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Analysis of Post-Harvest Management Practices among Maize Farmers in Oju, Benue State, Nigeria

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Abstract

The study analyzed post-harvest management practices of maize among farmers in Oju, Benue State, Nigeria. Data were collected from randomly selected 90 maize farmers using a structured questionnaire. Data were analyzed using descriptive statistics such as frequency, percentage and mean. Results of the study showed that maize post-harvest losses were caused by pests and diseases (M=3.0), poor packaging (M=2.8), poor processing facilities (M=2.8), lack of proper storage facilities (M=2.7) and pre-mature harvesting (M=2.6). About 98.9% of farmers used chemicals for maize treatment in storage and grinding machines for grinding, 97.8% used motor cycles and 96.7% used motor vehicles for maize transportation. High use of traditional post-harvest management practices such as sun drying (M=3.0), hand winnowing (M=2.8) and hand threshing (M=2.7) and moderate use of storage sacks (M=2.1) and mortal and pestles (M=2.0) for grinding were reported by producers. Farmers faced serious post-harvest management problems of pests and diseases (M=2.9), lack of extension services (M=2.8), lack of access to improved post-harvest technologies (M=2.8), inadequate storage infrastructure (M=2.8) and low level of education (M=2.7). It is recommended that government and non-governmental organizations should provide modern post-harvest facilities to farmers for improved post-harvest management practices which could enhance their income and food security.

Keywords: Post-harvest, practices, maize farmers

1. Introduction

Maize plays an important role in the diet of millions of people because of its capacity to produce a large amount of dry matter per hectare, its ease of cultivation, versatile food uses and storage characteristics (Adeboye & Oyetoro, 2011). In sub-Saharan Africa, absence or shortage of maize invariably leads to famine and starvation as the crop provides food for about 50% of the population (International Institute for Tropical Agriculture (IITA, 2009). Maize is highly responsive to production inputs, its food and industrial uses are many and the production potential can hardly be matched by many of the other major cereals (International Maize and Wheat Improvement Centre (CIMMYT, 2009) and IITA (2009). The crop is an important source of carbohydrate, protein, iron, vitamin B and minerals (Abdurahaman & Kolawole, 2006).

Despite the usefulness of maize as food for humans, feed for livestock and raw materials for the industries, ineffective management of post-production activities of the crop could reduce the quantity and quality of the produce/products, resulting to loss of income and food insecurity among producers, processors and marketers. Agoda *et al.* (2011) reported that maize post-harvest losses in Nigeria was estimated to be about 15-20%. The causes of post-harvest losses in maize were due to poor pre-production and post-harvest management as well as lack of appropriate processing and marketing facilities (Atanda *et al.,* 2011). Other causes of losses include: harvesting at an incorrect stage of produce maturity, excessive exposure to rain, drought or extremes of temperature, contamination by micro-organisms and physical damage that reduces the value of the product (FAO, 2011). According to Kader (2003), reduction in post-harvest losses through effective post-harvest management technologies such as post-harvest handling, cleaning, and sorting could increase food availability to the growing world population, decrease the area under production and conserve natural resources.

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Post-harvest management is a set of post-production practices that deals with harvesting, storage, processing, packaging, transportation and marketing (FAO, 2011). The system comprises interconnected activities from the time of harvest through crop processing, marketing and food preparation to the final decision to eat or to discard the food (Action Contre La Faim (ACF) (2014). These activities eliminate undesirable elements and improve-product appearance as well as ensure that the product complies with established quality standards for fresh and processed products**.** The post-harvest practices in staples by farmers, traders and processors in Nigeria consist of traditional techniques, which result in considerable loss of harvested crops, thereby contributing to high food prices and food insecurity.

Researches in maize over the years have resulted in the growing of improved varieties, mineral fertilizer use, rotations and intercrops, and these technologies have boosted production considerably (Tinsley, 2009). Nevertheless, the gains of technological advancement are threatened by poor post-production techniques to process, handle, and store the increased production. According to Kader (2005), over the past three decades, significant amount of resources have been allocated to increasing agricultural productivity, with 95% of research investment being focused on increasing production, while only 5% was targeted at reducing post-harvest losses.

Despite the huge advantage in using modern post-harvest technologies to process, handle and store increased maize produce, leading to reduced wastage and food security, farmers in rural areas have little or no access to modern post-harvest technologies, which are considered of great benefits to them. The implication is that, despite efforts made by government to transform agricultural sector in our farming communities, maize crops continue to waste, while the country continues to import maize products which affects the economy negatively.

In view of the foregoing, this research was designed to assess the post-harvest practices of maize by farmers in Oju Local Government Area of Benue State, Nigeria. Specifically, the study objectives were:(1) describe the socio-economic characteristics of the respondents; (2) determine the causes of post-harvest losses in maize among farmers; (3) ascertain farmers' awareness of modern maize post-harvest management technologies; (4) determine the use of modern post-harvest management practices of maize by farmers; (5) determine the level of use of traditional post-harvest practices of maize by farmers; and (6) identify the problems of post-harvest management practices of maize

2. **Materials and Methods**

2.1 Description of the study area

The study was carried out in Oju Local Government Area (LGA) of Benue State, Nigeria. The LGA has a population of about 170,236 people (National Population Commission, 2006). It is bounded on the West by Ebonyi State; on the East by Konshisha LGA; on the North by Obi LGA; and on the South by Cross River State. The annual temperature is about 27^0c. The highest of about 32^0c-34^0c occurs in April and May, while the lowest temperature of between 21^0c and 23^0c occurs during the months of December and June. There are two main seasons; the wet and the dry season and agriculture is the main occupation of the people. Some of the major crops produced in the area are; yam, cassava, maize, rice, sweet potatoes, beans, groundnuts, soya beans, tomatoes, guinea corn and millet. Some households also engage in rearing of small ruminants and poultry for income and for food. The main ethnic group is Igede, and this constitutes the major language of the people.

2.2 Sample selection, data collection and analysis

The population for this study comprised all the maize farmers in Oju Local Government Area of Benue State, Nigeria. Multi-stage sampling procedure was employed for sample selection. Firstly, three (3) council wards where maize is predominantly grown were selected from the eleven (11) council wards that constitute the LGA using a purposive sampling technique. Secondly, two communities in each council ward were selected using simple random sampling technique giving a total of six (6) communities that were used for the study. Thirdly, fifteen (15) maize farmers from each community were selected for the study, also using simple random sampling technique, bringing the total sample size to 90 maize farmers. Data for the study were collected using a well structured questionnaire. Data collected were analyzed using frequency, percentage and mean.

3. Results and Discussion

3.1 Socio-economic characteristics of maize farmers

The socio-economic characteristics of maize farmers in Oju Local Government Area of Benue State are presented in table 1. Finding on sex of the respondents showed that 57.8% were women while about 42.2% were men. This implies that most post-harvest activities of harvesting, handling, storage, processing, packaging, transportation and marketing were predominantly undertaken by women in the family or as hired labour. These women usually used traditional equipment which are labour intensive and time consuming. In order to reduce maize losses, the role of women should be recognized and gender sensitive intervention packages designed. It is important to recognize that women are receptive to the adoption of improved technologies that reduce drudgery and free them time to undertake other economic activities for enhanced income and food security.

Result on age of farmers revealed that about 41.1% were in the middle age bracket of 40-50 years, 27.8% were in the age group of 31- 40 years, 18.9% constituted the age bracket of 51-60 years, about 11. 1% belonged to the age group of 21-30 years, while those below 20 years accounted for 1.1% with the mean age of 52.6 years for the study area. This finding agrees with Agea *et al.* (2008) who reported that 41.0% of the farmers were aged between 41 and 50 years. This shows that most of the farmers were middle aged people who were still strong and energetic and who were capable of conducting post-harvest management practices of maize effectively and prevent losses. Ansah &Tetteh (2016) and Okoedo-Okogie & Onemolease (2009) showed in their studies that age was a significant factor in the management of post-harvest losses.

The number of years of formal education indicated that 40.0% of the respondents had between 7 and 12 years of formal education, followed by those who did not have any formal education (32.2%), 26.7% had 1-6 years of formal education, 1.1% had 13-17 years with an average number of years of formal schooling of 9 years. This implies that maize farmers had a considerable level of formal education that could enhance their access to information on modern maize technologies for post-harvest management activities. Education is a key factor in the effective use of modern post-harvest management technologies. As observed by Arah, Kumah, Anku & Amaglo (2015) proper handling of post-harvest losses is a function of different factors such as knowledge and skills hence, education is a key factor in the reduction of post-harvest losses. Farmers who have formal education are more likely to accept modern technologies than those who do not.

Majority (58.9%) of maize farmers in the study area had between 5-9 persons in their households, followed by those whose households comprised 10-14 persons (38.9%), 1-5 persons (1.1%) and 15-19 persons (1.1%) respectively with an average household size of 9 persons. This shows that majority of those involved in maize enterprise had large households. Maize harvest and post-harvest management activities are labour intensive and having a large household could assist in reducing the drudgery involved in these activities and lower the rate of post-harvest losses incurred by farmers. According to Ansah & Tetteh (2016), larger households have more readily available and cheaper sources of labour to effectively manage post-harvest losses in maize compared to smaller households. It also indicates that maize farming plays a major role in supporting family livelihoods as the respondents did not only provide for themselves but also for their dependants. The finding also corroborates the work of Agea *et al.* (2008) who stated that farm families in Nigeria were in the range of 6-10 individuals. Result on maize farm size owned by the respondents shows that close to a hundred percent (95.5%) had less than 3.0 hectares of maize farm while about 4.4% had 3.1-5.0 hectares with a mean farm size of 2.5 hectares for the study area. This implies that maize farmers in the study area are smallholder farmers.

Maize farming experience for majority (75.6%) of the respondents was more than 20 years with an average of 28 years. Experience is important in farming business, and it helps the farmer in decision making on post-harvest management practices. This finding agrees with the study of Meena *et al.* (2009) who reported the average involvement of farmers in maize farming to be 28 years which implies that the respondents were well experienced in their enterprise and have the capacity to effectively conduct the post-harvest operations of maize.

The estimated household income from farming showed that about 51.1% of the respondents earned N100,000 annually, followed by 21.1% who obtained N150,000, 17.7% got less than N50,000 while 10.0% obtained between N150,000 and N200,000. The mean annual household income was N91, 833.3 which meant that each farmer earned about N7, 652.8 monthly. This is far below the National Minimum Wage of N18, 000/month. The low household income could be attributed to low yield arising from poor production techniques, small farm size, poor knowledge and access to modern post-harvest technologies for enhanced shelf life of produce.

The finding confirms the classification of Nigeria as the poverty capital of the world in 2018 as about 86.9 million or close to half (46.7%) of her estimated population of 180 live below the poverty line of less than USD 1.90 a day (World Bank, 2018).This is equally in line with the study of Kader (2003), which stated that post-harvest losses not only affect output but reduce farmers' income. It also conforms to the finding of Mohammed & Afework (2016) that insect excrement and body parts left in the food may affect the taste and food safety, and consequently reduces the price consumers are willing to pay.

Table 1: Distribution of respondents according to socio-economic characteristics (n=90)

Characteristics	Frequency	Percentage	Mean
Sex			
Men	38	42.2	
Women	52	57.8	
Age (yrs)			
<20	2	1.1	
21 – 30	10	11.1	
31 – 40	25	27.8	52.6
41 – 50	37	41.1	
51 – 60	17	18.9	
Education			
None	29	32.2	
Primary (1 – 6 years)	22	26.7	6.2
Secondary (7 -12 years)	36	40.0	
Tertiary (13 – 17 years)	1	1.1	
Household Size			
1 – 4	1	1.1	
5 – 9	53	58.9	9.0
10 – 14	35	38.9	
15 – 19	1	1.1	
Maize Farm Size (ha)			
≤3.0	86	95.6	2.5
3.1 – 5.0	4	4.4	
Maize Farming Experience (yrs)			
1 – 9	21	12.1	
10 – 19	11	12.2	28.0
20 and more	68	75.6	
Annual Household Income (N)			
<50,000	16	17.8	
50,000 – 100,000	46	51.1	91,833.3
100,001 – 150,000	19	21.1	
150,001 – 200,000	9	10.0	

Source: Field survey, 2017

3.2 Causes of post-harvest losses in maize

Results on the causes of post-harvest losses in maize are presented on table 2. Respondents agreed that all the nine causes listed contributed to post-harvest losses in maize. These include pests and diseases (M=2.99); high temperature (M=2.70); poor handling (M=2.16); poor packaging facilities (M=2.78); poor ventilation (M=2.24), poor processing facilities (M=2.78), and poor marketing facilities (M=2.24). This implies that the causes of post-harvest losses of maize are many and diverse; therefore, farmers need training on the strategies to reduce post-harvest losses in maize. Also, government should provide modern post-harvest management facilities to enable maize farmers have more returns on their investment.

The finding corroborates the study of Atanda *et al.* (2011) which showed that post-harvest losses in maize occurred due to poor pre-production and post-harvest management as well as lack of appropriate processing and marketing facilities which have had adverse impacts on farmers' income, consumer price and nutritional quality of produce. It also agrees with the work of Olayemi *et al.* (2012) which indicated that farmers experienced serious post-harvest losses particularly due to improper storage structure. The finding of this study is similar to the work of Maziya-Dixon *et al.* (2004) who showed that households attributed their food losses largely to spoilage and insect/rodent attack of preserved foods.

The finding equally agrees with the study carried out by Hodges *et al.* (2011) who posited that the causes of post-harvest losses are varied and complex, depending on several factors, including weather and regional and crop differences and in Nigeria, the most significant variables include lack of proper storage, inadequate transportation infrastructure and limited or no information on where or how food is lost.

Table 2: Mean score of causes of post-harvest losses in maize (n=90)

Causes	Mean	Std Deviation
Pests and disease	2.99	0.105
High temperature	2.10	0.541
Premature harvesting	2.59	0.717
Lack of proper storage facilities	2.70	0.484
Poor handling	2.16	0.668
Poor package facilities	2.78	0.444
Poor ventilation	2.24	0.481
Poor processing facilities	2.78	0.418
Poor marketing facilities	2.24	0.658

Cut off mean ≥ 2.0
Source: Field survey, 2017

3.3 Awareness of modern post-harvest technologies for maize

Awareness is the knowledge a farmer possesses about a new technology. Results in table 3 depict farmers' awareness of modern post-harvest technologies in maize. All (100.0%) the farmers reported they were aware of the use of chemicals (100.0%) for maize treatment, motor cycle (100.0%) and motor vehicle (100.0%) for maize transportation. About 61.1% indicated they were aware of the use of grinding machine for maize grinding. A few were aware of metal silo bins (14.0%) and hermetic bags (5.0%) for maize storage; and mechanical drier (2.0%) for drying maize. This implies that farmers were only aware of those technologies available in their environment. A few who were aware of metal silos bin, hermetic bags and mechanical drier may have heard/read about them or had travelled outside the communities and seen them.

Table 3: Awareness of modern post-harvest technologies and practices in maize by farmers (n=90)

Technologies/Practices	Aware	
	Frequency	Percentage
Metal silos bins (storage)	14	15.6
Hermetic bag (storage)	5	5.6
Mechanical Drier (drying)	2	2.2
Chemicals (treatment)	90	100.0
Grinding machine (grinding)	55	61.1
Mechanical winnower (winnowing)	00	00
Motor cycle (transportation)	90	100.0
Motor vehicle (transportation)	90	100.0

Source: Field survey, 2017

3.4 Use of Modern Post-Harvest Management Technologies in Maize

Results indicated that most farmers used chemicals (98.9%), grinding machine (98.9%), motor cycle (97.8%) and motor vehicle (96.7%) (Table 4). This means that the modern post-harvest technologies used by maize farmers were those that they could access. Access to modern post-harvest technologies of maize is imperative in reducing post-harvest losses of maize. Adejo *et al.* (2017) noted that farmers who have access to modern agricultural technologies performed better than their counterparts who did not readily have access to them. In the light of this result, it is expedient that maize farmers' access to improved post-harvest management technologies be enhanced as the use of these technologies could improve the shelf life of the product, and enhance farmers' income, food security and livelihood.

Table 4: Use of modern post-harvest management technologies and practices in maize by farmers (n=90)

Technologies/Practices	Use	
	Frequency	Percentage
Metal silos bins (storage)	00	00
Hermetic bag (storage)	00	00
Mechanical Drier (drying)	00	00
Chemicals (treatment)	89	98.9
Grinding machine (grinding)	89	98.9
Mechanical winnower (winnowing)	00	00
Motor cycle (transportation)	88	97.8
Motor vehicle (transportation)	87	96.7

Source: Field survey, 2017

3.5 Level of use of traditional post-harvest management practices in maize

The level of use of traditional post-harvest management practices in maize by the respondents is presented in Table 5. Most maize farmers reported high use of sun drying (M=3.00), and use of hands for threshing (M=2.79) and for winnowing (M=2.69). The use of sacks (M=2.09) for storage and mortal and pestles (M=2.03) for grinding was moderate, while the use of head load (M=1.79), truck (0.89) and hanging of maize cobs (M=0.78) was low in the study area. This implies that maize farmers relied on the use of traditional methods, particularly sun drying for maize post-harvest activities. This finding agrees with the reports of Mtambanengwe *et al.* (2006) and Adeboye & Oyetoro (2011) which stated that post-harvest practices for maize include sun drying, threshing (use of hand), storage (use of sacks and hanging) and transportation.

Although farmers' indigenous methods of post-harvest handling have kept them in business for several years, they are cumbersome and less effective when compared to modern post-harvest operations. For instance, Omoruyi & Orhue (1991) as cited by Chukwunta (2014) found that produce stored under the traditional system usually do not keep long and farmers suffer great losses. Thus, there is need for intervention by government at all levels and non-governmental organizations with interest in improving agricultural post-harvest management operations to enhance farmers' capacities not only to produce but also to manage what they have produced in order to improve their income and food security for poverty reduction.

Table 5: Mean score of level of use of traditional post-harvest management practices in maize (n=90)

Practice	Mean	Std. Deviation
Sun drying (drying)	3.00	0.000
Use of hand (threshing)	2.69	0.489
Mortal and pestles (grinding)	2.03	0.853
Hanging (storage)	0.78	1.149
Using of sacks (storage)	2.09	1.346
Head load (transportation)	1.79	1.393
Truck (transportation)	0.89	1.336
Use of hand (winnowing)	2.79	0.485

Key: High =2.50-3.00; Moderate =2.00 – 2.49; Low < 2.00

3.6 Problems of post-harvest management practices in maize

Farmers reported that eleven (11) out of the twelve (12) listed post-harvest management problems in maize were serious problems (Table 6). These included pest and disease attack in stored grain (M=2.90), lack of extension services on modern post-harvest management practices (M=2.84); lack of access to modern post-harvest management practices (M=2.82); inadequate storage infrastructure (M=2.76); low level of education on effective post-harvest management practices (M=2.72); low level of awareness of modern post-harvest management practices (M=2.64); lack of sorting to minimize defects before storage (M=2.57); high cost of transportation to markets (M=2.48); lack of market infrastructure (M=2.45); lack of capital (M=2.41) and use of poor packaging materials (M=2.26). This implies that the respondents encountered different challenges in maize post-harvest management practices. Maize farmers loose a considerable amount of grains each year due to numerous problems. The various problems reported by farmers could reduce their output and income from maize farming leading to poverty and food insecurity.

Table 6: Mean score distribution of problems of post-harvest management practices of maize (n=90)

Problems	Mean	Std. Deviation
Inadequate storage infrastructure	2.76	0.481
Lack of capital	2.41	0.538
Lack of sorting to minimize defects before storage	2.57	0.524
Low level of awareness of modern post-harvest technologies	2.64	0.528
Use of poor packaging materials	2.26	0.514
Low level of education on effective post-harvest management practices	2.72	0.541
High cost of transportation to markets	2.48	0.545
Pest and disease attack in storage grain	2.90	0.368
Lack of market infrastructure	2.45	0.543
Lack of access to modern post-harvest technologies	2.82	0.447
Lack of extension services on modern post-harvest technologies	2.84	0.479
Inadequate cooling and maintenance	1.81	0.668

Mean cut off ≥2.0 = Serious problems

4. Conclusion and recommendations

4.1 Conclusion

The study concluded that maize farming in Oju Local Government Area of Benue State, Nigeria was dominated by middle-aged and experienced women with little education, large households, small farms, and low income. Loss of maize after harvest was high due to poor access to modern post-harvest technologies and the use of traditional post-harvest management practices which were ineffective, resulting in low income and food insecurity.

4.2 Recommendations

Based on the findings of this study, the following recommendations were made:

1. In view of the fact that maize farmers had little or no access to improved post-harvest technologies, government and non-governmental organizations should facilitate farmers' access to these facilities to reduce grain losses and enhance farmers' income and food security.
2. Extension workers should train farmers on effective post-harvest management practices of maize in order to increase production, minimize losses and improve the quality of the produce.
3. Small scale improved facilities for storage and processing should be provided to farmers by the state and local governments to reduce maize losses in the study area.

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