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Commercial vegetable and polyculture fish production in Bangladesh: Their impacts on household income and dietary quality

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Abstract

Given the low access that women in rural Bangladesh have to productive assets, their crucial role as caretakers, and their high vulnerability to micronutrient deficiencies, numerous non-governmental organizations target women for food-based income-generating activities. Three such programmes were examined, which promote adoption of polyculture fish production (two sites) and commercial vegetable production (one site). The programmes evaluated had income generation—and not better nutrition—as their primary objective. The fish and vegetable technologies were found to be more profitable than rice production, although rice production provided a higher share of total income. On the basis of the evidence collected, there is little reason to believe that adoption of the two technologies has improved the micronutrient status of members of adopting households through better dietary quality. There was no finding of disproportionately high own-consumption of fish and vegetables by adopting households. The impacts on overall household income, although positive, were not strong. The effects of adoption on women's status and time allocation do not change this conclusion.

It is consumers in general who benefit from research, extension, and credit programmes to increase the market supply of vegetables and fish. All other things being equal, increased market supply will lower prices for these foods. Although inflation-adjusted cereal prices in Bangladesh have fallen by 40% over the last 25 years (a remarkable achievement), real prices of lentils, vegetables, and animal products have increased by 25% to 50%. Real fish prices have perhaps doubled. Dietary quality for the poor may be declining over time due to these price effects.

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Introduction

Poor dietary quality, that is, low intake of vegetables, fruits, pulses, and animal and fish products, is a primary cause of micronutrient malnutrition. Non-staple foods, particularly animal and fish products, are rich sources of bioavailable minerals and vitamins. Although many non-staple foods are high-status foods, the poor cannot afford these high-energy-cost foods in sufficient amounts in their diets. Their food expenditures are dominated by low-energy-cost, but mineral- and vitamin-poor, staple foods.

In the Bangladesh environment of water-rich flood plains, polyculture production of fish and vegetables, two foods rich in micronutrients, can be very profitable if managed properly, leading to higher incomes for farming households. Increases in income, in turn, may translate into higher expenditures for non-staple foods. In addition, households that take their consumption needs into account in their production and cropping patterns might consume a disproportionate share of their own production.

Numerous non-governmental organizations (NGOs) in Bangladesh are promoting adoption of vegetable and fish pond activities through credit and training programmes targeted at women. The present study examines three such programmes:

- commercial vegetable production (Saturia thana, Manikganj District, referred to below as "Saturia");
- polyculture fish production in household-owned ponds (Gaffargaon thana, Mymensingh District, and Pakundia and Kishoreganj Sadar thanas, Kishoreganj District, referred to below as "Mymensingh");
- polyculture fish production in group-managed ponds (Jessore Sadar thana, Jessore District, referred to below as "Jessore").

The primary objective of the study, stated in general terms, was to undertake a comparison of the differences in the patterns of linkages between agricultural production and nutrition outcomes in adopting and non-adopting households in the three study sites. To achieve this objective, and thus to derive useful

Food and Nutrition Bulletin, vol. 21, no. 4 © 2000, The United Nations University.

conclusions for programme and policy implementation, required detailed information on (a) technology profitability and its effect on household income, (b) women's status and decision-making, (c) expenditures for health care and other non-food items, (d) food-consumption patterns and intrahousehold distribution of food, and (e) health and nutrition outcomes. In order to evaluate these programmes, the methodology involved selecting and surveying the following three groups of households in each site: 110 households that were members of NGOs and had adopted the technology (A households); 110 households that were NGO members residing in villages where the NGO had not yet introduced the new technology and that were deemed likely to adopt if and when the new technology was introduced (B households); and a random selection of 110 households from the remaining pool of households in A and B villages (C households). Four survey rounds were undertaken at four-month intervals during 1996–1997 to examine differential effects of technology adoption across seasons. This paper summarizes findings for (a) and (d) above; see Bouis et al. [1] for more information on (a) through (e).

It is important to note at the outset that the specific programmes being evaluated here had income generation—and not better nutrition—as their primary objective. Thus, these programmes may be distinguished from home vegetable garden interventions, in which nutrition education of adopting households is emphasized and specific vegetables that are high in provitamin A content are promoted. Some nutrition education was provided by the NGOs to the survey households studied here. However, nutrition was not emphasized.

How well are the poor targeted?

Across sites, households with more education, better access to land, primarily employed in farming, and with older spouses were more likely to adopt the new technology. In Jessore, 57% of adopting A households fall in the functionally landless category (less than 0.5 acres), as compared with 12% of A households in Mymensingh. Forty-one percent of A households in Mymensingh fall in the medium and large landowning categories (greater than or equal to 2.5 acres), as compared with 13% of A households in Jessore. The ownership distribution for A households in Saturia falls between these two extremes.

The group-managed polyculture fish pond programme in Jessore appears to be the best targeted of the three cases studied, in terms of reaching those households with the least access to land and the lowest value of consumer durables. However, even in this case, the ownership distribution of adopting households is similar to that found among rural households in Bangladesh on average, i.e., adoption does not appear to be skewed towards the poorest of the poor.

Profitability of vegetable and fish pond production as compared with rice

Rice accounts for about 50% of the total area harvested in Saturia, about 85% in Mymensingh, and about 75% in Jessore, so that rice is clearly the predominant crop. Vegetable production accounts for 9% of the area harvested in Saturia. Vegetable production accounts for only 1% to 2% of the total area harvested in Mymensingh and 3% to 4% in Jessore. The number of acres devoted to fish pond production in Mymensingh is about 25% less (however, there is no fallow period) than the number of acres devoted to vegetables in Saturia in absolute terms, but constitutes only 5% of the total area harvested because of larger farm sizes among sample households in Mymensingh. Fish pond areas among sample households are much smaller in Saturia and Jessore.

Feasibility of group-managed fish ponds

In Jessore, in four of nine group ponds surveyed, production was never planned and undertaken by the NGO-sponsored groups themselves. In two of these four cases of non-operation, excavation of ponds was not undertaken at all or was inadequate.* In the two other cases, the NGO groups leased out their ponds as a consequence of intragroup disagreements as to how to operate the pond and share in the output. Of the five ponds that were managed by groups themselves, only three were operated as intended with decision-making, work, and pond output shared among all group members.

In theory, programmes that make productive assets available to groups of women from asset-poor households can be an effective way to raise the incomes of the poor. However, as the above case study demonstrates, such programmes can be fraught with institutional constraints related both to ensuring actual control over the productive assets by the participants and to intragroup disagreements once access is secured. Such problems cannot be eliminated but can be minimized by the active participation in group activities of highly motivated extension officers who are employees of the NGO administering such programmes.

* Pond owners agreed to long-term leases to the NGO in return for excavation of their ponds. Pond management was then given over to groups of women organized by the NGO.

Profitability of individually owned fish ponds and vegetable production

In Mymensingh, cash profits for A households from operation of family-owned fish ponds on a per acre per month basis were about twice as high as profits from rice production.* For B households, rice and fish pond production were about equally profitable. In Saturia, vegetable production for A and B households was two to three times as profitable on a cash basis as rice production, although this calculation does not take account of fallow time for either crop.**

Even though vegetable production is apparently considerably more profitable than rice production, as indicated above, households devote much more land to rice production than to vegetable production. There are a number of possible explanations. Rice can be grown virtually all year round (subject to availability of water), whereas vegetables do not grow well during periods of heavy rain and hot temperature. Vegetables cannot be grown on land that is subject to flooding (which may be ideal for rice production), or the risk of doing so is too high. Rice can be stored, whereas vegetables must be marketed immediately; thus, vegetable prices are more variable and vegetable production is more risky. Identifying the constraints to expanded vegetable production is an important question that merits further inquiry.

* This assumes that rice land is left fallow about one-third of the year. The ponds studied in Mymensingh are perennial.

** Similar findings for a much earlier period may be found elsewhere [2].

Effects of adoption on household income

Incomes are highly diversified, for example, as shown in table 1 for Mymensingh. Although apparently highly profitable as compared with rice, the two technologies

TABLE 1. Income (taka[a] per capita per month), by source as compared with total per capita expenditures, by household category for Mymensingh

Source of income	Household type			
	A[b]	B[c]	C1[d]	C2[d]
Profits on cash basis				
Rice production	192	198	133	57
Fish pond production	62	36	8	6
Vegetable production	4	3	3	0
Other crop production	35	28	15	6
Livestock	50	42	44	26
Rental of animals and equipment	21	41	24	2
Computed from 24-h recall information				
Value of collected food	18	27	19	27
Value of own-farm fruit	23	17	10	7
Net food transfers in	–10	–24	–1	10
Total own-farm income	395	368	255	141
Agricultural and non-agricultural wages	15	5	42	75
Trade and self-employment	102	184	145	198
Salaried employment	83	54	49	71
Remittances	29	55	41	5
Total off-farm income	229	298	277	349
Estimated total per capita incomee	624	666	532	490
Per capita total expenditures	650	691	659	474
Estimated income as percent of total expenditures	96%	96%	81%	103%

a. 40 taka = US$1.00.
b. 110 households that were members of NGOs and had adopted the new technology (fish or vegetable production).
c. 110 households that were NGO members residing in villages where the NGO had not yet introduced the new technology and that were deemed likely to adopt if and when the new technology was introduced.
d. A random selection of 110 households from the remaining pool of households in A and B villages. 55 C1 households were selected from A villages where the new technologies had been introduced and where the 110 households under b. resided. 55 C2 households were selected from B villages where the new technologies had not been introduced and where the 110 households under c. resided.
e. Not included are food collected and sold (e.g., fish caught in public water bodies) and own-farm production (other than fruit or livestock production) on land not included as plot production. The profitability per acre of non-rice, non-vegetable land is assumed to be the same as for rice.

under study here contribute rather modestly to overall household incomes. In Mymensingh, fish pond production accounts for 9.9% and 5.4% of total household income in A and B households, respectively. The difference between the two figures, 4.5% of income, represents a rough estimate of the marginal effect of applying the polyculture management technology to existing fish ponds. Vegetable production in A and B households in Saturia contributes only 2.5% and 2.1%, respectively, of total household income, so that the marginal effect of adoption of improved seeds as compared with local seeds would constitute less than 1% of total household income.

Income effects of adoption, then, are rather modest for A households as compared with B households across all three sites. However, because of the high profitability of the polyculture fish and commercial vegetable production, the potential exists for much higher impacts on household income, if land devoted to production and other inputs were to be increased. A priority for research would be to understand what are the constraints to more intensive adoption by households.*

Food-consumption patterns

Given the small impact of adoption on overall household income, it is a foregone conclusion that dietary patterns and nutritional status will not be much affected through the adoption–income linkage. However, it may be that adopting households consume disproportionate amounts of fish and vegetables that are rich in micronutrients and so improve their nutritional status through the adoption–home consumption linkage. It may also be that, in general, increasing the market supply of fish and vegetables will hold down prices of these commodities and so increase the intakes of these micronutrient-rich foods. Thus, it is important to understand the underlying factors that drive patterns of food consumption, in particular household income and food prices.

Income and food-consumption relationships

Rice and wheat are the least expensive sources of calories. Rice is preferred to wheat. These two facts, in conjunction with low purchasing power, explain the high levels of rice consumption relative to intakes of other foods. Rice consumption does not vary significantly by income group, suggesting that consumers at all income levels give high priority to satiating hunger through rice consumption first, then purchase non-staple plant foods and animal and fish products for variety in their diets, to the extent that food budgets permit.** Likewise, consumption of vegetables varies little with income. In fact, consumption of green, leafy vegetables declines marginally with income.

In contrast, animal and fish consumption roughly doubles between low- and high-income terciles for the surveyed households. Non-staple plant food consumption rises by a slower rate with income; there is roughly a 50% increase in intake of non-staple plant foods between low- and high-income terciles, so that the lack of effect of income on vegetable consumption is atypical of non-staple foods in general. Although animal and fish consumption accounts on average for only 3% of total energy intake, because of their high cost it is striking that animal and fish consumption accounts for 20% to 25% of food budgets on average. Moreover, animal and fish consumption accounts for a high proportion of the marginal increase in food expenditures as income rises. This implies that there is much latent demand for animal and fish consumption as income rises, as well as for selected non-staple plant foods, such as fruits and sugar.

Consumer demand for both vegetable and fish products is sensitive to changes in their price, whereas consumption of rice is relatively insensitive to price changes.

Vitamin A and iron intakes

Most vitamin A intake (in the form of provitamin A carotenoids) comes from vegetables. There is a great deal of seasonality in vitamin A intake because of seasonality in vegetable prices and consumption. Animal and fish contribute small proportions of total iron intake (4% to 8%), although it is known that trace minerals from such food sources have higher bioavailability and contribute to higher bioavailability of iron from plant sources. Non-staple plant foods contribute about one-half of total iron intake across the three sites, and cereals about 45%.

Intra-household food distribution

Pre-schoolers appear to be favoured in the intra-household distribution of food, particularly pre-school boys, who receive a disproportionate share of animal and fish products, which are the most expensive sources of energy and account for a high percentage of foods purchased at the margin as income increases. It is adult women who tend to receive disproportionately lower shares of preferred foods. Although the energy intakes of adult women are, of course, substantially greater than those of pre-school children (a multiple of about

* Preliminary results from a follow-up study in Saturia indicate that vegetable production has expanded considerably in the two years after these initial surveys were undertaken.

** A stronger relationship between rice consumption and income has been found in other studies in Bangladesh [3].

two), consumption of animal and fish products (in absolute amounts) is about equal in adult women and pre-school boys.

Effects of adoption of polyculture fish pond technology on own-consumption

The adoption of the polyculture fish pond technology leads to greater consumption of large fish, but not of total fish consumption; there is apparently a one-for-one substitution of small fish in non-adopting, fish pond-owning households. Although the magnitude of this substitution is small, nevertheless it should be noted that small fish in general are more nutritious gram-for-gram than large fish, so that the impact on dietary quality may be negative [4].

From one-half to two-thirds of the value of small fish consumed comes directly from market purchases. Much of this market supply, in turn, presumably originates from public water bodies, in that small-fish cultivation in privately owned ponds is not the subject of fisheries research nor encouraged by extension agents and programmes. If scientifically feasible, there would seem to be a large opportunity for profitable production of small fish in privately owned fish ponds if these small fish could be harvested from February through August, when small-fish prices are seasonally high.

Similar to the results for polyculture fish production, vegetable-producing households do not consume disproportionately high amounts of vegetables in total. A plausible explanation is that there is no latent, unsatisfied demand to be met. To encourage greater vegetable consumption through lower prices, production and marketing efforts need to concentrate primarily on extending growing seasons in order to dampen seasonal price fluctuations and, perhaps secondarily, on improving marketing channels so that vegetables may move cheaply and freely about the country in order to take advantage of differential regional growing seasons.

Effects of technology adoption on nutritional outcomes and implications for agricultural policy

Based on the evidence presented, there is little reason to believe that adoption of the two technologies under study has improved the micronutrient status of members of adopting households through better dietary quality. There was no finding of disproportionately high own-consumption of fish and vegetables by adopting households. The impacts on overall household income, although positive, are not strong (table 1).

Nutritionists know that inadequate consumption of animal and fish products in general, and of particular categories of fruits and vegetables, is a primary, underlying cause of micronutrient malnutrition. Thus, it is consumers in general (both non-adopting and adopting households) who benefit nutritionally from research, extension, and credit programmes to increase the market supply of vegetables and fish. Increased market supply will lower prices for these foods that increase consumption.

Although inflation-adjusted cereal prices in Bangladesh have fallen by 40% over the last 25 years (a remarkable achievement), real prices of lentils, vegetables, and animal products have increased by 25% to 50%. The price of fish has risen even more rapidly. Demand estimates demonstrate that consumers are price-responsive: consumption of these non-staple foods will increase if prices decline. Conversely, if policies are not undertaken to increase supply, prices of non-staple foods will almost certainly increase in the face of population growth, and nutritional status will be further compromised.

From a short-run perspective, the story that emerges is a discouraging one, in the sense that food-based production strategies based on commercial incentives cannot immediately result in a substantial reduction in the number of malnourished people. In the short run, such production strategies can only start to improve the nutritional situation at the margin—the initial step in a longer journey. It is very much a medium- to long-run objective for the agricultural sector in Bangladesh to produce sufficient quantities of non-staple foods for consumers to meet recommended daily allowances of minerals and vitamins. The task of developing and introducing these technologies is more complex than for rice, however, in the sense that potentially a large number of food commodities are involved. Nevertheless, the challenge of increasing the growth rate of non-staple food production must be met. Whether food prices are rising or falling sets the overall context for the extent to which complementary nutrition interventions (e.g., supplementation, fortification, and nutrition education) can be effective at the margin in lowering the prevalence of malnutrition.

Can food-based interventions work *in the short run* to improve micronutrient status? The cost of animal and fish products is simply too high with respect to consumer purchasing power. However, vegetable sources of provitamin A are well within the purchasing power of poor consumers. Thus, diet-based interventions may be possible for improving vitamin A status, in that the problem would appear to be one of consumer motivation, that is, informing and convincing consumers of the benefits of provitamin A consumption and providing the knowledge of which vegetables are rich sources. Education is key, because there does not appear to be a strong, latent demand for vegetables, as there is for animal and fish products, as income increases. Relatively weak demand is a serious constraint as well with respect to the role of vegetables as a sustainable source of production growth.

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