



Africa Rice Center (WARDA)



Research and Development Brief August 2008 NERICA Adoption and Impact: Summary of findings from four countries

Introduction

The Nerica (New Rice for Africa) rice varieties is a group of rice varieties resulting from interspecific crosses between the *Oryza sativa* rice species from Asia and the locally adapted and multiple-stress resistant *Oryza glaberrima* African rice species. They are the outputs of the interspecific hybridization breeding program started in 1991 by the Africa Rice Center (WARDA). The Nerica varieties promise to raise significantly the productivity, income and food security of of rainfed upland rice farmers in sub-Saharan Africa.

The Nerica varieties were introduced to rice farmers starting in 1996 in West Africa through Participatory Varietal selection (PVS) trials. To date up to eighteen Nerica varieties have been disseminated in numerous countries across Sub-Saharan Africa through informal channels by farmers and by development projects including the \$35 Nerica dissemination project funded by the African Development Bank (starting in 2004).

Studies on the adoption and impact of the Nerica varieties are being conducted in 9 countries. In this brief we summarize the main findings on the adoption and impact of Nerica in four countries: Benin, Cote d'Ivoire, Guinea, and Gambia. The methodology used in the studies is briefly described at the end of the document.

Diffusion and adoption of NERICA¹

In Côte d'Ivoire, the diffusion rate was 9% while the adoption of lines of NERICA[®] was only 4% in 2000. However, the adoption rate in the population could have been up to 27% if the whole population had been exposed to the NERICA (Diagne 2006a).

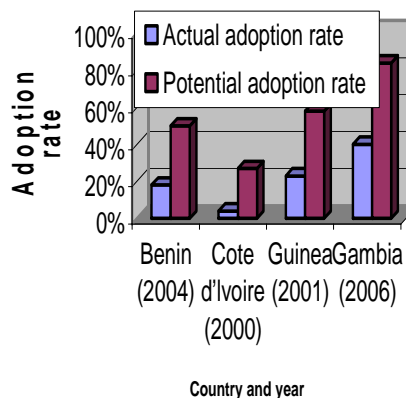
In Guinea, the rate of diffusion of NERICA was estimated at 40% in 2003, which is much higher than in Côte d'Ivoire. The potential adoption rate of NERICA by the population (if all farmers in Guinea had been exposed to NERICA) was 53%, which is more than double the actual adoption rate of 23% observed in the sample (Diagne *et al.* 2006a). Up to 59% of farmers who were exposed to lines of NERICA had adopted them in 2001. The total area under NERICA in Guinea has been estimated at 28,000 hectares (ha) in 2002 and 51,000 ha in 2003 (Diagne *et al.* 2006b). The area of NERICA is rowing fast and has quickly superseded IRAG's modern varieties. The area estimate for 2003 represented a third of the potential area if all farmers had known of NERICA and had access to its seed.

In Benin, the diffusion rate for NERICA in 2003 was 26%. Varieties of NERICA were

¹ The adoption of a variety is defined here to mean its *use* at the individual level or at the aggregate population level. The term diffusion is used to mean the extent of *knowledge* or *awareness* of (or *exposure* to) the variety in the population (which does not necessarily implies its use)

adopted by 18% of the farmers in the sample in 2004, an adoption rate three times lower than the estimated potential adoption rate of 57%. Up to 70% of farmers who were exposed to lines of NERICA in Benin in 2003 have adopted them. About 2000 ha were estimated to be under NERICA in

sample in 2006, an adoption rate lower than the estimated potential adoption rate of 84%. Up to 86% of farmers who were exposed to NERICA in The Gambia by 2006 had adopted them. The adoption rates in The Gambia for NERICA are the highest so far among all countries.



Actual and potential adoption rate

Benin in 2003. The potential area under NERICA in 2003 (if all farmers in the surveyed area knew about NERICA) is estimated to be 5500 ha (Adegbola *et al.* 2005).

In The Gambia, the diffusion rate for NERICA in 2006 was 57%. NERICA lines were adopted by 40% of the farmers in the

The results of the econometric analysis of the socioeconomic determinants of adoption of NERICA in Côte d'Ivoire show that the main factors which positively influenced the adoption of NERICA (i.e. with estimated effects statistically significant at the 5% level) included; growing rice partially for sale, household size, growing upland rice (positive impact), past participation in PVS trials, and living in a PVS-hosting village. On the other hand, age of the farmer and having a secondary occupation had a negative impact on adoption, (Diagne 2006b).

In Guinea, the main socio-economic determinants of adopting NERICA with positive effects were participation in a training program and living in a village where the NGO SG2000 has had activities (Diagne *et al.* 2007).

Table 1: Area under NERICA and adoption rates

Population Adoption parameters	Benin (2004)	Côte d'Ivoire (2000)	Guinea (2001)	The Gambia (2006)
Estimated area of NERICA in ha (year)	1995 ha (2003)	-	51,000 ha (2003)	-
Exposure rate	26%	9%	39%	57%
Actual adoption rate (adoption and exposure)	18%	4%	23%	40%
Potential adoption rate (ATE)	50%	27%	58%	84%
Adoption rate among exposed (ATE1)	68%	38%	59%	86%
Adoption rate among non-exposed (ATE0)	53%	25%	57%	82%
Adoption gap	32%	23%	35%	44%

In Benin land availability and living in a PVS-hosting village were found to have positive effects on adoption. In addition to the analysis of the socioeconomic determinants of adoption of NERICA, it was also found in Benin that varietal attributes such as swelling capacity and short growing cycle were important determinants of adoption of NERICA (Adegbola *et al.* 2005).

In The Gambia, the main determinants of adoption of NERICA with positive effects were living in a village where dissemination activities for NERICA had been conducted by WARDA and contact made with the National Agricultural Research Institute (NARI), as well as access to credit. Experience in upland rice farming also had a positive impact on adoption (Dibba *et al.* 2008a).

The policy implication of the empirical findings regarding the important role played by PVS, both in the diffusion and adoption of the NERICA and also within and outside the populations involved in the trials, goes beyond the endorsement and promotion of PVS as an effective tool for technology development and dissemination. Indeed, the finding that the mere implementation of PVS trials in a community promotes the adoption of NERICA beyond the subpopulation participating in the trials points to a possible strategy for scaling-up PVS: focus on covering more villages with relatively few PVS participants per village (i.e. inter-village scaling-up) and letting the naturally-occurring phenomenon of “social learning” about the characteristics of a technology do its work within the village community (i.e. the intra-village scaling-up).

Impact of adoption of NERICA²

In Côte d’Ivoire, the NERICA impact assessment results show the impact on the

average yield of rice of adopting NERICA to be heterogeneous with a sizable and statistically significant impact found for female farmers (+741 kg/ha) and the non statistically significant impact found for male farmers (Diagne 2006c). The results also suggest that a large number of farmers, especially those in the forest ecology, adopt varieties of NERICA not because of their yield potential but because of non-yield varietal attributes such as short growth cycle, height, and consumption and grain qualities.

In Guinea, the results of the analysis of the impact of the introduction of NERICA on rice biodiversity shows that the relatively high level of adoption has not led to a concomitant reduction in the number of pre-existing cultivated rice varieties (Barry *et al.* 2006). It appears that because of their short duration, the NERICA varieties are used by farmers to complement traditional varieties and thus enhance the varietal diversity of rice. Results on the productivity impact indicate that an additional rice yield gain of 491 kg/hectare was achieved by farmers adopting NERICA. Consistent with findings from other countries, results show that the impact of NERICA adoption is higher among women (1090 kg/ha) than among men (442 kg/ha) (Diagne *et al.*, 2007).

In Benin, results based on the data for the 2003 season show that the adoption of NERICA has significant and positive effect on yield, production and incomes of producers. An additional rice yield gain of 1587 kg per hectare was attained by farmers adopting NERICA, with per capita rice production and income gains of 109 kg and 14,100FCA (\approx \$28) respectively. However, the impact at the national level was very limited because of the presently low diffusion of the NERICA in Benin (Adegbola *et al.* 2006). Results from another analysis based on data from the 2004 season show that the impact of NERICA adoption is higher for women than for men. Female potential adopters have a surplus of production of 850 kg of paddy per hectare compared to 517 kg of paddy per hectare for men and an additional gain of 171,978 CFA

² The impact estimates are based on the Local Average Treatment Effect (LATE). However, the estimates for Guinea are based on the Average Treatment Effect (ATE) (see the references listed at the end for more details on the methodology).

Table 2: Impact of NERICA adoption on rice productivity

Productivity indicators	Benin (2004)	Côte d'Ivoire (2000)	Guinea (2004)	The Gambia (2006)
Yield mean difference (all)	937***	-258*	-39.10***	117***
Men	724***	-498**	-34.03***	227***
Women	1096**	30	122.46***	105***
Impact on yield (kg/ha) (all)	710***	276	491.97**	131 ***
Men	261**	-134	442.74**	0.17***
Women	966**	741*	1090.34**	142***
Impact on income for women (\$/ha)	337		660.26*	
Impact on income for men (\$/ha)	277		35.68*	
Impact on rice production (kg/capita/year) in 2003	109			

*, ** ; *** ; statistically significant at 5%, 1%, and 0.1% , respectively

(≈ \$337) per hectare for women compared to 141,568 CFA (≈ \$277) for men (Agboh-Noameshie *et al.* 2006).

In The Gambia, results based on the data for the 2006 season show that adoption of NERICA had a significant impact on yields of producers. Results indicate that an additional rice yield gain of 131 kg/hectare was achieved by farmers adopting NERICA. Results further show that the impact of NERICA adoption is higher for women (142 kg/ha) than for men (0.17 kg/ha) (Dibba *et al.* 2008b).

A study on the impact of NERICA adoption on selected Millennium Development Goal poverty indicators was conducted in Benin. The impact assessment on child schooling revealed that NERICA adoption resulted in a 6% increase in school attendance rate, a 14% increase in the gender parity index and an 11,400 CFA (≈ \$20) increase in school expenditure per child (Adekambi *et al.* 2008a). The impact on consumption spending, calorie intake and poverty was also assessed by Adekambi *et al.* (2008b). The study found that adoption of NERICA had a positive impact on household consumption expenditure per adult

equivalent (+147.51 CFA/day ≈ \$0.30). The highest impact was observed in female-headed households (161.75 CFA/day ≈ \$0.32 compared to 128.34 CFA/day ≈ \$0.26 for male-headed households). Results further revealed that growing varieties of NERICA led to an improvement in daily calorie intake of 35.82 kcal per equivalent adult (significant at the 10% level). However, the difference between the two groups was not statistically significant. Moreover, the consumption expenditure deficit ratio of the poor was reduced by 19%, suggesting that NERICA adoption led to an improvement in the living conditions of poor households.

Table 3: Impact of NERICA adoption on selected Millennium Development Goal poverty indicators

Poverty indicator	Benin (2004)
Child school attendance rate	6%
Child school gender parity index	14%
School expenditure per child (\$)	20
Total daily consumption expenditure per adult equivalent (\$)	0.30
Daily calories intake per adult equivalent (Kcal/adeq)	36
Consumption expenditure deficit	-19%

Methodology

The New Rice for Africa (NERICAs) varieties are relatively new and are not yet widely adopted and their diffusion (exposure) and adoption by farmers is non-random. Under these circumstances the estimation of adoption rates and impact using traditional procedures (eg sample adoption rate, difference in mean outcomes between adopters and non adopters) suffer from “*non exposure*” bias and “*selection*” bias. As a consequence, they generally yield biased and inconsistent estimates of the population mean adoption and impact parameters. To address these problems the WARDA impact assessment team uses the counterfactual outcomes or the Average Treatment Effect (ATE) framework of modern Evaluation Theory (see, for example, Heckman and Vytlacil, 2005; Imbens, 2003 for reviews of the literature) to estimate potential and actual adoption rates and mean impact of adoption as measured by the Average Treatment Effect (ATE) and the Local Average Treatment (LATE) effects parameters. More details on the methodology and the data used can be found in the papers listed at the end.

In terms of implementation, except the work for Cote D’Ivoire for which WARDA was fully responsible, the work in all other countries are being conducted by the National Agricultural Research System (NARS) in WARDA member states with WARDA providing funding, training, tools for analysis and backstopping on the field work and data analysis. A common methodology is being used in all countries so as to facilitate comparability and aggregation of adoption and impact across countries.

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