Feasibility of Adopting Aquaculture to Increase Resource Productivity in Existing Bangladesh Farming Systems

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Background

In Bangladesh, farmers are becoming hard-pressed by shortages of land and capital, whereas labor and farm-generated by-products are more widely available. It is common for small farms to produce a wide range of produce and to use outputs and by-products of some enterprises as inputs to others. This is largely based on the farmer's existing knowledge. A recent survey of small waterbodies in sample village units in Kapasia and Sreepur thanas (subdistricts) in the district of Gazipur, 68 km north of Dhaka, showed that well-managed stocking, feeding, fertilizing and harvesting of Indian major carps (*Labeo rohita, Catla catla, Cirrhinus mrigala)* in polyculture were practised in only 1% of these waterbodies. Most harvests from farmed and nonfarmed waterbodies, consist of both stocked and wild fish and the average fish yield was only about 550 kg/ha/year (Ahmed 1992). New aquaculture systems that combine culture of Indian major carps with common *(Cyprinus carpio)* and Chinese carps; and the short-cycle culture of species such as tilapia *(Oreochromis niloticus)* and silver barb *(Puntius gonionotus)* could increase productivity by as much as three times (Gupta et al. 1992).

Survey

A project is currently under way to extend such technologies to farmers in one of the two thanas to adopt and to assess the impact of the improved fish culture practices within the farm economy. A survey of resource availability and use in different farm enterprises was conducted in six unions of the two thanas. Sample households were selected from among the owners and operators of existing small waterbodies (ponds/ditches). Households were stratified by size of waterbodies - small (< 0.06 ha), medium (0.06-0.12 ha) and large (> 0.12 ha) - and a total of 333 pond-operating households were randomly selected, taking proportionate samples from each stratum. Data on the availability of resources, their use patterns and farm production were obtained over 12 months (1990-91), using a predesigned questionnaire. Statistical analysis was done in terms of simple frequencies, means and percentages.

Fig. 1 shows the availability of land and its allocation among different farm enterprises of pond operating households. On average, the households own 2.33 ha of land, of which pond and ditches occupy only 0.09 ha (3.8%). Crops occupy most of the farm lands. Fig. 2 presents the labor utilization patterns over different enterprises: very little time (2%) was used in aquaculture. Up to 68% was devoted to crops. Labor use per hectare was significantly higher (61%) for the users of material inputs as compared to non-users (Table 1). This indicates that, with increased use of material inputs in aquaculture, more employment will be created. Moreover, systems productivity also increased through increased use of material inputs, i.e., there were higher output-labor ratios for users (8.33) than non-users (6.13) of material inputs.

Farms generate by-products (rice bran, cowdung, compost, poultry droppings and kitchen wastes) and waste resources which are in turn used as inputs into

Table 1. Output-labor ratio of users and non-users of material inputs (feed, fertilizer, etc.) for existing aquaculture practices in Kapasia and Sreepur thanas, Gazipur, Bangladesh, 1991.

Type of farm	Labor use (person-days/ha)	Fish output (kg/ha)	Output-labor ratio (kg/person-day)
User of materials inputs [n=172]	88.21 (148.99)	734.51 (577.04)	8.33
Non-user of material inputs [n=161]	54.64 (143.66)	334.68 (565.39)	6.13
All [n=333]	71.98 (147.18)	541.20 (604.65)	7.52

Figures in parentheses are standard errors.

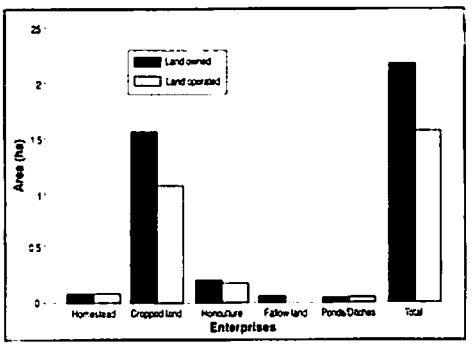

Fig. 1. ***Land owned and operated by farm households in Kapasia and Sreepur thanas, Gazipur, Bangladesh, 1991.***

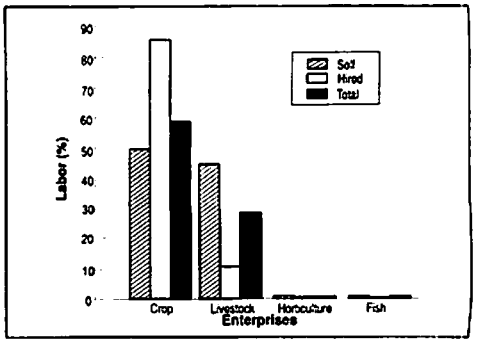

Fig. 2. ***Distribution of farm labor to different farm enterprises in Kapasia and Sreepur thanas, Gazipur, Bangladesh, 1991.***

Cowdung being used by a farmer in the project area in Gazipur District, Bangladesh, to make compost for fertilization of his fishpond. (Photo by M. Ahmed)

subsystems of the farm. On average, farm households generate 1 t of rice bran, 6 t of cowdung and 880 kg of kitchen wastes. Fig. 3 shows current uses of these resources over different enterprises. Almost 58% of total rice bran production and 89% of kitchen wastes were used as animal feed. More than 80% of the total available cowdung was used in crop fields. Aquaculture, in general, made very little use of all the

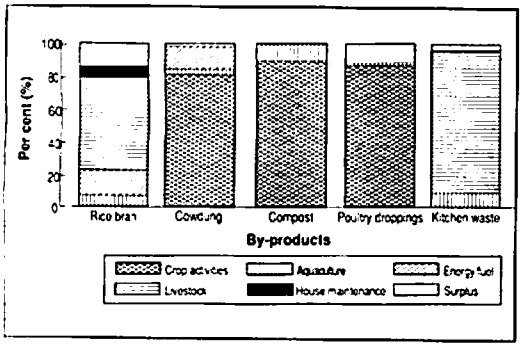

Fig. 3. *Use pattern of farm-generated by-products and wastes (%) in Kapasia and Sreepur thanas, Gazipur, Bangladesh, 1991.*

above resources, but they are important *potential* inputs for small-scale fishponds.

Discussion

Land scarcity poses a serious limitation to physical expansion of farm enterprises in Bangladesh. Intensification of land use by increasing soil fertility, transferring lands from lower productive enterprises to higher productive enterprises and utilization of unused/fallow lands are some of the remaining options to increase farm production. Returns from waterbodies (ponds/ditches) could be high if well-managed aquaculture were adopted. Land allocation for aquaculture might even expand in the future by including fallow and unused lands, adopting improved aquaculture technologies (Ahmed 1992).

Aquaculture needs little household labor compared to crops and livestock but demand for labor would increase with the introduction of improved aquaculture technologies. Again, the higher output-labor ratio in farms using material inputs as shown in Table 1 implies that the introduction of improved aquaculture would enable labor to obtain a higher marginal productivity. However, the additional labor needed for improved aquaculture would still be small as compared to the size of labor demand in the entire farm. Farm households would probably be able to allocate surplus/unused labor without hampering other enterprises. Most household labor is currently used on crops and this is seasonal, peaking during planting and harvesting. Aquaculture has essentially no peak and lean seasons. Fish can be stocked and harvested any time. Hence, farmers can adjust fish stocking and harvesting to suit their resources.

Crops also absorb most of the on-farm by-products and waste materials and are the main source of rice bran, household wastes and some of the ingredients of compost preparation. However, rice bran and cowdung which could potentially be used for aquaculture were used either to generate bio-energy and maintain houses (rice bran mixed with mud) or was sold. The cost effectiveness of these options should be a subject of future investigation. Yet there remains the possibility of redirecting these resources into aquaculture, if alternative sources of fuel and house materials can be found as substitute for existing uses.

Production of rice bran is directly linked with the crop yield and rice processing technology. It can be augmented through the use of modern husking techniques (milling), which is already popular in rural areas. Farm households usually sell surplus unmilled rice. If the opportunity cost of rice bran increases, households will be induced to sell processed rice in the markets and thereby increase the on-farm supply/production of rice bran.

Production of compost could be greatly increased through the dissemination of knowledge relevant to its preparation. Important ingredients of compost preparation such as straw, cattle dung and waste materials are available within the farm.

Farm households currently make little use of composts and poultry (chickens and ducks) droppings in aquaculture. Under the current free range rearing of poultry, there are no feasible techniques for collection or cycling of droppings. This, however, could be increased by rearing in closed or semi-enclosed environments.

Studies are now under way to examine how resources are being reallocated as a consequence of adoption of improved aquaculture practices. It is expected that a large quantity of resources previously under use in non-aquaculture enterprises will now be shifted to aquaculture. The preliminary analysis presented here suggests that these shifts in resource use will probably increase the overall productivity of farming systems in Bangladesh.

References

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ICLARM Contribution No. 874.

An earlier version of this paper was presented at the 12th Annual Farming Systems Symposium, 13-18 September 1992, East Lansing, Michigan, USA.