

## ADOPTION OF NEW FARMING TECHNIQUES IN GURARA LOCAL GOVERNMENT AREA OF NIGER STATE: A PROBIT APPLICATION

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### ABSTRACT

*The study examined the analysis of institutional actors on adoption of new farming techniques in Gurara Local Government Area of Niger State. A multistage sampling technique was used and a total of eighty (80) respondents formed the sample frame. Data was collected from both primary and secondary sources, descriptive statistics, regression analysis and probit model were used to analyse the data. Result revealed that 73.75% of the respondents were male; mean age was 42.94% years. The result revealed extension services, income of the farmer, access to irrigation facilities, access to research and development and farm structure were the institutional factors available in the study area. Problems revealed were mainly inadequate credit facilities, Problem of land tenure system, lack of good road network, insufficient storage facilities, late supply of fertilizer and its application and high cost of agro-chemical. The probit analysis revealed that extension services, income, and access to irrigation facilities were the significant institutional factors that influenced the adoption of new farming techniques. It was thus recommended that farmers should form co-operative bodies to enable them benefit from collective bargaining of inputs especially fertilizer. The Local Government should construct feeder road network across the area ease transportation, and the establishment of storage facilities.*

**Keywords:** Institutional factors, new farming techniques, probit analysis

### INTRODUCTION

The importance of food in the socio-economic development of any country cannot be over emphasized despite the fact that Nigeria is empowered with huge expanse of fertile agricultural land, river, streams, lakes and large active population; there is still insufficient food supply. Increasing agricultural productivity and production with the adoption of new farm technique is a pre-condition for achieving food security in the study area and in Nigeria as a whole.

According to Okunlola (2001) that as long as farmers continue to use traditional techniques of farming and not benefitting from some institutional factors that will aid the adoption of new farm techniques, the vision of achieving agricultural growth will be a mere illusion. Additionally he reiterates that emphasis has been placed on the training need of change agents to ensure that farmers reap the fruits of science and technology.

Institutional factors are those factors that will foster adoption and enhance farmer's adoption of new farming techniques which will lead to higher economic returns for the farmer. While on the other hand farm techniques are the modern scientific packages which if adopted will increase farmer's farm size, increase yield and above all increase economic returns to the farmer. (New Nigeria agricultural policy, 2001). This includes:

Institutional Factors	New farm Techniques
i. Access to credit	Tractors hiring services and mechanization
ii. Extension services	Improve seed
iii. Income of farmer	Timely supply of fertilizer
iv. Price of agricultural products	Insufficient and cost afro-chemical
v. Water resource and irrigation	Livestock
vi. Research and development (land)	Patronage and production of new fish farming technology
vii. Insurance	Agro forest production
viii. Agricultural co-operation	Pest and disease control
ix. Human capital	Agricultural extension and technology transfer
x. Agricultural statistics and information management	Agricultural commodity storage
xi. Revenue	Processing
xii. Land tenure	
xiii. Good road network	
xiv. Farm structure	

Source: New Nigeria agricultural policy, 2001.

However, the study is going to look at specific institutional factors and new farm technique as follows:

#### **New Farm techniques**

- I. Tractor hiring services and mechanization
- II. Timely supply of fertilizer
- III. Patronage and production of new modern fish farm technology

#### **Institutional factors**

- a. Access of credit
- b. Extension services
- c. Income of the farmer
- d. Insurance patronage
- e. Utilization of water resources and irrigation from river Gurara
- f. Access to research and development (R and D)
- g. Land tenure system
- h. God road network
- i. Farm structure

Gurara Local Government is endowed with huge expanse of fertile agricultural land; despite this there still exists insufficient food supply. The presence of River Gurara which flows all year round has not been maximally utilized by farmers. This can be linked to the near absence and dearth of utilization of some institutional factors, which are assumed to enhance adoption of farming techniques in the study area. As a result of these problems stated above the study aims to answer the following questions:

1. What are the socioeconomic characteristics of farmers in the study area?
2. What is the effect of institutional factors on the adoption of new farm techniques in the study area?
3. What are the institutional factors existing presently in the study area?

The main objective of this study is to analyse the effect of institutional factors on the adoption of new farm techniques in the study area. The information generated will provide an insight for development planning and policy formulation that is more relevant to the farmers in the study area.

## MATERIALS AND METHODS

The study was carried out in Gurara Local Government of Niger State. Farming is the predominant occupation of the people in this area. The study employed a multistage technique, firstly four (4) district areas were randomly selected, and this includes Gawu, Gurara, Dikko and Kemi. Secondly two (2) villages were purposely selected from each of the district areas due to the high prevalence of small scale farmers in the areas. These villages are Gawu and Tufa; Lambatta and Izom; Dikko and Isheo and Lefu and Kuda respectively, giving a total of eight (8) villages. Thirdly ten (10) respondents were randomly selected from each ward giving a total of eighty (80) respondents. Data was collected during the 2009/2010 cropping season and obtained primarily through oral interview and questionnaire. Information collected includes socioeconomic characteristics of respondents, such as age, gender, level of education etc and access to institutional factors such as credit, extension services, insurance, utilization of water resource and irrigation facilities from river Gurara, research and development, income of the farmer, land tenure system, good road network and farm structure. Data were analyzed through descriptive statistics and probit model.

In technology adoption studies, limited dependent variable models such as Logit, Probit and Tobit continue to have extensive applications in obtaining information from the non-normal distribution of such data (Adesina and Zinnah, 1993). The ordinary least squares regression is inappropriate when the dependent variable is discontinuous (Feder et al., 1985; Pindyck and Rubinfeld, 1998). Logit and Probit models are appropriate when the dependent variable is discrete, usually taking two values, 0 or 1. These models are useful if the question is whether to adopt or not. Farmers were assumed in these models to make adoption decisions based on an objective of utility maximization. If,  $U^a \geq U^b$ , then the farmer would prefer  $U^a$  to  $U^b$  or would be indifferent.

Given agriculture as an occupational technology, access to and use of institutional factors may influence farmer's adoption of new farming techniques. A probit model was used to capture the adoption process. Probit modeling is used for explaining a dichotomous dependent variable with the empirical specification formulated in terms of latent response variable (Verbake et al., 2000). Defining  $Y_i$  as the utility index of adoption of new farming techniques then  $Y_i$  is a function of the institutional factors the farmer assesses.  $Y_i = 1$  for farmers adopting new farming techniques under study, (ie mechanization/tractor hiring service, improved seed and timely application of fertilizer) and  $Y_i = 0$  for farmers not adopting any of the new farming techniques under study.

$$Y_i^* = \beta_0 + \sum_{k=1}^k \beta_k X_{ki} + \varepsilon_i \quad \text{eqn (1)}$$

$$E(\bar{X}) = 0 \quad E(\varepsilon) = 0 \quad \text{Var}(\bar{X}) = 1 \quad \text{Var}(\varepsilon) = 1$$

Where  $Y^*$  is the latent or unobservable variable. The observable variable is a dummy representing the adoption of new farming techniques of the farmer.  $Y = 1$  if  $Y^* > 0$  and  $Y = 0$  otherwise;  $i$  is the respondent,  $X_{ki}$ :  $k = 1$  through  $k$  independent variables explaining the phenomenon of respondents,  $\beta_k$  is the parameter that explains the effect of  $X_k$  on  $Y_i$ ;  $\beta_0$  is the intercept that shows the expected value of  $Y^*$  when all  $X_k$  have a value of zero.  $\varepsilon_i$  is the stochastic error term for respondent  $i$ ,  $E$  = the expected value and  $\text{var}$  = variance,  $\bar{X}$  = the mean of  $X$ . As such  $Y_i^* \sim N(0,1)$ . Since utilities are random the  $i^{\text{th}}$  farmer adopt the new farming

techniques if and only if  $U_{ai} > U_{bi}$  for the  $i^{th}$  farmer therefore, the probability of adopting a new farming technique is given by the utility maximizing function

$$\begin{aligned}
 P(Y = 1|X_{ij}) &= P(U_{ai} > U_{bi}) \\
 &= P(\beta_1 X_1 + \varepsilon_i^a > \beta_0 X_1 + \varepsilon_i^b) \\
 &= P(\varepsilon_i^b - \varepsilon_i^a < \beta_1 X_1 - \beta_0 X_1) \qquad \text{eqn (2)} \\
 &= P(\varepsilon_i < \beta_1 X_1) \\
 &= \Phi(\beta_1 X_1 - \varepsilon_i > 0)
 \end{aligned}$$

Where,  $\Phi$  is the cumulative distribution function for  $\varepsilon_i$ . The functional form for  $\Phi$  depends on the assumptions of  $\varepsilon_j$ . Since  $Y_j \sim N(0)$ , then probability of the  $i$ -th adoption of the  $i$ -th farmer of new farming techniques is thus given by

$$P(Y = 1 | X_{ij}) = \Phi(Z_i) \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_i} e^{-\frac{1}{2}z^2} dz \qquad \text{eqn (3)}$$

where

$$Z_j = \beta x$$

It is important to note here that the parameters of the model like those of any non linear regression model are not necessarily the marginal effects that we are accustomed to analyzing (Green, 2000). In, general, marginal effects are given by

$$\begin{aligned}
 \frac{\partial E[Y=1/X_{ij}]}{\partial x} &= \left\{ \frac{dF(\beta'X)}{d(\beta'X)} \right\} \beta \qquad \text{eqn (4)} \\
 &= f(\beta'X)\beta
 \end{aligned}$$

Where  $f(\cdot)$  is the density function that corresponds to the cumulative distribution. For the probit model Eq. 2 results to

$$\frac{\partial E[Y=1/X_{ij}]}{\partial x} \Phi(\beta'X)\beta \dots\dots\dots(5)$$

Where :

- Y = Adoption of new farming techniques (1 for adoption, 0 otherwise)
- X<sub>1</sub> = Access to credit (dummy variable 1 for access, 0 otherwise)
- X<sub>2</sub> = Extension services (number of contacts/month)
- X<sub>3</sub> = Income of farmer (in ₦)
- X<sub>4</sub> = insurance patronage (dummy variable 1 for patronage, 0 otherwise)
- X<sub>5</sub> = Utilization of water resources and irrigation from river Gurara (dummy variable 1 for utilization, 0 otherwise)
- X<sub>6</sub> = Access to research and development (dummy variable 1 for access, 0 otherwise)
- X<sub>7</sub> = Land tenure system (dummy variable 1 for security of tenure, 0 otherwise)
- X<sub>8</sub> = Good Road network (dummy variable 1 for good road network, 0 otherwise)
- X<sub>9</sub> = Farm structure (number of farm structures/storage available)

## RESULTS AND DISCUSSION

### Socio – Economic Characteristics of Respondents

The result in table 1 revealed that 43.75% of the respondents were between the age of 25 – 35, with a mean age of 33 years. This implies that majority of the farmers in the study area

are middle age group. The study also revealed that 92.5% of the respondents are married. The assumption here is that the married respondents will adopt new farming techniques than unmarried respondents because, they have a larger family labour force, high capital base and their demand for socio-cultural and economic needs for their families. But this is in contrast with the findings of Akopko (2007), in which he observed that households with large family labour force tend to use the availability of manual labour to perform their farm operations rather than bother about adopting new farming techniques.

The study revealed that 32.5% of the respondents had tertiary education. Turton (2000), observed that as far as adoption of new farming techniques was concerned, education served a vital role because farmers that are educated easily adopted new farming techniques if institutional factors are available. Accordingly Osuji (2000) also reported that education is considered as a very important factor in the acceptance of new farming practice. This position was also in agreement with Okunlola and Jimoh (2001), that the level of education is a major determinant of the adoption of new farming technologies. This implies that education is a necessity for any technological change.

The study also revealed that 42.5% of the respondents had years of farming experience between 1 – 15 years. Azadeh et al., (2009), reported that young farmers with experience between 10-15 years were liable to adopt new technologies and new skills. But nevertheless, long farming experience of the farmer was an advantage for increase in farm productivity, being that it encourages rapid adoption of farm innovation and continual practice (Oblin, 1991 and Akpoko, 2007). The study revealed that 73.75% of the respondents were males.

From table 2, the study revealed that income of the farmers with 43.02%, farm structure with 27.34% and access to research and development (R and D) with 19.56% respectively were the available institutional factors in the study area. This agreed with findings of Atala (2005), that income of the farmer, accessibility to research and development and improved farm structure are major economic capacity for adoption of agricultural innovation.

### **Effect of Institutional Factors on the Adoption of New Farming Techniques**

In attempting to observe the effect of institutional factors on the adoption of new farming techniques, probit analysis was used to generate the maximum likelihood estimate (MLE) of the relevant variables of interest. It was hypothesized that the adoption of new farming technique is influenced by some specific farmer related-cum-institutional factors as shown in table 3. The result in table 2, indicated the model had a goodness of fit chi-square value of 637.345 which is statistically significant at 1% implying that the variable (x) included in the model adequately explained the dependent variable (Y) adoption. The table also showed that out of the nine (9) variables modeled only two (2) namely extension contact and income of the farmer had positive values of 0.461 and 0.001 respectively. Access to irrigation (water) was significant but negatively related to adoption, with maximum likelihood estimate value of -0.665.

The estimated maximum likelihood estimate value of extension contact is 0.461 which is positive. This implies that the more the number of extension contacts the more the adoption of new farming techniques. This is in accordance with the findings of Monu *et al.*, (2001) that agricultural extension functions to clientele, prepares them to a freedom of minds that make them adopt new technology.

The estimated maximum likelihood value for income of the farmer was 0.001 and positive, this implies that the more the income of the farmer the more the adoption of new farming techniques. This finding is in agreement with the findings of Osta and MacDonald (1999), that any fixed investment requires the use of capital. The estimated likelihood for access to

irrigation facilities (water from River Gurara) was -0.665. This implies that there exists an inverse relationship between accessibility to irrigation and adoption of new farming techniques.

### **Problems Identified In the Study Area**

Problems identified included, insufficient credit facilities, lack of insurance institutions, and lack of irrigation facilities, inaccessible road network, insufficient storage facilities and late supply of fertilizer to farmers

The study revealed that farmers had no access to credit due to unavailability of adequate collateral requested by financial organizations. It was also observed that the farmers in the study area were not organized into any cooperative societies to enable them benefit from a collective bargaining. The study also revealed that 80% of the respondents had no knowledge about insurance patronage. The road network around the study area was observed to be highly inaccessible especially during the raining seasons which hampered farming activities and consequent adoption of new farming techniques.

### **CONCLUSION AND RECOMMENDATION**

The study revealed that adoption of new farming techniques, can be effective and sustained by farmers where institutional factors are available and accessible. Therefore the following recommendations were drawn from the study.

1. It is imperative that farmers in the study area should, form co-operative bodies to enable them harness their funds together and also give them the opportunity of collective bargaining.
2. Farmers should be enlightened on the benefits of patronizing institutional institutions. Government should also set up functional irrigation facilities particularly in the study area, to take advantage of the river Gurara. The availability of good rural/feeder road network is inevitable. This has to be provided by the local government
3. Government should input more agricultural machines into the country and distribute them to farmers at a subsidized rate and also initiation should be made to manufacture local machines, locally adoptable to the soil, climate condition and with ease of operation.

**Table 1. Socio – Economic characteristics of respondents**

<i>Age</i>	<i>Frequency</i>	<i>Percentage</i>
25-35	35	43.75
36-45	11	13.75
46-55	11	13.75
56- 66	12	15.00
66 and above	11	13.75
Total	80	100
<i>Marital Status</i>		
Married	74	92.5
Single	6	7.5
Total	80	100
<i>Level of education</i>		
Primary	6	7.5
Secondary	15	18.75
Tertiary	26	32.5
Adult	1	1.25
Qur;anic	16	20
None	16	20
Total	80	100
<i>Family Size</i>		
1-10	60	75
12-21	16	20
22 and above	4	5
<i>Years of Experience</i>		
1-15	34	42.3
16-30	25	28.75
31-40	7	8.75
41 and above	16	20
Total	82	100
<i>Sex</i>		
Male	59	73.75
Female	21	26.25
Total	80	100

Source: Field survey data 2010

**Table 2. Maximum likelihood estimate (MLE) of institutional factors affecting the adoption of new farming techniques in the study area**

<i>Institutional Factors</i>	<i>Parameter</i>	<i>Z-ratio</i>	<i>Level of significant</i>
Intercept	-2.436	9024***	1%
Access to credit	0.181	0.697	N.S
Extension services	0.461	1.832*	10%
Income of the farmer	0.001	1.978	5%
Insurance patronage	0.322	0.996	N.S
Access to irrigation facilities	0.665	2.022	5%
Access to research and development (R and D)	0.112	0.424	N.S
Land tenure system	0.040	0.196	N.S
Good Road network	0.087	0.383	N.S
Farm structure	0.247	0.795	N.S

Source: Field survey data 2010

Note: \*\*\*, \*\* and \* implies statistically significant at 1%, 5% and 10%

N.S = not statistically significant

Goodness of fit of chi-square =637.345

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