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Determinants of Post Harvest Losses of Maize in Akure North Local Government Area of Ondo State, Nigeria

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The study was carried out to determine some of the factors that were responsible for post harvest losses of maize in Akure North Local Government Area of Ondo State. Data for the study were collected with the aid of a well structured questionnaire from a sample of one hundred (100) respondents which was drawn from five (5) purposively selected villages in the study area. The data collected were analyzed using frequency distribution, percentage and regression analysis. The findings revealed that 69% of the maize farmers were male while 76% of them were married. The results further showed that 85% of the farmers were literate, 69% of them acquired their farmlands from communal sources and by inheritance. Also, 75% of the farmers obtained maize seeds from either the ADP or their cooperative societies. The results of the study indicated that 51% of the farmers in the study area had access to and obtained extension messages from extension agents. The major problems faced by the farmers in the study area were inadequate finance, insect pest attack, high cost of transportation and price instability, among others. The results of the regression analysis showed that gender, source of information and type of storage facilities were some of the determinants of postharvest losses in the study area. Efforts to reduce postharvest losses in maize should therefore be directed at providing appropriate information on postharvest handling of maize and to facilitate access to appropriate storage facilities for maize.

Keywords: determinants, maize and post harvest losses

Introduction

Maize (Zea mays L) Known in many English–Speaking countries as corns, is a grain domesticated by indigenous peoples in Mesomaria in prehistoric times and it is the most widely grown grain crop in the Americas with 332 million metric tons grown annually in united state alone, Raouf (2011). He submitted that maize that is useful in various ways as human food, alternative medicine, chemicals, biofuel, ornamental and other uses.

He further reported that maize is a major ingredient in home cooking and in many industrialized food products. Maize also a major source of cooking oil (corn oil) and of gluten. Maize starch can be hydrolyzed and enzymatically treated to produce syrups, particularly high fructose corn – syrup, a sweetener, and also fermented and distilled to produce grain alcohol for whiskey production and as the starch source for beer: Maize is grown as forage , silage or grain to feed livestock. It is also a significant ingredient of some commercial animal food products such as feed, dairy poultry, piggery; dog food. It is also used for production of dough ball for fish bait.

Diversified uses of maize for starch industry, corn oil production, baby food, pop corns etc and potential of exports provide the much needed impetus for Nigerians to cultivate maize (Obilana & Fajemisin 1997).

The rate of food production is reducing while hunger and malnutrition are on the increase (Obilana & Fajemisin, 1997). According to (FAO, 1998), food production cannot satisfy the increasing food demand unless attention is focused on reducing post-harvest losses. This will create an opportunity for providing a substantial amount of food for consumption and other uses. Most of the post harvest losses are occurring in the developing countries while most of the increased food production is taking place in the developed countries.

According to Ajirenike, (2005) the rise in price of maize in Nigeria indicates a higher demand and low supply. This low supply in Nigeria may be attributed to low grain yield compared with the world average. Due to the increasing demand as a result of population increase; there is need to increase production of maize to meet demand of the growing population. This can be achieved by instituting maize improvement programmes such as the development of high yielding, early maturing and disease resistant varieties; and provision of credit and extension services to boost domestic maize production (Ajirenike, 2005).

On the basis of the fact that maize is useful in various ways, its potential for export, the need to

reduce postharvest loses as a way of bridging the gap between demand and supply it is imperative therefore to carry out research work on postharvest losses of maize in a given market; the basis upon which Akure North Local Government was chosen as the area of Study.

Literature Review

Maize, also known as corn, which is the name that has come into common usage primarily because it is used in united states, the world's largest producer, consumer and exporter of maize; Kranja (2003). Maize is the third largest planted crop after wheat and rice. It is mostly used and traded as a leading feed crop but it is also an important food staple. In addition to food processing to manufacturing of ethanol, Nyoro (2004). Maize is an annual plant with high productivity which also enjoys exceptional geographic adaptability, an important property which has helped its cultivation to spread throughout the world. Geer (1986).

Jayne et al (2001) in his study on maize carried out in Kenya reported that maize is main staple food and an important source of calories to a large proportion of the population in both urban and rural areas and that maize is also important in Kenya crop production patterns accounting for roughly 25 percent of gross farm output from the small scale farming sector. Nyoro et al (1999) summited that overtime, maize production in Kenya has not increased as fast as demand in Kenya has not increased as fast as demand driven mainly by population growth. Maize consumption in Kenya is estimated to be in excess of 30million bags per year to bridge the ever increasing gap between the maize supply and demand in that country Kenya has been importing maize formally and informally across the border from Uganda and Tanzania in addition to large offshore imports from as far as South Africa, Malawi, United states of America and other southern America countries like Brazil and Argentina. RATES (2002) and Awuvour (2003) documented the continued existence of regulatory barriers and high transportation costs that impede maize trade cost in Uganda and Kenya.

The harvesting process is the final stage in the production of crop. Proper handling of the crop after maturity and correct harvesting procedures may often be the difference between profit and loss. When the crop is sufficiently matured, it is desirable to initiate harvesting and attempt to harvest a large percentage of the crop with as high quality as possible. The time to begin harvesting will vary considerably in the various production area of the Nation. The crop's maturity and the number of days of favorable weather that can be expected will determine the time to begin harvesting (Bishop et al, 1983).

Losses on yield can be due to improper harvesting techniques or harvesting too early or too late. If harvesting is too early, the plant may not have reached full maturity resulting in shrinkage of the grains. If harvest is too late, plant can lodge or stalk can break, grains can shatter or ears can drop and quality will deteriorate. Producers who are willing to take the time needed to adjust and operate their harvesting properly will reap extra profit from extra yield. Harvest losses from properly adjusted and operated harvesting should not exceed 3 percent as anything greater represents needless loss (Bishop *et al,* 1983).

After harvesting, it is necessary to store the produce and protect it properly until it is processed into a usable product for consumers. Producer will often market their produce shortly after harvesting and move the product on into the channel of commerce. But in many cases, the producer will process and store a product for a period of time before it is used (Bishop *et al,* 1983).

Odeyemi and Daramola, (2000) reported that an essential objective in food storage is to preserve the quality of the food commodities so as to prevent food wastage and make food available all the time. The climatic factors such as sunshine, rainfall, humidity and temperature, influence condition during storage and may have a direct or indirect effect on the food. The direct effect on food is through physical and chemical processes while the indirect is through influence or the agent of biological deterioration. All food commodities, even when not subjected to infestation by insects and micro-organisms may suffer changes in textures and moisture content of the food during prolonged storage. The changes do not necessarily rendered the food unfit for human consumption but they make it less palatable and sometimes unacceptable to the consumer.

Storage losses of food in the tropics can be very high when the weather is hot and dry. Temperature in storage structures can reach 5^0c. This causes increased respiration of the food accompanied with weight loss. When it is hot or wet, food may rot very quickly. At high humidity and temperature, grains and legumes may absorb water from the atmosphere leading to deterioration (Odeyemi and Daramola, 2000).

Despite the available resources and laudable programmes and policy undertaken by government to boost agricultural productivity in Nigeria, farm produce suffer serious neglect from the government and research institutes (Proctor *et al,* 1987). One of the common complaints from farmers is lack of proper storage facilities to take advantage of better off-season prices, lack of vital market information and inadequate rural credit (Harper, 1983). Post-harvest management of maize grains has to do with pest damage in storage. The most important insects associated with maize storage include the grain

weevils (*Sitophilius Zeamais, Sitophilus oryzae and Sitophilus granaries*), amongst others. For some species such as the grain weevils, the infestation starts right from the field and is brought into the store. Grain is usually most susceptible to damage when it is stored under high grain moisture content. Losses during storage vary considerably from13% level in commercial silo to 80% in tropical on-farm store in developed countries (Harper, 1983). Current control strategies of post harvest losses in maize include proper conditioning of grain by sun drying to acceptable moisture content or forced air-drying and storage in sealed container devoid of oxygen to arrest insect development. Insecticides can also be applied to husks, ear and grain to reduce insect damage. A popular insecticide, actellic (*Promisphomethy*) is commonly used. Plant breeding to reduce storage losses has largely focused on improving husk cover, which serve as an important first line of defense against invasion (Harper, 1983).

Maize Losses

Loss is a concept which is difficult to define. However estimates of quantitative losses will eventually give a broad picture of where the losses are occurring, their relative scale and how a specific crop has been handled during the post harvest operation. Losses are often estimated as a percentage of the amount remaining from the previous stage of postharvest operation. If losses are determined on the basis of the original weight of the crop, it can lead to an overestimation of losses (FAO, 1996). On the other hand, there are other losses, which are difficult to determine, and these losses include time, manual labor, agricultural inputs, opportunity cost, illusion and hopes. For practical reasons, methodologies for estimating postharvest losses are directed at giving an idea about the main quantitative losses that are occurring post-production (FAO, 1992).

Factors and Causes of Grain Loss

The maize postharvest system or pipeline shows several stages at which losses of food can occur. The main agents or factor responsible for the losses can be grouped as physical, biological, engineering and mechanical, socio-economic (Odeyemi & Daramola, 2000).

Physical factor include both the temperature and moisture content of the stored grains. Temperature has a great influence on the respiration rate of the stored food commodity, pest organisms, relative humidity and food moisture content. The temperature in tropical and subtropical climate provide ideal living condition for insect pest and in areas with high relative humidity, condition are also ideal for fungi growth. The effects of temperature in storage include increase or decrease in drying rate of foods, damage to seed viability by high temperatures and acceleration of the physiological process by living organisms. All foods contain water in different proportions. Once harvested, the moisture content of the stored food will fluctuate. Higher moisture content is conducive to infestation with fungi, mould and moisture-loving insects. Foods with high moisture content hence deteriorate rapidly.

Biological factors include insects and mites, birds, rodents and other wildlife and micro-organism (fungi, mould and bacteria). Apart from eating the foods, they contaminate them with their droppings, urine, hair and carcasses. They also introduce diseases and parasites through contamination of the foods by their droppings. Microorganisms can cause loss and spoilage. The food values and palatability are altered by their toxins which affect animal and man. Also deterioration of packaging and sealing material occur due to moulds. In dry foods, the spore and mycelia of the microorganisms are dormant until conditions become favorable for their growth. Increased relative humidity of the environment or increased moisture content of the commodity provides the favorable conditions they require.

Engineering and mechanical factors that affect post harvest losses include types and efficiency of harvesting tools, equipment and machines; primary processing equipment and machines; drying and storage structures; type and efficiency of non-farm transport, etc. The socio-economic factors include financial status of the farm household, farming system and storage; and marketing system. This study was carried out to determine some of the factors that are responsible for post harvest losses of maize in Akure North Local Government Area of Ondo State.

Research Methodology

Study Area

The study was carried out in Akure North Local Government Area of Ondo State. The local government shares boundaries with Ikere Local Government of Ekiti State in the North, Ifedore Local Government in the West, Owo Local Government Area in the East and Akure South Local Government in the South. It spreads over an area of about 15,911 square Kilometers with a population of about 185,596 inhabitants (Babayemi, 2006). It lies on the longitude of 51150.50300t and latitude of 60411.60491 (Oyesanmi, 2009). The communities under the jurisdiction of the local government include Oba-Ile, Aiyede Ogbese, Iju, Itaogbolu, Owode, Eleyowo, among others. The people of the area are predominantly farmers with keen interest in arable crops in general and maize in particular.

Sampling technique

Random sampling technique was first used to select five communities in the local government area. Twenty respondents each were then randomly chosen from each of the five communities selected and a total of 100 respondents were used for the study.

Method of data collection

Data were collect through structured questionnaire supplemented with interview schedule to elicit information from the respondents. The questionnaire was designed to collect information on demographic and variables. The demographic variables include age of farmers, sex, major occupation among others while the non-demographic variable include type of farming operations, problem faced by the farmers in the course of harvesting and postharvest handling of the produce.

Method of data analysis

Descriptive statistics such as frequency distribution, percentages and regression analysis were used. The ordinary least square method of regression analysis was used with the functional forms of semi log and double log to estimate the relationship between the dependent variables and the set of explanatory variables. The best-fit equation was selected based on the goodness of fit as indicated by the coefficient of determination (R^2) and adjusted R square (R^{-2}), the signs of regression coefficients, the overall significance of the model as indicated by the F – value and the statistical significance of individual coefficients as indicated by the t – test.

The implicit model is specified as:

$Y = F(x_1, x_2, x_3, x_4, x_5, x_6, x_7, e_i)$ ……..(1)

Where:

Y = Average loss of yield of maize in kilogram
X_1 = Gender
X_2 = Marital status
X_3 = Level of education
X_4 = Level of output
X_5 = Source of information
X_6 = Type of storage facilities
X_7 = Frequency of sales
e_i = Error term associated with information collected from maize farmers.

The explicit statements of the semi log and the double log are presented in equations (2) and (3), respectively.

Semi log

$$\text{Logy} = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + e_i \text{…….……(2)}$$

Double log

$$\text{Logy} = \log b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6\log X_6 + b_7\log X_7 + e_i \text{…….…(3)}$$

Where:

b_0 = intercept

$b_1 – b_7$ are regression coefficients of X_1 - X_8 respectively.

Results and Discussion

The outcome of demographic and socio economic characteristics of respondent on the determinants of post harvest losses of maize in the area of study are shown in Tables 1 to 5

Table 1 shows gender, marital and educational status of the respondents. About 69% of the respondents were males. The result shows that males were involved in maize production than the females. Majority (71%) of the respondents were within the age range of between 20 – 40 years. This indicates the preponderances of young people in maize cultivation in the study area. In spite of the majority of the respondents being young, about 70% of them were married. Also 85% of the respondents had formal education.

This is in line with the expectation of young people in Ondo State being educated. It corroborates NBS (2006), which indicates the adult and youth literacy rates for the State as 69.7% and 94.1%, respectively.

Table 1. Socio-economic characteristics.

	Characteristics	Frequency	Percentage
Gender	Male	69	69.00
	Female	31	31.00
	Total	100	100.00
Age	Below 20	1	1.00
	20 – 25	14	14.00
	26 – 30	27	27.00
	31 – 35	23	23.00
	36 – 40	6	6.00
	41 – 45	11	11.00
	46 and above	18	18.00
	Total	100	100.00

Table. 1. Continued

Marital Status	Single	11	11.00
	Married	76	76.00
	Divorced	12	12.00
	Widowed	1	1.00
	Total	100	100.00
Educational Status	No formal education	15	15.00
	Primary education	3	3.00
	Secondary education	34	34.00
	Post secondary education	48	48.00
	Total	100	100.00

Table 2 shows the sources of land, credit, labor and information as inputted by the respondents. Majority (69%) of the farmers acquired their farmlands from communal sources and by inheritance. This may act as disincentive to farm improvement since such parcels of land are governed by customary tenure system. About 89% of the respondents had access to informal sources of credit while 11% had access to formal sources. This may be an indication that the formal sources of credit are difficult to access in terms of conditions that must be fulfilled. About 50% and 42% of the respondents made use of family and hired labour, respectively. Also 51% of the farmers got information on improved farming technique from extension agents. This shows that the level of awareness and use of extension services by the farmers were just average in the study area. Furthermore 40% of the maize farmers got seeds from the Agricultural Development Project while 35% got seeds from their cooperative societies.

Table 2. Sources of inputs.

Farmland Acquisition	Frequency	Percentage
Inheritance	49	49.00
Gift	9	9.00
Purchase	17	17.00
Leasehold	5	5.00
Communal	20	20.00
Total	100	100.00
Source of Credit		
Bank	4	4.00
Cooperative Society	6	6.00
Friend and relative	44	44.00
Personal Savings	45	45.00
Total	100	100.00
Source of Planting Materials		
Agricultural Development Project	40	40.00
Cooperative Society	35	35.00
Personal Farm	25	25.00
Total	100	100.00
Source of Labor		
Family labor	8	8.00
Hired labor	50	50.00
Family and Hired	42	42.00
Total	100	100.00
Source of Information		
Extension Service	51	51.00
Radio	10	10.00
Television	30	30.00
Newspaper	9	9.00
Total	100	100.00

Table 3 provides information on the output, storage and sales of maize in the area of study. Majority (57%) of the farmers produced 3 – 6.99 tones of maize per annum. This is an indication that the respondents were small-scale farmers. Majority (48%) of the respondents recorded the highest level of sales between October and December. About 40% of the respondents used cribs to store their maize produce. This appears to be the most appropriate means of storage given the size of their outputs and the cost of silos.

Table 3. Output, storage and sales of Maize.

Output (tones)	Frequency	Percentage
Less than 1	5	5.00
1 – 2.99	34	34.00
3 – 4.00	35	35.00
5 – 6.99	22	22.00
Above 6.99	4	4.00
Total	100	100.00
Types of Storage		
Cribs	40	40.00
Earthen pot	22	22.00
Silos	35	35.00
Others	3	3.00
Total	100	100.00
Peak of Sales		
January – March	12	12.00
April – June	20	20.00
July – September	20	20.00
October – December	48	48.00
Total	100	100.00

Table 4 shows the outcome of respondents view in respect of post harvest losses and marketing problems in the area of study. About 40% of the respondents encountered a lot of problem in marketing their produce. Also 67% of the respondents indicated that their most important sources of produce loss are insect pests' and rodents' attack. Price instability (40%) and high cost of transportation (39%) were the most important problems encountered in maize marketing.

Table 4. Post harvest losses and marketing problems.

Most important source of losses	Frequency	Percentage
Insect Pest attack	39	39.00
Rodent attack	28	28.00
Activities of man	20	20.00
Birds attack	1	1.00
Untimely harvest	12	12.00
Total	100	100.00
Problems of maize marketing		
High cost of transportation	39	39.00
Inadequate finance	21	21.00
Price instability	40	40.00
Total	100	100.00

Table 5 shows the outcome of regression analysis. The double log function was chosen as the lead equation based on the value of R^{-2}, the signs and the significance of the coefficients. The function shows that 11.5% of post harvest losses recorded by the farmers were accounted for by the explanatory variables. It could be seen from the result that only gender (X_1), source of information (X_5) and types of storage facilities (X_6) were significant at 5% level. It therefore implies that gender (X_1), source of information (X_5) and storage facilities (X_6) are some of the important variables which affect losses of maize produce in the study area.

Table 5. Regression analysis result.

Variables	Semi Log	Double Log
Constant = (B_0)	- 0.468	0.23
	(0.403)	(0.258)
Gender = (X_1)	0.193	0.321*
	(0.110)	(0.160)
Marital status = (X_2)	0.131	0.252
	(0.098)	(0.182)
Level of education = (X_3)	0.01934	- 0.1768
	(0.056)	(0.110)
Level of output =(X_4)	- 0.06347	- 0.071021
	(0.061)	(0.143)
Source of information = (X_5)	0.06651	0.164*
	(0.050)	(0.091)
Type of storage facilities = (X_6)	0.09569	0.209*
	(0.046)	(0.091)
Frequency of sales = (X_7)	0.09413	- 0.09285
	(0.036)	(0.127)
R square (R^2)	0.136	0.115
R-square (R^{-2})	0.060	0.048
F – statistics	1.792	1.708

* Significant at 5% level

Recommendation

Based on the findings, from this study, it is recommended that efforts to reduce post harvest losses in maize should therefore be directed at providing appropriate information on post harvest handling of maize and to facilitate access to appropriate storage facilities for maize.

Conclusion

The findings revealed that 69% of the respondents engaging in maize production are male while 76% of the respondents were married. The results further showed that 85% of the farmers in the study area were literates, 69% of them acquired their farmlands from communal sources and by inheritance. Also, 75% of the farmers obtained maize seeds from either the ADP or their cooperative societies. The results of the study indicated that 51% of the farmers in the study area had access to and obtained extension messages from extension agents.

The major problems faced by the farmers in the study area were inadequate finance, insect pest attack, high cost of transportation and price instability, among others. The results of the regression analysis showed that gender, source of information and type of storage facilities were some of the determinants of post harvest losses in the study area.

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