International Journal of Research (IJR) Vol-1, Issue-8, September 2014 **ISSN 2348-6848**

Marginal Effects of Farmers' Income Tercile on their Irrigation Technology Adoption in Reducing Poverty in Kwara State

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ABSTRACT

This study analyzed the marginal effects of farmers' income tercile on their irrigation technology adoption in poverty reduction in Kwara State, Nigeria. Multistage sampling procedure was employed for the selection of respondents for the study. Farm-level and household-level primary data were obtained with the use of well-structured questionnaire and interview schedule on 348 respondents, covering a total of five (5) Local Government Areas. Data were subjected to descriptive statistics and instrumental variable of two-stage least square regression model. The mean annual income for low, middle and upper annual income tercile were ₦ 363 924.41, ₦ 812 224.86 and ₦ 1 915 500. In the low and middle annual income tercile, the coefficients of adoption of irrigation were positive. The adoption of irrigation technology increases annual per capita income of the low and middle annual income household terciles by 1.2 and 0.4 % respectively, relative to that of the non adopter. However, the upper annual income tercile, coefficient of adoption of irrigation was negative. Thus, the rich households reduced their adoption of irrigation technology as their income enhances. It was concluded that, appreciable number of farmers were below the upper annual income tercile. The rich household reduced their adoption of irrigation technology as their income enhances.

Keywords-*Adoption, Income, Irrigation and Marginal Effects.*

1. INTRODUCTION

Irrigation is widely perceived as a key element in the promotion of agricultural production in sub-Saharan Africa (Tanko, Jirgi and Ogundeji, 2010). Irrigation increases agricultural production by providing all year round farming opportunities through the artificial supply of water to crops. It has the ability to regulate water supply to crops especially at times when the crops need water most and provides drainage facilities for the disposal of excess water, which is impossible with rain-fed agriculture (Simeon, 2010). The adoption of modern agricultural inputs has been considered slow in Sub-Sahara African (SSA) countries including Nigeria (Takeshima, 2011). The lack of complementary inputs, for example irrigation technology for improved seeds or vice versa, can cause low adoption of these inputs if production function is in Leontief shape, in which the production is determined by the minimum level of either inputs used (Leontief, 1941). Majority of farmers in Nigeria are still significantly poor with little access to credit or insurance and their liquidity constraints often limit their ability to best exploit market conditions to purchase needed inputs (Takeshima, 2011).

The objectives are to;

- Determine the annual income tercile of the respondents in the study area,
- Compute the marginal effects of farmers' income tercile on their irrigation technology adoption in the study area.

2. METHODOLOGY

The study was conducted in Kwara State, Nigeria. Kwara State consists of sixteen (16) Local Government Areas. The State is located in the middle belt (North Central) of the country within latitude $7^0$45'N and $9^0$30'N and longitude $2^0$30'E-$6^0$25'E. The State is bounded in the north by Niger State, in the South by Osun and Ondo States, in the East by Kogi State and in the West by Oyo State. Kwara State shares an international boundary with the Republic of Benin (Taiwo, 2005). The population of the state is put at 2,371,089 which is made up of 1,220,581 males and 1,150,508 females. It covers an estimated land area of 32,500km^2 out of which 75.3% is cultivable and found suitable for almost all forms of food crops (Saraki, 2008)..

Population of the study was made up of all farmers in the rural areas of Lower Niger River Basin Development Authority in Kwara State, Nigeria. A multistage sampling procedure was employed for the selection of respondents for the study. The first stage involved the

purposive sampling of Oke-Oyi and Songa irrigation scheme. The second stage involved random sampling of villages and communities where farmers that were involved in the irrigation scheme are located. The third stage involved the random and representative selection of irrigation farmers (treatment) and non-irrigation farmers (control). Farm-level and household-level primary data were obtained with the use of well-structured questionnaire and interview schedule from 348 respondents, from villages and communities covering a total of five (5) Local Government Areas.

The data were mainly primary: these were obtained through the use of a well-structured questionnaire and interview schedule. This was employed to make enquiries on socio-economic, household and farm characteristics, adoption of irrigating activities of the respondents. The crops considered were okra, pepper, maize and sorghum.

The tools and procedure that were employed elucidated the objectives of the study: this includes the following.

Descriptive statistics were employed. They are the mean, percentages and frequency distribution. These were used as tools to describe the socioeconomic information of the individual farmers that were selected for the survey.

An important factor in impact measurement is the problem of endogenous explanatory variables. Variables that are endogenous to adoption may influence poverty, but be unobserved by the econometrician, and thus be correlated with the error term in the regression and cause a bias. One of the common approaches to address these problems is the use of instrumental variables (IV) regression or two–stage least squares (2SLS) estimation. In order to investigate the impact of irrigation technology adoption on poverty status of farmers, an instrumental variable in a two-stage least squares regression was done. This is to isolate the impact of technology adoption from other intervening factors. The establishment of a counterfactual outcome is required, as is the ability to overcome selection bias.

It is estimated as:

$$Y_i = \alpha + \beta p_i + \gamma X_i + \xi_i \quad (1)$$

Where;

$E(\xi_i) = 0$

Y_i = Poverty indicator (Logarithm of per capita annual income)

P_i is the adoption indicator (dummy variable: yes = 1, no = 0)

X_i is the vector of explanatory variables

$expected\ to\ influence\ Y_i\ \gamma =$

$a\ vector\ representing\ the\ marginal\ impacts\ of\ each\ component$

X_i is the vector of explanatory variables $(X_1, X_2, \ldots X_i)$

$X_1 =$ Adoption of irrigation

$X_2 =$ Years of schooling

$X_3 =$ Dependency ratio

$X_4 =$ Household size

$X_5 = Okra\ farm\ size$

$X_6 =$ Pepper farm size

$X_7 =$ Maize farm size

$X_8 =$ Sorghum farm size

$X_9 =$ Ease of land acquisition

$X_{10} =$ Number of extension visit

$X_{11} =$ Frequency of irrigation

$X_{12} =$ Access to credit

Variables that influence adoption of irrigation were awareness, credibility of irrigation scheme, years of schooling, dependency ratio, household size, okra farm size, maize farm size, sorghum farm size, pepper farm size, ease of land acquisition, number of extension visit, frequency of irrigation and membership of cooperative society.

3. ANALYSIS OF RESULTS OF DATA AND DISCUSSION

3.1 HOUSEHOLD ANNUAL INCOME TERCILE

In this study, the the households were placed in different income groups using income tercile of the household annual income. These are low annual income tercile, middle annual income tercile and upper annual income tercile. Results on Table 1 shows the mean annual income of the upper and middle terciles were ₦363,924.41 and ₦812,224.86. These were not sufficient to adequately cater for their household: thus there will be little or nothing to put into productive use. However, the rich household/upper annual income tercile's mean income was ₦1,915,500. This could adequately cater for the household and also be useful for investment in agricultural production.

Table 1: Household annual income tercile

Annual income tercile (₦)	**Frequency**	**Percentage**
Low tercile		
≤ 50, 000	7	6.0
50 001 - 150 000	7	6.0
150 001 - 250 000	12	10.4
250 001 - 350 000	15	12.9
350 001-450 000	32	27.6
> 450 000	43	37.1
Minimum = 6 000, Mean = 363 924.41, Maximum = 540 000		
Middle tercile		
≤ 600 000	16	13.8
600 001 – 700 000	18	16.4
700 001 – 800 000	18	16.4
800 001 – 900 000	29	19.8
> 900 000	35	33.6
Minimum = 540 000, Mean = 812 224.86, Maximum = 1 009 992		
Upper tercile		
≤ 1 500 000	55	48
1 500 000 – 2 500 000	41	34.2
2 500 000 –3 500 000	9	7.6
> 3 500 000	11	10.2
Minimum = 1 009 992, Mean = 1 915 500, Maximum = 7 500 000		

Source: Field survey, 2013.

3.2 MARGINAL EFFECTS OF ANNUAL INCOME TERCILE OF THE HOUSEHOLD HEADS

The marginal effects of annual income tercile of the household was presented in Table 2. In the low and middle annual income tercile, the coefficients of adoption of irrigation were positive but not statistically significant to household annual per capita income. This implies that the adoption of irrigation technology increases annual per capita income of the low annual income household tercile by 1.2 per cent relative to that of the non adopter. Moreover, the adoption of irrigation technology enhances annual per capita income of the middle annual income tercile of household by 0.4 per cent relative to that of the non adopter. Thus, the household in the low and middle annual income tercile will be able to reduce their poverty status by their adoption of the irrigation technology.

In the upper annual income tercile, coefficient of adoption of irrigation was negative and not statistically significant. The result implies that the rich household reduced their adoption of irrigation technology as their income enhances. They probably invest less in irrigation farming because of the high risk associated with agricultural production. Aina and Omonona (2012) agreed that, agricultural production is associated with high risk due to the problems of natural disaster which are beyond the control of the farmers.

Table 2: Marginal effects of annual income tercile of the household heads

Variables	Coefficients: Low income tercile	Coefficients: Middle income tercile	Coefficients: Upper income tercile
DEPENDENT VARIABLE (Log of annual per capita income)			
INTERCEPT	11.819***	13.577***	14.804***
Adoption of irrigation	0.012	0.004	-0.136
Years of schooling	-0.024	0.004	-0.007
Dependency ratio	0.007	-0.028	-0.050
Household size	0.016	0.001	-0.050***
Okra farm size	0.137	-0.056	-0.091
Maize farm size	0.111	-0.001	-0.066***

Sorghum farm size	-0.236	0.030	0.391***
Pepper farm size	0.337	0.046	0.281***
Ease of land acquisition	-0.085	0.026	-0.391
Number of extension visit	0.143	0.023	-0.063
Access to credit	0.655	.	.
Frequency of irrigation	-0.079	-0.013	-0.061
Members of cooperative society	0.168	0.048	-0.045
R^2	0.153	0.11	0.428
Probability X^2	0.076	0.262	0.000

*** 1% level of significance, ** 5% level of significance, * 10% level of significance

Source: Field survey, 2013.

4. CONCLUSIONS AND RECOMMENDATIONS

An appreciable number of farmers were below the upper annual income tercile. Therefore, credit and input facilities should be made available to enable them to optimally practice irrigation farming that could improve their livelihood. The rich household reduced their adoption of irrigation technology as their income enhances. This was probably done in other to avert the high risk associated with agricultural production. Thus, viable agricultural insurance policies that could reduce or eliminate the risk of perennial losses in agricultural production should be legislated and implemented.

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