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ASSESSMENT OF FARMERS' KNOWLEDGE AND AWARENESS ON PROPER MANAGEMENT OF FARM-SAVED MAIZE (Zea mays L.) SEEDS IN LAKE ZONE, TANZANIA

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ABSTRACT

Maize farm-saved seeds are characterized by low quality which generally is influenced by managerial practices used by farmers during saving process. A study was conducted to assess farmers' knowledge and awareness on proper management of maize farm-saved seeds in the Lake Zone of Tanzania. A survey across six regions in the zone was conducted during the 2021/22 cropping season at peak maize planting time. Mixed sampling techniques (multi-stage and purposive sampling) were deployed, whereby 96 farmers who save maize seeds were consulted with an interview using a semi-structured questionnaire to collect information on maize farm-saved seed management practices. Results revealed that 79.2% of farmers obtained seeds from their own saved seeds (own stock). More than 50% of recycled seeds were improved varieties. Above half of farmers were not aware about varieties contamination through cross-pollination and mechanical admixture. A minority dry their seeds using inappropriate drying materials. About 37.5% of sampled farmers did not clean their seeds after shelling, and 53.1% store seeds and grains in the same store. The majority are knowledgeable and aware about proper packaging materials. Generally, the majority of farmers managed their farm-saved seeds in improper ways. Therefore, there is a need to improve farmers' seed management practices so as to improve seed quality or to increase availability and accessibility of seeds from formal system. More research is recommended on maize farm-saved seeds management.

Keywords: Seed drying, cropping season, recycled seeds, cob size, landrace varieties.

1. INTRODUCTION

Farmers' saved seeds are used by the majority of maize producers in Tanzania compared to certified seeds (Mghweno et al., 2020). Smallholder farmers reserve seeds from their farms or obtain them from their community, either through neighbours or local markets, to plant next season as part of the practice of seed recycling (Almekinders & Thiele, 2003). Farmers use farm-saved seeds for more than one season before considering buying or obtaining new seeds. In the majority of developing countries, an informal seed system serves as the base for food production and smallholder livelihoods (Almekinders & Thiele, 2003; Njonjo, 2019). The use of farmer-saved seeds for cereal crops production, especially maize, is estimated to be as high as 75% in developing countries, especially in Sub-Saharan Africa (ACB, 2015; McGuire & Sperling, 2016).

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Currently, maize is a staple food crop in Tanzania; its production is dominated by a subsistence model characterized by low-quality inputs, including seeds (Ndinya et al., 2020). Farmer-saved seeds are more commonly used compared to purchased improved varieties seeds due to their availability, accessibility, taste preferences, and affordability. These factors facilitate the majority of farmers in Sub-Saharan Africa's dependence on farmer-saved seeds (Mulesa et al., 2021). Adoption of improved seeds in Tanzania is still low, whereas for some crops, adoption is estimated to be 1% or below (Mwalongo et al., 2020). In cereal crops, more than or equal to 75% of the seeds used in Tanzania are obtained from informal seed systems which are produced using indigenous knowledge (Mghweno et al., 2020). The trend showed that for the past four decades, the use of improved varieties has been steadily increasing. Several initiatives have been taken by the Tanzanian government to increase the availability of improved maize seed varieties to farmers. During the 1974s, the National Maize Research Program (NMRP) was established, and until the 2010s, more than 90 different improved maize varieties have been released; however, adoption is below 30% (Stephen et al., 2014).

Farmer-saved seeds in developing countries are sourced from either improved or landrace varieties and then recycled through saving from season to season using indigenous knowledge on selection, production, processing, treatment, and storage (Lobulu et al., 2020). Despite the importance of farmer-saved seeds in terms of availability, affordability, taste, and reliability, quality control is not given priority in Tanzania. Therefore, the physical, physiological, genetic, and health quality of farmer-saved seeds is doubtful due to the managerial practices used by farmers during saving. The likely low quality of farmer-saved seeds is attributed to a deficiency of knowledge and awareness about good seed management, such as seed selection, processing, treatment, packaging, and storage, which are the key determinants of seed quality (Bèye & Wopereis, 2014). Farmer-saved seeds play an important role in seed availability in Tanzania, especially in the Lake zone. However, information on the knowledge and awareness of the management of farmer-saved seeds, especially in Lake Zone regions, is scarce (Kansiime et al., 2021). Therefore, this study aimed to the assess the farmers' knowledge and awareness in Lake zone, Tanzania. Results of this study can be used to identify a segment in the seed chain at which interventions can be made to help small-scale farmers to improve their farm-saved seeds.

2. METHODOLOGY

2.1. Description of the study area

The study was conducted in six regions of the lake zone of Tanzania (Mwanza, Shinyanga, Kagera, Mara, Simiyu, and Geita). From each region, two districts were selected, comprising 12 districts, 24 wards and 48 villages. The Lake zone is located roughly at latitude 2°41′ 21.48″ south, longitude 32°50′ 12.48″ east, and an altitude 950-1850 m.a s. l. The zone receives rainfall that ranges from 850 to 1500mm annually (Mafuru et al., 1999). The reason for selecting the Lake zone is due to the low adoption of improved maize varieties compared to other areas in Tanzania.

2.2. Sample determination and sampling techniques

In the study area farmers saving maize seeds are more than 10,000, according to Cochran (1977) proposed the formula to be used to determine the sample size with such nature of population.

$$N = \frac{z^2pq}{d^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where N = required sample size (when the population is more than 10,000) Z = 95% confident limit (= 1.96), p = population proportion to be included in the sample (p = 10% = 0.1), q = 1-p = 1–0.1 = 0.9), d = margin of error (d = 5% = 0.05). Hence, the sample size (N) calculated as.

$$N= \frac{(1.96)^2(0.1)(0.9)}{(0.05)^2} = 138$$

Though, due to geographical position of the study area, time of the study (which targeted exact planting season in the zone which is about month), and resource constraints, the sample size was reduced to 96, which was distributed equally across all six regions. Multi-stage and purposive sampling techniques were used to select areas and farmers for interviews. Regions, districts, wards, and villages were selected using multi-stage techniques, whereby farmers were sampled using purposive techniques. From each region, two districts, two wards from each district, two villages from each ward, and two farmers who save maize seeds were selected with the assistance of agricultural officers from the respective wards and villages. This sampling resulted into, 12 districts, 24 wards, 48 villages and 96 farmers who save maize seeds.

Farmers were interviewed about demographic information and seed management practices used during saving their seeds.

2.3. Data collection

The administered semi-structured questionnaire solicited farmers' demographic information and seed management practices, which were used by farmers when saving their seeds. Managerial practice questions aimed to capture the knowledge and awareness of farmers on seed management. Demographic data collected included age, education level, and gender, whereas seed management practices were about the source of saved seeds, the name of the variety for landrace seeds, and post-harvest maize seed handling practices used by farmers.

2.4. Data analysis

The collected data were coded and subjected to IBM SPSS Statistics Software version 20 for descriptive statistics analysis.

3. RESULTS AND DISCUSSION

3.1. Demographic data of sampled farmers using farmers saved maize seeds in the study area

Table 1 presents demographic information of the interviewed farmers on farm-saved seed managements practices. Majority (67.7%) of farmers who saved seeds were aged 50 years and above while young respondents (18-29 years) constituted only 1%. Geita, Simiyu, and Kagera showed that the majority, over 80%, were aged 50 and above years while in Mwanza, Shinyanga, and Mara, about 60% of farmers were 50 years and older. This means that seed saving practices are dominated by elders in the study area. This implies that the majority of farmers use their skills and knowledge inherited from the past experience, when the availability of certified seeds was less than 10%. Similar results were reported by Shengu (2019) who reported that the majority of farmers who save seeds in different regions of Ethiopia were 50 years old or above. This implies that elder people are more involved in seed saving than the younger generation.

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This could be due to the fact that the majority of elder people practice conservation of their landrace seeds, which are used for years.

It was also found that more than half (61.5%) of the sampled farmers in the study area were female. Mara region was leading, with 87% of the sampled farmers being female, while Kagera region was the least dominated, with females (less than 40%). This means that despite the low number of sampled females in Kagera, overall, females who save maize seeds dominated in the study area. This implies that seed saving practices are dominated by women. This is in line with studies by Esther et al. (2021); Khan et al. (2016); Mudege et al. (2015) who both reported that women are more involved in saving seeds practices compared to men in different regions of their studies. This means that seed management and savings in households are mostly handled by women and not given much attention. This could be due to reason that women are more involved in domestic activities, including seed selection, saving, and light activities, which are assigned at home.

Table 1 also shows that the majority (72.9%) of respondents who save seeds had a primary education, 10.4% had a secondary education, and 16.7% did not attained formal education. The majority (37%) who do not have formal education were found in Geita region, while Mwanza region dominated by 81% of sampled farmers having primary education. This indicates that farmers who are using saved seeds have low levels of education, which could also be a reason for them to depend mostly on saved seeds. This is similar to the study by Shengu (2019) who reported that majority of farmers involved in seed saving had low levels of education, with the majority having primary education. A low level of education could have led them to continue depending on indigenous knowledge of agriculture and its practices, including seed saving, rather than obtaining seeds from formal seed sources.

Table 1. Percentage demographic data of the sample farmers using farmers saved maize seeds in the Lake zone, Tanzania

	Regions						
Characteristics	**Mwanza**	**Geita**	**Mara**	**Kagera**	**Simiyu**	**Shinyanga**	**mean**
Age (%)							
18-29	6.20	0.00	0.00	0.00	0.00	0.00	1.00
30-39	12.50	0.00	25.00	6.20	12.50	0.00	9.40
40-49	18.80	18.80	18.80	12.50	6.20	56.20	21.90
Above 50	62.50	81.20	56.20	81.20	81.20	43.80	67.70
Sex (%)							
Female	62.5	50.0	87.5	37.5	68.8	62.5	61.5
Male	37.5	50.0	12.5	62.5	31.3	37.5	38.5
Education level (%)							
Primary	81.3	62.5	62.5	81.3	81.3	68.8	72.90
Secondary	6.3	0.0	25.0	12.5	6.3	12.5	10.40
Non-formal	12.5	37.5	12.5	6.3	12.5	18.8	16.70

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3.2. Source of recycled seeds, types of varieties, and names of local varieties used

Table 2 shows that majority (79.2%) of farmers who recycle seeds used their own seeds (own stock) which replant in the next season, while other sources (neighbour and local markets) of farm saved seeds constitute (20.8%) as 5.2% local markets and 15.6% neighbours. Shinyanga, Simiyu and Mara were leading regions with large number (above 80%) of farmers used their own stock (own saved) seeds for planting, whereas Geita showed low percentage (68%) of farmers used their own stock seeds and higher percentage averaged (10%) of farmers sourced their seeds from local markets compared to other regions. Also, it was found that majority (57.35%) of saved seeds in the study area are non-landraces varieties compared to local varieties which occupied an average 42.65%. Kagera region showed the largest number (75%) of farmers using none landraces seeds whereas Simiyu region showed majority (81%) of sampled farmers using landraces seeds compared to other regions. In other regions, landrace seeds usage was about 37% consistently, among the recycled maize seeds. Among the landraces recycled in the study area *Bunane* variety observed to dominate (10.43%) of landraces recycled.

This infers that farmers do consider the importance of timely availability, cost constraints, and adaptability since the majority recycle their own saved (own stock) seeds; Moreover, improved seed varieties need a lot of inputs compared to their own adapted seeds. Also, perhaps economic constraints could be the driving force for them to recycle improved seed varieties due to their inability to purchase their seeds each season. These could be the reasons why farmers prefer their own recycled seeds. The domination of own saved seeds (own stock) as source of seeds in the study area signifies that the informal seed system act as core source of seeds. High frequency usage of *Bunane* local variety in a study area perhaps is due to the added advantage especially higher cultivation value. These results are similar to the studies by Lobulu et al. (2019); Shengu (2019); Nathaniels and Mwijage (2000); Wambugu et al. (2012) who both reported that more than 60% of farmers who save seeds own saved seeds is a dominant source compared to other sources of farm-saved seeds. The higher frequency of farmers dependence on own saved seeds implies lack of knowledge and awareness on a good source of seeds. Also, these results imply that farmers are lacking knowledge on the effects of recycling improved varieties including hybrid seeds since found that more than 50% of recycled seeds sourced from improved varieties. Replanting improved maize varieties including hybrids signify are not aware with the effects of hybrids recycling. Similar, results reported by Wambungu et al. (2012) who reported that farmers who recycle maize seeds in West Kenya recycle both improved and landraces varieties.

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Table 2; Source of recycled seeds, types of varieties, and names of local varieties used (%)

	Region						
	Mwanza	**Geita**	**Mara**	**Kagera**	**Simiyu**	**Shinyanga**	**Mean**
Source of seeds used (N=96)							
Local markets (%)	0	18.8	6.3	6.3	0	0	5.2
Neighbours (%)	25	12.5	12.5	18.8	12.5	12.5	15.6
Own recycled (%)	75	68.8	81.3	75	87.5	87.5	79.2
Variety type (N=96)							
Landrace (%)	37.5	37.2	37.5	25	81.2	37.5	42.65
none landrace (%)	62.5	62.8	62.5	75	18.8	62.5	57.35
Landrace names							
Bunane (%)	18.8	12.5	0	0	0	31.3	10.43
Gembe (%)	0	0	0	0	31.3	0	5.21
Kakuyu (%)	0	0	0	0	31.3	0	5.21
Kebweye (%)	0	0	25	6.3	0	0	5.21
Katumaini (%)	0	6.3	0	0	0	0	1.05
Katumbili (%)	12.5	18.8	0	6.3	6.3	0	7.31
Kazenze (%)	0	0	0	6.3	0	0	1.01
Nyade (%)	0	0	0	6.3	0	0	1.01
Nchanana/yanga (%)	6.3	0	6.3	0	12.5	6.3	5.21
Nyabulogori (%)	0	0	6.3	0	0	0	1.01

3.3. Farmers' knowledge on pollen contamination from other fields and seed selection practices

Table 3 presents information of farmers' knowledge and awareness on seed contamination through cross pollination, cobs separation during harvest, criterion used and time of seed selection. The results showed that the majority (55.8%) of sampled farmers knew that their seeds could be pollinated by pollen from neighbouring fields (cross-pollination) and cause variety admixture. In general, Simiyu region had higher number (75%) of sampled farmers know their seeds can be contaminated through cross pollination whereas Geita had least (25%) and the rest regions ranged from 56.3% to 68.8%. It was also found that majority (79.2%) of sampled farmers select their seeds from grains whereby (20.8%) do not select. Mwanza, Mara, Simiyu and Shinyanga regions had higher percentage (above 80%) of sampled farmers select their seeds whereas Geita and Kagera regions had least percentage of sampled farmers (below 70%). About 73.95% among farmers who select seeds, select their seeds after harvest. Geita and Kagera regions had lower percentage (below 70%) of farmers who select their seeds compared to other regions which scored higher percentage above 80%. Furthermore, observed that majority (47.55%) of those who select seeds use cob size as a main criterion to consider when selecting their seeds. Mwanza, Simiyu and Shinyanga regions had higher percentage (above 55%) of

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farmers who select seeds considered cob size as a criterion for seed selection whereas Geita, Mara and Kagera regions scored below 45% of farmers who select seeds consider cob size.

These results mean that majority of farmers who save seeds are not aware with the effect of cross pollination on contaminating their intended seeds by foreign pollen. This implies that there is high possibility of contaminating and lose their landraces varieties due to the lack of knowledge and awareness on control of cross pollination with uninterested varieties. Since majority of farmers select seeds/cobs after harvest this means agronomic characteristics of the crop is not well known. Failure to select seeds before crop harvest facilitate varietal impurity since seed crop is not well assessed for homogeneity during crop development in the field. Seeds saved by farmers are selected by considering minimal criterion mostly cob size. This means selection practices are not effective on producing seeds with high varietal purity. Minimal consideration on diseases and pests while selecting seeds leads to high chance of transmitting diseases and pests or selecting seeds already infected or infested by pests. These findings are similar to the study by Bøhn et al. (2013) who reported that due to a lack of knowledge on the effects of cross-pollination and the control of cross-pollination, majority of farmers who save seeds had their landrace seeds mixed through cross-pollination while growing. These findings are contrary on seed selection practices to the study of Shengu (2019) who reported that majority (44.4%) of farmers who saved seeds in Ethiopia selected their seeds during harvesting in the field. However, Shengu (2019) study showed similar results on farmers who do not select seeds instead plant grains without selecting. These results corelate studies with Shengu (2019); Wambugu et al. (2012) on criterion used by farmers when selecting seeds, both reported that the majority of farmers who save maize seeds in Kenya and Ethiopia, respectively, considered cob size as the main criterion on seed selection. A study by Letting et al. (2022) reported similar results for lablab famers in Tanzania considered mainly yield as their key criteria when selecting seeds. The required genetic purity of the seeds cannot be achieved since it is not given priority during seed selection. This means that over 40% of farmers who save seeds in the lake zone regions of Tanzania lack knowledge and awareness on good practices for selecting seeds since they consider little information when selecting seeds.

Table 3; Farmers' awareness on pollen contamination from other fields and seed selection practices

	Regions						
	Mwanza	**Geita**	**Mara**	**Kagera**	**Simiyu**	**Shinyanga**	**Mean**
pollen contamination (N=96)							
Aware (%)	56.3	25	68.8	56.3	75	50	55.2
Not aware (%)	43.8	75	31.3	43.8	25	50	44.8
Seed selections from grains to be saved as seeds (N=96)							
Yes (%)	93.8	68.8	87.5	56.3	87.5	81.3	79.2
No (%)	6.3	31.3	12.5	43.8	12.5	18.8	20.8
Time of seeds selection (n=76)							
Before harvesting (%)	6.7	0	14.3	11.1	6.7	0	6.47
After harvesting (%)	86.7	63.6	85.7	44.4	80	83.3	73.95

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During planting (%)	6.7	36.4	0	44.4	13.3	16.7	19.58
Criteria used for seed selection from grains in the study area (n=76)							
cob size (%)	66.7	27.3	28.6	44.4	60	58.3	47.55
Free from diseases and pest (%)	13.3	9.1	0	0	13.3	0	5.9
both cob size and free from diseases pests (%)	13.3	18.2	21.4	11.1	13.3	16.7	15.67
cob and grains size (%)	6.7	45.5	50	44.4	13.3	25	30.83

3.4. Farmers' practices on maize farm saved seeds management prior to storage.

Table 4 shows post-harvest farmers' practices prior to storage on farm saved maize seeds in the Lake zone. Generally, observed that 91.7% of the farmers dried the crops (cobs) after harvest whereas 8.3% left the crop to dry off in the field (late harvest). Shinyanga, Simiyu, Mara and Geita regions found up to 18% of sampled farmers left their crops to dry-off in the field. It was also, observed that all farmers who save seeds in Mwanza and Kagera regions dried their seeds. The majority (85.2%) of farmers who dry seeds use proper drying materials (mats/tarpaulin). Simiyu region had smallest number (60%) of farmers who use mats/tarpaulin to dry their seeds while in Mwanza region about 6% dry their seeds on rocks after harvest. Furthermore, it was found that 86.5% of farmers who save seeds shelled their seed cobs using fingers. It was observed that all sampled farmers in Kagera and Simiyu regions shelled their seeds using finger threshing method whereas beating by sticks was a second method after finger shelling method to be used in the study area, whereas least of farmers used machine to shell their seeds. It was also found that 62.5% of sampled farmers cleaned their seeds after shelling. Majority (81%) of sampled farmers in Mara region do not clean their seeds after shelling while in other regions ranged between 56% and 80% clean their seeds after shelling. Moreover, it was found that 79.3% among farmers who clean their seeds used winds winnowing methods. In Mara region observed that combination between wind winnowing and hand picking, and hand-picking methods are the only two methods used in the region, whereby 50% used hand-picking and 50% used a combination method between wind winnowing and hand picking. Furthermore, observed that none of the farmer used sole hand-picking method in Geita, Mwanza and Simiyu region to clean their seeds instead majority used combination and wind winnowing method.

These results imply that some farmers lack seed drying knowledge since they do leave seeds to dry-off in the field. This situation can impair the quality of the seeds, especially their physiological properties. Field dry-off of seeds can facilitate the loss of some produce through different means, such as rodent infestation when left in the field to dry off. This indicate that about 10% are lacking knowledge and awareness on harvesting and drying seeds. This result means that majority of farmers are knowledgeable about proper seed-drying methods after harvesting. Moreover, the majority are aware of the importance of drying seeds before packing, although there are no appropriate methods of moisture determination before storage. Late harvesting practices can facilitate the loss of some produces through different means, such as rodent attacks when left in the field to dry off. These results are contrary to the study by Obura et

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al. (2021) who reported that the majority (81%) of farmers who save seeds in Uganda, especially bambara nuts, dry improper their seeds on the bare ground, whereas minority 21.3% of farmers dry their seeds using proper materials such as tarpaulins. In the study area finger shelling method observed to dominate this imply that most of seed lots are shelled with proper method. This could be due to small quantity of seeds needed and the amount of maize produced, which is appropriate to be shelled by finger. Motorized (machine) shelling method is not an appropriate method for maize intended to be used as seeds compared to the finger shelling method. Finger shelling method is more used by farmers in the study due to its easy implementation and cost implication compared to the motorized shelling method. These results relate to the study by Amare et al. (2017) who reported that the majority of farmers in developing countries shell their saved seed using the finger method. Also, the study by Msuya (2019) suggested using appropriate seed processing methods, including finger threshing, for small quantities and important seed lots to increase quality, such as germination. It was observed that some farmers who save seeds do not clean their seeds (table 4). This means that these farmers do not consider physical seed quality since inert matters and trashes are not removed after shelling. This also facilitates the varietal heterogeneity of the seeds since no sorting is done to remove unrelated seeds. Moreover, seeds and grains that are not well cleaned facilitate the development of mould and other pests, such as grain borer, which attack grains and seeds. Shelling method could be one of the factors facilitating to leave their seeds uncleaned, believing finger threshing produces seeds with a trace amount of inert matter. Wind winnowing method as a cleaning method dominate in the study area this could be due the easy to implement compared to other although are not effective over others on separating unwanted seeds inert matter. These results resemble that of Shengu (2019) who reported that some farmers clean their seeds after shelling to increase seed purity before planting, while others do not clean their seeds. This implies that those leaving their seeds without cleaning are lacking knowledge and awareness on proper seeds management after shelling.

Table 4; Post-harvest farm-saved seeds handling in Lake zone regions, Tanzania

	Regions						
	Mwanza	**Geita**	**Mara**	**Kagera**	**Simiyu**	**Shinyanga**	**Mean**
Seed drying after harvest (N= 96)							
Yes (%)	100	93.8	93.8	100	81.3	81.3	91.7
No (%)	0	6.3	6.3	0	18.8	18.8	8.3
Seed drying materials (n=88)							
Rocks (%)	6.3	0	0	0	0	0	1.1
house roove (%)	0	0	0	6.7	0	0	1.1
bare ground (%)	6.3	20	0	0	40	7.7	12.5
mats/tarpaulin (%)	87.5	80	100	93.3	60	92.3	85.2
Shelling methods used (N=96)							
Finger threshing (%)	81.3	93.8	75	100	100	68.8	86.5
Beating by sticks	6.3	6.3	12.5	0	0	18.8	7.3

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(%)							
Machines (%)	12.5	0	12.5	0	0	12.5	6.3
Seeds cleaning after shelling (N=96)							
Yes (%)	75	56.3	18.8	81.3	68.8	75	62.5
No (%)	25	43.8	81.3	18.8	31.3	25	37.5
Cleaning methods used (n= 58)							
Winnowing (%)	83.3	88.9	0	91.7	90.9	58.3	79.3
Hand picking (%)	0	0	50	8.3	0	8.3	5.2
Both (Winnowing and hand picking (%)	16.7	11.1	50	0	9.1	33.3	15.5

3.5. Seed storage condition, packaging materials, and seed storage practices in the study area

Table 5 presents seed staking in the store, seed separation with grains in the store during storage, seed treatment against pests, and seed packaging materials used by farmers who save maize seeds in the Lake zone, Tanzania. It was found that 86.5% of farmers stake (raised platform) their seeds in stores. Results indicate that Mara region recorded higher number (43.8%) of sampled farmers do not stake their seeds while in other regions was less than 15%. About 45.8% of farmers separate seeds and grains in the stores during storage. Overall, results showed that approximately halfway of sampled farmers do not separate their seeds with grains during storage. It was observed that majority (71.88%) of sampled farmers treated their seeds against pests during storage. Furthermore, observed that popular packaging materials in the study area was polypropylene bags (79.2%), Shinyanga, Kagera, Geita and Mwanza above 85% of sampled farmers packed their seeds using polypropylene bags. Traditional cribs, hanging at trees and smoking in the kitchen practiced in Simiyu, Kagera region and (Simiyu and Mara) at 18.8%, 12.5% and 12.5% respectively.

These findings infer that majority of farmers manage their stores properly since seeds are staked (raised platform in the store). This practice avoids direct contact of the seeds with the floor which in turn would influence moisture absorption from the floor and fungal growth which in turn facilitate seed deterioration during storage. This means that most of the farmers are knowledgeable on proper store managements during seed storage. Seed treatment during storage implies that majority of farmers are knowledgeable and aware with the effects of grain pests which infest both seeds and grains during storage. Seeds which are not treated are likely to be attacked by pests easily which in turn cause seeds deterioration and fail to germinate once planted. This imply that most of farmers are changing from local methods of seed handling to modern methods. These findings are similar to the study by Shengu (2019) who reported minority 34% and 35% of farmers who save maize seeds in Dilla and Abaya districts in Ethiopia respectively do not use chemicals to treat their seeds against storage grains pests. Moreover, these findings corelate study by Shengu (2019) on local storage facilities who reported that about 7% of farmers who save maize seeds in Ethiopia store their seeds by hanging in trees and smoking in the kitchen. It was observed that majority of farmers do not separate seeds and grains

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during storage. The implications of storing seeds in the same store could be due to a lack of knowledge on proper seed handling practices during storage and storage facilities including stores. This situation facilitates the admixture of seeds and grains, which are not intended for seeds. These relate to the studies by Njonjo et al. (2019); Shengu (2019) who both reported that farmers who save seeds in Kenya and Ethiopia, respectively, do not have special rooms for seed storage; instead, seeds and grains are stored in the same store. It was also, found that polypropylene bags as dominating packaging materials in the Lake zone. Polypropylene bags are termed "mid-term packaging materials," which cannot maintain seed properties for more than one year since there is the possibility to contact between seeds and the external environment. Farmers' selection of seed storage materials in rural areas is influenced by availability, cost aspects, and accessibility; these factors may have caused polypropylene bags to be used mostly compared to other materials. These results are similar to those reported by Njonjo et al. (2019); Wambugu et al. (2009) who reported that the majority of farmers pack their seeds in polypropylene while storing their saved maize seeds in Kenya.

Table 5; Seed storage condition, packaging materials, and seed storage practices in the study area

	Regions						
	Mwanza	**Geita**	**Mara**	**Kagera**	**Simiyu**	**Shinyanga**	**Mean**
Seeds staking (pallet) (N=96)							
Yes (%)	93.8	100	56.3	81.3	87.5	100	86.5
No (%)	6.3	0	43.8	18.8	12.5	0	13.5
Separation of seeds and grains during storage (respondent N = 96)							
Yes (%)	62.5	31.3	68.8	37.5	50	37.5	45.8
No (%)	37.5	68.8	31.3	62.5	50	62.5	54.2
Seed treatments against storage pests by farmers in the surveyed area (N = 96)							
Yes (%)	87.5	81.2	81.3	50	50	81.3	71.88
No (%)	12.5	18.8	18.88	50	50	18.8	28.15
Packaging materials used (N=96)							
hermetic bags (%)	6.3	0	12.5	0	25	0	7.3
plastic containers (%)	6.3	6.3	12.5	0	0	0	4.2
Polypropylene bags (%)	87.5	93.8	62.5	87.5	43.8	100	79.2
Smoking (Kitchen) (%)	0	0	12.5	0	12.5	0	4.2
hanging at a tree (%)	0	0	0	12.5	0	0	2.1
Traditional cribs (%)	0	0	0	0	18.8	0	3.1

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4. CONCLUSION AND RECOMMENDATION

In the study area, observed that some farmers who save seeds are using inappropriate seed management practices. This means that they lack knowledge and awareness on different maize seed management practices while saving their seeds. Most of farmers in the study area take little initiative over seed quality control, especially on varietal purity maintenance. It was observed that most of the current farmers' practices on farm-saved seed management cannot produce seeds that meet the required qualities as per Tanzanian standards. During seed storage, the majority of farmers do not separate seeds from other produce, which facilitates the mechanical admixture of seeds varieties. Moreover, seed pre-harvesting and post-harvest handling are not given priority to maintain quality. This implies that the majority of farmers lack knowledge and awareness about proper seed handling to maintain seed quality. The study revealed that 41.7% of sampled farmers use local seed varieties, which implies that there is a need for improving these seeds since they are used by a large number of farmers in the study area. There is a need to improve the quality of farm-saved seeds through capacity building for farmers on good seed management practices. Since quality seed is the pivot toward successful agricultural production, there is a need for the government to improve the availability of quality seed to farmers. Due to the importance of quality seeds in ensuring food security, improving farmers' knowledge and awareness is important. This will facilitate seed security for farmers throughout the cropping season. Also, the collection of landrace varieties from farmers should be done from time to time to ensure a wide range of breeding materials.

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