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## Factors Affecting the Adoption of Improved Rice Varieties in Borno State, Nigeria

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### Abstract

*The study investigated the factors that affect adoption of improved rice varieties in the southern part of Borno state, Nigeria. The research involved 120 respondents and 12 farmers groups from three districts that were randomly selected. Questionnaire was used to collect data which were interpreted using frequency table, percentage, chi-square and cluster analysis. Comparison of the significance results between the individual locations was done to look for the individual differences. Focus group was used to explore some of the issues in greater detail. The result of the analysis showed that (44%) were fast adopters, (35%) slow adopters and (21%) were non-adopters. The findings revealed that access to improved rice seed (47.38<sup>\*\*\*</sup>), access to credit (17.70<sup>\*\*\*</sup>), contact with extension agents (247.59<sup>\*\*\*</sup>) and membership of farmer's association (24.65<sup>\*\*\*</sup>) are highly significant while age (16.05) and farming experience (16.84) are also significant to adoption of improved rice varieties in the area. Farmer's groups also mentioned that lack of a medium maturing variety and a thresher are amongst their most important problems. This challenges present implication for developing different technologies and support system that take such variance in to account or government will keep on spending a huge resources that will not give a good results and also a threat to food security.*

**Keywords:** Adoption, Technology, Rice. Improved Varieties

### Introduction

Technology adoption by farmers is an essential pre-requisite for economic prosperity in developing countries. In many developing nations, a huge amount of resources have been devoted to extension service in order to educate farmers to new agricultural practices. In Nigeria, such initiatives have been undertaken through the Agricultural extension project (ADP) and Sasakawa Global 2000 (SG 2000) (Dugje *et al.*, 2008; Donye *et al.*, 2013). The efficiency

of these programmes depends on the factors that influence technology adoption. Therefore, extension educators and technical assistants have to understand factors affecting technology adoption in order to target and deliver effective programmes.

Many studies on rice technology adoption have been conducted in developing nations including Nigeria (Awotide *et al.*, 2010; Dontsop-Nguezet *et al.*, 2011; Mustapha *et al.*, 2012; Kijima and Sserunkuuma, 2013). However, because of variability in natural resources, culture, political system, traditions, beliefs and socio-economic factors, the factors affecting technology adoption differs across the locations. For instance, in a review of technology adoption studies in Africa Heissey and Mwangi (1993) showed that factors that affect technology adoption vary among the locations. In Nigeria, a rice seed is one of the important improved varieties that need adoption in order to improve domestic rice production so as to reduce importation.

Meanwhile, agriculture is the second largest economic sector in Nigeria after petroleum. It contributes more than 40% to gross domestic product (GDP) (NBS, 2013) and remain the most important sector in transforming rural communities (USDA, 2014). Due to the contribution of the agricultural sector in the country the government support agricultural research and extension aiming at producing and disseminating new technologies to improve the productivity of farmers. However, there is a lack of good evaluation of their impact on farmers. Research and extension efforts have been initiated and terminated without formal analyses of their effectiveness.

This study was aimed at identify the socioeconomic characteristics and institutional factors that affect adoption of improved rice varieties in three local government areas in Borno state, Nigeria due to their contribution in rice farming. Rice demand in Nigeria is high and meeting this demand is among the food security priorities (NRDS, 2009). In 2011 the annual rice demand was nearly 7.0 million tonnes while domestic production was around 4.5 million tonnes of milled rice and hence, there is a deficit of 2.5 million tonnes (FAOSTAT, 2014). Importing large volumes of rice to make up this shortfall is costly and causes a problem to the foreign exchange. Despite that, Nigeria government has invested on developing improved rice varieties for farmers so as to increase production and cut importation of rice. For instance, the National Rice Development Scheme (NRDS) was established to improved domestics' production by encouraging farmers to adopt improved rice varieties (NRDS, 2009). The efficiency of these programmes is determined by the factors that affect adoption of rice technology.

### **Agricultural Extension Service**

The extension service is one of the most important institutional factors that influence the adoption of improved rice varieties. Many studies shows that famers with a regular extension contact are more willing to adopt innovation (Ogunlana, 2004; Anderson 2007; Kassie *et al.*, 2009). A weak extension

service will have a negative effect on adoption of improved rice varieties in Nigeria (David, 2012). Lack of extension support and motivational incentives affect extension service delivery (Anderson, 2007). Meanwhile, private extension service has promoted agricultural production and kept agricultural skills in rural area (Yahaya and Luka, 2012). The agricultural non governmental organisations have promoted information dissemination and reduce the gap between public extension and farmers (Adedeji *et al.*, 2012). Majority of the farmers prefer information from private extension workers (Okoro, 2006). This is due to their effective service delivery (Saliu and Age, 2009). However, the ADPs are the main advisory system in the area.

Rice production practice in the area; they cultivate upland and lowland varieties in which majority of the farmers goes to rain fed lowland varieties (Kamara *et al.*, 2011). The upland is cultivate when the rain start, from late May to early June on average rain of 700mm. The available rice seeds are NERICA varieties L41 and 42 for lowland and NERICA L1 and L4 for upland and the varieties has an average of 8mt/ha under good management system (Ekemele *et al.*, 2008). Old improved varieties (ITA 150) that was disseminated in 1996 also available in the area.

Meanwhile, adoption of the improved rice varieties by farmers is facing challenges. This study examined the factors that make farmers to adopt or reject the improved rice varieties. A further aim of this study was to gain insight and good understanding of the farmer's situation which will help government, extension and research programme to develop a policy for future rice development programmes and food security.

### **Objectives of the study**

The objective of this study was to identify the factors that affect the adoption of improved rice varieties by farmers in southern Borno state, Nigeria.

The specific objectives were to;

Identify the socioeconomics characteristics of the respondent that affect adoption of improved rice varieties

Examine the institutional factors that will influence the adoption of improved rice varieties.

### **Hypothesis**

The adoption of improved rice varieties in Borno state is strongly influenced by socioeconomics characteristics and institutional factors.

### **Methodology**

Borno State is located in the north eastern part of the Nigeria at latitude 10<sup>0</sup>N to 13<sup>0</sup>N and longitude 11.04<sup>0</sup>E and 14.04<sup>0</sup>E and has an area around 69,436 km<sup>2</sup>. It shares an international border with Cameroun to the east, Chad to the north-east and Niger republic to the north. Borno State also shares a local border with Adamawa State to the south, Yobe State to the west and Gombe State to the

south-west. Two method sampling were employed (purposive and random). Three local governments were purposely selected due to their contribution to rice farming in Biu, Hawul and Shani local government areas. While, 120 respondents and 12 farmers group were randomly selected within the area. Open and closed ended questionnaire was used to collect a data from 120 respondents and 12 focus groups were also interviewed. Descriptive statistics (frequency and percentage), chi square and cluster analysis was used in data analysis.

Frequency, mean and percentage were used in analysing data. The data was categories base on dependent variables (socioeconomics and institutional factors) and Independent variables (adoption of rice technology). Chi square analysis was used in testing the statistical significance of different hypothesised variables that may influence the adoption of improved rice varieties. Cluster analysis was employed to analyse the relationship of more than one (dependents) variable at a time.

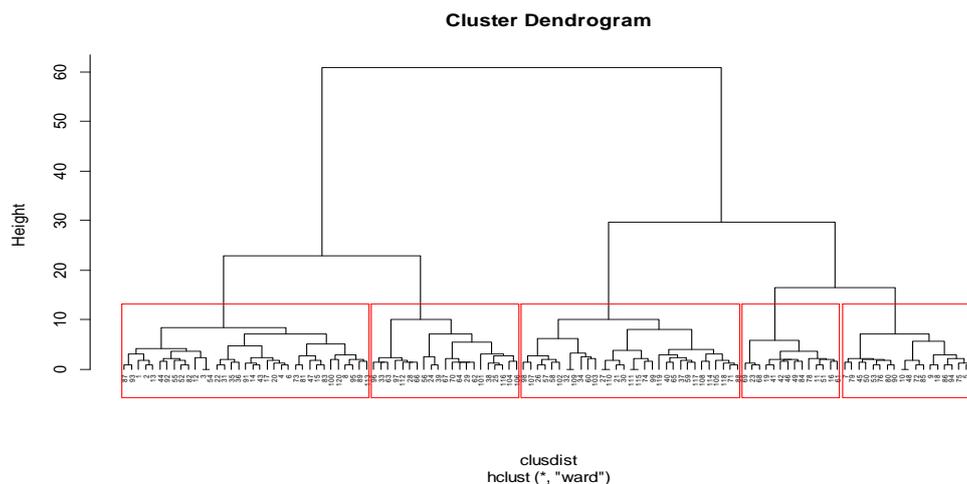


Figure 1: A cluster dendrogram

Cluster analysis was selected because it allows the effect of more than one variable at a time to be examined (Emtage and Suh, 2006) and gave confidence in making conclusion. The main consideration in cluster analysis is the size of the clusters, size of the data and determination of the clusters is subjective. Too many clusters may make it difficult to detect specific relationship. In this study different numbers of clusters was tested and five clusters was finally identified for use as these resulted a highly significant result ( $X^2=32.33$ ,  $df=8$ ,  $P=0.00008$ ). See figure 1 above.

## Results and Discussion

### Adoption Categories

Farmers were assigned to three adoption categories. *Fast adopters* defined as farmers who have adopted recently (2012) introduced rice varieties, whereas *slow adopters* are farmers who cultivated old improved varieties. *Non-adopters* were farmers who planted local varieties. Figure 2 shows that, 44% of the respondents were fast adopters, 35% were slow adopters and 21% were non-adopters. The high percentage of the fast adopters it may be due to the free rice seed distributed by government in the year 2013. ITA 150 is an old variety that distributed by IITA in 1996 but still farmers used it because it mature (mature at late season) when the rain end. NERICA is an early maturity variety and the consequences is that, it matures before the rains end and this will cause loss as it is susceptible to fungi and mould during storages, on the other hand threshing will be difficult as the rice will not dry due to the rain and high rate of moisture at the time.

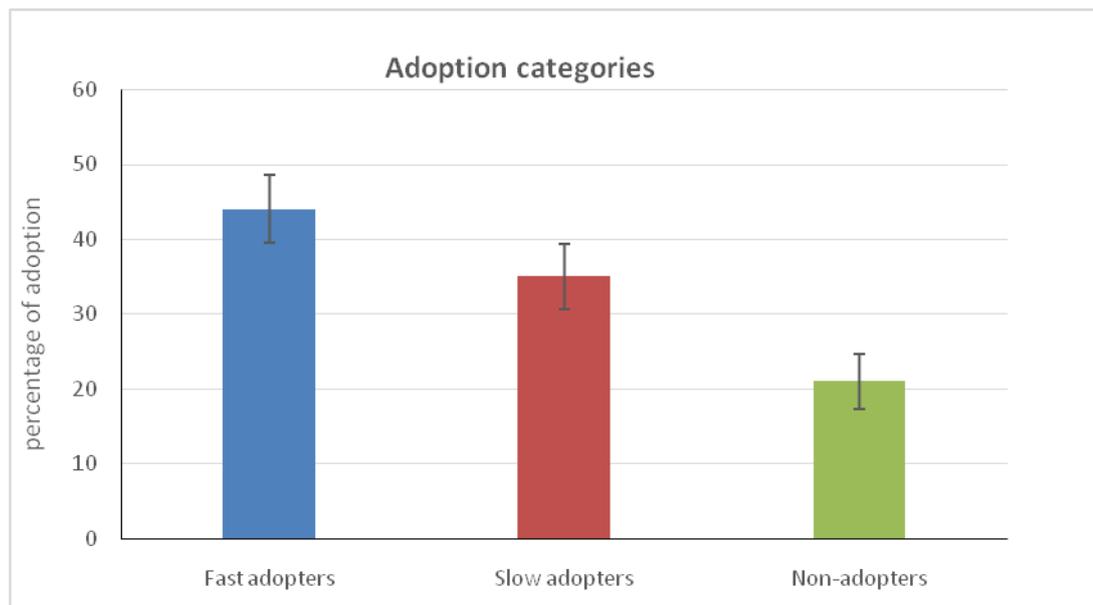


Figure 2: Percentage of respondents in different adoption categories in Borno State Nigeria (n=120)

### Socioeconomic characteristics of the respondents

Table 1 shows that out of 120 respondents the majority (61) obtained their improved rice seeds through the public extension service and the majority of farmers in this category were fast adopters while, only 3% of the farmers sourcing their seeds through the private extension service and the Chi square showed a significant difference to seed access. The majority (67%) of the respondents were male. The majority of the respondents are within the middle

age categories (30-50 years) which is dominated by fast adopters. The level of experience in farming is important to adoption of improved rice varieties as more than 50% of the respondents have more than ten (10) years' experience in farming and the Chi square result showed the significance of the experience in farming.

**Table 1: Socioeconomics characteristic of the respondents**

Variables	Categories	Numbers	Fast Adopters	Slow Adopters	Non Adopters	X2 test
Sources of Seed	Public Ext.	61	37	13	1	47.3*** df=6
	Private Ext.	4	1	1	1	
	Open market	28	9	11	3	
	Family & friends	27	9	11	3	
Gender	Male	80	28	24	14	0.27
	Female	40	16	16	6	
Age	18-30 years	3	1	1	1	16.05* df=8
	31-40 years	44	20	12	4	
	41-50 years	38	13	13	5	
	51-60 years	26	10	5	7	
	61 & above	9	0	3	5	
Farming Experience	1-5 years	6	2	1	2	16.84* df=6
	6-10 years	52	24	16	3	
	11-15 years	38	23	13	7	
	16 years & above	24	5	6	9	
Educational Level	Primary	31	13	9	3	8.76
	Secondary	27	13	6	4	
	Tertiary	14	5	6	1	
	Non-formal edu.	48	13	14	13	
Farm Size	1-3 acre	57	22	16	10	6.84
	4-6 acre	44	18	12	7	
	7-9 acre	16	2	8	3	
	10 & above	3	2	0	1	
Ploughing Method	Mechanical	48	19	13	8	4.82
	Manual	17	9	5	1	
	Ox-bull	55	17	17	13	

Source: Survey 2014. \*\*\* $p < 0.01\%$  \*\* $p < 0.1\%$  \* $p < 5\%$

### Institutional factors that affect adoption of improved rice varieties

Table 2 shows that the majority of the respondents have access to credit (65) with a larger part of fast adopters. Table 2 access to credit is significant. Fifty three of the respondents had access to extension contact. The text showed that most of the persons that had access to extension contact. The majority of the respondents (65) were members of association and the bulk of fast adopters. the government thought that subsidising input will influence the adoption decision of the farmers, however, inappropriate chain of supply/distributing the input or late arrival of input (seed, fertilizer, chemical spray) will seriously affect the adoption decision of farmers. Poverty also among the major constraints that affect adoption as some farmers used to cook free seed distributed by government instead of planting.

**Table 2: Institutional factors that affect adoption of improved rice varieties**

Variables	Categories	Numbers	Fast Adopters	Slow Adopters	Non Adopters	X2 test
Credit Access	Yes	65	36	11	8	17.70***
	No	55	9	24	13	df=2
Membership of Association	Yes	65	33	18	3	24.65***
	No	55	11	18	18	df=2
Extension Contact	Yes	53	30	11	2	27.59***
	No	67	13	24	20	df=2
Subsidy Access	Yes	40	19	10	4	4.48NS
	No	80	25	25	17	df=2

\*\*\* $p < 0.01$ . Source: Survey, 2014.

The responses from focus group discussion and that of the individual questionnaire are not always consistent. For instance from the focus groups interview, the groups reported that *Striga. Hermontica* and grasshopper are among their main issues while, during the individual questionnaire interview, majority of the respondents said that they did not have pest problems (weeds and insects). The group collectively responded that they prefer medium duration varieties than the early maturing varieties despite the high yield potential of the early maturing varieties. This unsuited character of early maturing varieties affects their adoption decision. This is because they depend on rainfall and early maturing varieties usually mature before the rains end. Consequently, they incur losses and even if they harvest the rice during the rainy season, drying it will be difficult and storage within the rainy season will make the rice

susceptible to fungal attacks. Threshing also will be difficult while medium maturing varieties will mature at the end of rainy season which will make it easy to dry and thresh the grain. According to Mrema *et al.*, (2008) there is high post-harvest loss in rice production which range between 30%-50% and this as a result of contamination or spoilage caused by rain prior to harvest and during storage. The groups further pointed out that low market price and poor linkage with agro dealers also affect their adoption decisions and this will increase their production cost and affect their selling price.

### Individual locations analysis

Because of the variation in the individual locations, further analysis was done base on the individual location. Meanwhile, only the factors that showed significant results in combined analysis were considered in this section.

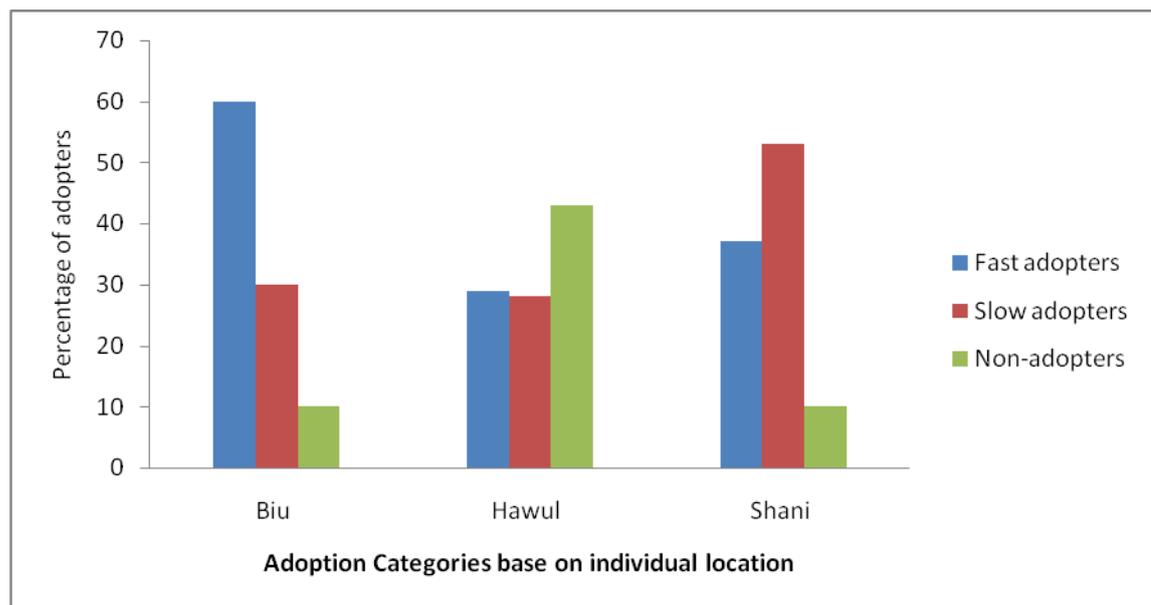


Figure 3: Percentage of respondents in different adoption categories in each of the three local government areas surveyed in Borno state (n=120).

Figure 3 shows that there were differences in adoption among the individual locations. Biu had the high percentage (60%) of fast adopters; Hawul shows the highest number (43%) of non-adopters while Shani is leading in slow adopters with (53%) of the respondents. Majority of the respondent's from Biu source their seeds through public extension and a larger proportion (56%) of them were fast adopters (see Appendix 1). This could be due to the presence of a zonal extension office in the area. From Hawul larger farmers got their seed through open market and the majority of them were fast adopters. Shani farmers source their seeds through family and friends (safe seeds) and slow

adopters dominate the category. This could be due to the remoteness of the area which required them to save their seeds from previous harvest. The majority of the respondents from Biu have contact with extension agents while most respondents in Shani and Hawul did not have extension contact.

Appendix 1 also shows that sources of seeds and extension contact have a significant effect on the adoption of improved rice varieties in all of the locations (see appendix 1, 2, & 3). However, farming experiences had shown significant result in Hawul and Shani (appendix 2 &3). Credit access and farmers association have shown significant relationship to adoption of improved rice varieties in Hawul Local Government Area only (Appendix 2). This could be due to the influence of education in the area which makes them to form association and take advantage of credit access.

### Cluster analysis of the variables that affect adoption

Table 3 shows that fast adopters dominated cluster 2, 4 and 5. Slow adopters have the highest number in cluster 1 while non-adopters leading cluster 3. The table also revealed that the biggest cluster is cluster 1 with 29% of the respondents, follows by cluster 4 with 26%, cluster 5 with 17%, cluster 2 with 16% and cluster 3 has only 12% of the respondents. However, cluster 4 has recorded slight differences between the fast and slow adopters and this weaken the conclusion that which class of adoption categories belong to. Therefore cluster 2 and 5 belong to fast adopters that will consider the relationship to rice technology adoption.

**Table 3: Percentage of the respondents in clusters and adoption class**

Adoption class	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Fast adopters	12	14	0	12	15
Slow adopters	15	5	6	11	5
Non adopters	8	0	8	8	1
Size of clusters	35 (29%)	19 (16%)	14 (12%)	31(26%)	21(17%)

Table 4 shown that cluster 5 with more than 95% of the respondents were male with a larger farm size, and 100% of the respondents use mechanical ploughing method. Cluster 2 with 100% of the respondents have access to credit, more than 80% have extension contacts, and nearly 90% registered with farmers association. These shows that gender, farm size, method of ploughing, credit access, extension contact, farmers association are significant to adoption of improved rice varieties. However, the table also shows that in cluster 4 and 5 has more than 60% of the respondents' access subsidy. This could be due to the numbers of the fast adopters in these clusters. The subsidy access may be significant to adoption as farmers are complaining high cost of improved rice seeds. Subsidised seeds may influence their adoption decision.

**Table 4: Mean value of the variables in cluster analysis.**

<b>Variables</b>	<b>Categories</b>	<b>Cluster1</b>	<b>Cluster2</b>	<b>Cluster3</b>	<b>Cluster4</b>	<b>Cluster5</b>
<b>Gender</b>	1=male, 0=female	0.6285714	0.5263158	0.4285714	0.709677	<b>0.952381</b>
<b>Age (Years)</b>	1=18- 30, 2=31-40, 3=41=50, 4=51-60, 5=61& above	2.2571429	2.4210526	3.428571	4.064516	2.5714286
<b>Education</b>	1=primary, 2=secondary, 3=tertiary, 4=Non-formal	1.4571429	3.263158	3.9285714	3.83871	1.5238095
<b>Farm size (acre)</b>	1=1-3, 2=4-6, 3=7-10, 4=11& above	1.3714286	1.3157895	1.5714286	2.00000	2.285714
<b>Farming Experience (Years)</b>	1=1-5, 2=6-10, 3=11-15, 4=16 & above	2.2571429	2.2631579	3.3571429	3.354839	2.2380952
<b>Ploughing method</b>	1=mechanical, 2>manual, 3=ox- bull	2.80000	2.842105	2.6428571	1.1935484	1.00000
<b>Credit Access</b>	1=Yes, 0=No	0.4857143	1.00000	0.1428571	0.677419	0.666667
<b>Extension Contact</b>	1=Yes, 0=No	0.2571429	0.842105	0.0714286	0.612903	0.3809524
<b>Farmers Ass.</b>	1=Yes, 0=No	0.60000	0.894737	0.0714286	0.5806452	0.3809524
<b>Subsidy Access</b>	1= Yes, 0=No	0.1428571	0.0526316	0.00000	0.677419	0.619048

Sources: Survey, 2014. n=120 respondents

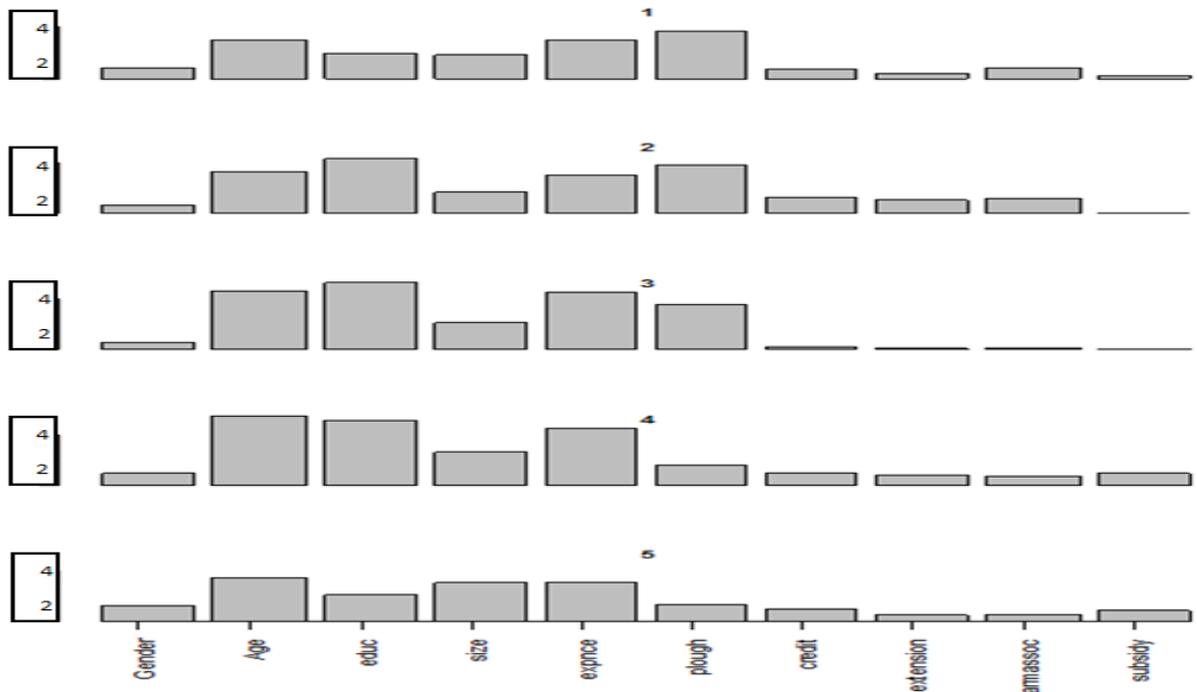


Figure 4: Cluster result in bar chart

Figure 4 showed that *Cluster 2* indicate a relationship to adoption with credit access, experience in farming and farmers association. *Cluster 4* shows a relationship to adoption in farming experience and subsidy access. *Cluster 5* shows a relationship in gender, farm size, subsidy access and ploughing method. These stated variables are significant to adoption of improved varieties in the area.

### Conclusion and Recommendation

Improved seeds access and selection of appropriate varieties for the specific location will also improve the adoption decision of the farmers as it will improve production to feed the growing population. Farmer's organisation, extension service, research institute and NGO are important tools for policy support and implementation for proper uptake in the future.

The contribution of rice production to national food security cannot be overemphasised. The production is below the consumption demand. The rice production sector in Nigeria is facing many challenges. However, institutional support and enabling environment for the service providers and local community commitment need to be address. This study recommended that in order to improve the adoption rate of farmers in the study area.

Government should provide medium maturing varieties to the area

Farmers group should link themselves with the local manufacturers of farm processing equipment, research institute, private extension and NGOs

Farmers should adopt integrated rice seed system development approach so as to help themselves in accessing improved rice seed through different ways.

Government should provide enable environment for the service providers in area like private extension and agricultural input suppliers.

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