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EVALUATING THE LONG-TERM IMPACT OF ANTI-POVERTY INTERVENTIONS IN RURAL BANGLADESH

ACCESS, ADOPTION, AND DIFFUSION
The Long-Term Impacts of Improved Vegetable and Fish Technologies in Bangladesh

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This series of notes summarizes findings of a project entitled "What development interventions work?" undertaken by researchers of the Chronic Poverty Research Centre, the International Food Policy Research Institute, and Data Analysis and Technical Assistance Ltd. As part of a larger longitudinal study that resurveyed 1,907 households and 102 villages in 14 of Bangladesh's 64 districts, the project focused on assessing the long-term impacts of a number of anti-poverty interventions—specifically, microfinance, agricultural technology, and educational transfers—on a range of monetary and nonmonetary measures of well-being. This note focuses on the long-term impact of improved vegetable and fish technologies, and whether early adoption is an important factor in alleviating poverty and improving nutritional status. It is hoped that these results will help policymakers, donors, and other stakeholders in effectively evaluating different interventions, thereby contributing to the design of future anti-poverty programs in South Asia.

POLYCULTURE FISH AND VEGETABLE PRODUCTION AS A POVERTY-ALLEVIATION STRATEGY

Among the poverty-alleviation interventions undertaken by government and civil society organizations in Bangladesh are food-based strategies designed to increase incomes and to alleviate micronutrient deficiencies. Polyculture fish and vegetables technologies are considered to have the potential to improve both poverty and micronutrient status by increasing the supply of micronutrients to household producers and the general population, by improving the incomes of household producers, and by lowering or keeping constant fish and vegetable prices in the face of rising demand due to population and income growth.

The Interventions

These interventions were implemented in three areas in Bangladesh. Starting in 1994, credit and training in small-scale vegetable

BACKGROUND AND METHODOLOGY

Although Bangladesh experienced impressive reductions in poverty from the mid-1990s until the onset of the food price crisis in 2007—with the percentage of the population living in poverty falling from 51 percent in 1995 to 40 percent in 2005—50 million of the country's people still live in extreme poverty, and 36 million people cannot afford an adequate diet. Women and children are particularly vulnerable to micronutrient deficiencies because of their relatively higher requirements for reproduction and growth, respectively, and because a pro-male bias prevalent in Bangladesh and other parts of South Asia limits women's bargaining power, which in turn inhibits their ability to meet their own and their children's micronutrient requirements. Child malnutrition rates remain among the highest in the world, wasting rates have risen alarmingly in recent years, and rice-based diets such as those consumed by the poor in rural Bangladesh may not provide all the micronutrients necessary for a healthy life.

This study focused on determining (1) the long-term impacts of the adoption of new vegetable varieties and polyculture fishpond management technologies on per capita consumption and gender-disaggregated measures of monetary and nonmonetary well-being; (2) the impact of the new technologies on physical and human capital accumulation; and (3) the underlying processes—at household, community, and national levels—that contributed to the success or failure of the adoption of the technologies.

These research questions were investigated using the quantitative techniques of covariate matching and propensity-score matching, together with the qualitative techniques of focus group discussions and life histories. This aspect of the study built on a carefully created evaluation sample of households and villages, both of which included treatment and comparison groups. Impacts were then evaluated by comparing changes in the outcomes between the original and the latest survey rounds for the treatment and comparison groups. This latter technique is known as the "difference-in-difference" approach and is intended to eliminate any unobserved pre-existing differences between the two groups.

varieties were provided to women who grow vegetables on small plots of land on or near their household compounds in Saturia. These varieties were initially developed at the World Vegetable Center in Taiwan (formerly the Asian Vegetable Research and Development Center). They were subsequently adapted to local conditions by the Bangladesh Agricultural Research Institute and were disseminated by the local nongovernmental organization (NGO) Gono Kallayan Trust. In Mymensingh and Jessore, technical advice in polyculture fish production was provided. These technologies had been developed by the World Fish Center (then known as the International Center for Living Aquatic Resource Management) and were disseminated in two ways. In Mymensingh, they were distributed to individual households that owned fishponds via a fisheries project that began in 1990 and was funded by the Danish International Development Agency (Danida). In Jessore, they were introduced via a medium-sized local NGO, Banchte Shekha, which arranged long-term pond leases managed by groups of 5 to 20 women who received credit and training starting in 1993 (Table 1).

Sample Details

A short-term impact evaluation of the three technologies was conducted in 1996/97. In each of these three sites, selection of households for the survey was preceded by a census in two types of villages: those where the disseminating institution had introduced the technology (treatment villages) and those where the technology had not yet been introduced but was planned to be introduced in the future (comparison villages). Both types of villages were affiliated with the same disseminating institution, received the same type of supporting service from that institution, and undertook the same agricultural activities, but households in the comparison villages were not given access to the improved technologies being studied.

Data were collected across four survey rounds covering a complete agricultural cycle in 1996/97 for three types of households: (1) adopting households in villages with the technology; (2) likely adopting households in the villages where the technology had not yet been introduced (that is, NGO members who had expressed interest in adopting the technology); and (3) a cross-section of all other non-adopting households, representing the general population in the villages under study (that is, non–NGO members and NGO members not likely to adopt). Detailed information was collected on production and other income-earning activities, by individual family member; expenditures on various food, health, and other items; food and nutrient intakes, by individual family member; time allocation patterns; and health and nutritional status, by individual family member.

The 2006/07 longitudinal study resurveyed households originally interviewed in 1996/07, mirroring the same agricultural season (November to March). At the agricultural technology sites, this involved 957 core households that took part in the original survey and 280 new households (or "splits") formed in the same district by children of the original households. The questionnaire was very similar to the original household questionnaire, enabling the researchers to estimate long-term impacts. At this stage, a community-level questionnaire was also administered to key informants to obtain basic information on each village and changes since the previous survey round.

Table 1. Extent of adoption of fish and vegetable technologies at study sites

	Site/technology introduced		
	Saturia: Vegetables	Jessore: Leased/group fish ponds	Mymensingh: Privately owned fish ponds
Adopters as a share of households in treatment villages (%)	40	16	50
Year that the technology was introduced	1994	1993	1990
Year of the initial survey	1996	1996	1996
Time elapsed between technology's introduction and the beginning of household survey (years)	2	3	6

Source: Hallman, K., D. Lewis, and S. Begum, "Assessing the impact of vegetable and fishpond technologies on poverty in rural Bangladesh," in *Agricultural Research, Livelihoods, and Poverty: Studies of Economic and Social Impacts in Six Countries*, M. Adato and R. Meinzen-Dick, eds. (Baltimore: Johns Hopkins University Press, 2007).

RESULTS

Adoption of New Technologies by Treatment and Comparison Households

In Saturia, there were relatively few differences between treatment and comparison households in 1996/97 in terms of total cropped area under either vegetables or improved vegetables. Comparison households, however, had significantly larger areas and larger proportions of cropped area devoted to high-yielding and local varieties of vegetables. Neither total cropped area under improved vegetables nor the proportion of total area under improved vegetables differed significantly between treatment and comparison households. A decade later, both treatment and comparison households allocated similar amounts of land to vegetable production, but early adopters had larger areas—and proportions of cropped areas—devoted to improved vegetables. About 10 percent of total cropped area was devoted to improved vegetables among early adopters, whereas the comparison group allocated only 4 percent of total cropped area to these varieties. Nevertheless, the proportion of cropped area devoted to improved vegetables had declined over the previous 10 years.

In Jessore, comparison households initially cultivated a significantly larger number of improved fish species, although total pond area under cultivation was larger for treatment households. The difference between pond area devoted to fish and fish varieties was not significant between early adopters and comparison households. By 2006/07, the difference between early adopters and comparison households had narrowed; early adopters and comparison households did not significantly differ in terms of the number of improved fish species cultivated, pond area under improved fish species, or pond area under fish cultivation. It is only in Mymensingh that early adopters seem to have preserved their lead in terms of the number of improved fish varieties cultivated, although early adopters and comparison households did not differ significantly in terms of pond areas under cultivation and under improved species. All in all, this indicates that the improved technologies have diffused well beyond the original treatment villages in the Saturia and Jessore sites.

Impact Estimates

Table 2 presents a summary of the immediate and sustained impacts of the early adoption of three agricultural interventions on household consumption, assets, and incomes; nutrient availability and intake; and individual nutritional status.

Across all three sites, the biggest monetary returns to early adoption at the household level are in the individually operated fishpond sites, where clear, long-term gains were found in terms of household consumption expenditures. These sustained impacts were achieved despite negative short-term impacts, reflected in lower monthly food and nonfood expenditures and per capita incomes among early adopters of the individually operated fishpond technology in the 1996–97 round. The pattern of sustained impacts differs sharply from that at the improved vegetables sites, which posted significant gains in equivalent food and nonfood expenditures per adult compared with comparison households early on, but negative estimates of sustained impact in terms of food and nonfood expenditure, total assets, land owned, and per capita household income. In the improved vegetables sites, early adopters benefitted from lower unit costs and reaped short-term gains referred to as quasi-rents.

Because improved vegetable technologies are easy to disseminate, it is no surprise that any initial advantage (or quasi-rents) accruing to the early adopters disappeared once the vegetables were more widely disseminated. In contrast, both the short- and long-term impacts of early adoption in the group-operated fishpond sites were largely insignificant. Thus, even if the technologies disseminated in Jessore and Mymensingh were very similar, early adopters in Mymensingh were better able to capture the long-term sustained gains. This possibly occurred because over time Banchte Shekha disseminated the group-operated fishpond technologies outside the original treatment area. Moreover, because several families would be sharing the quasi-rents from a single fishpond, benefits to individual families would be diluted. The quasi-rents did not disappear in Mymensingh because the technology was more difficult to adopt and required owning a pond. Changes in nutrient adequacy follow from changes in per capita or adult-equivalent incomes or expenditures through changes in food expenditures, food consumption, and individual food intake. Thus, given the large gains in per capita expenditures, it is not surprising that early adopting households in the individually operated fishpond sites posted the most significant sustained reductions in the proportions of household members consuming less than the recommended daily allowance (RDA) of calories, protein, and vitamin A, even if short-term impacts on nutrient deficiencies were negative. In the group-operated fishponds sites, although impacts on expenditure outcomes were insignificant, the sustained impact estimates indicate that early adopters did less well in terms of the proportion of household members who were able to meet their calorie and protein needs. Interestingly, despite negative differential impacts on monetary measures of consumption expenditures, income, and assets, early adopters of the vegetable technology did not differ significantly from late adopters in terms of nutrient deficiencies.

How food intake is translated into nutritional status at the individual level depends on factors that include care-giving and

Table 2. Summary of immediate and sustained impacts of early adoption

Outcome	Type of impact	Saturia: Improved vegetables	Jessore: Leased/group fishponds	Mymensingh: Privately owned fishponds
Household consumption[a]	Immediate	Increase in food expenditures	No significant impact	Decrease in food expenditures
	Sustained	Decrease in food expenditures	No significant impact	Increase in adult equivalent food and total expenditures
Household land and assets	Immediate	No significant impact	No significant impact	No significant impact
	Sustained	Decrease in the total value of land and asset holdings	No significant impact	No significant impact
Household incomes	Immediate	No significant impact	Increase in per capita household income	Decrease in per capita household income
	Sustained	Decrease in per capita household income	No significant impact	No significant impact
Household calorie availability	Immediate	No significant impact	No significant impact	Decrease in per adult equivalent calorie availability
	Sustained	No significant impact	No significant impact	No significant impact
Percentage below recommended daily nutrient requirements	Immediate	No significant impact	No significant impact	Increase in proportion of household members with less than the RDA of protein intakes
	Sustained	No significant impact	Increase in the proportion of household members consuming less than the RDA of calories and protein	Decrease in the proportion of household members with less than the RDA of calories, protein, and vitamin A
Nutritional status of children	Immediate	No significant impact	Increase in stunted and thin boys	No significant impact
	Sustained	Decrease in proportion of stunted girls and thin boys	Decrease in proportion of stunted and thin boys; increase in proportion of stunted girls	Decrease in proportion of thin girls; weak increase in proportion of stunted girls
Nutritional status of adults	Immediate	Decrease in women's BMI	Decrease in men's BMI; increase in proportion of women with low hemoglobin	Decrease in women's BMI
	Sustained	Increase in women's BMI, decrease in men's BMI	No significant impact	Decrease in fraction of women with low hemoglobin

Note: "Immediate" impact is based on single difference estimates in 1996–97; "sustained" impact is based on double-difference impact comparing differences between treatment and comparison groups in 1996–97 and 2006–07. RDA indicates recommended daily allowance; BMI indicates body mass index.
a. Consumption per capita or per adult equivalent.

care-seeking behavior, illness, and work effort. Despite the minimal monetary gains in the improved vegetables sites, early adopters achieved sustained improvements in nutritional status, particularly for women and children. The proportion of stunted girls (HAZ < –2) decreased differentially by 28 percentage points, while the proportion of thin boys decreased differentially by 43 percentage points. Women's body mass indexes (BMIs) also increased differentially among early adopters. However, men's BMIs were lower among early adopting households. Differential impacts on nutritional status in the group-operated fishpond site indicate some reversals of the short-term impacts. Whereas stunting and thinness rates for boys appear to have been higher among early adopters, these rates declined for boys in early adopting households over the long term. However, stunting rates for girls were higher among early adopting families, and there were no significant sustained impacts on adult anthropometric measures.

Given the significant monetary gains and improved nutrient adequacy among early adopters of the individually operated fishpond technology, one would have expected large improvements in nutritional status to occur. It is indeed the case that improvements in hemoglobin levels for women in 2006–07 were reflected in a sustained impact showing a reduction in the proportion of women with low hemoglobin levels. However, while the proportion of thin girls declined, the proportion of stunted girls increased—indicating that sustained impacts on long-term indicators of nutritional status did not occur, despite sizable monetary gains.

CONCLUDING REMARKS

Tracing the impact of agricultural technologies on household incomes and individual well-being is a complicated process. Differences in dissemination and targeting mechanisms may influence the types of households that adopt and benefit from the technologies, with richer households tending to adopt more quickly when individual targeting is used, and group approaches being better able to reach the poor. Some types of technologies may be more divisible and easily disseminated outside the treatment group, which is easier for improved vegetables and more difficult for fishponds because they require larger initial investments. Intrahousehold allocation processes and gender relations may also determine how gains from new technologies are allocated among household members—and, particularly, whether women and children benefit. For the improved vegetable sites, the emphasis on targeting women enabled a technology with minimal income gains to achieve substantial impacts on nutritional status. Implementation modalities also matter: in societies where the low status of women is linked with malnutrition, empowering women and targeting women's groups may be important in achieving long-term nutritional improvements and ensuring the health and productivity of future generations.

FURTHER READING: Bouis, H., B. de la Brière, L. Guitierrez, K. Hallman, N. Hassan, O. Hels, W. Quabili, A. Quisumbing, S. Thilsted, Z. Hassan Zihad, and S. Zohir, "Commercial vegetable and polyculture fish production in Bangladesh: Their impacts on income, household resource allocation, and nutrition," (IFPRI, Washington, DC, and Bangladesh Institute of Development Studies, Institute of Nutrition and Food Science, Dhaka, 1998); Hallman, K., D. Lewis, and S. Begum, "Assessing the impact of vegetable and fishpond technologies on poverty in rural Bangladesh," in *Agricultural Research, Livelihoods, and Poverty: Studies of Economic and Social Impacts in Six Countries*, M. Adato and R. Meinzen-Dick, eds. (Baltimore: Johns Hopkins University Press, 2007).

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