

Diversifying rice field systems in

Due to high population pressure and limited land resources, rice fields in Bangladesh are small. The smaller the fields, the more land is taken up by dikes. In addition, rice straw and animal manure are the main sources of animal fodder and household fuel and thus cannot be used to fertilise the fields. These are two important reasons why soils degrade and yields decline. To halt this negative development, rice farming needs to be diversified. Dikes can be used to grow fuelwood, and food security can be enhanced by introducing, for example, fish culture. Kevin Kamp and Fahmida Begum report on recent developments.

**Kevin Kamp and Fahmida Begum
with Adji Setijoprodjo**

Bangladesh is located at the confluence of the Jamuna, Ganges, and Meghna rivers which drain the Indian subcontinent. It is characterised by extensive flood plains cultivated in rice. The winter season from November through February can be quite cool, reaching temperatures below 10°C, while the rest of the year is hot and humid with temperatures usually greater than 35°C and humidity above 80%. Soil types can vary from sand to loam to clay, depending on the area. Cropping intensity is high. In a considerable proportion of the country there are three (rice) production seasons: one rainfed crop and one or two irrigated ones. Irrigation is primarily dependent upon ground water resources accessed by mechanized tubewells. The low topography combined with heavy rainfall often results in large parts of the country being flooded during the monsoon season.

With a population of approximately 115 million and growing, Bangladesh is one of the most densely populated countries in the world. The majority of farmers in the country are poor, owning and cultivating less than 0.4 hectares of land from which most of their household needs must be met. Combined with insufficient off-farm employment opportunities, food security is a major issue.

Current production levels of rice are being threatened by the demand for cooking fuel in households and fodder for animals. Residues from rice and other crops are used as cooking fuel and for animal fodder, with animal manure used to augment fuel needs. Adding to the problem, having almost no rock resources, Bangladesh relies heavily on bricks and brick chips for all concrete and road construction activities. The production of bricks is almost totally dependent on wood resources for heating the kilns. According to farmers and agriculture experts in the country, insufficient crop

and livestock wastes are returned to fields resulting in declining soil fertility and, consequently, reductions in rice yields.

Rice field size in Bangladesh is decreasing as a result of land divisions in response to the increasing population. Farmers are finding it difficult to produce enough food and income to support their families, forcing them to find ways to intensify and integrate their production systems. In Bangladesh, this pressure is most pronounced in rice fields where there is a critical need to produce not only more rice but other farm products that households rely upon for food security: fuelwood, construction wood, fodder, fruit, vegetables, fish and other aquatic organisms.

Rice intensification systems

A number of organizations are supporting farmers to do just this. The Swiss Development Corporation (SDC) supports a significant number of local NGOs around the country in a highly successful programme to incorporate greater numbers of trees onto farmland. Proshika, another large national NGO, is also committed to bio-intensive agriculture. Another integrated approach, and the focus of this article, is being promoted by the British Overseas Development Administration and the European Union through CARE International in Bangladesh. This programme, which began pilot activities in 1991, now works with more than 20,000 farmers per year to integrate fish, vegetable crops and trees into their rice fields. The programme also focuses on integrated pest management strategies aimed at reducing the costs of pest management and increasing the profitability of rice cultivation.

The importance of integrating other activities into rice fields in Bangladesh cannot be understated. In order to reduce the net flow of crop residues from rice fields to a sustainable level, fuelwood and fodder substitutes must be made available. Given the limited land resources of the average Bangladeshi farmer, there are few alternatives. Homesteads are exceedingly small and the added shade from additional trees would only reduce further the limited capacity of homesteads for vegetable production, an important activity performed mainly by women.

Indonesia: trees on dikes

Rice fields appear to have the greatest potential for further integration and intensification efforts. The average size of a rice plot in Bangladesh is less than 0.08 hectares. This means that a considerable proportion of the land area for rice cultivation is actually taken up by rice field dikes. The smaller the plot, the greater this proportion will be. Given the amount of land utilised for dikes, the fact that they are usually fallow and underutilised, and that they tend to be higher than normal water levels in the rice fields, dikes make suitable areas for planting of trees and other crops if

properly managed. One of the best examples of this can be found on the island of Lombok in Indonesia. There, a significant proportion of rice field dikes are planted with the perennial tree, *Sesbania grandiflora*, at a spacing of approximately 40 cm between trees. Trees are planted by direct seeding and are grown for a period of three years before final harvesting. During this period, farmers harvest flowers and leaves for human consumption, leaves and flowers for animal fodder, limbs for fuelwood and the limited shade, while not affecting crop production, is considered important for both farmers and livestock working in the fields. Farmers also feel that these trees provide structural stability to dikes during heavy rains. After three years, trees are harvested for domestic fuelwood, construction or sold and new trees are planted. The value of a three-year-old *Sesbania grandiflora* tree in Lombok where fuelwood is relatively abundant is approximately \$0.40. In Bangladesh, however, this same three year old tree (found only in homesteads) is worth approximately \$2.50. At this rate, the trees planted on one hundred metres of dike (0.06 hectare plot) every 40 cm would be worth up to \$625 after three years. This is considerably more than the rice grown inside the dikes during the same time period! In Indonesia, the trees also serve as support for cultivating a number of species of beans which are consumed and sold.

While planting *Sesbania grandiflora* on rice field dikes is not practised in Bangladesh, a number of trees are planted in limited amounts on dikes and in rice fields, the most notable being date palms (*Phoenix sylvestris*) and *Acacia arabica*. Date palms can be rented to palm tree tappers for approximately \$2.50 per year with farmers receiving the added benefit from fuelwood and fencing material from the palm branches. Farmers in many areas practice broadcasting *Sesbania* seeds on dikes just before the monsoon season for fuelwood purposes.

Local options

Based on the experiences of local farmers and other countries, the programme promotes intensifying the planting of trees on dikes as well as limited numbers in rice fields. In addition to the trees mentioned above, farmers in the programme have been experimenting with planting *Eucalyptus camaldulensis*, *Swietenia macrophylla* and *Dalbergia sissoo* on dikes with promising results. The demand for fuel-biomass from households and the brick industry is so high that farmers could easily sell any amount of tree resources they produce with little likelihood of extreme changes in prices.

One of the most exciting vegetable crops that farmers in a few limited areas of Bangladesh grow on rice field dikes is the country bean, *Dolichos lablab*. At a harvested value of approximately \$5.00 per cultivated

Bangladesh

metre of dike, farmers earn more off the beans than they could off the rice from the same plot. Unfortunately, farmers have yet to be provided the opportunity to learn the full economic, nutritional and biomass production potential of both *Dolichos lablab* and *Sesbania grandiflora* being cultivated concurrently on the same dike. In addition, the CARE programme promotes the production of other vegetable crops which have a nutritional and economic value to households such as tomatoes, ladyfinger, amaranth, taro and many varieties of gourds.

Finally, the programme works with farmers to stock fish in both irrigated and rainfed rice fields. Most farmers choose to invest limited money and effort into cultivating fish in rice fields while others invest in both the stocking substantial numbers of fingerlings and in raising the heights of rice field dikes to protect their investments against loss due to flooding. While average returns per hectare may be around \$50, considerable numbers of farmers also have returns which exceed \$400. Fish cultivation in rice fields contribute substantially to both the nutritional and in income needs of poor households. The case study of Ms. Hafis Khatun illustrates her efforts to diversify their rice field in Bangladesh.

Hafisa Khatun, her husband and three children rely on farming as their main source of livelihood. They own a total of 0.40 hectares of land. Hafisa became interested in planting vegetable crops and stocking fish in one 0.06 ha plot of irrigated rice in 1996 as a result of her participation in the CARE programme. She increased the width of the dikes to 70 cm and decided to plant ladyfinger (*Hibiscus esculentus*), ridge gourd (*Luffa acutangula*), ash gourd (*Benincasa cerifera*) and papaya (*Carica papaya*). In addition, she stocked 3500 common carp and 500 silver carp fry in the rice field itself. Her total investment for raising the dike, seed and fish fry was approximately \$20 raised from household resources. She expects a total vegetable harvest of 150 kilograms, of which she has already harvested 50 kilograms, from which she sold \$10 worth and her family has consumed 10 kilograms. Hafisa also expects the fingerlings she has cultivated and harvested to be worth almost \$100, which she will both sell and restock in the next rice season. If her expectations are realized, the total return on her investment of \$20 will be approximately \$130 plus 30 kilograms of vegetables for family consumption. Hafisa also reported that her husband has stopped using pesticides in their rice fields as a result of his participation in the project's promotion of IPM, resulting in a slight increase in production over the previous year. The value of the 300 kilograms of rice harvested from the 0.06 hectare plot is approximately \$50. She reports that the community has been watching her dikes and are now interested in knowing the details of what she did. She plans to expand her dike cultivation in the upcoming season.



photo: Kevin Kamp

Constraints

Even though the pressures to diversify rice systems are real and the potential benefits great, promoting new ideas has not been easy. There are a number of reasons for this.

- In areas and countries that practice intensive culture of dike areas of additional crops, norms have been established regarding ownership of the dikes, cultivation and sharing practices and protection. Norms are currently absent for dike cropping in Bangladesh and need to be established with full participation of the community, an area the programme needs to pay immediate attention to.
- Without an understanding of the potential benefits, farmers naturally under-invest in new ideas. Such under investment is often reflected in inferior quality seeds, poor soil preparation and inadequate management. It is caused by poor extension systems and leads to failure of even the best technologies and ideas.
- Often farmers are concerned about potential negative impacts of shade and nutrient competition from dike crops on rice. By facilitating trials for various crops and trees in which farmers participate from design through evaluation, farmers will have the information needed to make informed farm management decisions. While rice-fish and IPM learning mechanisms are well established and effective, this is an area where effective extension mechanism are poorly developed. Extension activities which provide farmers the opportunity to learn basic agronomical concepts in their own fields from which they can fully participate in developing appropriate practices are empowering, and should be promoted.
- Although women are the main users and gatherers of fuelwood, in Bangladesh, women's access to rice fields is extremely limited due to local social norms. Their male family counterparts simply do not understand the fuelwood supply crisis that women must face each day and are not as interested in addressing fuelwood issues as

A dike cultivated with gourds in Bangladesh

women. Vegetable production on dikes, another area of traditional women's involvement, is similarly constrained. CARE uses exclusively female extension staff to work with female farmers with considerable progress being made. The key to success, again, is concurrent work with community power structures to enhance the rate of change in social norms.

Conclusion

The productive capacity of humid lowland rice fields of Bangladesh is being compromised by short-term farm household and off-farm fuelwood needs and current agricultural practices. The productive potential for the small parcels of land has yet to be fully exploited by farmers, with border areas of rice fields providing opportunities to add significantly to the income and nutritional needs of farm households. More importantly, increased cropping of these border areas can contribute considerably to reducing the dependency and outflow of crop residues from rice fields for household fuel needs. Rice fields also offer opportunities for integrating fish production for income and nutritional benefits. Closing the gap between potential and current rice field productivity levels can be achieved only by very participatory extension systems which include farmers and their communities in all stages of the learning and change process.

Kevin Kamp and Fahmida Begum, CARE
Bangladesh, GPO Box 226, Dhaka-1209, Bangladesh,
Fax: +81 4183. E-mail: carebangla@drik.bgd.toolnet.org