Gendered impact of NERICA Adoption on Farmers' Production and Income in Central Benin

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Abstract

Today, development and dissemination of new technologies constitute an important strategy for agricultural intensification, poverty reduction and food security in developing countries. Rice is an important source of farmers' income and foreign currencies in developing countries. Although women play a vital role in rice production, they have not been adequately involved in technology generation activities until recently. The New Rices for Africa (NERICA) were developed by Africa Rice Center (WARDA) in 1994 and disseminated starting in 1997 in some Sub-Saharan African countries including Benin in collaboration with National Agricultural Partners. This paper use econometric method based on Local Average Treatment effect (LATE) to estimate the gendered impact of NERICA adoption on farmers' yield and income. The results show that NERICA adoption has positive and significant impact on farmers' yield and income. The impacts of NERICA adoption are higher within women farmers than within men farmers.

Introduction

During the last three decades, rice consumption in Africa and particularly in Benin experienced a drastic increase that leads to an increase of the national productions even though to a lesser extend. The consequence is an alarming dependency on rice importations for food security in African countries. The only way out of this position is the quantitative and qualitative improvement of national rice production for a real contribution to food security and poverty alleviation. Today, rice constitutes an important source of income in most developing countries (Ahoyo 1996; Houndékon, 1996; Kinkingninhoun-Medagbé 2003). To contribute to rice intensification, new production and post-harvest technologies including new rice varieties among which the NERICA (New Rice for Africa), were developed by Africa Rice Center (WARDA) in collaboration with the National partners and were disseminated in Benin towards the end of 90s. The NERICA were obtained from the interspecific hybridization between the African rice (*Oryza Glaberrima*) and the Asian rice (*Oryza sativa*) and combine many desirable characteristics from the two species including a high yield potential and resistance to many of the biotic and abiotic stresses found in the Africa environment (WARDA 2001).The main goals of the development, release and dissemination of the NERICAs are to increase rice production in Africa and to contribute to poverty reduction and food security through the increase of rice farmers' productivity and income.

Women's role in rice production is well known (Quisumbing 1996; Carney, 1993). However, they often have little access to production factors and were not considered in technological need assessment. As consequences, new technologies had less impact on women's efficiency, income generation and hence their welfare (Basile 2001). WARDA has adopted participatory research methods to develop gender-sensitive rice production technologies that would reach women and allow their contribution to poverty reduction and food security. Thus, women rice farmers were much involved in dissemination of NERICA in Benin. The present study aims to evaluate the impact of the adoption of NERICA on women's production and income. This paper will first present a brief description of the conceptual framework and methodology of the study (section 2), then analyze and discuss the different results (section 3) before giving some suggestions for improving rice farmers welfare.

Materials and Methods

The study was conducted in 24 villages selected in Central Benin comprised of 12 "NERICA villages" (villages where NERICA was introduced through participatory varietal selection (PVS) trials) and 12 "non-NERICA villages". About 300 rice-farming households (about 15 per village) were randomly sampled among the rice farming population in the villages. Primary and secondary data were collected through structured questionnaires non-structured discussions, semi-structured and structured interview, participatory observations. The primary data used in

the study are for the 2004 cropping season and were collected in July 2005. The data collected were analyzed using the Econometric package Stata. The gross margin method was used for income calculation,. The comparison tests were used to compare the income and the impact between men and women. Non-experimental econometric methods were used to estimate the impact of NERICA adoption on rice farmers' production and income. In particular, the Local Average Treatment Effect (LATE) of NERICA adoption on yield and income was estimated using the instrumental variable (IV) and Local Average Response Function (LARF) estimation methods (Lee, 2005; Abadie, 2003; Angrist, 1996 and Imbens and Angrist, 1994).

Results and discussion

Impact of NERICA adoption on farmers' yield

Overall, the NERICA gave higher yields and incomes as compared to other improved varieties (Table 2). LARF OLS regression model of rice farmers' yield (Table 1) indicated that the main determinants of rice yield are NERICA adoption, quantity of seeds per hectare, quantity of labor per hectare, quantity of fertilizers per hectare, quantity of insecticides, sex of farmer, formal education and number of household workers. The different values of Local Average treatment Effect (LATE) are positive and statistically different from zero for all the categories (Table 2). This reveals that NERICA adoption have positive impact on farmers' yield and has induced a yield surplus of 710 kg per hectare in paddy production on farmers' field. Comparing the LATE estimates of men and women, Table 2 shows that the impact of NERICA adoption on yield is significantly higher for women than for men (more than three times higher). NERICA adoption is thus more beneficial for women than for men.

Impact of NERICA adoption on farmers' income

The results of LARF OLS regression model for income (Table 1) indicate that NERICA adoption, cost of fertilizers per hectare and cost of labor per hectare are the main determinant of farmers' income. Table 1 shows that the LATE estimates of NERICA adoption on income is positive and statistically different from zero confirming that the adoption of NERICA have positive impact on farmers' rice income. The adoption of NERICA induced on average an impact of 10300 F CFA per capita on farmers' rice income. With respect

to the gender differentiated impact of NERICA adoption on income, Table 2 shows the same trends as for yield. Women NERICA adopters experienced higher additional income gain (15685 FCFA) compared to men (9145 FCFA). Their average additional income gain is almost twice as high than that of men. That women show a higher impact with NERICA adoption is explained by the combination of the following facts: 1) NERICA is a upland variety 2) in Benin upland rice cultivation is mostly done by women 3) Most women have been growing the low yielding traditional "Gambiaka" rice variety, 4) Most men who have adopted the NERICA have used it in lowland plots where there are already many improved varieties adapted to the lowland ecologies of Benin. Hence, because of these facts the mostly women upland farmers who adopted NERICA have experienced higher yield increase (and income) than the mostly men lowland farmers who adopted the NERICA.

Conclusion

The main goal of agriculture research in Sub-Saharan Africa is the development and dissemination of agricultural technologies targeted to poor farmers to contribute to poverty reduction and food security through the increase of rice farmers' productivity and income. This study evaluated the impact of the new NERICA rice varieties developed by WARDA on farmers' productivity and income and found a positive and significant impact on farmers' rice yield and income. The positive impacts are explained by the higher yield potential of NERICA varieties compared to the improved rice varieties previously disseminated in Benin. Hence, we can conclude that the NERICA rice varieties could enhance rice production and farmers' income and welfare in Sub-Saharan Africa if they are widely promoted with the necessary access to complementary technologies (soil fertility and post-harvest) and credit. The study had also revealed that the impact of NERICA adoption was higher for female farmers than for male farmers. This result suggests that it could be more profitable to target women in upland for NERICA dissemination in order to have more impact on poverty and gender inequality.

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Table 1. Determinants of NERICA yields using LARF OLS regression model

Variables	Equation for Yield	Variables	Equation for income
NERICA adoption	710.27 *** (66.639)	NERICA adoption	10299.95 ***(2385.37)
Quantity of seeds	-2.935 *** (0.278)	Cost of seeds	-0.013 (0.03)
Quantity of labor	0.30 *** (0.024)	Cost of fertilizers	-0.020 (0.030)
Quantity of fertilizers	2.54 *** (0.31)	Cost of insecticides	-0.73 (1.11)
Quantity of insecticides	-153.365*** (19.64)	Sex of farmer	213.03 (2774.69)*
Sex of farmer	-793.62 *** (90.15)	Upland farming	-8972.56 (5025.704)
Upland farming system	-919.77 ***(149.72)	Training in rice farming	10103.16**(3376.45)
Training in rice farming	-70.2 (65.73)	Being in NERICA village	-3756.37 (3328.05)
Schooling	-198.44 *** (74.45)	Household size	-1164.75 (751.77)
Number of workers	-265.13 *** (25.13)	Being in association	-4025.80 (3059.83)
		Number of workers	-531.05 (896.10)
Constance	2500.10 ***(150.89)	Constance	17556.67*** (4027.77)
Number of observation	*98*	*Number of observation.*	*98*
F(9, 217)	*52.18*	*F(9, 217)*	*4.55*
Prob > F	*0.0000*	*Prob > F*	*0.0000*
R-squared	*0.8571*	*R-squared*	*0.3679*
Adj R-squared	*0.8407*	*Adj R-squared*	*0.2870*
Root MSE	*304.79*	*Root MSE*	*11063*

*Robust standard errors in parenthesis, ***=Significant at 1%, **= significant at 5%, *=significant at 10%,*
Source: Socio-economic survey (WARDA - FSA/UAC, 2005

Table 2. Average yields and Local Average treatment effect (LATE) for yield and income

	Yield observed (Kg/ha)		Difference	LATE for yield (kg/ha)	LATE for income (F CFA/capita)
	Adopters	Non adopters			
Men	2390	1660	730***	262***	9145 ***
Women	2680	1590	1090***	966***	15685 ***
All	2550	1620	930***	710***	10300 ***

***=Significant at 1%, **= significant at 5%, *=significant at 10%.
Source: Socio-economic survey (WARDA - FSA/UAC, 2005