Adoption of Recommended Management Practices in the Lowland Rice Ecology of Niger State, Nigeria

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Summary

Despite the perceived adoption of improved varieties and recommended management practices of rice by farmers in the lowland ecology, the yield per hectare on the farm has remained low relative to the potential yield. A survey was conducted on lowland rice farmer's fields to determine the major causes of low rice yield in the lowland ecology and the adoption of improved technology packages. Data collected were analyzed using simple statistics and the Tobit model. Results revealed a partial adoption of improved management practices such as the use of quality seeds, modern farmers' farm implements, plant density, rate and time of fertilizer application and herbicides.

Résumé

Adoption de nouvelles techniques de culture du riz dans une zone écologique de basse altitude de l'état du Niger, Nigeria

Malgré l'impression d'adoption de variétés améliorées et des recommandations des techniques concernant la culture du riz par les cultivateurs dans une zone écologique de basse altitude, le rendement à l'hectare chez les agriculteurs est resté bas par rapport au rendement potentiel. Une enquête a été menée dans cette zone pour déterminer les principales raisons de la faiblesse du rendement et du manque d'adoption des nouvelles technologies. Les données collectées ont été analysées en utilisant des statistiques simples et le modèle Tobit. Les résultats obtenus ont montré une adoption partielle des pratiques de culture modernes tels que l'utilisation des semences de bonne qualité, l'utilisation d'outils modernes, la densité de semis, la dose et le moment d'application des engrais et des herbicides.

Introduction

Rice (*Oryza sativa* L.) is an important food and cash crop in the world. It feeds more than half of the world's population. Rice is very important in the food economy of Nigeria. It is the sixth major crop cultivated in area after sorghum, millet, cowpea, cassava and yam. It is the only crop that is cultivated in all agro ecological zones from the coastal swamp to the Sahel. It is grown in all the 36 states of Nigeria. The area planted to rice has increased greatly from 0.149 million hectares in 1961 to 1.6 million hectares in 2000. During the same period rice output increased from less than 0.500 million tonnes to 2.96 million tonnes. However, the supply has consistently fallen below the demand and the production deficit has to be met by importation. This has serious implications for a developing economy with foreign exchange limitation. The technology package required to enhance rice production and productivity abounds and many farmers have been exposed to it. When a farmer uses the improved technologies in his physical and economic environment there is a wide yield gap difference between what the farmers get and what the researchers obtained. The wide disparity in yield is partly due to incomplete adoption of the total technology package, which may be due to stepwise adoption pattern of farmers (12), risk consideration and scarcity of funds. Limited access to information and non-availability of complementary inputs such as fertilizer are other likely factors. The technology package includes components such as high yielding rice varieties, fertilizers, herbicides and corresponding management practices. While the components may complement each other, they can be adopted independently (5) depending on whether the technology is divisible or not divisible. Since the rice package technology is divisible, the farmers face many definite technological options (6, 11).

Farmers' primary environment such as personnel, socio-economic and biophysical factors, has frequently been associated with determinant of technology characteristics (1). A farmer may adopt the whole package or a subset of the package. Thus, several adoption and diffusion processes may occur at the same time. The adoption processes may follow specific and predictable sequential pattern. According to Ojehomon *et al.,* (10) farmers who adopted the improved rice variety in lowland also adopted the use of fertilizer. This is because these two inputs are complementary. The adoption of herbicide was low relative to improved variety and fertilizer because hand weeding was readily substituted for herbicide.

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Weed infestation in Nigeria has been established to cause yield losses of between 33-75 percent in lowland rice (7). Weed control methods include mechanical, cultural preventive, biological and chemical control. Mechanical methods are used in combination with hand weeding. Hand weeding is a traditional practice, which involves high labour input (13). Effective control of weeds can be achieved through the application of herbicides. Studies on the control of weeds by chemical herbicides are increasing because of the high cost of labour and lack of timely availability of labour.

Despite the high adoption rate of improved rice varieties in Niger State (10) the average yield is 50% below the researchers' yield, which is 3.5 tons per hectares. Non or partial adoption of the management practices may be a factor in the low yield on farmer's field.

Farmers in Niger State, Nigeria therefore, carried out this study to determine the level of adoption of the management practices. The aspect of the management practices highlighted in this study includes land preparation, planting, weed control, fertilizer application rate, timing, and harvesting.

Material and methods

The study area

Niger State is in the Middle Belt (North Central) Zone of Nigeria. It is situated between latitude 80^0 and 110^o, 30' East. Niger State covers about 80,000 km^2, which is about 8% of the total land area of Nigeria. It has a distinct dry and wet season and an annual rainfall between 1,300 mm and 1,600 mm. The minimum temperature, which is ± 25 ^{0}C occurs in January - December while the maximum that is ± 35 ^{0}C in March - April. The vegetation is Guinea Savanna with mixture of trees, shrubs, herbs, and grasses. The lixisols, cambisols and luvisols are common in the study area. The soils are of low to medium fertility level and have medium productivity. These are used for growing cereals, root and tree crops.

Niger State has 19 Local Government Areas (LGA) which are divided into three agricultural zones. Lowland rice is mostly grown in zone I while in zone II both lowland and upland rice are cultivated. Rice is sparingly grown in zone III.

The headquarters of the National Cereals Research Institute (NCRI) is located in Lavun Local Government Area of Niger State. From its inception in 1954 to date the rice programme in NCRI in collaboration with International Institute of Tropical Agriculture (IITA), and West Africa Rice Development Association (WARDA) has developed and released 55 varieties of rice out of which 34 were recommended for lowland ecology of Niger State.

Sampling technique and data collection

There are eleven LGA in zones I and II of Niger State that grow rice and 6 LGA were randomly chosen from them. These LGA are, Bida, Gbako, Lapai, Lavun, Paikoro and Shiroro. The number of villages selected in each LGA was proportional to the number of districts that are major producers of lowland rice in the LGA. About 15 farmers were randomly selected per village in 22 villages making a total of 330 respondents. Villages were also randomly selected.

Primary data were collected through field surveys in phases using observation and questionnaires. In the first phase, a preliminary survey of Niger State was conducted on between June and September 1991 using informal interview format. Village listing and names of some farmers were compiled. The farmers were interviewed individually and in groups in their local languages, Hausa and in English in order to confirm the information given by the respondent.

Information collected were on calendar of farm operations, cropping pattern, production technique, availability of credit market, accessibility to input and output markets. Two hundred and forty-one of the selected farmers were interviewed and their fields surveyed. Physical measurements of the fields to confirm plant spacing were also taken. The second phase involved the administration of the interview schedule to the farmers. Information collected were personal data, rice farm size, contact with extension agents, accessibility to farm inputs, quantity of fertilizer and herbicide used, cost of inputs, land tenure, credit and farmers perception of, improved and local varieties grown by farmers.

Panicle samples of the rice varieties were verified by breeders to confirm if they were improved varieties. This was carried out to determine the percentage purity of rice as follows: Hundred grains of the varieties were taken and the number of red grains counted. Thus % purity was calculated as indicated below:

$$\% \text{ Purity} \quad \frac{\text{Number of pure seeds}}{\text{Total number of seeds (100 seeds)}} \times 100$$

Similarly, % red rice was calculated as follows:

$$\% \text{ red grain} \quad \frac{\text{Number of red grain}}{\text{Total number of grain (100 seeds)}} \times 100$$

Pure seed is a seed that is true to type. Physical purity is absence of other crop seeds, inert materials and weed seeds. Seeds of other varieties, inert materials such as broken straw and weeds affect purity.

Data analysis

Descriptive statistics and Tobit model were employed in the analysis of the data.

The Tobit model estimated the intensity of use of fertilizer and herbicides in the study area. The Tobit model uses the iterative likelihood method to estimate the coefficients which are asymptotically efficient, unbiased and normally distributed. The dependent variables measured the proportion of improved lowland rice to which herbicide/fertilizer is applied. The explanatory or independent variables were schooling, extension, family labour, fertilizer adoption, credit, varietal adoption, exposure to on farm or on station demonstration and years of experience in the cultivation of low landrice (Table 6)

Results and discussion

The empirical Tobit model was specified where the variables used were schooling, extension, family labour, fertilizer adoption, credit, varietal adoption, herbicide, experience and demonstration. These variables are defined in table 1.

It was observed that farmers are still planting some of the rice varieties released more than 20 years ago. The names of the varieties varied from village to village (Table 2). It was discovered that the naming of these varieties by the villagers was based on the individual who introduced them, plant height, yield, swelling ability of the rice, taste, etc. For example the local names Asha and Ibrahim Tsadu are names of individual who introduce the varieties while the names such as Jankara, Baban Tundu Edochi Dokochi, Guianakwo, Kpakugi and Nasaragi are names of villages where the farmers got the varieties from. Further more, Wata Uku in the local language means 3 months.

This indicates that the variety matures in three months. Also Pasatukunya means “break pot” and Danpete means short. These names reveal that Pasatukuny has high swelling capacity while Danpete has short height. This system or habit of naming the varieties had led to these varieties losing their identities and makes it difficult for the varieties to be easily identified. Most of the varieties said to be traditional were found by the breeders to be the improved released varieties by NCRI (2) but which have lost their real names for local names. The real official names are FARO (Federal Agricultural Research Oryza), followed by a number. The number indicates the position of the varieties in the list of improved variety released by NCRI (Table 2). The other varieties such are Trinidad Hill rice, WARNA 1 Nupe rice and Okiticha which do not have FARO name were varieties that were taken while they were being evaluated on the field. They were not released to farmers. The situation in Ndaloke village, where most of the component technologies have been adopted either completely or partially (Table 3), was influenced by the closeness of the village to the Research Institute, NCRI and farmers’ participation in research activities as labourers. Some of NCRI’s research plots are located in this village. Here it is demonstrated that farmers’ participation in research enhances adoption of technologies, which are beneficial to them.

Fertilizer application

Farmers were found to be aware of the benefits of fertilizer usage. They partially adopted the right types to be used at the appropriate time. In all the villages visited, except Ndaloke, farmers were not using the correct rate of fertilizer (Table 3). Fertilizer quantity applied depended on the availability and the farmers’ purchasing power. When little quantity is available as a result of scarcity or lack of funds to purchase enough quantity of fertilizer, less than the recommended amount is applied. And when there was enough fertilizer, farmers applied more than the recommended dosage. Therefore, the majority of the farmers did not follow the recommended rates and time of fertilizer application. Throughout the survey, it was observed that farmers were mixing compound fertilizer (NPK) and Single Super Phosphate (SSP) before

Table 1
Variables employed in the Tobit model

Symbol/variable		Variable definition and unit
Y	hintense	The dependent variable, the proportion of the improved lowland rice area to which herbicide is applied
X,	= sch	Number of years spent in school
X_2	= exten	Number of extension visits per year (This relate to verbal discussion with farmers)
X_3	= lab	Number of family members who worked on the improved lowland rice farm
X_4	= Feadp	Fertilizer adoption: 1 if fertilizer was use on the lowland rice production, 0 otherwise
X_5	= Cred	Credit: 1 if farmer took credit for the improve lowland production, 0 otherwise
X_6	= adp	Improved varieties: 1 if improved lowland is used, 0 otherwise
X_7	= dummy	Exposure to on farm or on station demonstration: I if yes, 0 otherwise
X_8	= exp	Experience in growing lowland rice – years

Table 2
Percentage purity of samples of rice varieties collected from farmers in villages in Niger State, Nigeria

Local name given to rice variety by farmers	Real or official name of rice varieties	Grain type	Percentage pure seeds	Percentage red grain
Anfani	FARO 18 (Okiticha)	B	51.33	48.67
Wata Uku	Nupe Rice	C	100.00	0.00
Baban Tudun	Trinidad Hill Rice	A	74.33	0.67
Asha	FARO 8	A	63.00	8.00
Bakin Tudun	WARNA 1	B	77.67	21.00
Gbaguzu	FARO 17	B	42.00	18.33
Pasatukunya	FARO 18	B	21.33	16.67
Husea	Trinidad Hill Rice	A	81.67	6.33
Akere	IR 30	C	81.33	7.33
Jankara	FARO 8	A	80.33	6.33
Agbaguclu	FARO 35	B	92.00	0.67
Mai Alura	FARO 17	B	83.00	0.33
Laramaketu	FARO 15	B	89.00	2.00
Tsumogi	FARO 13	B	78.50	15.00
Lamambe	FARO 23	B	54.33	17.33
Laramgbakieto	FARO 13	B	54.67	24.67
Ibrahim Tsadu	Nupe Rice	C	69.33	16.67
Edochi	FARO 6	B	100.00	0.00
American Rice	Trinidad Hill Rice	A	78.33	7.67
Dokoci	Nupe Rice	C	82.00	18.00
Zuruchi	(Okiticha)	C	94.67	0.33
One Four (14)	FARO 21	C	33.00	37.00
Dan Pete	FARO 2	B	100.00	0.00
Guianakwo	FARO 15	B	53.00	0.67
Yaba	FARO 9	A	99.33	0.00
Kpakugi	FARO 21	C	100.00	0.00
Nasaragi	FARO 21	C	94.00	0.00
Guiana	FARO 8	A	62.00	0.00
Sokwnwunyeu0	FARO 18	B	91.33	0.00
Woshegi	SMC81B	B	82.00	1.67
Sossaci	FARO 9	A	100.00	0.00
Lamietu	FARO 19	B	60.00	39.67
Mambeci	Nupe Rice	C	93.67	6.33
Ebangici	HMA 9	A	95.00	0.00
Mambefuci	FARO 19	B	91.00	0.00
Zhitsu Umaru	SMC 81B	A	92.00	0.00
Jaugi	3apanese Rice	C	95.00	0.00
Ugbabaa	Nupe Rice	C	90.00	1.00
Toma	FARO I	B	85.00	0.00
Ladand	FARO 16	B	79.67	0.00
Kpurugi	Nupe Rice	C	99.00	0.00
Egwazanvukpa	SMIL 81B	B	72.00	0.67
France	SKL 140/5	A	83.00	1.67
Gabaci	SMC 81B	A	73.33	0.33
Banned	FARO 21	C	99.00	0.00
Salamakwo	D99	B	56.33	1.67
Ba ba ka ro	BG400-1	C	98.00	0.00
FARO 35	FARO 35	B	99.33	0.00
FARO 15	FARO 15	B	96.33	0.00
Abakaro Tetengi	FARO 11	B	100.00	0.00
SIPI	FARO 44	A	94.00	0.00
Ndako Saba	FARO 37	A	97.33	0.00
BG 90	FARO 29	B	98.67	0.00
Salamagi	FARO 20	B	87.67	6.00
Etsuagutagi	Agani	B	100.00	0.00
Gbako Zuru	FARO 29	B	35.67	28.00
Innagbati	FARO 10	A	42.33	3.00
Lamgbakieto	FARO 23	B	97.67	2.00
Kparazhikwogi	WARNA 1	B	97.67	0.33
Gbokoboku	FARO 9	A	88.33	0.00
Tsomigi	FARO 35	B	97.33	0.00
Zungwandami Girima	T136	A	87.67	0.00
Nazara	FARO 19	B	93.67	0.00
MAS	FARO 8	A	99.00	0.00

Source: Survey data 1995.

Table 3
Indication of adoption of technology by farmers in the villages surveyed

Villages Surveyed	Use of improved varieties	Herbicide use	Fertilizer Type	Fertilizer Rate	Fertilizer time of app.	Spacing	Use of nurseries
Zukuchi	Yes	No	P	No	Yes	No	No
Mashigi	Yes	No	P	No	Yes	No	No
Faka	Yes	No	P	No	Yes	No	No
Daza	Yes	No	P	No	Yes	No	No
Adunu	Yes	No	P	No	Yes	No	No
	Yes	No	P	No	Yes	No	No
Ebbo Lapai	Yes	No	P	No	Yes	No	No
	Yes	No	P	No	Yes	No	No
Kuchi Kebba	Yes	No	P	No	Yes	No	No
	Yes	No	P.	No	Yes	No	No
Nasarawa	Yes	No	P,	No	Yes	No	No
Lapai	Yes	No	P	No	Yes	No	No
Ndaloke	Yes	No	P	Yes	Yes	P	Yes

a) Improved varieties: P= Partially, Yes= Adoption, No= Non adoption.

application. This mixture was applied indiscriminately before and after panicle initiation. Such application at panicle initiation or after is a colossal waste of the nutrients (N, P and K). The recommended practice is to apply 60 kg N/ha for tall varieties and 80-120 kg N/ha for short to medium height varieties. It was also found that the seed is sometimes mixed with fertilizer before planting. Average of 50 kg/ha of fertilizer is applied, this is grossly inadequate considering the low percentage of nutrient (7.5%) contained in each bag of fertilizer.

Normally for tall lodging indica varieties such as FARO 7 and FARO 14, 3.7 bags (total of 188 kgs) of sulphate of ammonia per hectare are broadcast 14 days after transplanting. The second application of another 3.7 bags (total 188 kgs) per hectare of sulphate of ammonia should be applied broadcast at panicle initiation. Each bag of fertilizer contains 50 kg of fertilizer.

For the improved non-lodging varieties such as FARO 15, 3.7 bags (188 kgs) of sulphate of ammonia per hectare are required to be puddled into the soil before transplanting. This is followed by another 2 bags of urea per hectare broadcast 30 days after transplanting. Additional 2 bags of urea per hectare should be applied at panicle initiation. More extension activities on the types rates and time of fertilizer application is very necessary.

Use of herbicides

Farmers attributed non-usage (Table 3) of herbicides to the following factors: lack of knowledge of herbicide usage due to low education of the farmers, exorbitant cost of chemicals, poor extension activities with respect to herbicide technology. A few enlightened farmers used total weed killer (Gramoxone) under non - crop situation. Weeding was found to be carried out with hoes having large blades.

Plant spacing

Some farmers in Ndaloke Village partially adopted the recommended plant spacing (Table 3). The nearness of this village to NCRI was a factor. The recommended plant spacing for non-lodging varieties is 20 x 20 cm while 25 x 25 cm is for lodging varieties. Recommended plant population is 250,000 plants.ha^{-1}. Average farmers plant population in Ndaloke village was estimated at 110,000 plant.ha^{-1}. In villages more than 20 km away from NCRI the plant population was estimated at 44,000 plant.ha^{-1}. In such villages, direct-seeding on ridges that are 74 cm to 100 cm apart are done (Table 4). Wide spacing was found to be closely linked with the hoe used for weeding.

Transplanting

Apart from Ndaloke village, where transplanting is done, direct seeding is practiced in the other villages.

Table 4
Spacing on ridges and within rows and average seed rate in the villages surveyed

Villages	Spacing on ridges	Spacing within rows	Average seed rate
Zukuchi	75 cm - 1 m	35 - 40 cm	80 kg - 1 ha
Mashigi	60 x 75 cm	75 cm	
Fuka	75 x 100 cm		
Daza	-		20 per hole
Adunu	-		
Ebo Lapai	60 cm	30 cm	72 - 96 kg/ha
Kuchi Kebba			10 per hole
Nasarawa	75 x 100 cm		15 - 20 per hole

Source: Survey data (1995) NCRI.

Farmers said they seed directly because more labour is required for transplanting. However, there are benefits in transplanting that are yet to be known to farmers. One of such benefits is that it minimizes early weed growth and competition that are more serious in the direct-seeded rice.

Bird control

Farmers regard birds as a serious menace where rice in a particular farm matures earlier later than other rice crops or is isolated or grass seeds are not present in the vicinity of the farm during rice maturity. Human scaring and the use of old cassette tapes are presently the only control measures (3, 4). However, human scaring has been the most practicable and successful recommended method.

Socio - economic issues

In the study area, the average years of experience in lowland rice cultivation fell within the range of 11 and 15 years. About 92% of the respondents were male. The mean numbers of family labour utilized in rice production was about 7 people and mean number of years of schooling was 4 years. About 77% of the farmers owned the land where the improved varieties were planted, 46% used credit in 1994. Most of the lowland farmers visited were under rainfed ecology (except Ndaloke in Lavun LGAS), irrigation was done by diverting water from nearby stream or river into the rice fields. Ndaloke has formally constructed a dam, which supplies water for irrigation.

About 73 local names given to rice varieties by farmers were found in Niger State. Identification and characterization of these varieties showed that some are early improved varieties released by NCRI, IITA and other agencies (Table 2). These have lost their identity to local names and mechanical mixture. In 1990, the cumulative percent of the respondents that have adopted the improved rice varieties was 64 but by 1994, 97 had adopted them. At Ndaloke village, in Lavun LGAS, all the farmers have adopted improved rice varieties. The farmers interviewed were aware of the benefit of using fertilizer. About 97 and 30 percent have adopted the use of fertilizer and herbicide respectively in 1994. Farmers (63%) indicated that fertilizer was not available at the required quantity and at the right time. At the time of this research the Government was responsible for fertilizer procurement and distribution. Thus there was at bureaucratic bottleneck involved in fertilizer distribution.

The percentage purity of rice seeds collected from farmers and analyzed by the breeders ranged from 21 - 100% purity. Out of 64 samples that were analyzed for purity only 7 of the samples had 100% purity (Table 2). About 47% of the farmers had seeds of between 60 and 91% purity. About 50% of the farmers had seeds of the B grains type (Table 5).

Table 5
Grain types preferred by farmers

Type	Frequency	%
A	47	28
B	70	50
C	20	22

A= Long grain B= Medium grain C= Short grain

Source: Survey data (1995) NCRI.

The B grain type of rice had low amylose content (9), which makes it chalky and suitable for the making of «tuwo» (a local staple diet of the Nupes in Niger State). Fifty percent of the farmers preferred the B grain type while 28% preferred the long grain A type. Although 22% of the farmers preferred the C grain type but NCRI has only released one lowland rice variety, FARO 21, which is of the C grain type.

The Tobit model estimated the intensity of use of fertilizer and herbicides in the study area. The Tobit model uses the iterative likelihood method to estimate the coefficients which are asymptotically efficient, unbiased and normally distributed. The dependent variables measured the proportion of improved lowland rice to which herbicide/fertilizer is applied. The explanatory or independent variables were schooling, extension, family labour, fertilizer adoption, credit, varietal adoption, exposure to on-farm or on-station demonstration and years of experience in the cultivation of lowland rice (Table 6). All the independent

Table 6
Descriptive statistics of variables used in the Tobit model

Variables	Number	Mean	St-deviation	Minimum	Maximum
Sch	241	3.98	5.11	0	20
Ext	241	2.81	5.48	0	40
Lab	241	7.34	7.60	0	50
Feadp	241	-	-	0	1
Cred	241	-	-	0	1
Adp	241	-	-	0	1
Dummy	241	-	-	0	1
Exp	241	-	-	0	1

Table 7
Tobit regression coefficient of herbicide adoption in Niger State

Variables	Normalized Coefficient	Standard Error	T-ratio	Regression Coefficient
Sch	0.38588E-01	0.16565E-01	2.3295**	0.13349
Exten	-0.27284E-02	0.17272E-01	-0.15796	-0.94381E-02
Lab	0.18959E-01	0.11742E-01	1.6146*	0.65583E-01
Cred	-0.15597E-01	0.18772	-0.83086E-01	-0.53953E-01
Adp	6.5527	0.29845E+06	0.21955E-04	22.667
	0.72093	0.31144	2.3148**	2.4939
Constant	-7.6287	0.2984E+06	-0.25561E-04	-26.390

* = Significant at 10 percent.
**= Significant at 5 percent.

Table 8
Tobit regression coefficient for determinant of fertilizer adoption

Variable	Asymptotic		T-Ratio	Regression Coefficient
	Normalized	Standard Error		
Sch	-0.22873E-02	0.13032E-01	-0.17551	-0.8156E-02
Exten	-0.68736E-03	0.13063E-01	-0.52619E-01	-0.25290E-2
Lab	-0.13801E-01	0.93336E-02	-1.4787	-0.50779E-01
Cred	-0.14381	0.14161	-1.0156	-0.52912
Adp	-2.1813	1.1753	-1.8560*	-8.0257
Dummy	-0.12653E-01	0.27726	-0.45637E-01	-0.46556E-01
Constant	1.3632	1.0192	1.3375	5.0156

variables used in the herbicide adoption (Table 7) gave the expected positive coefficients but credit and extension gave negative coefficients. Schooling and exposure to on farm or on station demonstration were significant at 5% probability level, while family labour was significant at 10%. The non-significance of credit and ‘the negative coefficients may be attributed to the belief of some farmers that if herbicides can kill weeds it can also destroy the rice plant. Thus with more credit the farmer will invest in more labour.

The independent variables postulated as influencing fertilizer adoption and use intensity all gave negative signs. This may be due to factors other than the ones presented in this model that condition fertilizer adoption and use intensity (Table 8).

One of such factors may be the non-availability of fertilizer mentioned by the farmers. According to Adesina and Zinnah (1) and Langyintuo and Dogbe (8) found that farmers’ perceptions of the technology-specific attributes of the varieties are the major factors determining adoption and use intensities. Farmers in the study area were asked to rank the order of importance of the characteristics of improved lowland varieties that motivated their adoption. High tillering capacity, high yield, good swelling capacity, early maturity were ranked in that order as important factors in the choice of the varieties they grew.

Conclusion

This study showed that the adoption of improved lowland rice varieties and fertilizer is high relative to herbicide adoption in the study area. Personal and socio-economical factors did not increase the intensity of use of fertilizer due to the non-availability of this technology at the right time and quantity.

The exposure of farmers to on farm or on station demonstration of the use and benefit of herbicide and education will significantly increase the adoption and intensity of use of this technology.

The survey revealed that proximity to a research centre and participation in research activities greatly influenced adoption of the technology package. This stresses the point that participatory demonstration plots be sited near farmers’ fields to enhance adoption of new technology. Implements used by farmers should be considered in making recommendations.

Farmers in majority of the villages visited, except in Ndaloke, planted rice under rainfed ecology. Though opportunities abound for irrigation facilities, these are yet to be developed. This stresses the fact that presently farmers in this area need more of rainfed lowland rice than irrigated rice varieties. The rainfed lowland rice varieties should be either resistant or tolerant to drought since most of the rainfed ecologies are drought prone.

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