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BY

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Abstract

Factors influencing the adoption of improved crop production technology in Katsina State, Nigeria are analysed in this study. The adoption of improved crop production technology will help greatly in the provision of enough food to curb away poverty and improve foodinsecurity situation in the Country. The adoption is influenced by number of factors which has been broadly categorised into two i.e. Socio-Economic (Fadama participant, age, education, awareness, primary occupation, household size, marital status and status of the respondent while Institutional factors include belonging to a social group and technical assistance by the agricultural department. The findings found "fadama" participation, household size, status of the respondent and primary occupation to have statistically significant impact on the adoption of improved crop production technology. The findings support the idea of mass mobilization in whetting the peoples' appetite about new innovations through governmental and Non- governmental agencies as well as judicious use of available resources especially water in actualization of maximum utilisation of natural resource endowment.

Key : Logit, Log odds estimates, Odds ratio, Marginal effects, improved crop production technology.

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Introduction

In Nigeria, agriculture contributes more than 30% of the total annual gross domestic products (GDP), employs about 68% of the labour force, account for over 70% of the non-oil exports and provides over 80% of the food needs of the country (Adegboye, 2004). Therefore, Nigerian agriculture is one of the important sectors of notable relevance in economic development and growth.

The Government recognizes that agricultural growth is the key to achieving poverty alleviation, food security, and the Millennium Development Goals (MDGs), and that further effort is urgently needed. The Country Partnership Strategy (CPS) notes that from mid-70s to mid-90s there was a nine-fold increase in degraded lands. It emphasizes that Nigeria's agricultural growth has resulted in expansion of area cropped and recommends that the sector must shift to intensification. The irrigation potential is only very partially developed.

In the Northern part of the country where rainfall amounts are small, farmers had long depended on the use of shallow ground water in a manner similar to Egyptian "shadoof" for raising crops especially vegetables. The "shadoof" system is very labour intensive and consequently, could only be used to cover very small plots of about half a hectare. To increase production, farmers started to use pumps to lift water from streams and ponds prior to 1980; most of the direct pumping was practiced in Kano State (NFDO, 2005). It would be noted that direct pumping is only feasible where there are perennial source of water at the surface (stream and ponds). These sources are quite limited in the North and as a result, the development of dry season farming was restricted. Water bearing sands and gravels occurs as shallow depth beneath the flood plain and that this water could be exploited by using simple methods of construction of small diameter tube wells/wash bores. Exploiting the water resource available on the flood plain recognized the significant increase in food production by exploiting the water resource available on the flood plain (Faye and Sutheland, 2006). Initial, the development of small-scale irrigation on flood plains appears to be most appropriate in the Northern States because of the abundance of large expanse of "fadama" lands. Such lands are especially suitable for irrigated production and fishing, and traditionally provide feed and water for livestock. The enormous potential of this land is only very partially developed.

Given the need for all-year-round cultivation to exploit the potentials of the dry seasons for farm income generation and the campaign for food security and poverty alleviation, the Nigerian Government, in collaboration with the World Bank and the Agricultural Development Bank (ADB), initiated the small-scale farmer-managed irrigation schemes to develop the "Fadama" lands nationwide. In addition, it was realized that increased agricultural production was necessary to make the rate of growth in food production faster than the population growth rate. This cannot be attained without recourse to supplementary irrigation for the major food production areas of the country (Adeolu & Taiwo, 2004), hence, the need for the initiation and implementation of the National Fadama development Project (NFDP) in the country.

Katsina State agricultural sector has a high potential for further growth. Productivity is low and can be much improved. Productive infrastructure is both inadequate and in a state of decay due to low budgetary provision for operation and maintenance of the facilities and lack of community participation in maintenance. The agricultural research and extension systems are unable to respond to the increasingly diverse needs of rural clients, including advice on sustainable land management. Deficiencies in input distribution systems limit the timely availability of improved seed, fertilizers, chemicals, and machinery. Livestock and fishery sub-sectors also lack adequate availability of inputs such as feeds and veterinary inputs. Lack of access to financial services (less than 10 percent of rural household use formal banking and insurance services) limits the farmers' ability to obtain inputs and exploit the opportunities offered by a huge and rapidly growing domestic market. Many markets in Katsina state are temporally or locally saturated with horticultural produce that spoils due to lack of storage and processing facilities as well as difficulties in moving produce to the market on the impassable rural roads. Awareness and implementation of proven approaches to sustainable land management are low. In short, much can be improved, World Bank (2007 in Mohammed, 2013).

Description of the Study Area

Katsina State was created on 23rd September, 1987 from the former Kaduna State. The state is one of the thirty six (36) states of the Federal Republic of Nigeria, bordered with Zamfara State in the western part, Kaduna State in the southern, Kano and Jigawa States in the east and Niger Republic in the northern part. The research was conducted in Katsina state which comprised of three agricultural zones namely Zone I (Ajiwa, Katsina zone consists of 15 LGAs), Zone II (Funtua Zone consists of 8 LGAs) and Zone III (Dutsin-ma Zone consisting of 11 LGAs) (KTARDA, 2003). The state as part of Nigeria territory lies between latitude 11002" and 13003"N, and longitude 6005" and 9003"E. It covers an area of about 22,983km2 with a population of 5,801,584 people from which 2,948,279 were male while 2,853,305 were female. Katsina State being agrarian has about 80% of its population living in rural areas fully engaged in agricultural production (Mohammed, 2013). The people comprised of Hausa, Fulani, Kanuri, Yoruba, Igbo and many Nigerians with migrants from neighbouring countries like Niger republic. Weather in the state varies according to season. It has a maximum temperature of about 29-380c and a minimum of 18-270c with the average rainfall of 400-1300mm. The soil types include clay loamy in the south, sandy loamy in the central and sandy soil in the central with clay soil in most of the low lands of the area. Katsina State produces crops like cotton groundnut, millet, guinea corn, maize, beans, rice, cassava, sesame, etc. and livestock like cattle, sheep, goats, poultry, donkeys and horses. It has many markets including rural and urban types scattered all over where agricultural products are assembled for sale (Mohammed, 2013).

Sampling Technique

In order to assess the adoption rate of technologies in Fadama III project in Katsina State on the participants (treatment) at the household level and also the spillover of the benefit to non-participants (control), the respondent in the communities with similar socio-economic characteristics were sampled more especially those operating at small scale. The expectation according to Nkonya et al (2010) is that even the non-participants living in similar communities with National Fadama III project participants may benefit from spillover of some of the project benefits, such as improved technology, while the new information on project technology might be shared with non-participants. It need to be noted that few women are operating in the area because socio-cultural background of the study area.

Sampling procedure involved purposeful selection of twenty (20) Local Government Areas (LGAs) from Katsina States that are the project areas, in each of the LGA, FUG were selected were the project operate and seven respondents were randomly selected. In each location out of the seven selected three of which must be female to represent the vulnerable group. For the treatment group it gives a total of one hundred and forty (140) respondents, equally in the control area seven (7) LGAs were purposefully selected and in each LGA "fadama" farmers association are selected and forty nine (49) respondents were randomly selected based on corresponding number in treatment areas. This selection based on treatment and control gives one hundred and eighty nine (189) respondents (Mohammed, 2013).

The LGAs selected are :- Treatment (Batagarawa, Charanchi, Dutsinma, Kaita, Katsina, Kurfi, Rimi, Baure, Bindawa, Daura, Ingawa, Kankia, Maiadua, Mani, Bakori, Faskari, Kafur, Kankara, Matazu and Sabuwa) while in Control are (Jibia, Batsari, Kusada, Mashi, Dandume, Danja and Musawa).

Conceptual framework

The conceptual framework of the study is based on the theory of diffusion of innovations. According to the theory, the innovation decision process can lead to either adoption, a decision to make full use of an innovation as the best course of action available, or rejection, a decision not to adopt an innovation. Such a decision can be reversed at a later point (Rogers, 2003). Jabbar et al. (1998) opined that technology adoption is a dynamic process in which information gathering, learning, and experience play pivotal roles particularly in the early stage of adoption. The adoption pathway of improved crop production technology hypothesised to be influenced by a host of variables. We categorise these variables broadly under Socio-economic and Governmental factors based on the literature of farmers' adoption behaviour (Adesina and Forson, 1995; Pattanayak et al., 2003; Mercer, 2004; Ellis, 2006). Under Socio - Economic characteristics, age, education, Marital Status, Household size, Respondents Status, Primary Occupation and awareness, the influences of individual awareness about improved crop production technology and his/her attitude about social acceptance are considered, as awareness of an individual is related to locally perceive benefits, (Vodouhe et al., 2010). Governmental factors are the membership of a social group and technical help received from agricultural officials. Standard of living plays an important role on individual decision making behaviour, as poverty and unsustainable practices are closely associated particularly in developing countries where policy framework in many cases fails to generate adequate result (Nguyen et al., 2010).

Theoretical framework

Under the theoretical framework of the problem, it is assumed that there are ‹t' numbers of choices available for clearing land for cultivation, and improved crop production technology is one of them. While making a choice, it is assumed that a farmer›s decision is guided by his/her utility maximisation behaviour. When the expected utility of improved crop production is higher than the expected utility of alternative practices, farmers decide to adopt improved crop production technology (Kishore et al, 2012). The utility function, which ranks the preference of the ith farmer, is given as follows:

Uti = βiFi(SEti; Gti;) + εti; t = 1 or 2 and i = 1; 2;…;N (1)

Where

t 1, if practicing improved crop production technology, or

t 2, if not practicing slash and burn agriculture,

U underlying utility function which ranks preferences of ith farmer βi vector of coefficients,

SEti Socio - Economic factors,

Gti Governmental factors, and

εti error term.

The utility Uti is random and the ith grower practices improved crop production technology, if U1i>U2i. Thus, for farmer i, the probability of practicing improved crop production technology is given as follows (Kishore et al, 2012):

$P\,(A^* > 0) = P\,(U1i > U2i)$

$$= P\{\beta 1 Fi(SE1i; G1i;) + \varepsilon 1i\} > \{\beta 2 Fi(SE2I; G2i;) + \varepsilon 2i\} \quad \textbf{(2)}$$

$= P\{(\varepsilon 1i - \varepsilon 2i) > Fi(SEti; Gti;)\,(\beta 1 - \beta 2)\}$

$= P\{Vi > Fi(SEti; Gti;)\ \beta = \varphi(Xi\beta)$

Where

P a probability function,

A* latent variable,

Vi random disturbance term,

β β1−β2 is a vector of parameters to be estimated,

Xiβ vector of explanatory variables,

φ(Xiβ) is the cumulative distribution function for Vi evaluated at Xiβ.

However, A* is not observable. A is equal to one, if a farmer practices

Improved crop production technology, which is observable i.e.,

$$\mathbf{A = \{1 \text{ if } A^* > 0,\ 0 \text{ if } A^* \leq 0\}} \quad \textbf{(3)}$$

Empirical Model and Data Analysis

Although there are numerous studies using different models such as linear regression models, nonlinear probabilistic models, participatory rural appraisal, etc., for analysing the influence of different factors on decision variables, the use of logit and probit models are more frequent (Pattanayak and Mercer, 1998; Subejo, 2000; Neupane et al., 2002; Johnson, 2005; Adeogun et al., 2008; Muneer, 2008; Kassie et al., 2009). However, there is little theoretical justification for choosing between probit and logit models as they often produce similar result (Greene, 1997; Stock and Watson, 2003). Gujarati (2004) is of the view that researchers generally prefer logit model because of its comparative mathematical simplicity.

A Logit model is employed to assess the adoption rate of improved crop production Technology in Katsina State of Nigeria. Respondents in this study were asked whether they used improved technology or not. The binary model specifies the factors considered by farmers in making their decision. The aim is to investigate which factors influenced the decision process. The observed yes/no answer regarding the use of improved crop production technology are viewed as the outcome of a binary choice model. Hence, each farmer's choice is represented by the dummy variable:

The adoption decision is modeled as a binary variable which takes the value of 1 for adopters and 0 for non-adopters. Logit model is used to analyse the impact of different factors that influence farmers› adoption decision of new technology. Here, the dependent variable (Yi) is binary in nature, taking value 1, if a farmer employs improved crop production technology and 0, if he does not. Let Pi be the probability that a farmer practices improved crop production technology and (1−Pi) defines the probability that the farmer does not practice.

The probability that a farmer adopts the technology is denoted as p = P[yi = 1] while the probability for non-adopters is 1 - p =P[yi = 0]. This binary adoption variable has a probability function f(y) = py(-p)1-y where y = 0, 1. The model proposed for analysing the influence of the factors on new technology agriculture is specified below as:

$Yi \int (Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q8,Q9,Q10\, \upsilon i)$ **(4)**

Where

Y (independent Variable) is 1, if a farmer adopts improved crop production technology and 0, if he does not,

Q1 = «fadama» participant

Q2 = Marital Status

Q3 = Age {continuous variable}

Q4 = Household size {continuous variable}

Q5 = Status of respondents

Q6 = Education

Q7 = Primary Occupation

Q8 = Social Group

Q9 = Awareness of improved variety

Q10 = Adoption of improved technology

υi random disturbance term.

Table (1): Results of the logit model of farmers› adoption of improved crop production technology

Variables	Log odds estimates	Odds Ratio	P- value	Marginal Effect (dy/dx)
Q1	1.168683	3.217753	0.018	.1581018
Q3	.0048729	1.004885	0.793	.0005333
Q4	-.1724501	.8416003	0.020	-.0188729
Q5	-1.994489	.1360832	0.000	-.1882692
Q6	0253735	1.025698	0.870	.0027769
Q7	1.996564	7.36371	0.000	.2185038
Cons	.4632689	1.589261	0.673	

Source : Field Data (2013) Computed with Stata

Logistic regression		Number of obs =	18
LR chi2 (6)		=	60.73
Prob > chi2		=	0.0000
Log likelihood =	-77.795559	Pseudo R2 =	0.2807

Results and Discussion

There are twelve (12) variables (11 dependent and one independent) in the proposed model. Marital Status, Social group, improved livestock breed, Sex and Agro Processing were dropped by the Stata may be due to perfect predictability or less variation with the improved crop production technology. They are one hundred and forty (140) adopters (treated) of "Fadama" III, while forty-nine (49) were non adopters. Because of this therefore, these variable were dropped from the analysis.

The likelihood ratio chi- square (the goodness of fit) measured by the value of 60.73 with a p-value of 0.0000 showed that the choice of explanatory variables included in the Logit model explained the variation in decisions in improved crop production technology.

In the estimated model, "fadama" participant, Household size, Status of Respondent and Primary occupation of the respondents are found to have statistically significant and positive impact on improved crop production technology. On the other hand, age and education of the respondents are found to be statistically insignificant on the improved crop production technology.

The estimated odds ratio shows that the probability of adoption of improved crop production technology increases with increase in "Fadama" participation. The logit (odds ratio) goes on increasing by 3.218% units with a positive marginal effect of 0.16% holding other factors fixed. This could be explained by the fact that as times goes on there is all possible indication that one would be able to realize the importance and possible impact of the adoption of improved crop production technology through financial benefit by way of increased crop yield. Also, the estimated odds ratio shows that the probability of adoption an improved crop production technology increases with increases in household size with 0.842% and a negative marginal effect of -0.019%. The possible reason for this is that, there is the possible tendency that increases profitability of the adoption of improved crop production technology which has raise the standard of living may result from the abundance of cheap labour from the family-fold. The status of the respondent as estimated from the logit (odds ratio) indicates that the coefficient is 0.136% an indication that there is an increase in the adoption of improved crop production technology as a result of a unit increase in the variable. Furthermore, the marginal effect is negative at 0.188%. Being the head of the household is a responsibility which goes along with catering for dependents (wives, children and other dependents). Adopting improved crop production technology to enhance better condition of living is a welcome idea and must be looked into for posterity sake. Another reason might be that a member of the household aspire to be a head of an household one day and adopting an improved crop production technology could be a means to an end by speedy up his progression. The odds ratio estimate of primary occupation is positive at 7.364% which is an increase for a unit increase in adoption of an improved crop production technology with a positive marginal effect of 0.219%. The tendency is that majority of the respondents are farmers and have had an experience or awareness of adoption of improved innovation some time ago and its attendant benefit. So there are more than ready to adopt an improved crop production technology to boost their chances of raising their standard of living at any slightest opportunity.

Conclusion and Policy Implication

The adoption of improved crop production technology is influenced by a host of factors such as socio-economic and Governmental. In the study, “Fadama” participant, household size, status of respondents and primary occupation of the respondent are found to have statistically significant positive impact on the adoption of improved crop production technology.

Adoption of improved technology could have been more successful with more pronouncement from different quarters notably government and non- governmental organizations campaigning to influence the individual awareness about improved technology in agriculture. Resource endowment is also an important concern and policy makers should emphasise on extending institutional support to the farmers in the form of financial help, technical knowhow related to other methods of cultivation generally.

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