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ABSTRACT

Agricultural innovation can halt the vicious cycle of poverty by improving income while reducing hunger, malnutrition and improve health. The specific objective of this study is estimates of the impact of NERICA adoption on rice yields, income and food expenditure of male and female farmers in selected states Nigeria (first generation of NERICA project beneficiaries). A three stage sampling was done: the states and the villages were purposively selected. while two adjacent villages and the farmers were randomly selected. Data for the study were as collected from primary source using structured questionnaire. Descriptive statistics and counterfactual analytical procedure using two instrumental variable(IV)-based estimators to estimate the Local Average Treatment Effect (LATE) of adoption of rice variety innovation on productivity and poverty indicators health and education of women and men in NERICA dissemination project States in Nigerian. Sixty (60%) of male headed household with autonomous production systems for husband and wives adopted the rice innovation. The percentage of adopter dropped from 42% significantly to 40% in 2010 due to lack of access to seed. The result indicated a 354.61Kg yield impact recorded for female adopters. When compared with the male farmers, the female adopters had 84% more yield increase than male adopters. The implication is that adoption of rice innovation (NERICA) will be expected to be high in household where both men and women are empowered to make decision as relates to agriculture. Innovations have to be accessible to for transformation to take place.

Keywords: ***Agricultural Innovation,*** **Education, Health, Local Average Response Function (LARF)**

INTRODUCTION

The concern to increase food productivity, enhance farmers income and welfare has led to development of various innovations in agriculture. Agricultural Innovations can transform the economy particularly in the sub Saharan Africa; where the agricultural sector offers 70% of the population employment and contributed 30% to its gross domestic product (Bill & Melinda Gates Foundation, 2010). In 2009 the region had about 265 million people (32% of the population) suffering from chronic hunger; many of whom were women, children and the elderly (Conway, et al., 2010). There are many constraints to agricultural productivity in Africa, especially the smallholder farming sector. Boko, et al., (2007) noted that the constraints in technological options, limited infrastructure, skills, information and links to markets increase, poor health and education. Due to low adaptive capacity in many smallholders farming systems there is a need to develop new innovations that enhance the resilience of agricultural production and reduce vulnerability to stresses (Cooper et al., 2008). Conway et al(2010) stated the need to double Green Revolution (citing Conway, 1999) that will translate agricultural system to a highly productive, stable (less affected by shocks) and equitable (providing food and incomes for the poor and hungry).

Research has shown that agricultural innovation can help halt the vicious cycle of poverty by improving income while reducing hunger, malnutrition and improve health. Thereby, increasing production in a sustainable way. When farmers grow more food and earned more income, they are better able to send their families to school and provide family health and invest in their farms.

Innovations to help farmers improve yield require an all inclusive approach that includes development of improved seeds that are resilient to stresses and address gender disparity. In Africa women and men are vital contributors to farm work.

Nigeria Agriculture is dominated by small scale farmers who cultivate less than 5hectares (NISER, 2002) and account for over 90% of the sectors output. Nigeria food crop production includes millet sorghum, maize and rice but rice has emerged as the fastest growing staple crop among the rural and urban dwellers.

Low productivity has continued to characterize Nigeria'a agricultural sector thereby limiting the ability of the sector to perform its traditional role in economic development. In order to break out of this cycle and improve the performance of this sector the Nigerian government, over the years introduced and implemented several policies and programmes to improve the sector(Ajibefun and Aderinola, 2004). A recent effort by the Government towards production and enhancement of farmers' poverty status is the introduction and implementation of the National Dissemination Project on New Rice for Africa(NERICA) in 2006 in some selected States in Nigeria. The States are Ekiti, Kaduna, Nasarawa, Ogun, Ondo and Taraba.

NERICA is varietal innovation specifically bred by African scientists at Africa Center for the African farmers to address the problem of low productivity of upland rice in sub-Sahara Africa.

NERICA varieties have unique characteristics, such as shorter duration (maturing between 30 and 50 days earlier than traditional varieties), higher yield, and tolerance to major stresses, higher protein and good taste compared with the traditional rice varieties (Jones et al., 1997; Dingkuhn, et al., 1998; Johnson et al., 1998, Diagne, 2006 Wopereis et al., 2008). These varieties have also been reported to have stable yields under different management conditions and their introduction to farmers' fields was considered as a first step towards stabilization and sustainable intensification of Africa's fragile production of upland rice.

In 2007 a survey was carried out in Ekiti State to examined exposure rate, the potential population adoption rate, determinants of adoption and the returns to farmers' labour and management of NERICA production. The results showed that the observed sample adoption rate was 40 percent while the average treatment effect which is the potential population adoption rate was estimated to be 71%. The average yield for NERICA and non NERICA farmers were 1.54 tons per hectare and 1.18 tons per hectare respectively (Ojehomon et.al, 2012).

The primary objective of the study is to determine the Impact of rice innovation on the Health and Education on Farm Households in Selected States in Nigeria. The specific objective of this study To provide estimates of the impact of NERICA adoption on rice yields, income and food expenditure of male and female farmers in selected states Nigeria(first generation of NERICA project beneficiaries)

METHODOLOGY

The study was carried out in five (5) selected States that were the first generation of NERICA dissemination project beneficiaries. Two (2) of the States, Kaduna and Nasarawa are in the North Central part of Nigeria while the other three(3)States are situated In the south West zone of the country). Taraba State was not included because data. A three stage sampling was done; in the first stage the States were purposively selected. In the second stage, Villages where NERICA dissemination activities were carried out were also purposively chosen while two adjacent villages were randomly selected. Rice farmers were randomly selected from each of the villages selected in the third stage. Data for the study were as collected from primary source using structured questionnaire.

In this study, the conditional independence-based estimators of ATE, ATT and ATU that were used are called inverse propensity score weighing estimators (IPSW), which are given by the following formulae (Imbens , 2004; Lee, 2005; Hirano et al., 2000 and 2003):

$$\hat{ATE} = \frac{1}{n}\sum_{i=1}^{n}\frac{(d_i - \hat{p}(x_i))y_i}{\hat{p}(x_i)(1-\hat{p}(x_i))} \qquad (1)$$

$$A\hat{T}T = \frac{1}{n_1}\sum_{i=1}^{n}\frac{(d_i - \hat{p}(x_i))y_i}{(1-\hat{p}(x_i))} \quad (2)$$

$$A\hat{T}U = \frac{1}{1-n_1}\sum_{i=1}^{n}\frac{(d_i - \hat{p}(x_i))y_i}{\hat{p}(x_i)} \quad (3)$$

Where n is the sample size, $n_1 = \sum_{i=1}^{n} d_i$ is the number of treated (i.e. the number of NERICA adopters) and $\hat{p}(x_i)$ is a consistent estimate of the propensity score evaluated at $\boldsymbol{x}$. We use a probit specification to estimate the propensity score.

Secondly, there are instrumental variable(IV)-based methods (Heckman and Vytlacil, 1999, and 2005; Heckman and Robb, 1985; Manski and Pepper, 2000; Imbens, 2004; Abadie, 2003; Imbens and Angrist, 1994), which are designed to remove both overt and hidden biases and deal with the problem of endogenous treatment. The IV-based methods assume the existence of at least one variable, an instrument called ***z,*** which explains treatment status but is redundant in explaining the outcomes y_1 and y_0 once the effects of the covariates $\boldsymbol{x}$ are controlled for. Different IV-based estimators are available, depending on functional form assumptions and assumptions regarding the instrument and the unobserved heterogeneities. Other recent papers on semi-parametric and non-parametric models with non-separable error terms and an endogenous, possibly continuous, covariate include papers using quantile instrumental variable methods, such as Chernozhukov and Hansen (2005) and Blundell, et al., (2006), and papers using a control function technique, such as Altoji and Matzkin (2005), Blundell and Powell (2004), Powell (2004) Chesher, (2003, and 2007), and Imbens and Newey (2002). In this study, we propose to use two instrumental variables (IV)-based estimators to estimate the Local Average Treatment Effect (LATE) of adoption of NERICA on yield, income and expenditure of Nigerian rice farmers (Imbens and Angrist, 1994). The first one is the simple non-parametric Wald estimator proposed by (Imbens and Angrist, 1994) which requires only the observed outcome variable y, the treatment status variable d, and an instrument z. The second IV-based estimator, Abadie (2003) generalization of the LATE estimator of Imbens and Angrist, (1994) to cases where the instrument z is not totally independent of the potential outcomes but will become so, conditional on x, a vector of covariates that determines the observed outcome y.

Following the Imbens and Angrist, (1994) LATE estimator and that of Abadie (2003), we note that a farmer's exposure status to the NERICA varieties (i.e. his awareness of the existence of the NERICA varieties) is a 'natural' instrument for the NERICA adoption status variable (which is the treatment variable here). Firstly, one cannot adopt a NERICA variety without being aware of it and we do observe some farmers adopting NERICA (i.e. awareness does cause adoption).

Secondly, it is natural to assume that exposure to NERICA affects the overall household income outcome indicators only through adoption (i.e. the mere awareness of the existence of a NERICA variety without adopting it does not affect the welfare outcome indicators of a farmer). Hence, the two requirements for the NERICA exposure status variable to be a valid instrument for the NERICA adoption status variable are met.

Now, let z be a binary outcome variable taking the value 1 when a farmer is exposed to the NERICA and the value 0 otherwise. Let $d_1$and $d_0$be the binary variables designating the two potential adoption status of the farmer with and without exposure to the NERICA varieties, respectively (with 1 indicating adoption and 0 otherwise).

Because one cannot adopt a NERICA variety without being exposed to it, we have $d_0 = 0$ for all farmers and the *observed* adoption outcome is given by $d = zd_1$. Thus, the sub-population of potential adopters is described by the condition $d_1 = 1$ and that of actual adopters is described by the condition $d = 1$ (which is equivalent to the condition $z = 1$ and $d_1 = 1$). Now, if we assume that z is independent of the potential outcomes d_1, $y_1$and y_0 (an assumption equivalent to assuming that exposure to NERICA is random in the population), then the mean impact of NERICA adoption on the outcome of the sub-population of NERICA potential adopters (i.e. the LATE) is as given by

$$
\begin{aligned}
E\left(y_1 - y_0 \middle| d_1 = 1\right) = LATE &= \frac{\operatorname{cov}(y,z)}{\operatorname{cov}(d,z)} \\
&= \frac{E\left(y|z=1\right) - E\left(y|z=0\right)}{E\left(d|z=1\right) - E\left(d|z=0\right)} \\
&= \frac{E\left[y_i \cdot \left(z - E\left[z_i\right]\right)\right]}{E\left[d_i \cdot \left(z - E\left[z_i\right]\right)\right]}
\end{aligned}
\qquad (4)
$$

which is the well known *Wald* estimator that can be estimated using two-stage least squares. For applications using parametric models with covariate, see Hiraino et al. (2000) and Mealli et al. (2004). Moreover, it has been shown that, under the same assumptions, the entire marginal distributions of potential outcomes are identified for compliers. In particular, Abadie (2003) shows that if those assumptions1 hold in the absence of covariates:

$$E(y_1 | d_1 > d_0) = \frac{E(y \cdot d | z = 1) - E(y \cdot d | z = 0)}{E(d | z = 1) - E(d | z = 0)}$$

$$E(y_0 | d_1 > d_0) = \frac{E(y \cdot (1-d) | z = 1) - E(y \cdot (1-d) | z = 0)}{E((1-d) | z = 1) - E((1-d) | z = 0)}$$

These equations identify average treatment responses for compliers.

The assumption that exposure to the NERICA varieties is random in the population is, however, unrealistic given the way the dissemination of NERICA took place in Nigeria (PVS). We therefore use Abadie's (2003) LATE estimator, which does not require the randomness assumption but instead requires the conditional independence assumption: the instrument *z* is independent of the potential outcomes d_1, y_1 and y_0 conditional on a vector of covariates ***x*** determining the observed outcome *y*. With these assumptions, the folowing results can be shown to hold for the conditional mean outcome response function for potential adopters $f(x, d) \equiv E(y \mid x, d; d_1 = 1)$ and any function *g* of (*y, x, d*) (Abadie and Lee, 2005). These equations identify average treatment responses for compliers.

$$f(x,1) - f(x,0) = (y_1 - y_0 \mid \boldsymbol{x}, d_1 = 1) \quad (5)$$

$$E(g(y,d,x) | d_1 = 1) = \frac{1}{P(d_1 = 1)} E(k \cdot g(y,d,x)) \quad (6)$$

Where $k = 1 - \frac{z}{p(z=1|x)}(1-d)$ is a weight function that takes the value 1 for a potential adopter and a negative value for a non-adopter. The function $f(x, d)$ is called a Local Average Response Function (LARF) by Abadie (2003). Estimation proceeds by a parameterization of the LARF $f(\theta; x, d) = E(y | x, d; d_1 = 1)$. Then, using equation (3) with $g(y,d,x) = (y - f(\theta; x, d))^2$, the parameter θ is estimated by a weighted least squares scheme that minimizes the sample analogue of $E\{\kappa (y - f(\theta ; x, d))^2\}$. The conditional probability $P(z=1|x)$ appearing in the weight κ is estimated by a probit model in a first stage. Abadie (2003) proves that the resulting estimator of θ is consistent and asymptotically normal. Once, θ is estimated, equation (7) is used to recover the conditional mean treatment effect $E(y_1 - y_0 | x, d_1 = 1)$ as a function of *x*. The LATE is then obtained by averaging across *x* using equation (7). For example, with a simple linear function $f(\theta, d, x) = \alpha_0 + \alpha d + \beta x$ where $\theta = (\alpha_0, \alpha, \beta)$ then $E(y_1 - y_0 | x, d_1 = 1) = \alpha$. In this case, there is no need for averaging to obtain the LATE, which equals to α. Hence, a simple linear functional form for the local average response function with no interaction between *d* and *x* implies a

constant treatment effect across the sub-population of potential adopters. In this study, we postulate an exponential conditional mean response function with and without interaction to guaranty both the positivity of predicted outcomes (poverty productivity) and heterogeneity of the treatment effect across the sub-population of potential NERICA adopters. Because exposure (i.e. awareness) is a necessary condition for adoption, it can be shown that the LATE for the sub-population of potential adopters (i.e. those with d_1=1) is the same as the LATE for the sub-population of *actual* adopters (i.e. those with d=zd_1=1).

descriptive statistics and counterfactual analytical procedure using two instrumental variable(IV)-based estimators to estimate the Local Average Treatment Effect (LATE) of adoption of rice variety innovation on productivity and poverty indicators health and education of women and men in NERICA dissemination project States in Nigerian.

RESULTS AND DISCUSSION

Descriptive statistics and counterfactual analytical procedure using two instrumental variable(IV)-based estimators to estimate the Local Average Treatment Effect (LATE) of adoption of rice variety innovation(NERICA) on productivity and poverty indicators health and education of women and men living in the states where the innovation was first launched in Nigerian.

Table 1: Descriptive Statistics

Table presents descriptive statistics of the male and female headed household and ANOVAs was used to test the significance level. It shows the percentage of the respondents that are female or male heads of household and the rice production relationship that exist between the household head and the spouse

S/N	Number of Farmers	Variable	% adopters of Innovation	%Non adopters of Innovation	Cumulative % of Adopters and non Adopters	Significance level
1	621	Female Headed household (widow)	4	**7**	**6**	

2	619	Single female household head(husband working elsewhere)	3	1	2	***
3	276	Female bread winner	1	1	1	
4	618	Male headed household with automonous production system for husband and wives	60	47	53	***
5	624	Male headed household with mix management of production system for husband and wivies	30	40	36	***
6	619	Male headed household with production system mainly managed by husband(with maginal plot owned by wivies)	21	17	19	
7	624	Training Courses	48	22	34	***

		attended				

Legend: *** significant at 1%

The table revealed that few of the women are heads of household. The headship resulted from widowhood (6%), husband migration to somewhere else to work (2%) and female bread winners (1%). Female headship is expected to increase the poverty status of the household. Female-headed households are likely to have less income than a comparable male-headed household. It has been asserted that women's productivity in agriculture is hampered both by their lack of assets and access to resources. The adoption of innovation is significantly higher among the single female headed households whose husbands are working elsewhere. The survey data provide the opportunity to examine whether female-headship is associated with lower crop yields, and thus a reduced impact on the effort on poverty reduction. The percentage of female headed households is few because traditionally men are heads of household in Nigeria.

Autonomous Production System for Husband and wives

There are three (3) categories of autonomy in this study, the male headed household with independent production system for the husband and wife(53%); Male headed household with mixed production system for the husband and the wives(36%); male headed household with mainly production system managed by husband with marginal plot owned by wives(19%). Sixty (60%) of the respondents in the group of farmers in the male headed household with autonomous production systems for husband and wives adopted the rice innovation. The percentage of adopters decreased to 30% for male headed household with mixed management of production system. These groups are significant at 1% significance level. The implication is that adoption of rice innovation(NERICA) will be expected to be high in household where both men and women are empowered to make decision as relates to agriculture.

Percentage Household that cultivated NERICA in2008, 2009 and 2010

Adoption of Nerica Varieties in 2010	Freq.	Percent	Cum.
0	446	59.95	59.95
1	298	40.05	100.00
Total	744	100.00	

Percentage of farmers that have cultivated NERICA in 2009

Adoption of NERICA Varieties in 2009	Freq.	Percent	Cum.

0	431	57.93	57.93
1	313	42.07	100.00
Total	744	100.00	

Percentage of farmers that have cultivated NERICA in 2008

Adoption of NERICA Varieties in 2008	Freq.	Percent	Cum.
0	459	61.69	61.69
1	285	38.31	100.00
Total	744	100.00	

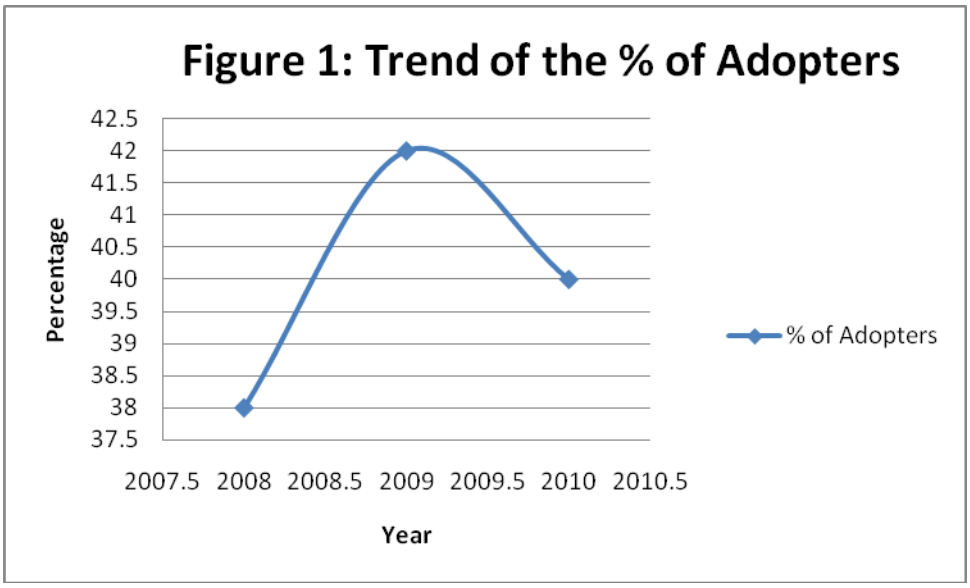
ANOVA table of adoption of NERICA in 2008, 2009 and 2010

Number of obs = 744 R-squared = 0.5701
Root MSE = .319371 Adj R-squared = 0.5690

Source	Partial SS	df	MS	F	Prob > F
Model	100.24641	2	50.1232049	491.42	0.0000
Adoption 2009	14.3863452	1	14.3863452	141.05	0.0000
Adoption 2010	1.06869275	1	1.06869275	10.48	0.0013
Residual	75.5802031	741	.101997575		
Total	175.826613	743	.236644163		

ERICA during the cropping years 2008, 2009 and 2010

Table 1: Percentage of farmers that have cultivated NERICA in 2008, 2009 and 2010



The figure 1 summaries table 1 that there were 38% adopters in 2008, the percentage rose to 42% but this significantly dropped to 40% in 2010. This drop in percentage adopters is due to access to seed. The mean total area cultivated to NERICA was 3.36ha in 2009 and 3.58ha (significant at 1%). This is evidence that those who have cultivated the variety before are increasing the area grown to NERICA.

Figure 2: Poverty Indicators among men and Women NERICA Adopters

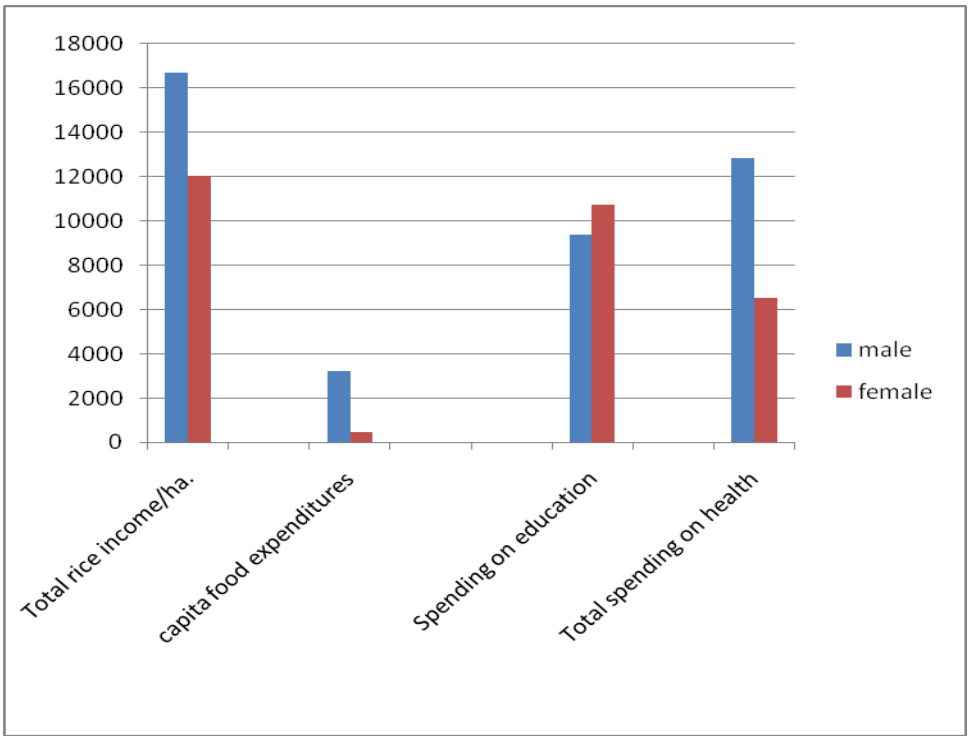


Figure 2 compares the poverty indicators of both women and men. The indicators, total rice income per hectare, per capita food expenditure total spending on education and health are significant. The table revealed that the total rice income per hectare for men was higher than that of men even though the women had higher yield and plant more hectares than men. This may be due to the fact that women dispose their harvest earlier than men. Also a higher proportion of the rice harvested is consumed in the household.

Per capita spending on food by men is more than that of women may put value on the food items gotten from the homestead farm which includes vegetable, cereals, livestock and small ruminants.

Spending on Education

The spending on education indicates the expenditure on the children education. Women spend more on children's school fees and other school requirements. NERICA variety disseminated in these States mature earlier (during the hunger period May - July) than other varieties cultivated in the States. This affords the women the opportunity to feed the family and have income to take care of the children's school fees in September.

Spending on Health

In terms of the spending on the health of the household, the figure shows that women spend less on health. This is because the male are expected to pay for the drug of the sick family member while the women nurse the sick (no monetary value is place on this). The number of sick cases reported by the respondent was an average of 2.4% within a 12 month period. This is significant at 1% level of significance. This may indicate that other sick cases were treated with local herbs which are got freely around the farm.

Table 2: Impact of Rice Varietal innovation on male Adopters

Table 2 presents the late parametric (OLS) estimation of impact of rice varietal innovation adoption on rice yield for men and means difference in yield between the innovators and non innovator. Yield is a measure of rice per unit area under cultivation, more yield translate to increase in rice production income.

LATE parametric (Ols) estimation of population parameters
Number of obs: N = 558
Number of treated: N1 = 238
Number obs with inst=1: Nz1 = 296

	Robust				
yield10	parameter	Std. Err.	z	P>|z|	[95% Conf. Interval]
LARF					
late	192.328	5.288818	36.37	0.000	181.9621 202.6939
Observed					
diffmo	279.3164	81.66286	3.42	0.001	119.2601 439.3727
mo_N1	1112.344	63.22292	17.59	0.000	988.4289 1236.258
mo_N0	833.0271	51.68836	16.12	0.000	731.7198 934.3344

The impact of adoption NERICA on yield is 192.33kg. There was significant difference (33.53%) between the mean yield of adopters and non adopters of rice Varietal innovation as indicated above.

Table 3: States the late parametric (OLS) estimation of impact of rice varietal innovation adoption on yield obtained by women and mean difference in yield between the women innovators and non innovator.

LATE parametric (Ols) estimation of population parameters
Number of obs: N = 36
Number of treated: N1 = 15
Number obs with inst=1: Nz1 = 17

	Robust				
yield10	parameter	Std. Err.	z	P>|z|	[95% Conf. Interval]
LARF					
Late	354.6102	8.481841	41.81	0.000	337.986 371.2343
Observed					
diffmo	696.111	266.0185	2.62	0.009	174.7243 1217.498
mo_N1	1196.191	198.7513	6.02	0.000	806.6458 1585.736
mo_N0	500.0801	176.8157	2.83	0.005	153.5276 846.6325

The result indicated a 354.61Kg yield impact recorded for female adopters and 139% mean difference between the and the non adopters. When compared with the male farmers the female adopters had 84% more yield increase than male adopters. Thus if more women are brought into rice production they will help to increase rice production and break the cycle of poverty by enhancing the house hold income.

Impact on Total households' Spending on Education

Table 4: States the Late Parametric (OLS) Estimation of Impact of NERICA Adoption on Total Household Spending on Education mean difference

Number of obs: N = 330
Number of treated: N1 = 153
Number obs with inst=1: Nz1 = 198

	Robust				
tschoolexp10	parameter	Std. Err.	z	P>|z|	[95% Conf. Interval]
LARF					
late	9105.92	178.6804	50.96	0.000	8755.713 9456.127
Observed					
Diffmo	6010.443	4892.383	1.23	0.219	-3578.45 15599.34
mo_N1	31759.61	3665.433	8.66	0.000	24575.49 38943.72
mo_N0	25749.16	3240.372	7.95	0.000	19398.15 32100.18

The household that embraced innovation spent NGN31, 759.61 on the education of members of their family during the period. The impact of adoption of was NGN9105.92 but the difference between adopter and non Adopters is not
Significant.

impact on Total households' spending on health

Table 4: States the Late Parametric (OLS) Estimation of Impact of NERICA Adoption on Total Household Spending on Health and the mean difference
Average number of sickness cases over the last 12 months in the household and amount spent of showed that 2.38 percent of the 130 respondents were significantly sick.

LATE parametric (Ols) estimation of population parameters
Number of obs: N = 160
Number of treated: N1 = 62
Number obs with inst=1: Nz1 = 89

	Robust				
thealthexp10	parameter	Std. Err.	z	P>|z|	[95% Conf.Interval]
LARF					
Late	10638.76	699.8074	15.20	0.000	9267.159 12010.35
Observed					
diffmo	-2195.072	2131.318	-1.03	0.303	-6372.378 1982.235
mo_N1	3083.53	532.2633	5.79	0.000	2040.313 4126.747
mo_N0	5278.602	2063.786	2.56	0.011	1233.656 9323.548

The adopter spent NGN3083.53 for sick members of the household while non adopter spent NGN5278.60. but the mean difference is not significant. The impact of adoption was NGN10, 638.76

CONCLUSION

Agricultural innovation can halt the vicious cycle of poverty by improving income while reducing hunger, malnutrition and improve health. The specific objective of this study is estimates of the impact of NERICA adoption on rice yields, income and food expenditure of male and female farmers in selected states Nigeria (first generation of NERICA project beneficiaries). A three stage sampling was done: the states and the villages were purposively selected. while two adjacent villages and the farmers were randomly selected. Data for the study were as collected from primary source using structured questionnaire. Descriptive statistics and counterfactual analytical procedure using two instrumental variable(IV)-based estimators to estimate the Local Average Treatment Effect (LATE) of adoption of rice variety innovation on productivity and poverty indicators health and education of women and men in NERICA

dissemination project States in Nigerian. Sixty (60%) of male headed household with autonomous production systems for husband and wives adopted the rice innovation. The percentage of adopter dropped from 42% significantly to 40% in 2010 due to lack of access to seed. The result indicated a 354.61Kg yield impact recorded for female adopters. When compared with the male farmers, the female adopters had 84% more yield increase than male adopters. The implication is that adoption of rice innovation (NERICA) will be expected to be high in household where both men and women are empowered to make decision as relates to agriculture. Innovations have to be accessible to for transformation to take place.

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