



ANALYSIS OF THE ADOPTION OF IMPROVED RICE PRODUCTION TECHNOLOGIES AMONG MEMBERS AND NON-MEMBERS OF RICE COOPERATIVES IN BAUCHI STATE, NIGERIA

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ABSTRACT

The study was carried out to assess the Adoption of Improved Rice Production Technologies among Members and Non-members of Rice Cooperatives in Bauchi State, Nigeria. A multi-stage sampling procedure was used to select 342 respondents comprising of 171 members and 171 non-members. Data were collected using structured questionnaires and analysed using descriptive and inferential statistics. The results showed that, the mean age of the respondents was 41 years for the members and non-members in Bauchi State, with the mean farming experience of 7 and 12 years for both the members and non-members respectively. The results showed a significant difference ($P < 0.05$) between the mean household size among members and non-members in Bauchi State as the calculated Z-value (2.94) is higher than the tabulated Z-value (1.96). The results showed no significant difference ($P < 0.05$) between the mean farm size among members and non-members in Bauchi State as the calculated Z-value (0.63) is lower than the tabulated Z-value (1.96). All the members (100%) adopted all the improved rice production technologies at various level of adoption, which include, using best varieties (0.69), field preparations (0.92), improved planting techniques (0.78), weed management (0.77), fertilizer application (0.84), pests and disease management (0.75) and storing (0.84) were highly adopted by the members. High cost of inputs (98.8%), poor participation in to groups and associations (95.3) and inadequate tractor hiring service (92.9%) were among the major constraints faced by the respondents in the study area. The study concluded that members of rice cooperatives in the study area were better than non-members in terms of overall adoption of improved rice production technologies. The study therefore recommends that, farmers should form formidable cooperative societies so as to enjoy economies of scale in pooling their resources to purchase farm inputs.

Keywords: Analysis, IRPTs, Members, Rice, Cooperatives.

INTRODUCTION

Agriculture is the backbone of Nigerian economy and has persistently play substantial role in the national economy since then. Bala *et al.* (2022) reported that in the 1960s agriculture added up to 64% to the aggregate Growth Domestic Product (GDP) but progressively declined in the 1970s to 48%, this was as a result of oil boom of the 1980s. Oji-Okoro (2021) stated that agricultural sector is the largest sector in the Nigerian economy with its leading share to the GDP, employment of more than 70% of the energetic labour force and the generation of about 88% of non-oil foreign exchange earnings. Currently in Nigeria rice is one of the fastest growing agricultural sub-sectors and has stirred from ceremonial to a



staple food in many Nigerian homes within the last two decades, such that some families cannot do without rice in a day (Bala *et al.*, 2022).

Rice (*Oryza Sativa*) is a staple food in numerous countries of Africa and most parts of the world. It is also the most ingress staple food for about half of human race (Udemezue, 2014). According to Bala *et al.* (2022), rice has become the second most significant cereal in the world after wheat in terms of production due to a recent drop in maize production. In West Africa, Nigeria ranks uppermost as both the producers as well as consumers of rice in the sub-region with a statistics marginally above 50% (Udemezue, 2022). Small scale farmers living in rural areas are the predominant producers of food in Nigeria. They still rely on traditional technology characterized by low productivity due to limited access to farm machines, fertilizer and improved seeds. According to the Bala *et al.* (2022), only 10 tractors are available per 100 hectares of farm land in Nigeria as compared to 241 tractors per 100 hectares in Indonesia.

Adoption refers to "the stage in which a technology is carefully chosen for use by an individual or an organization" (Rajesh and Rajhans, 2014). Adoption of improved agricultural technology is crucial to the attainment of self-sufficiency in food production and access to agricultural extension services and availability of farm credit for food production is major drivers of adoption of improved agricultural technology by farmers. It has been observed that members of farmers associations have better access to farm credit and agricultural extension services than non-members (Okwoche and Obinne, 2021).

Cooperatives are all types of business enterprises or organizations owned and controlled by members in the pursuit of perceived mutual benefits and need actualization (Adeleye *et al.*, 2021). Farmer cooperatives are regarded as social instruments for making the market environment work for resource poor farmers who are faced with the challenge of limited and uncertain demand for the commodities they produce (Adeleye *et al.*, 2021).

The study is therefore, expected to provide empirical data that will confirm or invalidate the premise that members of rice cooperative societies in the study area are better than non-members in terms of adoption of improved rice production technologies and rice yield. The findings from the study will contribute to policy discourse on domestic rice production in the country. As far as rice production in Bauchi and Gombe States is concerned, there is paucity of data validating or rejecting the premise that members of cooperative societies perform better than non-members among rice farmers. It is against this backdrop that the study analyzed the adoption of improved rice production technologies among members and non-members of rice cooperatives in Bauchi State, Nigeria. The study attempted to;

- i. describe the socio-economic characteristics of rice farmers in cooperative societies in the study area;
- ii. examine the rate of adoption of improved rice production technologies among members and non-members of rice cooperative societies; and
- iii. describe the constraints faced by rice farmers in cooperative societies in the adoption of improved rice production technologies in the study area.

METHODOLOGY

The Study Area

The study was carried out in Bauchi State, Bauchi State lies between latitude 9.3° and 12.3° north of the equator and longitude 8.5° and 11° east of the Greenwich Meridian. The State is delimited by Yobe and Gombe States to the north-east; Taraba and Plateau States to the south, Kaduna State to the west, and Kano and Jigawa States to the north. Bauchi State



covers a total of 49,119 km² which is about 5.3% of the total land mass of Nigeria (BSADP, 2003). It has a total population of 4,676,465 people based on 2006 population census (NPC, 2006); this was projected to be 7,793,041 people in 2024 at 4.03% population growth rate. The area experiences both dry and rainy seasons with a maximum rainfall of about 700 mm per annum in the north to about 1300 mm per annum in the south. The average monthly temperature ranges from 29.2°C in July and August to 37.6°C in March and April. The mean daily minimum ranges from about 11.7°C in December and January to about 24.7°C in April and May (NIMET, 2022). The State is categorized by two distinct vegetative zones which include Northern Guinea Savannah and Sudan Savannah. The soil encompasses of loamy, clay, sandy loamy and sandy soil which are appropriate for cultivation of major crops like groundnuts, guinea corn, rice, root crops and tubers like sweet potato, cassava and cash crops such as cotton, soya beans etc (BSADP, 2017). Bauchi State consist of 20 Local Government Areas (LGAs) namely: Alkaleri, Bauchi, Bogoro, Dambam, Darazo, Dass, Gamawa, Ganjuwa, Giade, Itas Gadau, Jama're, Katagum, Kirfi, Misau, Ningi, Shira, Tafawa Balewa, Toro, Warji and Zaki.

Sampling Techniques and Sample Size

Multi-stage sampling procedure was used for the selection of the respondents. In the first stage, Bauchi was divided into three (3) agricultural zones for administrative convenience which were considered as strata. In the second stage, from each stratum (zone), proportionately 40% of L.G.As were randomly selected in Bauchi State where three, two and four LGAs from Western, Central and Northern Agricultural Zone respectively were selected, making a total of nine(9) L.G.As. In the third stage, two communities were purposively selected from each L.G.A across Bauchi State giving a total of 18 communities. In the fourth stage, with the assistance of Agricultural Development Project (ADP) officers in the State, a list of registered rice farmers cooperative societies were compiled from each of the communities earlier selected, proportionately 50% of the number of cooperative societies were randomly selected from each of the selected community. This gave a total of 50 rice farmers' cooperative societies. In the fifth stage, the researcher then applied the formula (Yamane) as used by (Ryan, 2013; and Ariola, 2006) to select the sample size proportionate to the population of registered rice farmers. In the sixth stage, based on the fact that the number of rice farmers was not equal in the communities selected, a proportionate formula was applied to select a sample of rice farmers from the sampling frame of rice farmers (members of cooperative societies) in each of the selected communities to obtain a sample size. In the final stage, simple random sampling technique was applied to select same number of non-members of rice cooperative societies from each of the selected 18 communities to serve as a control. Altogether a total of 342 respondents were randomly selected for the study. Yamane formula for determining sampling size is expressed as:

$$n = \frac{N}{1 + N(e)^2} \quad \dots (1)$$

where;

n=sample size for the study

N=Total sampling frame

e=limit of tolerable error or level of precision ($P \leq 0.05$)

1=unity

Proportionate Sampling Allocation Procedure is expressed as:



$$\frac{N_h}{N} = \frac{N_h(n)}{N} \dots(2)$$

where;

n_h = Sample taken from the h^{th} stratum,

N_h = Sample population of the h^{th} stratum,

n = Sample size, and

N = Total population

Method of Data Collection

Primary data were collected through the administration of structured questionnaire as the survey instrument with the help of trained enumerators. The questionnaire was divided into sections to achieve the stated objectives.

Method of Data Analysis

Combinations of different statistical tools were used in analyzing the data for the study. The tools include both descriptive and inferential statistics. The descriptive statistics used include; frequency, percentages, means, and ranking. The inferential statistical tool used was adoption index.

Descriptive statistics was used in analyzing objectives i, and iii. Z - Statistics was also used to test whether there is a significant differences or not in the socioeconomic characteristics and other institutional factors (objective i) among members and non-members of rice farmers cooperative societies. Z-statistics was calculated using the formula below:

$$Z = \frac{m_1 - m_2}{\sqrt{\frac{sd_1^2}{n_1} + \frac{sd_2^2}{n_2}}} \dots(3)$$

Where:

m_1 = mean of members of cooperative societies

m_2 = mean of non-members of cooperative societies

sd_1 = standard deviation of members of cooperative societies

sd_2 = standard deviation of non-members of cooperative societies

n_1 = number of members of cooperative societies

n_2 = number of non-members. of cooperative societies

Adoption Index

Adoption index shows the rate of use of a number of recommended practices by farmers which is measured by adoption score (number of improved practices used) or by an adoption quotient (number of improved practices used over total number of recommended practices). For the purpose of the study, adoption index was calculated to obtain each farmer's level of use of multiple practices from the 9 recommended components of rice production and finally categorize them into low, medium and high level of adoption. In order to determine the level of adoption of the improved production packages, adoption index of individual farmer was calculated using the following formula of adoption quotient adapted from Sani *et al.* (2018). This was done to achieve objective ii of the study.



$$A_i = \sum_{i=1}^n \left(\frac{BVQSA_i}{RRV_i} + \frac{FPA_i}{FPR_i} + \frac{SDTA_i}{SDTR_i} + \frac{TPA_i}{TPR_i} + \frac{WMA_i}{WMR_i} + \frac{FAA_i}{FAR_i} + \frac{PDMA_i}{PDMR_i} + \frac{SA_i}{SR_i} \right) \dots (4)$$

N_p

Where:

A_i = Adoption index (non – adoption = 0, low adoption = 0.01 – 0.33; Medium adoption = 0.34 – 0.66; and high adoption = 0.67 – 1.0)

$i = 1, 2, 3, 4, n$, and n = total number of farmers.

N_p = number of practices

A_i = adoption Index of i^{th} farmer

$BVQSA_i$ = best variety and qualitative seeds by i^{th} farmer (varieties)

RRV_i = recommended rice varieties for the crop (varieties)

FPA_i = field Preparation by i^{th} farmer (Number of times)

FPR_i = field preparation recommended for the crop (Mechanize)

$SDTA_i$ = seed dressing/treatment by i^{th} farmer (g)

$SDTR_i$ = seed dressing/treatment recommended for the crop (g)

TPA_i = time of planting by i^{th} farmer (month)

TPR_i = time of planting recommended for the crop (month)

WMA_i = weed management by i^{th} farmer (agro-chemicals)

WMR_i = weed management recommended for the crop (g/l)

FAA_i = fertilizer application by i^{th} farmer (bags/ha)

FAR_i = fertilizer application recommended for the crop (bags/ha)

$PDMA_i$ = pest and disease management by i^{th} farmer (g/l)

$PDMR_i$ = pest and disease management recommended for the crop (ml/l)

HA_i = harvesting by i^{th} farmer (time)

HRI = harvesting recommended for the crop (Mechanize)

SA_i = storing by i^{th} farmer (bags)

SR_i = storing recommended for the crop (Paddy in bags)

The actual adoption index score ranges from 0 – 1. The adoption score of 0 implies non-adoption and the adoption score of 1 implies the farmers adopted all the recommended components. Thus, adoption indices of the farmers was categorized into four, cited also in (Ndagi, 2015), that is, non – adoption = 0, low adoption = 0.01 – 0.33; Medium adoption = 0.34 – 0.66; and high adoption = 0.67 – 1.0.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

To describe the socio-economic characteristics of the respondents in the study area frequency, mean and percentage was used to summarize the data obtained from the field. So that more important components would be accentuated. Z - Statistic was also used to test whether there is a significant differences or not in the socioeconomic characteristics and other institutional factors among members of rice cooperatives and non-members in the study area.

Age of the Respondents

The result in Table 1 revealed that the average age of members of rice cooperatives in Bauchi State were 41 years and 41 years for non-members meaning that members and non-members had same mean age in Bauchi State. There was no mean age difference among members and non-members in Bauchi State. The difference in age among members and non-members was found to be not significant ($P < 0.05$) in Bauchi State as the calculated Z-value



(0.0) is lower than the tabulated Z-value (1.96). This result implies that farmers in the study area were young, energetic and can actively perform well in agricultural activities more especially in rice production. Okwoche and Obinne (2020) found no significant difference in the mean age of women cooperative members (38) and non-members (40) in Benue State, North Central Nigeria.

Years of Experience in Rice Farming

The average farming experience of members of rice cooperatives in Bauchi State were 7 years and was lower than that of non-members 12 years. The results showed significant difference between the mean years of experience in rice production among members and non-members at $P < 0.05$ as the calculated Z-value (13.47) is higher than the tabulated Z-value (1.96). This implies that, the length of farming experience will affect technology adoption positively or negatively depending on the age of the farmer. Several studies had shown that farming experience has an influence on adoption of agricultural innovations. This agrees with the findings of Yusuf *et al.* (2022) who reported that, majority (76%) of the farmers had between 1 and 10-years farming experience and 23.8% had 11 – 20 years.

Household Size of the Respondents

The average household size of members of rice cooperatives in Bauchi State was 10 persons and was lower than that of non-members 11 persons. The results showed significant difference between the mean household size among members and non-members at $P < 0.05$ as the calculated Z-value (2.94) is higher than the tabulated Z-value (1.96). The result implies that, the number of household members involved in farming activities is an important factor in technology adoption especially when the technology is labour intensive. This agrees with the findings of Adenuga *et al.* (2020) in a research Adoption of Improved Rice Varieties and its Impact on Multi-dimensional Poverty of Rice Farming Households in Nigeria, who reported that, the mean household size for adopters 8 persons while 7 persons for non-adopters. The result implies that, the number of household members involved in farming activities is an important factor in technology adoption especially when the technology is labour intensive.

Farm Size of the Respondents

The average farm size of members of rice cooperatives in Bauchi State found to be 2.3 ha and was lower than that of non-members 2.4 ha. The results showed no significant difference between the mean farm size among members and non-members at $P < 0.05$ as the calculated Z-value (0.63) is lower than the tabulated Z-value (1.96). This shows that rice farmers in the study area were mainly smallholder/small-scale farmers. Umar and Mohammed (2021) in their research increasing rice production through adoption of improved variety in Niger State, Nigeria, revealed that the mean farm size of the respondents in the study area was 2.1 hectares.

Income of the Respondents

The average income of members of rice cooperatives in Bauchi State was ₦785,788.23 and was higher than that of non-members ₦714,447.21. The results showed significant difference between the mean income in rice among members and non-members at $P < 0.05$ as the calculated Z-value (710.36) is higher than the tabulated Z-value (1.96). This implies that, the a priori expectation was met because farmers with increased annual income are expected to adopt innovations more than those with lower annual income. This agrees with the findings of Chukwu *et al.* (2021), the annual income of the respondents was statistically significant at 1% and bore a positive coefficient. This implies that positive relationship exist between the farmers' annual income and their level of adoption of IRPTs.



Amount of Credit Collected by the Respondents

The average amount of credit collected by the members of rice cooperatives in Bauchi State was ₦210, 473.40 and was higher than that of non-members ₦166, 576.50. The results showed significant difference between the mean amount of credit collected by the members and non-members at $P < 0.05$ as the calculated Z-value (667.73) is higher than the tabulated Z-value (1.96). This implies that, farmers who belong to cooperative associations are more likely to obtain agricultural credit than those who operate as individuals. Okwoche and Obinne (2021) found significant difference in the amount of agricultural credit obtained by women co-operators (₦ 43,350) and non- cooperators (₦ 22,183). In the pooled data from Ekiti and Ogun States, Afolami *et al.* (2021) reported that 19.4% of the respondents had access to credit as opposed to 80.6% with no access.

Table 1: Distribution of Respondents Based on the Socio-economic Characteristics Among Members of Rice Cooperatives and Non-members in Bauchi State

	Members (n=170)				Non-members (n=170)		
	Min.	Max.	Mean	Z-statistics	Min.	Max.	Mean
Variables:							
Age	20.00	70.00	41	0.0	25.00	70.00	41
Farming experience	1.00	30.00	7	13.47*	1.00	35.00	12
Household size	1.00	26.00	10	2.94*	1.00	23.00	11
Farm size	1.0	6.00	2.3	0.63	1.00	9.00	2.4
Income	₦460,000	₦1,311,000	₦785,788.23	710.36*	₦ 171,000	₦1,805,000	₦714,447.21
Credit collected	₦460,000	₦4,800,000	₦210,473.4	667.73*	₦207,000	₦2,400,000	₦166,576.5

Source: Field survey, 2023 * $P < 0.05$, Tabulated Z-value = 1.96

Overall Adoption Index of Improved Rice Production Technologies among Members and Non-members of Rice Cooperatives in Bauchi State.

The overall adoption index of improved rice production technologies among members and non-members of rice cooperatives in Bauchi State is depicted in Table 2. The findings indicated that, members of rice cooperatives adopted all the improved rice production technologies at various adoption indices (mean scores) which include, using best varieties (0.69), field preparations (0.92), improved planting techniques (0.78), weed management (0.77), fertilizer application (0.84), pests and disease management (0.75) and storing (0.84) were highly adopted respectively by the members, followed by field preparations (0.63) and improved harvesting techniques (0.64) were medium adopted respectively by the members of rice cooperatives in Bauchi State. The trend was also similar among non-members who also adopted all the 9 technologies in Bauchi State at various adoption indices (mean scores) which include, using best varieties (0.89), field preparation (0.69), seed dressing (0.82), fertilizer application (0.93), pests and disease management (0.88), improved harvesting techniques (0.79) and storing (0.87) were highly adopted by non-members of rice cooperatives in Bauchi State respectively and weed management (0.24) was low adopted. This implies both the members and non-members of rice cooperatives adopted all the nine (9) IRPT in Bauchi State at various adoption indices. Being the whole range of continuum were found among non-members (low adoption, medium adoption and high adoption) while only



medium and high adoption were observed among members of rice cooperatives in Bauchi State.

This agrees with the findings of Alarima *et al.* (2021) who reported in their research adoption of sawah eco-technology in rice production by farm households in Kebbi State, Nigeria, reported that. bond construction had 100% adoption, nursery 99%, puddling 98%, flooding 95%, leveling and smoothening 94% and power tiller use 88% adoption. This reveals that sawah technology package has high adoption among the respondents. This disagrees with the findings of Umeh *et al.* (2022) who reported that only three out of the eleven recommended practices presented to their respondents for the production of cassava /maize/ telferia inter-crop were adopted. They are; use of improved variety of cassava ($m = 3.4$), processing and value addition ($m = 3.1$) and fertilizer application ($m = 2.9$). This shows that the package has not fully been adopted, therefore the extension agents has not done enough using the group and individual extension teaching methods in the study area.

Table 2: Adoption of Improved Rice Production Technologies by Members and Non- members of Rice Cooperatives in Bauchi State

Improved rice production Technologies	Members (n=170)		Non-members (n=170)	
	Mean Score	Decision	Mean Score	Decision
a. Using best varieties	0.69	High adoption	0.89	High adoption
b. Field preparations	0.63	Medium adoption	0.69	High adoption
c. Seed dressing (chemical)	0.92	High adoption	0.82	High adoption
d. Improved planting techniques	0.78	High adoption	0.49	Medium adoption
e. Weed management	0.77	High adoption	0.24	Low adoption
f. Fertilizer application	0.84	High adoption	0.93	High adoption
g. Pests and disease mgt.	0.75	High adoption	0.88	High adoption
h. Improved harvesting techniques	0.64	Medium adoption	0.79	High adoption
i. Storing	0.84	High adoption	0.87	High adoption

Source: Field survey, 2023

Non – adoption = 0, low adoption = 0.01 – 0.33; Medium adoption = 0.34 – 0.66; and high adoption = 0.67 – 1.0.

Constraints to the adoption of improved rice production technologies among members and non-members of rice cooperatives in Bauchi State.

The constraints faced in the adoption of improved rice production technologies among members and non-members of rice cooperatives in Bauchi State is presented in Table 19. The result in Table 19 revealed that the major constraints militating against the adoption of improved rice production technologies among members of rice cooperatives in Bauchi State were high cost of inputs (98.8%), poor participation in to groups and associations (95.3), inadequate tractor hiring service (92.9%), inaccessibility of loans (92.4%), farm inputs are difficult to obtain (91.8%) and inadequate fertilizer at the right time (90.6%) were ranked 1st, 2nd, 3rd, 4th, 5th and 6th respectively. Others include, flood incidence (88.2%), inadequate improved rice varieties (82.4%), inadequate awareness on improved rice technologies (80.6%), Inadequate seed dressing materials for farmers (77.6%), Inadequate herbicides (76.5%), Inadequate pesticides (75.9%), Inadequate extension agents (72.4%) and Extension



agents don't provide advisory services (69.4%) and were ranked 7th, 8th, 9th, 10th, 11th, 12th and 13th respectively.

The trend was not similar among non-members of rice cooperatives in Bauchi State, the major constraints were found to be poor participation in to groups and associations (100%) and inadequate awareness on improved rice technologies (100%) were ranked 1st respectively, Farm inputs are difficult to obtain (92.9%) and Inadequate improved rice varieties (90.6%) were ranked 3rd and 4th respectively, then followed by Inadequate herbicides (88.8%) and Inadequate tractor hiring service (84.7%) and were ranked 5th and 6th respectively. Others include, inadequate extension agents (84.1%) and flood incidence (77.6%), extension agents don't provide advisory services (72.4%), were ranked 7th, 8th and 9th respectively, while inadequate fertilizer at the right time (71.8%) and inadequate pesticides (71.8%) were ranked 10th respectively, then followed by high cost of inputs (71.2%), Inaccessibility of loans (69.4%) and Inadequate seed dressing materials for farmers (69.4%) were ranked 12th, and 13th respectively. The finding from the result implies the constraints faced by members of cooperatives differ from those that were non-members of cooperatives in Bauchi State.

This agrees with findings of Abubakar *et al.* (2020) who found out that 31.3% of the adopters were constrained by the high cost of inputs (chemical fertilizers, agro-chemicals and tractor hiring to carry out tillage operations) and ranked first in the order of magnitude. In addition, low availability of inputs was a constraint to 20.2% of the adopters to optimally comply with the recommendations. This situation was ranked second in order of importance. Soil low fertility (nitrogen deficiency) as a result of continuous cropping and excessive water erosion and leaching was a constraint to 14.1% of the adopters. Also, 15.7% of the adopters highlighted lack of credit facilities as an important constraint to adoption of lowland rice technologies in their study area. Adisa *et al.* (2021) in his unpublished M.Sc. thesis; factors influencing adoption of Faro 52 rice package by farmers in selected local government areas of Niger State, Nigeria revealed that sizeable proportion (32.2%) of the adopters were constrained by the high cost of the fertilizers, agro-chemicals and tractor hiring to carry out tillage operations. According to the findings of Adisa *et al.* (2021) it was revealed that, inadequate finance and credit facilities ranked 1st (as the most serious constraints to rice production in the study area, poor soil fertility ranked 2nd, inadequate size of farm land ranked 3rd, followed by lack of adequate and timely information and excessive weed (2.50).

Table 3: Constraints Faced by the Respondents on the Adoption of Improved rice Production Technologies in Bauchi State

Constraints	Members (n=170)		Non-members (n=170)	
	Frequency*	Ranking	Frequency*	Ranking
High cost of inputs	168(98.8)**	1 st	121(71.2)**	12 th
Poor participation in to groups and association	162(95.3)	2 nd	170(100.0)	1 st
Inadequate tractor hiring service	158(92.9)	3 rd	144(84.7)	6 th
Inaccessibility of loans	157(92.4)	4 th	118(69.4)	13 th
Farm inputs are difficult to obtain	156(91.8)	5 th	158(92.9)	3 rd
Inadequate fertilizer at the right time	154(90.6)	6 th	122(71.8)	10 th
Flood incidence	150(88.2)	7 th	132(77.6)	8 th
Inadequate improved rice varieties	140(82.4)	8 th	154(90.6)	4 rd
Inadequate awareness on improved rice technologies	137(80.6)	9 th	170(100.0)	1 st
Inadequate seed dressing materials for farmers	132(77.6)	10 th	118(69.4)	13 th
Inadequate herbicides	130(76.5)	11 th	151(88.8)	5 th
Inadequate pesticides	129(75.9)	12 th	122(71.8)	10 th
Inadequate extension agents	123(72.4)	13 th	143(84.1)	7 th
Extension agents don't provide advisory services	118(69.4)	14 th	123(72.4)	9 th

*=Multiple response, **= Figures in parenthesis were percentages

Source: Field survey, 2023

CONCLUSION AND RECOMMENDATIONS

The study concluded that members of rice cooperatives in the study area were better than non-members in terms of overall awareness and adoption of improved rice production technologies. This indicates that IRPT has an enormous potential in reinforcing the rice farmers in increasing production and productivity. However, the superiority of members over non-members in terms of the adoption of improved rice production technologies led to better rice yield per hectare and income of members of cooperative societies in the study area. In addition, low availability of inputs and other major challenges constraint farmers to optimally comply with the recommendations.

From the finding of the study the following recommendations were made:

- Farmers should be sensitized to pool their resources so as to enjoy economies of scale in purchasing farm inputs.
- There is the need for sensitization and enlightenment campaign by the cooperative Finance Agency on the importance of farmers' cooperative societies in accessing loans and other farm inputs.
- Financial institutions should provide loan to farmers at a single digit interest rate. Those stringent collaterals to be removed considering the status of these farmers, most of them are small scale farmers.
- ADPs and other relevant authorities should be up and doing in terms of sensitization so as to create awareness on the improved rice production technologies in order to boost the productivity of rice farmers in the study area.



- v. The ratio of extension agents to farmers is very wide in Nigeria. In the recent literatures the gap is about 1:1100 meaning an extension agent is to take care of 1100 farmers. In line with the above therefore, there is the need for the government to recruit more extension personnel as the experienced ones are retiring with no replacement.

REFERENCES

- Abubakar, H. N., Kolo, I. N. and Yabagi, A. A. (2020). Adoption of production technologies by lowland rice farmers in Lavun Local Government Area of Niger state, Nigeria. *International Journal of Agricultural Extension*, **4**(1):7 -15
- Adeleye, O., Atala, T. K., Akpoko, J. G. and Omolehin, R. A. (2021). Effect of Membership of Rice Farmers Association on Access to Institutional Support for Rice Production in Kaduna and Kano States, Northwest, Nigeria. *International journal of African and Asian studies*, **17**(2): 48-54. Retrieved January 12, 2022 from: www.iiste.org
- Adenuga, A. H., Omotesho, O. A. 1., Ojehomon, V. E. T., Diagne, A., Ayinde, O. E. 1 and Arouna, A. (2020). Adoption of Improved Rice Varieties and its Impact on Multi-Dimensional Poverty of Rice Farming Households in Nigeria. *Journal of Applied Tropical Agriculture*, **31** (1): 24 – 32
- Adisa, R., Ahmed, T. A., Ebenehi, O. and Oyibo, F.O. (2021). Perceived Benefits of Adoption of Improved Rice Production Technologies Among Small-Scale Farmers in Kogi state, Nigeria. *Journal of Agricultural Extension*, **23**(1):236-243. Retrieved February 22, 2022. from: <http://journal.aesonnigeria.org> or <http://www.ajol.info/index.php/jae>
- Afolami, C .A., Obayelu, A. E., Agbonlahor, M. U. and Lawal-Adebawale, O. A. (2021). Socioeconomic Analysis of Rice Farmers and Effects of Group Formation on Rice Production in Ekiti and Ogun States of South-West Nigeria. *Journal of Agricultural Science*, **4**(4):233-244
- Alarima, C. I., Awotunde, J. M., Adamu, C. O., Akerele, D., Masunaga, T. and Wakatsuki, T. (2021). Adoption of sawah eco-technology in rice production by farm households in Kebbi State, Nigeria. *Journal of Water and Land Development*, **37**(4): 11–17. Retrieved February 20, 2022. from: <http://www.itp.edu.pl/wydawnictwo/journal>
- Ariola, M. (2006). **Principles and Methods of Research**. Quezon City: Rex Book Store, Inc.
- Bala, J., Yusuf, H, A., Ajala, M. K., Abdulmumini, L. and Mumini, M. Y. (2022). Analysis of Adoption of NERICA 1 Rice Technologies Among Farmers in Gombe State, Nigeria. *Journal of Agriculture and Veterinary Sciences*, **11**(2): 14 – 29. Retrieved January 02, 2023 from: <https://www.researchgate.net/publication/338159670>
- Bauchi State Agricultural Development Project [BSADP] (2003). Agricultural Bulletin on the development of Agricultural Space in Bauchi State, Nigeria. Pp 12 – 45.
- Bauchi State Agricultural Development Project [BSADP] (2017). Agricultural Bulletin on the History of Agricultural and its contribution to the development of Economy in Bauchi State, Nigeria. Pp 111 – 137.
- Chukwu, Y. A., Eze, A.Y. and Osuafor, O. O. (2021). Socio-economic Determinants of Adoption of improved Rice Production Technologies Among Rice Farmers in Ebonyi, State, Nigeria: A Logit Regression Model Approach. *Elixir International Journal*, **94**(6):39900-39908. Retrieved February 25, 2022 from: <https://www.researchgate.net/publication/318216607>.



- Gombe State (2022). Briefs on Gombe State Government Publication. Retrieved on January 02, 2023 from www.gombestate.gov.ng.
- Gombe State Agricultural Development Programme (2017). Development of Agriculture in Gombe State, Nigeria. Retrieved January 09, 2023 from: www.gombestate.gov.ng.
- National Population Commission [NPC] (2006). Federal Government of Nigeria 2006 Population and Housing Census, Priority table volume iv Population Distribution by Age and Sex (State and Local Government Areas). 359pp.
- NIMET (2022). Report on weather Forecast 2022. Retrieved from www.nimet.gov.ng
- Oji-Okoro, I. (2021). Analysis of the Contribution of Agricultural Sector on the Nigerian Economic Development. *World Review of Business Research*, 1(1): 191 – 200.
- Okwoche, V.A. and Obinne, C.P.O. (2021). Comparative Analysis of Socio-Economic Characteristics of Rural Women Co-operators in Nigeria: Evidence from Benue State. *Journal of Human Ecology*, 32(2): 119-125
- Omorogbe, I., Aina, O. S., Yakubu, S. A. and Hassan, A. A. (2021). Socio-economic Determinants of Sweet Melon Production in Balanga Local Government Area of Gombe State, Nigeria. *Journal of biodiversity and endangered species*, 5(1): 3-4.
- Rajesh, S. and Rajhans, M. (2014). *A Review of Evolution of Theories and Models of Technology Adoption*. 6(2): 10-12.
- Ryan, T. (2013). *Sample Size determination and power*. (Rev.ed.) New Jersey: John Wiley and Sons.
- Rosenbaum, P., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(8): 41–55.
- Sani, M. H., Kushwaha, S. and Madaki, M. Y. (2018). Analysis of Agricultural Technologies and Adoption Efficiency in Western Agricultural Zone of Bauchi State, Nigeria. *Journal of Agriprenuership and Sustainable Development (JASD)*, 1(1): 1- 10. Retrieved January 22, 2020 from: <https://www.researchgate.net/publication>.
- Udemezue J. C (2014). Adoption of FARO- 44 Rice production and Processing Technology by farmers in Anambra State. Un published M. Sc Thesis, Department of Agricultural Extension University of Nigeria, Nsukka. Pp. 1-55
- Umar, I. S. and Mohammed, U. (2021). Increasing rice production through adoption of improved variety in Niger State, Nigeria. *Journal of Bangladesh Agricultural University*, 16(2): 182–186. Retrieved April 01, 2020 from: www.banglajol.info/index.php/JBAU
- Umeh, O. J., Igwe, K. C. and Anyim, A. (2022). Farmers Knowledge of the Role of Extension Services in Akwa-Ibom State Nigeria. *Journal of Agricultural Extension*. 22 (3): 22-30. Retrieved February 03, 2023 from: <https://dx.doi.org/>
- Yusuf, N., Salau, E. and Girei, A. A. (2022). Determinants of Adoption Rate of Rice Production Technologies Introduced by Agricultural Research Outreach Centers (AROCs) by Farmers in Niger State, Nigeria. *Asian Journal of Agricultural Extension, Economics and Sociology*, 35(1): 1-11. Retrieved December 12, 2022 from: <http://www.sdiarticle3.com/review-history/50819>