and diseases in storage**
*Source: Field survey*

**Table 5. Marketing of groundnut produce**

|  | Number of responses *n* (%) |
| --- | --- |
| **Ready market for groundnut produce** | |
| No | 17 (2.83) |
| Yes | 489 (81.50) |
| Missing | 94 (15.67) |
| **Market location for groundnut produce after harvest** | |
| None commercial | 260 (43.33) |
| Home | 82 (13.67) |
| Market | 239 (39.83) |
| Others | 1 (0.17) |
| Missing | 18 (3.00) |
| **Percentage of groundnut harvested that is sold after harvest** | |
| 25% | 123 (20.50) |
| 50% | 124 (20.67) |
| 75% | 167 (27.83) |
| 100% | 23 (3.83) |
| Others | 12 (2.00) |
| Missing | 151 (25.17) |
| **Scale with which groundnut is sold on market days** | |
| 100 kg bags | 138 (23.00) |
| 50 kg bags | 4 (0.67) |
| Bowls | 315 (52.50) |
| Others | 30 (5.00) |
| Missing | 113 (18.83) |
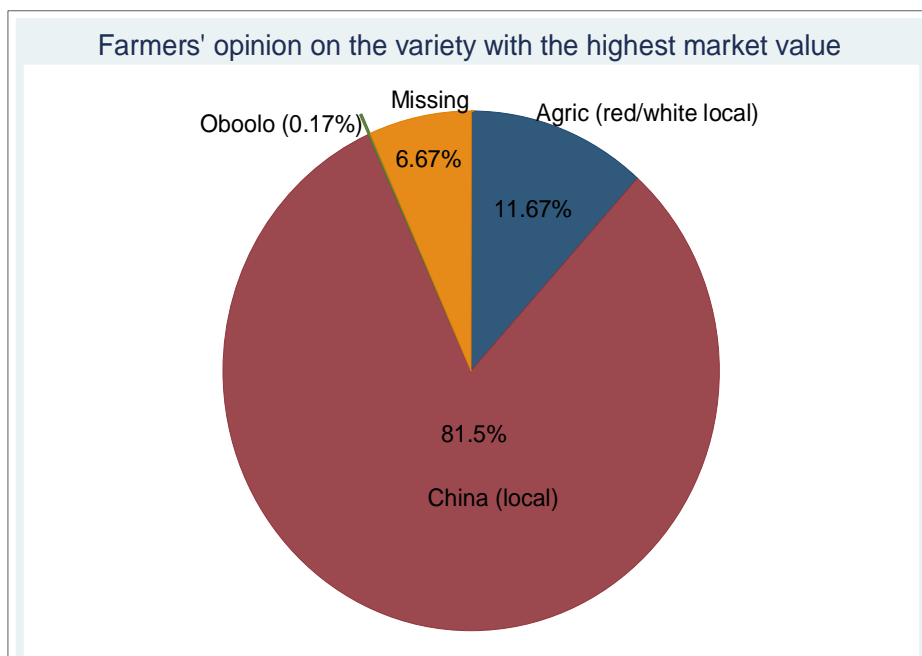


**Fig. 7. Opinion of farmers on choice of variety**
*Source: Field survey*

**Table 6. Average market price (and standard deviation) of groundnut across the three northern regions**

| Scales | UER | UWR | NR | Total |
|---|---|---|---|---|
| | *Mean* (sd) GH¢ | *Mean* (*sd*) GH¢ | *Mean* (*sd*) GH¢ | *Mean* (*sd*) GH¢ |
| 100 kg bags | 130.86 (152.13) | 189.94 (113.23) | 208.23 (138.73) | 201.92 (136.55) |
| 50 kg bags (at lean season) | 9.00 (0.00) | 100.00 (-) | 300.00 (-) | 104.50 (137.21) |
| Bowls | 30.79 (83.67) | 10.83 (13.04) | 14.57 (40.97) | 17.64 (51.08) |
| Others | 31.14 (83.17) | - | 350 (-) | 41.77 (100.34) |

*UER: Upper East Region, UWW: Upper West Region, NR: Northern Region*

**Table 7. Cost of groundnut production per activity per acre of investment**

| Activity | Mean (GH¢) | Standard deviation (GH¢) | Minimum (GH¢) | Maximum (GH¢) |
|---|---|---|---|---|
| Labour for land preparation (per acre) | 55.88 | 144.46 | 9 | 2805 |
| Planting | 65.31 | 381.28 | 0 | 9042 |
| Production (Cultural Practices) | 45.10 | 267.67 | 0 | 6530 |
| Harvesting | 34.18 | 92.68 | 0 | 2000 |
| Processing | 15.62 | 82.25 | 0 | 2000 |
| Storage | 21.02 | 129.71 | 5 | 3020 |

## 3.8 Uses of Groundnut

Majority of the groundnut farmers interviewed 414 (69.00%), representing more than half of the farmers used groundnut for food. Only a small percentage, 16 (2.67%) used groundnut for medicinal purposes. However, with regard to dishes of the produce, soup preparation came tops, 474 (79.00%) with more than two-thirds of the farmers. Vegetable sauce followed closely with almost fifty percent, 267 (44.50%). Snack formed the least, 30 (5.00%) among the uses.

Exactly half of the interviewed groundnut farmers, 303 (50.00%) indicated groundnut paste as the major end use of groundnut. This is opposed to 98 (16.33%), who mentioned groundnut feed as the end use (Table 8).

A majority, 358 (59.67%) of the farmers, indicated they did not receive services from MoFA extension officers, while a little 19 (3.17%) said they very often received services. Less than twenty percent of the farmers, 110 (18.33%) noted they received MoFA services once a month and 82 (13.67%) twice every month.

Among the departments or agencies relaying information to groundnut farmers, colleague farmers recorded the highest figure of 39.33% followed by MoFA (31.33%), NGOs (13.83%) and Retailers with 11.33% respectively. A little above 1 percent (1.17%) received meteorological information (Fig. 8).

## 4. DISCUSSION

### 4.1 Chi-Square Analysis

The Chi-Square method in Table 10 was initiated to answer the following question; 'does the number of months in storage depend on the type of storage structure used'?

The idea for this analysis is to investigate whether or not there is a relationship between the classifications of storage structures used by farmers and the duration of groundnuts in storage for the three northern regions.

**Table 8. Use of groundnut**

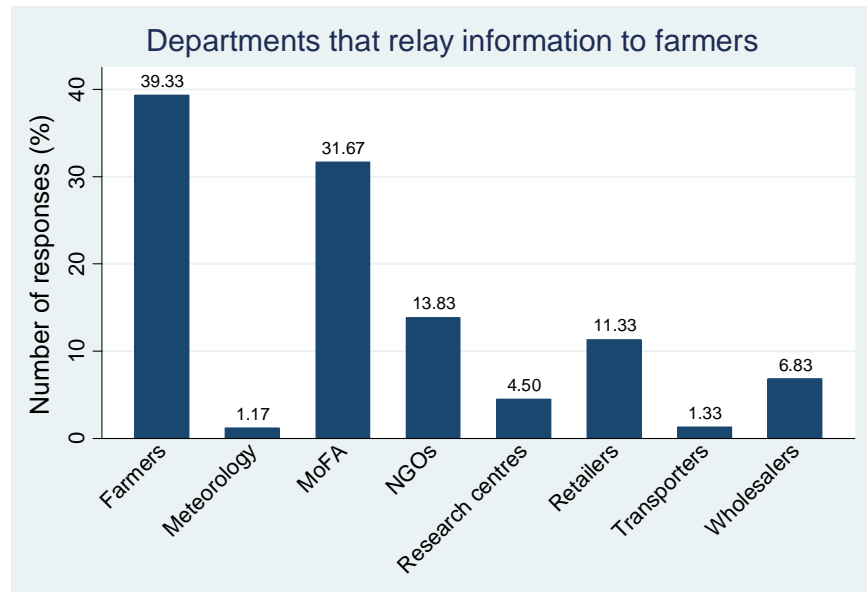| | Number of responses |
|---|---|
| | *n* (%) |
| **Use of groundnut** | |
| Food | 414 (69.00) |
| Medicine | 16 (2.67) |
| Animal feed | 101 (16.83) |
| Others | 127 (21.17) |
| **Dishes of groundnut** | |
| Vegetable sauce | 267 (44.50) |
| Soup preparation | 474 (79.00) |
| Stew preparation | 192 (32.00) |
| Snacks | 30 (5.00) |
| **End product of groundnut** | |
| Groundnut paste | 303 (50.00) |
| Groundnut oil | 129 (21.50) |
| Groundnut cake | 197 (32.83) |
| Groundnut feed | 98 (16.33) |

**Fig. 8. Department(s) relaying information to farmers**
*Source: Field survey*

The results in the current study (Table 10) indicate that there is enough statistical evidence to suggest that the classifications of storage structures and the duration of groundnut produce in storage are not independent (p-value = 0.000) at the 5% level of significance. This implies that improvement of the storage structures has a higher likelihood of increasing the duration of groundnut in storage.

The experience of pests and diseases on groundnut during storage was also found to be statistically significant at the 5% level of significance.

Since the classifications of storage structures and the duration of groundnut in storage were significant, it is reasonable to suggest that an improved storage structure that increases the life span of groundnut in storage could also reduce the rate at which pests and diseases attack the produce in storage.

### 4.2 Choice of Variety

'China variety was mostly planted by majority (76.5%) of the groundnut farmers and attributed high yield (73.33%), ease of harvesting (46.5%) and drought tolerance (32.67%) as their reasons for the choice of variety. 'China' variety is an early-maturing groundnut variety (2 to 3 months (65.67%). All others; Agric, Oboolo, Obooshie, Otuhia and Yenyawoso took 4 to 5 months to

mature), and it is highly accepted for its market value and ease of processing into groundnut paste, which also has high market value. These might be some of the reasons for the variety's popularity in the Northern regions [20]. The results again show that farmers in these communities were not adopting the new varieties of groundnut released by CSIR-Crops Research Institute, Savanna Agricultural Research Institute and MoFA. Moreover, it appears that most improved groundnuts varieties were yet to be adopted by farmers [21].

Today and future agriculture of these communities and the country as a whole must target large scale production of most staple crops in order to be able to feed the ever increasing population. Groundnut is one of the most important protein sources in the community since animal protein is expensive and not easily affordable by the rural people [22].

### 4.3 Yield

Majority (36%) of the groundnut farmers in the current study recorded yields for shelled groundnut at 2 to 3 bags per acre. Yield of unshelled groundnut was highest for 4 to 5 bags per acre. Moreover, worst yield (77.1%) for the past 5 years was highest for 1 to 2 bags per acre and least (1.5%) for 6 to 7 bags per acre.

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**Table 9. Frequency of receipt of extension services from MoFA**

|                                   | UER          | UWR          | NR          | Total        |
|-----------------------------------|--------------|--------------|-------------|--------------|
|                                   | *n* (%)      | *n* (%)      | *n* (%)     | *n* (%)      |
| **Access to extension services**  |              |              |             |              |
| Once a month                      | 53 (26.50)   | 4 (2.00)     | 53 (26.50)  | 110 (18.33)  |
| Twice a month                     | 21 (10.50)   | 12 (6.00)    | 49 (24.50)  | 82 (13.67)   |
| Very often                        | 10 (5.00)    | 1 (0.50)     | 8 (4.00)    | 19 (3.17)    |
| Not at all                        | 106 (53.00)  | 176 (88.00)  | 76 (38.00)  | 358 (59.67)  |
| Others                            | 3 (1.50)     | -            | 2 (1.00)    | 5 (0.83)     |
| Missing                           | 7 (3.50)     | 7 (3.50)     | 12 (6.00)   | 26 (4.33)    |

*UER: Upper East Region, UWW: Upper West Region, NR: Northern Region*

**Table 10. Association between storage structures and duration of groundnut in storage**

|                                        | Df  | LR Chi-square statistic | p-value |
|----------------------------------------|-----|-------------------------|---------|
| **Storage structure**                  |     |                         |         |
| *Form of storage*                      | 28  | 17.397                  | 0.940   |
| *Duration of groundnut in storage*     | 28  | 124.169                 | 0.000   |
| **Duration of groundnut in storage**   |     |                         |         |
| *Pests attack during storage*          | 4   | 119.782                 | 0.000   |
| *Diseases attack during storage*       | 4   | 52.417                  | 0.000   |

These yields were obtained without any fertilizer application and under low and erratic rainfall. Most farmers are generally of the erroneous view that groundnuts, like many other legumes, do no need fertilizer since it has the ability to fix atmospheric nitrogen, hence the results in the current study. The low yields obtained by farmers could account for the seasonal shortage of the crop since the farmers do not get enough for their household use, as majority produce smaller acreages on subsistence basis rather than on commercial basis. Therefore only a small percentage is marketed [20].

### 4.4 Storage

Storage (pests and diseases) was not a major problem (61.5%), perhaps the type of storage structure (jute sack) commonly used (74.45%) by majority of the farmers as well as storage of groundnut in the dried, unshelled form (92.33%,) helped to increase the storage life of groundnut produce [19]. Notwithstanding, a few of the farmers (9; 1.5%) stored their groundnuts by removing the shells to ensure low moisture content and to make storage less cumbersome. Farmers would normally only keep groundnut in the unshelled form until they want to process or sell in the market. Groundnut, either stored shelled or unshelled, still gave farmers reasons to worry as most of the farmers confirmed they had problems with the mode of storing groundnut after production. Results in the current study corroborate those of [19], who said that 'the main problem in storing legumes such as groundnut was susceptibility to insect attack'; There are over ten (10) pest species of grain legumes in Africa which destroy grain from the field and in storage and among these are weevils [23].

According to the Chi-Square statistic used to test the association between storage structures and duration of groundnuts in storage, the results indicated that there is enough statistical evidence to suggest that at (p-value = 0.000; 5% level of significance), improvement of the storage structures had a higher likelihood of increasing the duration of groundnut in storage The experience of pests and diseases on groundnut during storage was also found to be statistically significant at the 5% level of significance.

Since the classifications of storage structures and the duration of groundnut in storage were significant, it is reasonable to suggest that an improved storage structure that increases the life span of groundnut in storage could also reduce the rate at which pests and diseases attack the produce in storage.

Majority of the farmers interviewed did not have knowledge of management practices of the crop, especially the diseases and pests that attacked the crop, and also the recommended chemical(s) for controlling such diseases and pests. All farmers interviewed complained of attack of

pests and diseases that destroyed the crop in the field of which they had no control measures. Majority said that they did not adopt any management practices since they thought the crop is generally resistant to pests and diseases. These findings are in line with those of CGIAR, in a cowpea-Bambara groundnut study [24], who stated Bambara groundnut is resistant to pests and disease attack as compared to cowpea.

## 4.5 Marketing

Farmers had ready market (81.5%) for their groundnut produce. Groundnut is a produce which is in high demand, especially in the three Northern regions of Ghana, perhaps due to the various uses into which they are put to or processed into. This is true in the current study as 27.83% sold about 75% of their groundnut produce after harvest.

Scale of measurement used was common in bowls (52.5%); followed by 100 kg bag (23%) and 50 kg bag (0.67%). Average market price of 100 kg bag was Ghs136.55% and a bowl at Ghs Ghs3.43 only. Groundnut is a traditional crop that is mostly marketed by women. The use of bowls as a scale of measurement has therefore remained a convenient means and mode of marketing.

## 4.6 Choice of Variety and Marketing

Majority of the farmers chose 'China-local' as their preferred variety because it had highest market value (81.5%), followed by 'Agric' (11.67%) and 'Oboolo' (0.17%).

The different prices were quoted by the respondents because different market places have different prices for the produce. It was further observed that not all the landraces were sold at a higher price; the market women were interested in the 'China' variety because of the high demand and a relatively higher price at sales. This might also be the reason why majority of the farmers in the community preferred to grow the 'China variety, since it attracted ready market and higher price than the others [20]. Results found in the current study are in conformity with a grain legume baseline research carried out by [23]. The study concluded that 'use of improved, modern varieties was generally low across target countries during the baseline studies; unavailability of improved seed and, in some cases, lack of access to credit have been identified as major bottlenecks for improved variety adoption [23].

## 4.7 Uses

Majority (69%) used groundnut for food and a small 2.67% used groundnut for medicinal purposes. Dishes of groundnut, according to the current study were; Soup preparation (79%), Vegetable sauce (44.5%) and snacks (5%), But major end use of groundnut from the study was groundnut paste (50%), as against 16.33% as groundnut feed.

Results indicated that farmers in the community used the crop for traditional performances as well as preparation of dishes. These findings further confirmed the fact that groundnut was a traditional crop in these regions. However, all the respondents in the study indicated that traditional belief did not hinder groundnut production in these regions [20,25].

According to departments or agencies relaying information to groundnut farmers, colleague farmers recorded the highest figure of 39.33% followed by MoFA (31.33%). This results confirms those of CGIAR Research Program on Grain Legumes, [23] that concluded that, 'depending on the country, farmer-to-farmer exchange and government extension are two major sources of information on agricultural technologies for farmers.

## 5. CONCLUSION

The current research has provided positive results in offering a general overview of the postharvest activities as it pertains in the Northern part of Ghana.

It is concluded from the study that, 'China' local groundnut variety was the most cultivated in all the three regions. Reasons for choice of variety were 'high yielding, ease of harvesting and early maturing'. Most common disease reported was Early Leaf Spot (Caused by *Cercospora arachidicola*). Yield of groundnut was 2-3bags/acre (Shelled), 4-5bags/acre (unshelled). Most efficient Storage structure of groundnut was Jute sack. Length of storage was 5-6 months. Most common storage pests and diseases according to the current study were Grain weevils and *Cercospora* Spp. and Aflatoxin and *Aspegillus* Spp. respectively.

Groundnuts have ready market in Northern Ghana, and relay of (market) information was mostly by Colleague farmers, MoFA, NGOs.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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