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AN ANALYSIS OF THE PRE AND POST HARVEST MANAGEMENT TECHNIQUES IN RICE PRODUCTION: THE CASE OF UNVDA NDOP, NORTH WEST REGION, CAMEROON

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ABSTRACT

This paper examines the adoption of improved pre and post harvest management techniques with a view to finding means to improve on the livelihood of rice farmers. These farmers were selected from two divisions (Bui and Ngoketunjia) where rice is being produced by the Upper Nun Valley Development Authority (UNVDA) in the North West Region of Cameroon. The study was to identify; the major causes of pre and post harvest losses, the management techniques adopted to overcome these losses, the socio economic characteristics of farmers that influence the adoption of the techniques. The multistage random sampling technique was used to get a sample of 120 rice farmers, from whom necessary information were elicited using questionnaires. Data were analyzed with descriptive statistics and binomial logit model. The results revealed that marital status, quantity of grains harvested, membership into a common initiative group and surface area cultivated were statistically significant factors influencing adoption of pre and post harvest management techniques. Also household size, farming experience and farm type were positively and statistically not significant factors while gender, age of farmer, level of education and income level affected adoption negatively and were not statistically significant Lack of financial incentives, inadequate machinery, poor soils, were major constraints faced by respondents. It was recommended that all factors that significantly affect adoption of technologies be improved.

Keywords: Rice, Adoption, Losses, Management techniques, UNVDA, Livelihood.

Contribution/ Originality

This study is one of the few studies which have investigated the causes of pre and post harvest losses experienced by farmers of UNVDA and have used a different estimation methodology to determined factors influencing the adoption of pre and post harvest management techniques.

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1. INTRODUCTION

Rice is one of the most cultivated crops in the world. It is the staple food for over half of the world's population, most of who live in developing countries such as the countless millions in Asia who depend mostly on rice as their main dish. Rice cultivation is the principal activity and source of income for millions of households around the globe, and several countries of the world depend on rice as a source of foreign exchange earnings and government revenue (International Rice Research Institute, 2009). Rice is life for thousands of millions of people United Nations Conference on Trade and Development (2010) and it is a staple food in many African countries (Norman and Kebe, 2006). It sustains the livelihoods of 100million people and its production has employed more than 20 million farmers in Africa (West African Rice Development Association, 2005). In Cameroon, Rice is an important cereal crop for producers and consumers (Molua, 2010). Cameroon represented about 0.3% of African rice production in 2008 (Piebiep, 2008). Despite the investments made in this sector Cameroon satisfies only about 28.8%. This is because rice is being affected a lot by pre and post harvest losses and these losses represent more than just a loss of food as it ripples through factors including labor, water, seeds, time and fertilizers (Appiah *et al.*, 2011). According to Saunders *et al.* (1978), food losses and post harvest waste are estimated at 30 to 40% of total production. Between 10-40% of the food that is grown never reaches the market or a consumer's plate because of insects and rodents that get into storage containers, losses during harvesting and processing and other factors (Food and Agricultural Organisation, 1997). Not only do these losses reduce food security in the world but they equally increase cost of production. In other words, post harvest food loss translates not just into human hunger and financial losses to farmhers, but into tremendous environmental waste as well (Earthtrends, 2001).

Despite all that has been done to enable it attain its position and reach self sufficiency, Cameroon still satisfies only about 28.8% of demand via local production. Hence depends mainly on imports in order to satisfy its needs. Since the difference in demand is made up of imports which are continually increasing, special attention needs to be given to develop rice production in the country (Goufo, 2008). In order for Cameroon to have a sustained growth and to enable it achieve its goal of agricultural growth, there is need for proper management of pre and post harvest losses. This is because losses that occur during local rice production if reduced could reduce the huge deficit, cost of production, trade distribution and equally lower the prices for consumers at the same time increasing farmer's income (Panhwar, 2006). More so, despite the properties of locally produced rice in Cameroon, it is not competitive enough against imported rice in terms of price. This shows that, growth rate has really been slow and the expected level of growth has not been achieved. Reasons why the rice sector of the UNVDA area was revamp after the 2008 food crisis in Cameroon to take care of the activities of the area by improving on productivity through the use of various techniques of production. This paper therefore intends to: Identify the major causes of pre and post harvest losses in rice production, Assess the various pre and post harvest

management techniques employed in rice production, describe and analyze the socio economic characteristics of farmers that influence the adoption of these management techniques, identify the problems associated with the adoption of pre and post harvest management techniques.

2. METHODOLOGY

This study was carried out in the North West Region of Cameroon in 2014 specifically in two main divisions Ngoketunjia and Bui where the Upper Nun Valley Development Authority highly intervenes. The Upper Nun Valley shares boundary with Bui Division to the North, Mezam to the West, Bamboutous and Noun Divisions to the south and East respectively. The Upper Nun Valley lies between latitude 5 º 15 N and 6º 10 N and longitude 10º 15E and 10º 40E (Divisional Delegation of Agriculture and Rural Development for Ngoketunjia (DIDARDN), 2013). According to the 2010 population census, the divisions of Ngoketunjia and Bui had as populations 128.432 and 324.726 inhabitants respectively.

The annual rainfall ranges from between 1500 –17200mm. The temperature range is 20ºc to 35ºc with an average yearly temperature of 26-28ºc (DIDARDN, 2013) which favors the growth of rice and other crops. The major crops cultivated here are : rice, maize, tubers, and vegetable crops (okra, peppers, onions, tomatoes, carrots, and cabbage) etc.

The focus of this study is on rice farmers of the two main divisions (Bui and Ngoketunjia) of the North West regions were UNVDA highly intervenes in terms of rice production. Multistage random sampling technique was used to select Sub divisions, sectors, villages and respondents. At the end a sample of 120 farmers was used.

Primary data were collected through the use of well-structured questionnaires. Data were analyzed using descriptive statistics. Regression analysis and binomial logit analysis were used to test the hypothesis.

3. RESULTS AND DISCUSSIONS

3.1. Socio-Economic Characteristics

Results of the socio-economic characteristics of the respondents are presented on table 1. This shows that most of the rice farmers (52.50%) fall in the age range 40-60years while only a few of them (19.17%) fall between 61years and above. Also it was seen that majority of the respondents were males. This therefore means that more males are involved in rice production than females since it is an activity that involves a lot of energy.

Also majority of respondents (61.66%) had at least a primary school education, while only 5% had higher and university education. This shows that most of the rice farmers have a low level of education which affected their rate of adoption of management techniques of UNVDA negatively. Furthermore, majority of the respondents (65.83%) had an average income that ranged from 50 to 250 (thousands) from the sale of their paddy, while only 2.5% of the respondents had an average income of 651-850 (thousands).

This therefore shows that majority of the farmers earned just little income from sales. This explains why income affects the adoption of some techniques because they are expensive.

Table-1. socio-economic characteristics of respondents

Variable	Frequency	Percentage
age		
20 -40	34	28.33
41 - 60	63	52.50
61 >	23	19.17
Gender		
male	62	51.67
female	58	48.33
Marital Status		
Single	8	6.67
Married	96	80.00
divorced	4	3.33
Widowed	12	10.00
Educational level		
No formal education	20	16.67
Primary school	74	61.66
Secondary school	20	16.67
High school/ University	6	5.00
Access to funds		
Njangi houses	56	46.67
Past savings	35	29.67
Local banks	13	10.83
Others	16	13.33
Income level '000		
50 – 250	79	65.83
251 – 450	23	19.17
451 – 650	8	6.67
651 – 850	3	2.50
851 >	7	5.85
Farm type	78	65.00
Developed	42	35.00
Traditional		
Years of experience		
1 -9	36	30
10 -19	30	25
20 -29	28	23.3
30 -39	23	19.2
40 and above	3	2.5
Total	120	100

Source: fielddata

3.2. Causes of Pre and Post Harvest Losses

Respondent's perception on losses varied, 97.5% of the respondents reported that they experience losses of rice before harvest to an extent while 2.5% said they had not. Also,

98.3% of the respondents reported that they had experienced losses of rice after harvest whilst 1.7% of the respondents said they had not. The causes of losses are shown in table 2.

3.2.1. Causes of Losses at the Pre Harvesting Stage

The losses at pre harvesting stage are due to floods, bird invasion, weed, drought, and rodent attacks. From the analysis, 40% of the respondents reported that the main cause of losses at this stage were due to floods, here poor water control results to logging of the heads. Also, 22% reported that, losses at pre harvest were due to bird invasion, 21% said that losses were due to weeds. The main weeds that destroy grains here are the *Echinochloa colona* (man power) and *Romulea rosea* (onion grass). The "onion grass" is often killed by selective herbicides, while the "man power" is resistance to it. More so, 11% said losses at this stage were caused by drought which makes some grains to wither and die, 2% of the respondents said losses at this stage were due to rodents attack. Here, animals such as rats and frogs invade and destroy the grains especially when they are still at the nursery. Finally, 4% of the respondents said losses at this stage were due to other factors such as poor seeds, cows invading fields and destroying the crops, as well as attack from insects etc. These causes are similar with those highlighted by Ray (1999), according to him pre harvest losses are caused by weed, rodent and bird pest controls, planting varieties with admixtures of red rice, which are highly shattering, and have low resistance to lodging and uneven maturity dates.

3.2.2. Causes of Losses at the Post Harvesting Stage

At the harvesting stage farmers reported that losses were due to late harvesting, birth attack, and grains fall off from the stalk., 51.88% of farmers who experienced losses at this stage said it was principally due to bird attack in the field, 21.80% reported that it was caused by late harvesting due to scarcity of labor during harvesting time.

Here, labor becomes scarce during harvesting period since all farmers are harvesting at same time. Also, 26.32% reported that losses at this stage are due to the poor harvesting method (ie manually using sickles) used which causes the grains to fall off in greater quantities.

These results are equally in line with the publications of FAO (2008) which stated that, late harvest, for example, can bring about losses from attacks by birds and other pests. At the threshing stage, 46% of the respondents reported that losses occur here due to over dryness of the paddy. When the paddy becomes too dry and it is threshed it shatters away. Also 32% reported that, losses were due to the poor threshing methods (i.e. the bam-bam and the bag beating) this method shatters the grains in greater quantities, especially when the tarpaulins are insufficient or old.

Approximately, 14% of the respondents reported that some grains stick on the mud floor and it becomes difficult to carry hence grains are bound to be lost in t mud. These factors that account for threshing losses are in line with those enumerated by Ray (1999) who reported

that losses occur at the threshing stage due to bird invasion, fowls, grains are scattered when bundles are lifted up before threshing, and grains equally stick on the mud floor.

Table-2. Causes of losses at the Pre and Post Harvesting Stages

Causes of losses at the pre harvesting stage	Frequency	Percentage (%)
Floods	46	40.00
Bird invasion	26	22.00
Weed	25	21.00
Drought	13	11.00
Rodent attack	2	2.00
Others	5	4.00
Harvesting		
Late harvesting	18	21.80
Bird attack	60	51.88
Grains fall off from the stalk	42	26.32
Threshing		
Grains stick on the mud floor	16	14.00
Over dryness	53	46.00
Poor method	37	32.00
Others	10	8.00
Drying		
Animal attack	53	46.90
Bird	13	11.50
Grains fall off from the stalk	27	23.90
Inadequate or poor tapaulines	20	17.70
Storing		
Rats	112	94.92
Cats	2	1.69
Pests	4	3.39
Milling		
Over or under dry paddy	81	71.68
Poor machines	32	28.32
Transportation		
Poor packaging	103	89.56
Bad roads	12	10.44

Source: Field Survey 2014

At the drying stage, results show that 46.9% of the losses were due to animal attack. When the grains are dried on the yard, goats, pigs, and dogs eat them, 11.5% of the respondents reported that losses were due to bird attack. Also, 23.9% of the respondents reported that grains fall off from the stalk due to over dryness and finally 17.7% of the respondents reported that losses at this stage was due to inadequate or poor tarpaulins. According to the results from data at the storage stage, 94.92% of the respondents reported that losses were caused principally by rats. Here, the rats invade many storage rooms and burst the bags and equally destroy the grains in greater quantities. From discussions with some of the respondents, it was reported that from a bag of paddy harvested 2 or more buckets can be eaten by rats. Also, 1.69% of the respondents

reported that it was caused by cats, and equally 3.39% of the respondents said losses at this stage were caused by pests. From the above analysis, it shows that rats account for the greatest percentage of losses. Hence measures should be taken to reduce their attack on paddy. Furthermore, Losses at the milling stage are due to over or under dried paddy which leads to a lot of breakages during milling. Machine inefficiency is another cause because the machines are too old and spare parts are difficult to get. At the transportation or packaging stage, it was found that losses at this stage is mainly due to defective packaging (89.56% of the respondents) due to lack of good ropes and good bags. When bags are not well sealed they get loose on the way hence spilling the grains on the ground and when the bags are too old they easily get torn on the way. Also, 10.44% of the respondents reported that causes of losses at this stage were due to the bad nature of roads that cause most motorcycles and trucks to fall during movements losing some of the paddy either inside water or mud. This result is in line with the publications of FAO (2008) which stated that, poor transport conditions or defective packaging of grain can lead to quantitative losses of product.

3.3. The Management Techniques Employed By UNVDA to Reduce Pre and Post Harvest Losses

In an attempt to reduce pre and post harvest losses in rice production, UNVDA employs some
management techniques that help to curb the situation, increases productivity and hence enhances livelihoods.

Land Development: Generally, when land is not developed, it leads to so many losses mostly at the farm level due to floods, drought and the interference of animals. UNVDA has used its equipment pool to develop and maintain paddy fields. As a result of this development, floods and droughts are reduced. The corporation undertakes the maintenance of these infrastructure and resources together with the participation of its rice farmers. There is equally the construction and maintenance of irrigation and drainage infrastructure. Here dams, canals, distributors, have been built in most fields in order to help reduce water management problems.

Provision of Farm Inputs: In order for UNVDA to minimize losses at the pre harvesting stage, UNVDA supports rice farmers with fertilizers that helps the paddy grow well because when fertilizers are applied in the right quantity other things held constant, the yield becomes great. In that light UNVDA gives these products on credit to farmers and they pay back in paddy. In order to reduce the admixture of grains that have different maturity dates and ensure uniformity of seeds which leads to high quality products. UNVDA provides quality seeds to farmers at very moderate rates (150 FRS per kg as opposed to 700 FRS per kg in the open market). This technique is facilitated by the fact that UNVDA has a very large farm for seed multiplication (15hectares or 750 rooms).

Another management technique used by UNVDA is that of the provision of equipments to farmers on rentage. They take their tractors to the various farms, plough the farms for the farmers and the farmers only have to pay a small token.

Provision of a ready market: In order to avoid dumping and the selling of "*Porto Porto*" or unseasoned rice and equally in order to avoid losses at the marketing stage, UNVDA provides a ready market for rice farmers. Here it provides the necessary facilities to ease the buying of paddy from farmers at the various collection centers and its eventual storage and transportation to the main store for processing. To maintain high quality standards in the rice sub-sector, UNVDA assists farmers by using its state-of-the-art hulling facility with a capacity of 3.5tonnes/hr to process paddy into finished rice products and by-products (rice brand, flour, husk, rice starch, broken rice, parboiled rice, unpolished rice etc.) and then facilitates its marketing within the country. This aims at ensuring high quality products and also helps to minimize losses. This is because they sell a bag of paddy (100kg) for 8000 FRS to local buyers of which UNVDA normally buys a bag of paddy (100kg) for 12500 FRS).

UNVDA organizes seminars and workshops that help train farmers to better off their yields. Farmers are being trained and sensitized on modern methods of farming. In order for the above techniques to be implemented at the farm level, UNVDA assists farmers through the provision of extension services especially in the domain of rice cultivation. Its frontline extension workers live with the farmers and offer technical advice and equipment hiring to the farmers on daily basis. This technique is in line with that recommended by the Africa Rice Center (2009), that priority should be given to training programs, production and agric extension workers to prevent quality deterioration at the farm level and to gradually introduce quality standards both for paddy and milled rice.

3.4. Socio-Economic Characteristics of Farmers that Influence the Adoption of Pre and Post Harvest Management Techniques

From the results of the logit model in presented in table 3, the overall goodness-of-fit measured by the significance of the Chi-square statistic in the Omnibus tests of model coefficients is ($\chi 2$=29.113, significant at 1% level). The percentage of correct prediction is reasonably good (72.5%). The Hosmer and Lemeshow test shows that the model adequately fits the data (the test was not significant at 5% level with α=0.502, thus, the null hypothesis could not be rejected). Besides, most of the explanatory variables have the expected signs, except for the variable « level of income ». Adoption of pre and post harvest management techniques was regressed against some socioeconomic variables. The gender (1=male, 0=female) coefficient (-0.290) of the adoption mode was not significant at the 10% level suggesting that a male is 0.749 times less likely or not to adopt pre and post harvest management techniques and a woman is 1.596 times less likely or not to adopt the management techniques. This outcome is in contrast with previous findings by Dolisca *et al.* (2006) and Bayard *et al.* (2007) who concluded in their study that female farmers have been found to be more likely to adopt natural resource

management and conservation practices than male farmers. Similarly, the age (Years) coefficient is -0.019 showing that a unit increase in the age of the respondents will lead to a little or no decrease in their likelihood of adopting the management technique by 0.981 units predicting that age does not increase or decrease the likelihood of people adopting the management techniques. This outcome simply confirms the previous findings of Thatcher *et al.* (1997) and Zhang and Flick (2001) who claim that age had no influence on farmer's decision to participate in forest and soil and water management activities .

Also, the coefficient of the variable, marital statues (Single=1, married=2, divorced=3, widow(er) =4) is -0.487 and it is slightly significant at the 10% level with p value=0.117. The marginal effects of this result suggest that, a unit increase in marital status level will lead to a slight decrease in the likelihood of adopting the management techniques by 0.614units. More so, the education (never being to school=1, primary=2, secondary =3, high school=4, university =5) coefficient is -1.43 which is not significant at the 10% level. The marginal effects of this result indicate that a one year increase in the farmer's educational level will lead to a little or no decrease in the odds of adopting the management techniques by 0.867 units. This result is in line with a study carried out by Okoruwa *et al.* (2008) whose results showed that the level of education was negatively significant indicating that farmers hardly adopt fully the modern storage techniques. Furthermore, the coefficient of the family size (number) is 0.049 and is positively associated with adoption. Yet it is not statistically significant in explaining the decision of adoption. This result suggests the presence of other more binding constraints currently preventing the decision for such investments at the first stage.

Table-3. Logit results for model of pre and post harvest management technique adoption

Explanatory variables	B	SE	Wald	Sig	Exp(B)'
Gender	-0.290	0.524	0.305	0.580	0.749
Age	-0.019	0.022	0.790	0.374	0.981
Marital Status *	-0.487	0.311	2.451	0.117	0.614
Education	-1.43	0.284	0.255	0.614	0.867
Family size	0.049	0.045	1.213	0.271	1.050
Farming experience	0.023	0.024	0.936	0.333	1.023
Surface area cultivated ***	-0.063	0.023	7.872	0.005	0.939
Quantity of paddy harvested ***	0.106	0.038	7.635	0.006	1.112
Income	-0.127	0.507	0.063	0.802	0.881
Membership into CIG's *	1.236	0.646	3.658	0.056	0.326
Farm type	0.329	0.460	0.511	0.475	0.970
Constant	0.468	1.576	0.088	0.767	0.564

Note: *** and *: Significant at 1% and 10% level respectively.
Exp (B)' shows the predicted change in odds for a unit increase in the predictor
Number of valid observation n=120
-2log likelihood=130.649 Nagelkerke R^2=29.3%
Omnibus test of model coefficient: $\chi 2$=29.113 df=11 sig=0.002
Percentage of correct prediction= 72.5%
Hosmer and Lemeshow test: $\chi 2$=7.326 df=8 sig=0.502

The coefficient of the quantity (0.106) of grains harvested was found to be very significant and has positive effect on the likelihood of adoption of pre and post harvest management

techniques with the probability p=0.006 at the 1% significant level. This result is in line with a study carried out by Okoruwa *et al.* (2008) on the management of storage techniques where results obtained showed that the estimated model was highly significant at the 1% level and that a unit increase in the quantity harvested increases the likelihoods of the odd ratio of the adoption rate of these storage techniques. Similarly, the coefficient of the surface area (number of rooms) -0.63 was found to be significant and has a negative effect on the likelihood of adoption with the probability p=0.005 at the 1% significant level. Predicting that a one unit increase in the surface area will lead to a less than proportionate increase in the adoption mode by 0.970 units indicating that as the surface area increases it entails a lot of finances to manage the farm well in order to have better yields which is a big constraint for farmers hence the adoption rate is low.

Furthermore, the coefficient of the variable Common initiative groups (membership=1, non membership=0) was very significant at the 10% level, this result is in line with that of Tiamiyu *et al.* (2010) that membership of association has a significant effect on adoption of post harvest technologies in Nigeria. Our results predict that a 1 unit increase in the membership into a CIG is likely to increase the odds in adopting management techniques by 0.326 times. This is simply due to the fact that a member of a CIG is more susceptible to more advantages working with UNVDA (getting some input on credit, working mostly on developed lands etc) than a non member.

The coefficient of income (amount) -0.127 is not significant at a 10% level and it has a negative effect on adoption, showing that a one unit increase in income will lead to a little or no decrease in the likelihood or odds of the adoption of management techniques by 0.802 units. This means that income has little or no effect on adoption decision. This result is in contrast with those gotten by Tiamiyu *et al.* (2001) whose results showed that Income influences technology adoption positively. This is because farmers have capital to plowback into the production process in order to increase profit.

More so, the coefficient of the farm type (FT) (developed=1, underdeveloped=0) is 0.329 and is equally insignificant at the 10% level. Farm type here indicates the type of land that the farmers uses i.e. either developed or undeveloped. Therefore a one unit increase in the type of land be it developed or undeveloped will lead to little or no increase in the adoption rate by 1.389units. Finally the variable representing farming experience is positively associated with adoption (ie 0.023). Yet it is not statistically significant at the 10% level in explaining the decision of adoption. This means that, a one year increase in farming experience will lead to little or no increase in the likelihood of adopting by 1.023units.

3.5. Major Problems Faced by Rice Farmers in Adopting Pre and Post Harvest Management Techniques

The major problems faced by respondents were: Financial difficulties to better implement these techniques, poor access to equipments, poor soils, and other problems such as poor

pricing, low return, high input prices, lack of technical knowledge etc. These problems are presented on figure 1.

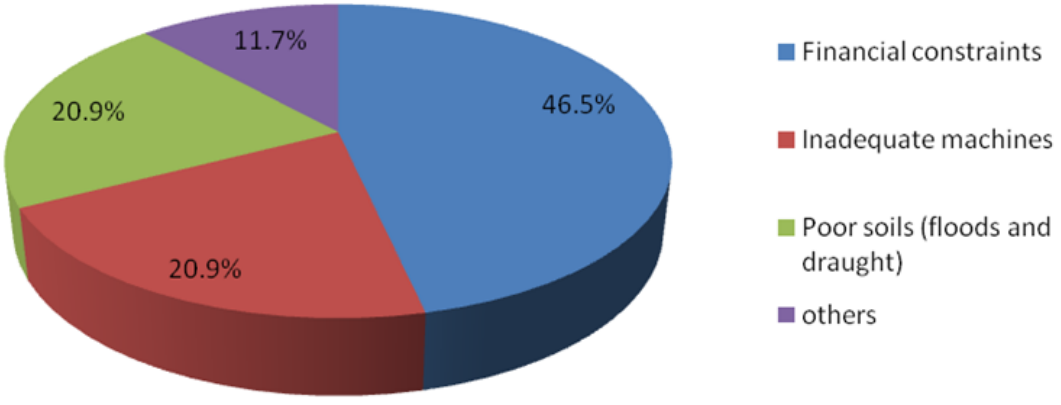

Figure-1. Problems faced by respondents in the adoption of pre and post harvest management techniques

4. CONCLUSION/RECOMMENDATIONS

This study was conducted with the aim of assessing the pre and post harvest management techniques employed by UNVDA in rice production. The study was carried out in the North West region of Cameroon specifically the Ngoketunjia and Bui divisions where rice is mainly produced. The following conclusions were made: that Pre harvest losses were caused by major factors such as floods, bird invasion, weed, drought, rodent attack etc post harvest losses were due to late harvesting, poor threshing method, rat invasion, old machines, rodents' attacks, bad roads, etc The following management techniques were employed: land development, provision of farm inputs at subsidized rates, provision of a ready market and the organization of training seminars . Results from the logistic regression analysis showed that marital status, quantity of grains harvested, membership into common initiative groups and surface area cultivated were statistically significant factors influencing adoption of pre and post harvest management techniques. Farmers faced the following constraints in adopting these management techniques: financial difficulties, inadequate machinery, poor soils, cumbersome techniques etc It therefore was recommended that all factors that significantly affect adoption of technologies be improved. Farmers should be encouraged to adopt pre and post harvest management techniques through adequate funding of research, training and extension activities, as well as provision of credit facilities to the major actors in the production chain.

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