

# Genetic Resource Policies

## Promising Crop Biotechnologies for Smallholder Farmers in East Africa: Bananas and Maize

Brief 21

### GAUGING POTENTIAL BASED ON CURRENT ADOPTION OF BANANA HYBRIDS IN TANZANIA

Jackson Nkuba, Svetlana Edmeades, and Melinda Smale

In the mid-1990s, new banana planting material was introduced into Tanzania in response to increased pest and disease pressures on banana production and the high levels of susceptibility of local endemic varieties, coupled with a lack of chemical inputs to combat these constraints. The formal introduction of new hybrid bananas into the region began in 1997 with the efforts of the Kagera Community Development Program (KCDP). The goal of the program was to increase farmers' food and income security by improving banana productivity. About a dozen new banana varieties were introduced to the Kagera region of Tanzania. Among them were the first banana hybrids, bred by the Fundación Hondureña de Investigación Agrícola (FHIA). New planting material was disseminated to farmers by KCDP and government extension agents through trials, demonstrations, and "mother gardens." In particular, farmers themselves played a major role in diffusing new planting material, as they have historically done in their search for disease-free, higher yielding bananas.

On-farm testing of the new varieties commenced in 1997 and was conducted concurrently with their multiplication and the dissemination of planting materials to farmers in the region (Nkuba et al. 1999). The results of on-farm testing showed that on average, the new banana varieties yielded a bunch weight of 18.9 kg, compared with 9.7 kg for local varieties (Nkuba et al. 2002; Mgenzi et al. 1997). Initial assessment revealed that these varieties are acceptable to farmers for their multiple uses (consumption as fruit; preparation by cooking, roasting, or drying; and fermentation for the production of beverages) and good marketability. From 1997 to 2002, about 2.5 million suckers (banana planting material) from the new banana varieties had already been distributed to farmers.

An initial adoption study conducted in 2002 indicated that 29 percent of 177 households surveyed from the five districts of the Kagera region had planted at least one new banana variety (Weerd 2003). Rates of use were found to vary significantly among agroecological zones within Kagera region, reflecting the severity of banana production constraints. Before the introduction of the new banana types, the Bukoban high-rainfall zones were worst affected in terms of pest and disease pressure on both local and exotic bananas. At the time of the survey, 100 percent of farmers in the Bukoban high-rainfall zone used new planting material, compared with only 6 percent of farmers in the Karagwe–Ankolean medium-rainfall zone (Weerd 2003).

Statistical survey data from our research confirm that the use of banana hybrids is greater in Tanzania than in Uganda, predominantly in the lowlands, where biotic pressures are most severe. Although adoption rates in Tanzania are substantially higher than in Uganda—about 50 percent of farmers in the Kagera region during the survey year—



#### About the Authors

*Jackson Nkuba is a doctoral student at the Department of Agricultural Economics and Agribusiness at Sokoine University in Morogoro, Tanzania, and a researcher at the Lake Zone Agricultural Research and Development Institute (LZARDI-Maruku) in Tanzania.*

*Svetlana Edmeades is a postdoctoral fellow in the Environment and Production Technology Division of the International Food Policy Research Institute (IFPRI).*

*Melinda Smale is a senior research fellow in the Environment and Production Technology Division of the International Food Policy Research Institute (IFPRI) and was also a senior economist with the International Plant Genetic Resources Institute (IPGRI) at the time this research was conducted.*

Tanzanian farmers who use the new varieties do not allocate much more of their banana grove to new types (16 percent) than do their Ugandan counterparts. The fact that 20 percent of farmers in Tanzania grow banana hybrids in areas not exposed to dissemination programs reflects the strength of farmer-based systems for exchanging new planting material. Such exchanges generally do not involve monetary transactions; rather, social relationships underpin exchanges.

Critical knowledge gaps remain, however. For example, although KCDP analyzed initial adoption rates and acceptability in the areas of project intervention, more systematic information is needed regarding the extent and determinants of adoption, as well as the social and economic impacts of growing hybrids on farm families. Despite the large financial resources devoted to development programs each year in Tanzania, there is limited awareness of the actual impact of such programs on the poor. This situation poses basic questions about whether targeted interventions have achieved the intended benefits. Although banana growers in Tanzania have participated in a number of extension and research programs, there is little documentation on the impact of these programs.

## Impact Assessment

One desirable impact of introducing hybrids is to reduce the vulnerability of households to production losses from banana pests and diseases, since this can have ramifications for consumption and income vulnerability. Reduced vulnerability could lead to higher or more consistent consumption levels, either directly through meeting subsistence needs, or indirectly, through more regular or increased sales and market purchases. Over time, introducing new hybrids could make banana production and income less variable, thereby improving the wealth status of the community, in particular among those households that use banana hybrids.

In our study of the Kagera region, we used an econometric model to identify the determinants of adoption of the FHIA hybrids and to test whether using the hybrids reduced farmer vulnerability and changed relative economic standing. The results obtained were then used to better understand the characteristics and production potential of adopters compared with non-adopters in areas exposed to the program interventions. In this single-

year cross-sectional study, we measured production vulnerability in terms of expected yield losses from pests and diseases, calculated from simple yield distributions and incidence levels elicited from farmers. Economic standing of a household was measured as “relative deprivation” (Stark and Taylor 1989), which was defined as the product of the proportion of households in the village that are richer than a given household, multiplied by their average wealth. Wealth was calculated as the value of all assets owned by the household, including equipment, implements, structures, livestock, and stored crops.

Perhaps the single most important finding was that growing new banana hybrids substantially and significantly reduced expected yield losses from pests and diseases, demonstrating the benefits of introducing banana hybrids to smallholder farmers in Tanzania. Furthermore, the analysis revealed that use of hybrids reduces relative deprivation, supporting the idea that with less vulnerability to banana production households may be able to diversify into other farm activities. Hybrid cultivars yield larger bunches and, hence, increase the efficiency of banana production per banana mat. Thus, if hybrids are used, fewer mats can be planted to meet the consumption needs of the household, leaving more land available for crop production or pasture.

The analysis also reveals that geographical location is strongly related to the use of hybrids, with 96 percent of households that grow banana hybrids residing in the lowlands. The use of hybrids is more pronounced in low elevation areas because pest and disease pressures are higher in those areas, and program intervention therefore has the highest impact. They are also the areas where formal dissemination of resistant planting material was undertaken to mitigate constraints and improve yields and food security of smallholder banana producers.

## Comparing Adopters and Non-Adopters in Areas Exposed to Program Interventions

A comparison of households with a high statistical likelihood of growing banana hybrids and those with a low likelihood of using them, in areas exposed to program interventions, provides insights into adoption patterns in the study villages (Table 1). The average expected yield is considerably higher for potential adopters than for those less likely to adopt the new hybrids, which is not surprising given the larger bunch size of banana

hybrids. The number of bunches consumed by adopters is also greater, but consumption constitutes a smaller fraction of the total banana output, so they sell proportionately more. The absolute number of bunches sold, and banana income, are similar for adopters and non-adopters, perhaps reflecting differences in the composition of banana varieties sold. Farmers with a high likelihood of using hybrids have higher farm incomes, perhaps reflecting other crops sold and a greater asset base in both livestock and farmland. Their average household income, as measured by their cash expenditure, is higher as well. They have larger family sizes, but fewer family members are dependents. They also received four times as many extension visits. The proportion of households headed by men is similar for adopters and non-adopters.

Overall, these comparisons reveal important differences between farmers who have high and low probabilities of adopting banana hybrids relative to the average relationship described in the regression model. These differences have implications for the dissemination and use of new hybrids in the exposed areas of the Kagera region.

Emphasizing contact with relatively deprived households (in terms of income and wealth) may increase hybrid adoption rates and could have positive income effects for poor households. The analysis also shows that adopters have more acquired human capital, in terms of both formal education and contacts with extension agents. More targeted extension visits may therefore be a useful tool for increasing adoption levels of hybrid bananas in the exposed areas.

Research findings have policy implications in favor of ongoing efforts to develop new resistant varieties bred or engineered to withstand pest and disease pressures. In addition, smoothing production has implications for food consumption and banana marketing. To sustain these benefits, however, institutional aspects of disseminating new varieties will need to be addressed.

## References

- Mgenzi, S. R. B., P. B. Steenhuijzen, and P. A. Rwezaula. 1997. Banana seasonally in Karagwe district. A problem of perception. Field Note No. 74.

**Table 1— Mean comparisons between likely non-adopters and adopters in exposed areas**

Variable	Non-adopters	Adopters
<b>Banana production and income</b>		
Average expected yield (kg)	15.45*	18.92*
Number of bunches consumed	95.75*	124.59*
Share of bunches consumed (percent)	79.06**	68.06**
Share of bunches sold (percent)	20.77**	32.39**
Number of bunches sold	71.52	67.73
Farm income (10,000 Tanzanian Shillings)	22.40*	43.08*
Banana income (10,000 Tanzanian Shillings)	5.86	5.91
<b>Other characteristics of households</b>		
Household expenditure (10,000 Tanzanian Shillings)	23.00*	37.74*
Livestock value (10,000 Tanzanian Shillings)	8.53***	53.05***
Mean household education level (years)	4.23***	7.70***
Farm size (acres)	1.38*	1.95*
Household size	5.25*	6.39*
Ratio of dependents to total number of household members	0.55***	0.32***
Number of extension service visits	0.95***	4.04***
Proportion of male-headed households	0.68	0.77

Note: \*\*\*, \*\*, and \* denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Agricultural Research and Development Institute, Lake Shore–Maruku District, Bukoba, Tanzania.

Nkuba, J. M., L. J. Ndege, and S. Mkulila. 2002. On-farm testing and acceptability of improved banana varieties in Bukoba district, Kagera region (1997–2001). Field Note No. 144. Agricultural Research and Development Institute, Lake Shore–Maruku District, Bukoba, Tanzania.

Nkuba, J. M., A. S. S. Mbwana, C. Schouten, and S. Mkulila. 1999. Testing improved banana varieties in Bukoba district, Kagera region. Field Note No. 96. Kagera Community Development Programme, and Agricultural Research and Development Institute, Lake Shore–Maruku District, Bukoba, Tanzania.

Stark, O. and E. Taylor. 1989. Relative deprivation and international migration. *Demography* 26 (1): 1–14.

Weedrt, J. 2003. *Adoption of superior banana varieties in the Kagera region: Accomplishment and constraints*. Bukoba, Tanzania: Kagera Community Development Programme and Economic Development Initiatives Limited.

### Further Reading

Kikulwe, E., K. Nowakunda, M. Byabachwezi, J. Nkuba, J. Namaganda, D. Talengera, E. Katungi,

and W. Tushemereirwe. 2006. Development and dissemination of banana technologies in Uganda and Tanzania. Chapter 4 in *An economic assessment of banana genetic improvement and innovations in the Lake Victoria region of Uganda and Tanzania*, M. Smale and W. Tushemereirwe, eds. IFPRI Research Report. Washington, D.C.: International Food Policy Research Institute (forthcoming).

Edmeades, S., M. Smale, Nkuba, J., E. Kikulwe, and E. Katungi. 2006. Characteristics of banana-growing households and banana cultivars in the Lake Victoria Region of Uganda and Tanzania. Chapter 5 in *An economic assessment of banana genetic improvement and innovations in the Lake Victoria region of Uganda and Tanzania*, M. Smale and W. Tushemereirwe, eds. IFPRI Research Report. Washington, D.C.: International Food Policy Research Institute (forthcoming).

Nkuba, J., S. Edmeades, and M. Smale. 2006. Adoption of banana hybrids and impacts on yield vulnerability in the Kagera region, Tanzania. Chapter 9 in *An economic assessment of banana genetic improvement and innovations in the Lake Victoria region of Uganda and Tanzania*, M. Smale and W. Tushemereirwe, eds. IFPRI Research Report. Washington, D.C.: International Food Policy Research Institute (forthcoming).

For further information, please contact Melinda Smale (m.smale@cgiar.org).

THIS WORK WAS MADE POSSIBLE IN PART BY SUPPORT FROM THE SWEDISH INTERNATIONAL DEVELOPMENT AGENCY (SIDA), SYSTEM-WIDE GENETIC RESOURCES PROGRAM OF THE CGIAR, EUROPEAN COMMISSION, AND THE U. S. AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID).

### INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

2033 K STREET, NW, WASHINGTON, DC 20006-1002 USA  
TEL +1.202.862.5600 FAX +1.202.467.4439 EMAIL ifpri@cgiar.org WEB www.ifpri.org

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