Edited by Paul Sillitoe

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Present and Future

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For the poorest of the poor in Bangladesh, may your voice be heard.

"We have for over a century been dragged by the preposterous West behind its chariot, choked by dust, deafened by noise, humbled by our own helplessness, and overwhelmed by the speed .... If we ever ventured to ask 'progress towards what, and progress for whom', it was considered oriental to entertain such doubts about the absoluteness of progress."

RABINDRA NATH TAGORE 1941 *Rabindra Nath Tagore on rural reconstruction.* Government of India, New Delhi.

Contents

12 Local Vegetable Seed Storage Methods and Women's Participation in Development

Wajed A. Shah and Salina Jahan Nuri

INDIGENOUS KNOWLEDGE has only recently been given due importance in the development of new technology and in rural development. Today it is recognised as complementary to scientific knowledge in development (Millet-e-Mustafa 1998). The adoption of innovated technology is generally not sustainable without the incorporation of local knowledge. Thus indigenous knowledge needs to be understood and adopted in agriculture and natural resources management for sustainable development (Zuberi 1998). This article is a brief analysis of how people use their local knowledge in vegetable seed preservation, and the extent and nature of women's participation.

Annual vegetable production in Bangladesh satisfies only about one-quarter of the total domestic demand (Shah *et al.* 1991). One of the primary requirements in expanding vegetable production is the supply of seeds and there is a need to assess vegetable seed storage at the farm level. Secondary information about farm-level vegetable seed storage methods and practices is scarce, as few studies have been made. In Bangladesh vegetable seed is supplied by the Bangladesh Agriculture Development Corporation (BADC), the Directorate of Agricultural Extension (DAE), private importers, farmers and small traders. The BADC and DAE supply annually about 15 and 5 metric tons of seed respectively and private importers about 150 metric tons. The remaining 830 metric tons of vegetable seeds are met at the farm level. The supply of seeds through national institutions satisfies only about one-fifth of the total demand. Production and supply of vegetable seeds at the farm level is crucial in meeting the vegetable seed requirement of the nation (see Samiruddin 1989; Mannan *et al.* 1990).

The question arises as to whether indigenous methods of seed preservation at the farm level are effective. Do they maintain viability and vigour of vegetable seed from harvest to next planting? This study was undertaken to survey preservation methods, the technology used and the extent of vegetable seed storage in different farm households. Since rural women in Bangladesh play a significant role in various operations in farming systems (Shah *et al.* 1991), an assessment of women's participation in vegetable seed storage technology at the farm level was also undertaken.

Methodology

Four villages around the Farming Systems Research Site in Kalikapur Thana, Ishurdi in Pabna district, were selected for study: Kalikapur, Dikshail, Degreepara and Azampur. Farmers were grouped into five categories: landless, marginal, small, medium and large farms. Twenty persons from each category were drawn using a proportionate sampling method making a total of 100 respondents. A female enumerator interviewed female respondents using a structured and semi-structured questionnaire. Data for this study was collected from January to May 1992 and case studies were carried out in

subsequent years on seed storage methods. A small quantity of different vegetable seeds was collected from the respondents. Germination tests on seeds were carried out at the Seed Testing Laboratory, Department of Agricultural Extension in Ishurdi to determine their quality.

Results and discussion

The majority of female respondents preserved seeds of leafy vegetables such as *data, lalsak*, and Indian spinach (Table 12.1). Approximately 20% 'seldom' or 'never' preserved seeds. Up to one quarter of the households may run out of leafy vegetable seeds each year, otherwise they meet their need by collecting seeds from available sources. The leafy vegetables *batisak* and *kalmisak* were recently introduced to farmers through field trials. None of the respondents stored the seeds of these vegetables. Housewives did not like to grow *kalmisak* and *batisak* or similar leafy vegetables in their homestead (Shah *et al.* 1989).

Table 12.1: Extent of seed storage of leafy vegetables in rural households

Name of vegetable	Extent of storage (%)		
	Never	Seldom	Always
Data	11	11	78
Lalsak	16	10	74
Batisak	100	0	0
Kalmisak	100	0	0
Indian Spinach	3	18	79

Female respondents cultivated two types of beans: country beans and yard-long beans. Whilst 78% always stored country bean seeds, only 27% preserved yard-long bean seeds (Table 12.2). It appears that yard-long bean seeds are both less popular and less available than country bean seeds. If the extension program plans to expand the cultivation of such beans, there is a need to increase the supply of seeds. Several types

Table 12.2: Extent of seed storage of beans, gourd and other vegetables

Name of vegetable	Extent of storage (%)		
	Never	Seldom	Always
Country bean	10	12	78
Yard-long bean	56	17	27
Wax gourd	0	24	76
Bottle gourd	0	16	84
Snake gourd	79	9	12
Ridge gourd	18	12	70
Sponge gourd	12	0	88
Bitter gourd	46	31	23
Cucumber	52	25	23
Pumpkin	7	12	81
Brinjal	68	11	21
Lady's finger	62	10	28
Radish	98	0	2

of gourds were grown. The majority of respondents preserved seeds of wax gourd (76%), bottle gourd (84%), ridge gourd (70%), and sponge gourd (88%). Almost 80% of respondents reported that they 'never' stored seeds of snake gourd and 46% 'never' stored seeds of bitter gourd. Rural women grow pumpkin and 81% of them 'always' preserved these seeds. A majority of women reported that they 'never' preserved seeds of cucumber (52%), *brinjal* (68%), lady's finger (62%), and radish (98%). There is a need to motivate women and farmers to preserve the seeds of these vegetables.

Indigenous seed storage methods

Large quantities of seeds can be stored using 'bulk', 'flat ambient' and 'conditional' methods. 'Bulk' storage refers to the mass storage of seeds, such as when a farmer stores rice seeds. 'Flat ambient' storage differs from bulk storage in that seeds are cleaned, bagged and stored in a building or wire house rather than a bin. The 'conditional' method prolongs the viability of seeds through control of humidity and temperature within the storage room. This can be achieved by air cooling, by installing moisture vapour proof packaging or by dehumidification (Islam and Rahman 1989; see also Toole 1958). These technological methods of vegetable seed storage are not those followed by rural women, who rely on their age-old experience of seed preservation.

Female respondents followed three different indigenous methods of seed storage (Table 12.3). Most women preserved vegetable seeds in bottles. A few used polythene bags. The seeds of the country bean, ridge gourd and sponge gourds they preserved inside the dried fruits, a method based on traditional practices. Seed storage in bottles or polythene bags may be considered a conditional method in that such methods offer a degree of protection from environmental effects such as moisture, temperature and insect/pest infestation.

Table 12.3: Indigenous methods of vegetable seed storage

Name of vegetable	Seed storage method (%)[a]		
	In bottle	Within fruit	Polythene bag
Data	92	0	8
Lalsak	83	0	17
Batisak	0	0	0
Kalmisak	0	0	0
Country bean	5	92	3
Yard-long bean	100	0	0
Wax gourd	99	0	1
Bottle gourd	99	0	1
Snake gourd	100	0	0
Ridge gourd	3	97	0
Sponge gourd	1	99	0
Bitter gourd	100	0	0
Pumpkin	98	0	2
Cucumber	100	0	0
Brinjal	91	0	9
Lady's finger	94	0	6
Radish	100	0	0

Note: [a]Percent estimated from Table 12.1.

Quality of seed stored

Seed stored by indigenous methods was tested for quality in the laboratory. The test results were rated 'good', 'fair' and 'poor' (Table 12.4). Seeds usually deteriorate through irreversible physical, biochemical and physiological changes; seeds that do not germinate are likely to be dead. The results showed that out of 18 types of vegetable seed stored in different households, only three (*data, lalsak*, and snake gourd) rated 'good'. The germination of leafy vegetable seeds was considerably better than other types. The preserved seeds of yard-long beans, wax gourd, cucumber and radish were found to be of 'fair' quality. The seeds of the other nine vegetables preserved in the households did not germinate well and were considered 'poor' quality.

Women's participation in vegetable seed storage

Almost one-fifth of female respondents had no involvement in seed storage before marriage. Women from large farms had the least involvement. 38% of the respondents participated 'sometimes' and 43% 'always' in seed storage. More than 50% of women in small farms were 'always' involved in seed storage activities before marriage (Table 12.5).

All female respondents reported that after marriage, despite other activities in and outside their home, they were involved in some work on vegetable seed storage and management: 82% of respondents 'always' participated, and 18% 'sometimes' participated in such activities for all farm types (Table 12.6).

Table 12.4: Germination test scores of different vegetable seed

Name of vegetable	No. of seeds tested	Percent germinated	Qualitative score[a]
Data	500	79	good
Lalsak	361	72	good
Batisak	na	na	na
Kalmisak	na	na	na
Indian spinach	200	26	poor
Country bean	144	46	poor
Yard-long bean	23	52	fair
Wax gourd	34	52	fair
Bottle gourd	40	50	poor
Snake gourd	13	100	good
Ridge gourd	106	11	poor
Sponge gourd	121	48	poor
Bitter gourd	16	33	poor
Pumpkin	88	32	poor
Cucumber	100	65	fair
Brinjal	220	5	poor
Lady's finger	160	46	poor
Radish	200	55	fair

Note: [a]Poor = less than 50% germination; fair = 50-70% germination; good = more than 70%; na = data not available.

Table 12.5: Women's participation in vegetable seed storage before marriage

Farm Category	Women's Participation in vegetable Seed Storage Before Marriage (%)		
	Never	Sometimes	Always
Landless	20	45	35
Marginal	10	45	45
Small	25	20	55
Medium	10	45	45
Large	30	35	35
All Farms	19	38	43

Table 12.6: Women's participation in vegetable seed storage after marriage

Farm Category	Women's Participation in Seed Storage After Marriage (%)		
	Never	Sometimes	Always
Landless	0	20	80
Marginal	0	15	85
Small	0	20	80
Medium	0	20	80
Large	0	15	85
All Farms	0	18	82

Women's participation in seed storage activities was higher than that of other family members (Table 12.7). Men and children had relatively less involvement, regardless of farm category. The children of large farms participated to a greater extent than did the children of other farm types. The joint participation of husband and wife was 21% in all farms taken together, with landless farms showing the lowest rate. Participation rates for marginal, small and medium farms were similar. The majority of rural women recognised the need for training in vegetable seed storage and management. Only 12% of respondents felt no need for such training.

Table 12.7: Participation in vegetable seed storage (%)

Farm Category	Children	Husband & wife	Women only
Landless	15	15	70
Marginal	10	25	65
Small	15	20	65
Medium	15	25	60
Large	30	20	50
All Farms	17	21	62

Conclusions

The supply of vegetable seed from government and private agencies satisfies only about one-fifth of the total requirement in Bangladesh. Seed stored at the farm level is the country's major source for vegetable production. In traditional farming systems, women play a significant role in vegetable seed storage and management. This study found that rural women usually store leafy vegetable seeds, although seeds of *batisak*

and *kalmisak* are not preserved. Country bean seeds are frequently stored while yard-long bean seeds are seldom stored. The majority of women store seeds of wax, bottle, ridge, and sponge gourd and seldom those of snake and bitter gourd. Few women preserve seeds of cucumber, *brinjal*, lady's finger and radish. Seeds are preserved using three indigenous methods: storage in bottles, in polythene bags, and within the fruit. Germination tests revealed the majority of stored seed to be of 'poor' quality except that of *data, lalsak* and snake gourd. The study also found that married women participate in vegetable seed storage and management more than unmarried women do. In all farm categories rates of participation were higher for women than other family members. The majority of female respondents recognised the need for storage and management training. The study highlighted some of the potential constraints of indigenous seed storage at the farm level and demonstrated that the majority of vegetable seeds were stored using indigenous methods.

13 Medicinal Plants for the Survival of Rural People

N. Begum, M. F. Haq and K. Naher

OVER THE COURSE OF CENTURIES, rural people such as farmers and others have developed location-specific knowledge and practices for natural resources management, human and animal health care and many other fields. This knowledge is generally transmitted by word of mouth and forms the basis of people's decision making (Mathias 1994). It is also dynamic and changes in relation to the physical and social environment. This acquired knowledge features in all spheres of rural peoples' daily life. The agricultural production system of Bangladesh for example relies heavily upon indigenous practices. People also continue to depend heavily on local knowledge of the medicinal properties of plants and other available resources. Rural people living in small farming communities have to depend on local medicinal plants as they cannot afford medicines or to be visited by doctors. Moreover, medical facilities provided by the Government are so poor that even urban people do not have proper access to them.

Bangladesh is one of the poorest countries of the developing world. The country suffers from an annual food deficit and requires assistance from various aid giving countries to feed its population. The Government subsidises food production. The nutritional and health status of many people is dire. Due to its poor economy, the nation has inadequate basic facilities. Many people cannot imagine medical facilities being available for them, even in urban areas. In rural locations, few people have access to medical services because of their economic poverty combined with a shortage of trained medicinal practitioners in villages. Only one graduate medical practitioner is available for every 4,955 persons in the country (Bangladesh Bureau of Statistics 1995). Modern treatment is so expensive that only the rich can afford it. Local medicinal plants continue to be of great importance to rural people (see also Rahman *et al.*, this volume). For centuries village women have been doctoring common ailments with locally available herbs and shrubs found around their homesteads, or in fields and jungles.

This chapter reports on an investigation into the health beliefs and medicinal practices of local people, with a view to documenting the use of indigenous methods of treatment. It stands on the premise that indigenous knowledge should be valued, as it comprises a wide range of accumulated experience about natural resources essential for peoples' health and well-being, supplying them with much-needed medicines, not to mention food. The study observed that almost 100% of village households use locally available medicinal plants to treat common diseases. In all villages studied, one or two women have expertise in the use of medicinal plants and give their services free of charge. Many herbs and shrubs grown in and around the village are selected to treat patients, sometimes with astonishing results. Though not all plant species were available in all locations, certain species were particularly common and used by people everywhere.

Method of study

The use of medicinal plants by rural people in Bangladesh was studied using participatory rural appraisal (PRA) techniques in eighteen villages located in eighteen different thanas representing eighteen agroecological zones (AEZ). The study was undertaken by a multidisciplinary team of research and extension personnel from the Department of Agricultural Extension in collaboration with two National Research Organisations: the Bangladesh Agricultural Research Institute and the Bangladesh Rice Research Institute. The research on indigenous knowledge of medicinal plants was a subsidiary study. The project's main objective was to research sustainable farming systems, giving particular emphasis to the cultivation of cereals (rice, wheat, maize and barley) by employing irrigation technologies to increase production. The survey was undertaken in 1996-97 in a collaborative programme between the Department of Agricultural Extension and the Thana Cereal Technology Transfer and Identification (TCTTI) Project. We surveyed a total of fifty-three thanas to meet the project's objectives. Information on indigenous medicinal practices was collected from eighteen of the thanas during PRA exercises (Table 13.1.), allowing people to present the information themselves, as they thought fit. The participants comprised a group consisting of twenty men and twenty women from farming families, selected by stratified sampling from four land-holding categories. The four categories of farm holding were marginal = < 0.20ha., small = < 1.0ha., medium = < 3.0 ha., and large = > 3.0ha. The forty persons selected represented the ratios of these four categories in the village population.

Table 13.1: Thanas involved in Participatory Rural Appraisal studies for indigenous medicinal knowledge practices by rural people

Name of Thana	Name of District	Agroecological zone
1. Mithapukur	Rangpur	3,27
2. Fulchari	Gaibandha	3
3. Natore sadar	Natore	5,11
4. Raiganj	Serajganj	4,25
5. Sarsha	Jessore	11
6. Faridpur sadar	Faridpur	10,12
7. Ghatail	Tangail	8,9,28
8. Melandah	Jamalpur	7,8,9
9. Dhamrai	Dhaka	8,28
10. Comilla Sadar	Comilla	19,22,29
11. Feni Sadar	Feni	18,19,23,29
12. Parsuram	Feni	23,29
13. Palash	Narsingdi	9,28
14. Nagorpur	Tangail	8,27
15. Madarganj	Jamalpur	7,8,9
16. Chowgacha	Jessore	11
17. Mohonpur	Rajshahi	11,25
18. Khansama	Dinajpur	1,3

We observed that women largely collect and prepare medicinal plants. Hence women, particularly the more experienced, were asked to collect samples, and then

present them to the group (by arranging them on the floor), and to name and describe the preparation and use of the medicinal plants. The information was checked by all other participants. These observations support the contention that women have pioneered plant domestication and agriculture since the arrival of civilisation (Childe 1971), and that close attention needs to be paid to gender issues relating to plant use (Stokoe, this volume).

Major findings of the study

We identified ninety-three species of plants during the study as having medicinal value for rural people (Table 13.2). The majority were herbs and shrubs, with a few derived from trees. People identified the plants by their local names, so some species may have been repeated since names can vary between locations. People, mostly women, collect samples from the backyards of their homesteads, fallow lands, along field boundaries, around *beels*, along riverbanks, roadsides, and from copses and forests. We found only four or five shrubs growing in homesteads as ornamental plants and two or three species cultivated as spices in homestead gardens or fields. Three species were grown in homestead gardens for their edible fruit: wood apple, guava, and blackberry.

Table 13.2: List of indigenous medicinal plants with their uses (Scientific names of plant species are from Huq 1986)

Catalogue of Medicinal Plants			
Local and scientific name	Thana location number (re. Table 13.1)	Medicinal parts and methods of use	Where available
1. *Arahar, Cajanas cajan*	4,7,11,12, 15,16,18	Leaves: together with the leaves of *swarnalata* smashed with 125 ml water. Used to treat jaundice.	Grown along crop field boundaries or in homesteads.
2. *Arjun, Terminalia arjuna*	7,11,15	Bark: soaked under water overnight. The water is given to patients suffering from jaundice, blood dysentery, heart disease (*Madarganj*).	Grows naturally in the forest.
3. *Almish* plant	10	Leaves: juice used for the treatment of amoebic dysentery.	Found around homesteads.
4. *Akanda, Calotropis procera*	10,18	Leaves: very effective if leaves are warmed and placed on wounds and fractures. Leaf juice is also used for curing coughs and colds and combating a low temperature (*Khansama*).	Found to grow around homesteads and on riverbanks.
5. *Aho-nondil*	5	Lower parts of young leaves: leaf paste used for quick drying of wounds.	Available in homesteads and bushland.
6. *Alaicha, Amomum aromaticum*	14	Leaves: juice used as a remedy for fever and to increase appetite.	Aquatic plant - grows in ponds and *beels*.
7. *Amrull, Oxalis corniculata*	8	Leaves: smashed with water and taken by patients suffering from dysentery.	Found around homesteads, ponds and fields.

(Contd.)

(Continued)

Catalogue of Medicinal Plants

Local and scientific name	Thana location number (re. Table 13.1)	Medicinal parts and methods of use	Where available
8. *Arash*	17	Leaves: smashed leaves, if applied to the forehead after warming, can cure colds. Especially effective for children.	No information.
9. *Ataswri*	17	Twig: used as a toothbrush and can cure pyorrhoea. The tender leaf sap is used to increase appetite.	Grows on roadsides, jungle and fallow lands.
10. *Alo kumari*	5	Leaves: juice used to reduce coughing.	No information.
11. *Aishada*	5	Leaves: half cup of juice of aishada mixed with one and a half cups of milk can control diarrhoea.	Found in jungle.
12. *Adamoni/Aguni*	8	Leaves: for indigestion the patient is advised to take this leaf with rice.	No information.
13. *Akh, Saccharum officinalis*	8	Root: half a cup of root juice, if taken before breakfast for 7 days, is very effective against liquirria.	Cultivated as field crop.
14. *Ashuti*	8	Leaves: smashed leaves mixed with salt are applied to forehead to control headache.	Found in jungle.
15. *Basak, Adhatoda vasica*	6,13	Leaves: juice of *tulshi* and *basak* leaves with *talmisri* used to cure coughs.	Found growing in backyards of homesteads, around *beels* and riversides.
16. *Bhanga lata, Anona reticulata*	6	Leaves: leaf juice is mixed with molasses and used to treat dysentery in people of all ages but especially children.	No information.
17. *Bel, Aegle mermelos*	14	Leaves and fruits: leaf juice used as a remedy for coughs and colds. Fruit juice is used to treat dysentery and constipation.	In backyard of homesteads or in forest.
18. *Bhamot*	15	Internodes: used for chicken pox.	Grown in homesteads.
19. *Bakcha*	5	Leaves: juice used for controlling coughs.	Found in homesteads and forest.
20. *Boita*	7	Leaves: juice used for controlling loose bowel movement in children.	Grown in bushland or backyards of homesteads.
21. *Bish katali, Polyponum hydropiper*	7	Leaves: juice used to coagulate blood if leg or hands injured.	Grown in the backyard of homesteads.
22. Betel nut, *Areca catechu*	16	Leaves: if smashed and applied to wounds prevents bleeding.	No information.
23. *Bash, Bambusa* spp.	8	Flower: used to alleviate labour pains and for easy delivery.	Found cultivated in the backyard of homesteads and on fallow land.
24. *Bat boila*	3	Used to treat amoebic dysentery.	Usually found on river banks.
25. *Bahat*	7	Leaves: treats tongue problems in children.	Found in bushland.

(Contd.)

(Continued)

Catalogue of Medicinal Plants

Local and scientific name	Thana location number (re. Table 13.1)	Medicinal parts and methods of use	Where available
26. *Chitki, Phyllanthus reticulatus*	4,13	Leaves: juice of green leaves used to cure dysentery and infant diarrhoea.	Grown around the homestead especially along old fences.
27. *Chirkuti*	3	Leaves: juice used to cure infant diarrhoea.	No information.
28. China rose, *Hibiscus rosa chinensis*	7	Used for cooling the scalp.	Found in homestead gardens as ornamental plants.
29. *Danda kalash, Leucas aspera*	4,14	Leaves: juice used to treat coughs and colds in children.	Grows beside roads and around homesteads.
30. *Durba, Cyanodon dactylon*	4,8,10, 14,15,16	Helps to coagulate blood. Root juice is used to treat problems associated with women (*Matherganj*).	Grows beside the road and around crop fields.
31. *Dolon, Hidychium crronarium*	3	Used as treatment for colds.	No information.
32. *Dhutura, Datura fastusa*	18	Leaves: juice used for scabies and chicken pox.	Found in jungle.
33. *Dheki sak, Ceratopteris thalictroides*	5	Leaves are fed to lactating mothers.	Grows on fallow land and around ponds.
34. *Daud*	15	Leaves: juice used to soothe skin irritation. The leaf is crushed on the palm and applied onto eczema 3-4 times daily; within 7 days the eczema is cured.	Found around homestead boundaries
35. *Dhol manik, Ipomoea fistulosa*	15	Leaves: juice used to treat dysentery.	Found around homestead boundaries and in jungle.
36. *Dhol kalash*	10	Leaves: paste, when applied to forehead reduces pain.	Found on footpaths and along riverbanks.
37. *Dom kalash*	7	Leaves: used for improving digestion and to increase appetite.	Grows in fields.
38. *Germanilata, Eupatorium odoratum*	5	Leaves: juice used for birth control.	Found in jungle and by the side of ponds.
39. Garlic, *Allium sativum*	10	Extract from garlic is used for amoebic dysentery.	Grown in homesteads and fields as a spice.
40. *Gella, Entada phaseoloides*	17	Spiny tender stem: eaten as a vegetable to cure skin disease.	Grown with dry land *rabi* crops. An annual weed.
41. *Gulal, Diospypos toposia*	7	Leaves: used to make curry with soft or half-rotten fish so that it tastes fresh.	Grown in homestead backyards.
42. Guava, *Psidium guajava*	17	Juice of tender leaves: cure for dysentery; 1 tablespoonful for a child and 2-3 tablespoonfuls three times a day for adults.	Grown in home gardens as edible fruit.
43. *Ganda badal, Paederia factida*	7	Leaves: juice used to increase appetite and as a remedy for stomach difficulties.	Grown around homesteads.
44. *Hotik jila*	10	Bark: extract used for gynaecological problems.	Grows on riverbanks and roadsides.

(Contd.)

(Continued)

Catalogue of Medicinal Plants

Local and scientific name	Thana location number (re. Table 13.1)	Medicinal parts and methods of use	Where available
45. *Himsagar, Kalanchae spatulata*	16	Leaves: juice used to cure indigestion.	No information.
46. *Harjora, Buetteneria pilosa*	3	Treatment for broken bones.	Found growing in bushland.
47. Jasmin, *Jasminum auriculatum*	5	Leaves: juice used to treat fever and chesty coughs.	Grown in homesteads as ornamental plants.
48. *Jam, Eugenia jambolana*	5,14	Bark: juice used to treat stomach pain.	Grown in homesteads, forest.
49. *Kharajora, Eugenia* sp.	14	Leaves: juice used to remedy scalp problems. Also effective for blood pressure.	Found growing in homesteads and bushland.
50. *Kota kare*	15	Root: used for treating wounds.	No information.
51. *Kemti kalokewcha*	10	Used as medicine for measles.	Found in homesteads, road-sides and fields.
52. *Kamranga, Stereosperonum chelonioides*	10	Fruit: juice used for amoebic dysentery and colds.	Grown in homestead gardens, forest.
53. *Kadam, Anthocephalus chinensis*	10	Leaves: used for arthritis.	Grows on roadsides, riverbanks and in forests.
54. *Kata khura, Amaranthus spinosus*	17	Root: eaten with betel leaf can cure *sutika*.	Found around ponds, on fallow land, roadsides and forests.
55. *Kuti pana, Spirodela polyrhiza*	7	Small green leaves: used for combating low temperature in infants.	Found around ponds, on fallow land, field boundaries, roadsides and forests.
56. *Kangra* grass, *Setaria italiac*	16	Runner: the stem of *kangra* grass prevents blockages when put in the ear.	Found in homestead backyards and in jungle.
57. *Kalo kachu, Colocasia nymphaefolio*	8	Leaves: juice used to control headache.	Found in homesteads and jungle.
58. *Kanchoti, Styrax serruletum*	3	Oral medicine used with coconut oil.	Found growing in bushland.
59. *Kalo Dhutura, Datura starmonium*	17	Leaves: smashed leaves applied after heating to alleviate pain.	Found in jungle, on roadsides and around ponds.
60. *Lal pata, Aerva sanguinolenta*	13	Used to stop bleeding from minor cuts.	No information.
61. *Lebu, Citrus aurantifolia*	15	Roots: used for healing wounds.	Found in homestead backyards, bushland and jungle.
62. Marygold, *Tagetes patula*	4,13,14,15	Leaves: juice used to stop bleeding from wounds.	Grown as ornamental plant in homegardens.
63. *Mon matal dal, Oroxylum indicum*	15	Branches: boiled with water, used to treat jaundice.	Grows in bushland, jungle, on roadside.
64. *Mouthal*	7	Leaves: used to alleviate stomach pain.	Grows in bushland and jungle.

(Contd.)

(Continued)

Catalogue of Medicinal Plants

Local and scientific name	Thana location number (re. Table 13.1)	Medicinal parts and methods of use	Where available
65. *Michri dana, Scoparia dulcies*	7	Leaves and root: juice used as treatment for dysentery and stomach pain.	Grows in bushland and jungle.
66. *Misti madhu, Glycyrrhiza glabra*	8	Leaves: paste mixed with salt used for stomach pain.	Found on fallow lands.
67. *Mukta borry, Acalypha indica*	8	Leaves: juice used to cure acute skin diseases.	Found on roadsides and in jungle.
68. *Mochani*	3	Leaves: juice used as cure for colds.	No information.
69. *Neem, Azadirachta indica*	6,7,11,13, 14,18	Leaves: used for seed storage. Smashed leaves used to treat fungal infections.	Grows in jungle and on roadsides.
70. *Okajuli*	13	Leaves: juice taken with sugar to stop skin irritations.	No information.
71. *Pipul pata, Piper sylvanticum*	7,14,18	Leaves: used to make curry with half-rotten fish to make it taste fresh.	Grows in bushland and homestead backyards.
72. *Pathar kuchi, Bryophyllum* sp.	14	Leaf: juice used for stomach trouble. Leaf extract is also helpful in the removal of stones from the kidney or prostate gland.	Found around homesteads.
73. Potato, *Solanum tubersum*	13	Tuber: paste used to treat skin burns.	Field crop.
74. *Panbilash, Piper betel*	5,15,17	Fresh leaves: used to improve the flavour of *pan* (Betel leaf).	Grown around homesteads.
75. Pineapple, *Ananas cosmosus*	6,10	Juice of soft leaf is taken with sugar to control worms in children. Also used by women for gynaecological problems (*Comilla Sadar*).	Cultivated as horticultural crop.
76. Prickly herb, *Chiscira* sp.	5	Root: juice used to control lecurrhia in women.	Grows in jungle.
77. Papaya, *Carica papaya*	5,16	Milky juice of green papaya: mixed with *loppipop* to control jaundice. Also taken with *batasah* (*Saret*) to cure liver pain.	Grows around homesteads and in jungle.
78. Red *shapla, Nymphaea nouchal*	7	Flowers: mixed with *rakta chandan* for lowering blood pressure.	Found in ponds and *beel*.
79. *Sishsu, Dalbargia sissoo*	11	Leaves: juice used to cure dysentery.	Grows in forest and on roadsides.
80. *Swarnalata, Cuscuta reflexa*	10,11,13	Leaves of *Swarnalata* and *arhar* smashed together with 125 ml of water, taken as medicine for jaundice. Leaf juice also used to remove hookworm in children in Narsingdi and by women for gynaecological diseases in Comilla district.	Grows with or near to *ber* and *mehendi* (henna).
81. *Sajna, Maringa aliefera*	10	Bark: used to treat colds and coughs. Green leaves are eaten for the treatment of blood pressure.	Grows around homesteads and in forest.

(Contd.)

(Continued)

Catalogue of Medicinal Plants

Local and scientific name	Thana location number (re. Table 13.1)	Medicinal parts and methods of use	Where available
82. *Shada akanda, Calotropis procera*	7	Leaf: juice to treat colds, coughs and low temperatures.	Grows in ponds, ditches, and on muddy roads.
83. *Thankuni, Centella asiatica*	4,5,10,14	Runner: used for dysentery and gynaecological diseases (*Raiganj*).	Found along homestead boundaries, roadsides, and on cultivated land.
84. *Tulshi, Ocinum americanum*	4,6,10,14, 15,16	Leaf: juice used with honey to treat colds. It prevents eczema and other skin diseases when mixed with red salts (*Chowgacha*).	Found in homestead gardens and around ponds.
85. Turmeric, *Curcuma domestica*	6,10	Paste made from spice with *neem* tree used to cure skin disease and worms in children.	Cultivated as a spice in fields and around homesteads.
86. *Tita neem, Azadirachta indica*	17	Twigs: used as toothbrush can cure pyorrhoea. Leaf also cures skin diseases.	No information.
87. *Uchey, Momordica charantia*	14	Leaves: juice used to prevent chicken pox.	Cultivated in homestead gardens.
88. *Venna*	3	Immature fruit can cure rheumatic pain.	No information.
89. *Vat, Clerodendrum viscosum*	3	Leaves: juice used as medicine for worms and fever.	Found in dense bush/forest.
90. *Vamot*	15	Leaves: extract used for measles.	No information.
91. *Vati*	9,17	Leaves: juice used to treat fever and reduce body temperature.	No information.
92. *Ziga, Lannea coromandecica*	3	Bark: extract with sugar is used to treat dysentery.	No information.

Irrespective of land-holding category, all villagers usually used medicinal plants as the only treatment for disease. They reported thirty-nine different diseases that could be treated with local medicines. For example, jaundice is a prevalent disease and affects people of all ages. The most commonly used plant to control it is *Cajanas cajan* together with the bark of the *arjun* tree. We were surprised to find that villagers also use local plants to control conditions such as high blood pressure and arthritis. Women aged above 30 years suffer particularly from various diseases, evidencing symptoms of iron deficiency, liquirria, *sutika* and so on, and rely on some eight species of plants to control them and other problems specific to women, notably gynaecological ones. Almost all rural children suffer worm infestation, a problem throughout the year. Four plant species were used as specifics to control them.

People use selected parts of plants for medicinal purposes. In about 80% of species it is the leaves that have medicinal value. Juice extracted from fresh leaves is used as medicine to treat several diseases. The roots, bark and wood of some plants have medicinal value too and the whole plant is used with several herbal species. People usually collect material used to prepare medicines just before use. After collection, they mash or soak the plant material in water to extract the juice, which patients usually take in the morning before breakfast (on an empty stomach). In all the villages one or two women know how to prepare remedies, and do so for their relatives and neighbours free of cost.

Rural people depend on indigenous medicinal plants for several reasons. The main ones are poverty, lack of availability of medicinal services in rural areas, and poor communications. They have no alternative but to use indigenous remedies. This is not all bad. In ill-informed hands modern medicines can adversely affect health. We need to devote more resources to understanding indigenous usage of medicinal plants given their importance to poor people in coping with healthcare problems. Thus, we conducted our study with the aim of furthering understanding and awareness of existing indigenous healthcare practices. And we present the results of our survey (Table 13.2) to highlight the importance of contemporary indigenous practices in Bangladesh.

14 Indigenous Medicinal Plant Use, Sustainability and Biodiversity: Learning from the Grameen Bank Experience

M. I. Zuberi

ACCORDING TO THE WORLD HEALTH ORGANISATION more than 80% of people, mostly in less-developed countries, depend on traditional herbal medicine for their primary healthcare needs. Neglected over the last century, the village poor in Bangladesh rely on a traditional medicinal system, known as the *kaviraji* system, for primary healthcare. In the past, the plants needed were collected from local forests and fallow lands, but with extensive deforestation and over-utilisation, wild populations of these plant species are disappearing fast. Moreover, with the domination of the modern allopathic medical system and the continued neglect of the herbal system, traditional practitioners are vanishing. Thus the indigenous knowledge associated with this system is eroding fast.

Bangladesh, situated in the fertile alluvial delta of the Ganges-Brahmaputra-Meghna River system and having a sub-tropical, monsoon climate, has a very rich biodiversity, much of which has already been destroyed by over-exploitation and deforestation. In spite of this, there remains a wide diversity of plant species. In the late 1980s the Government of Bangladesh, realising the risks of rapid biodiversity destruction, directed that all development projects must be cleared by the newly formed Ministry of Environment to assess their probable negative impacts on the environment. Bangladesh also signed, ratified and accessed more than two dozen international conventions, treatises and protocols relating to environmental conservation, including the Biodiversity Convention. Though development projects have environment impact assessments, most of these report little or no expected negative impact on natural resources or on the livelihoods of local people. The reverse invariably proves to be the case. The non-participatory approach adopted in development has been disastrous: without local people's input it is difficult to see how one can fully assess the impact of interventions on their lives.

The Ministry of Environment and Forests has been trying to formulate the National Environment Management Action Plan to set out a policy framework. Another attempt by the same Ministry is the National Conservation Strategy, which also awaits final approval. Recent recommendations for regional collaboration for the conservation of cultivated and wild plant diversity are still being formulated. Several NGOs, including *Gono Sasthya Kendra*, have been trying to conserve traditional plants following conventional methods e.g., by collecting and growing them in herbal gardens. However, very little has been done to assess the present state of medicinal plant species in Bangladesh. There is no list of threatened plants, though there are many candidates. The necessity of a detailed field survey at the national level, which would designate 'Red List' threatened species, has been indicated but never followed up.

Even today many villages throughout Bangladesh plan, co-ordinate and run their everyday activities according to a nature-based production system and the indigenous knowledge relating to its manipulation. Decisions relating to livelihood activities such as land preparation, seed sowing, tree planting, crop harvesting or animal care are made taking into account the influence of particular days, stars and the moon, according to traditional knowledge passed down from generation to generation.

A base line survey supported by the International Development Research Centre (Canada) of about 200 villages in North-western Bangladesh found that virtually every village had a herbal practitioner. A total of 461 folk medicine practitioners including 19 women were recognised giving an average of 2.23 herbals per village. In another pilot survey of ten villages of Southern Bangladesh, more than 30% of those suffering from poor health reported using herbal medicine. Of the 150 medical practitioners in these villages, 38% were herbals (Zuberi, unpublished). According to a 1978 World Health Organisation report, there are over 5000 registered and more than 3000 unregistered traditional medical practitioners in Bangladesh. Another International Development Research Centre survey indicated far more herbals operating in Bangladesh than this (Zuberi, unpublished). Of these herbals, only 540 are institutionally qualified; the remainder are folk medicine practitioners dependent entirely on indigenous knowledge.

Folk medicine in Bangladesh is a diverse tradition, which is ecosystem- and ethnic community-specific. It exists in all rural communities, with different localities having different characteristics. A region's indigenous knowledge is inexorably tied to its biodiversity, since the biodiversity of an area represents an important component of the environment in which local knowledge is generated. Local practitioners dependent on indigenous knowledge and local biodiversity include:

- elderly ladies, grandmothers and housewives administering plant-based home remedies, special foods and nutritious diets;
- herbals and *kaviraj* (folk medicine men) offering plant-based remedies and spiritual recommendations, taking small amounts of money or items in exchange;
- bone-setters, the traditional orthopaedics specialising in treating broken bones;
- poison specialists, experts in treating snake bites, dog bites etc.;
- *dai* (traditional birth attendants) responsible for home child birth.

In addition to herbal medicine for treating human diseases, another important indigenous knowledge based medical system developed in the villages of Bangladesh, is the ethnoveterinary system for the treatment of domestic animals. It is also dependent upon local plants. A pilot survey in five villages of North-western Bangladesh (Zuberi 1997*a*) indicated that there are an average of 5.5 ethnoveterinary practitioners per village. They reported treating 17 diseases (mostly of cattle), using 47 local plant species, 18 of which were readily identifiable. All these herbals reported successful treatment of diseased cattle but complained about disappearing plants and lack of opportunities for training or support. The wealth of knowledge associated with ethnoveterinary practices has been confined to village families. This indigenous knowledge is not documented or codified, though in many countries especially in India and China intensive research is being carried out with a view to conserving it.

Social situation: Social factors are important in regulating the passage of indigenous knowledge. Exposure to this intricate and vast world of knowledge begins very early in life when children see parents and others determining livelihood strategies against

the backdrop of the local environment. As children grow they acquire specialised knowledge and skills specific to their environment. The process is dynamic and individuals constantly adjust practices to suit the environment. They learn the local knowledge related to the identification, use and conservation of local plants used for food, fibre, medicine, fuel, etc. When a son follows his father to the field he learns about soil types, crop suitability, soil water, land preparation, sowing of seed etc. If he fishes with his uncle he learns the most reliable techniques, what should not be caught, how to allow fish to reproduce, and so on. All these are incorporated into the individual's knowledge base. Through this learning many identify so closely with the environment that they refer to it as a 'living person' like themselves. Thus, for example the soil can be 'hungry', 'starving' or 'dead', the water of the *beel* (shallow waterbodies) can be 'sick' and they can 'read' and 'feel' the land, climate or crops. This 'holistic' perspective of indigenous knowledge makes it efficient and sustainable, while the 'reductionist' view of modern science separates the components of the environment thus destroying the 'system' and its interrelated nature.

Ongoing research into traditional medicine (Zuberi, unpublished) indicates that village elders have a far more detailed knowledge and appreciation of indigenous techniques and medicines and their use than do members of younger generations, who have only vague ideas and limited knowledge about traditional systems. Most of the young are sceptical about the efficacy and appropriateness of remedies based on traditional knowledge as shown in the data gathered by the study; only 7% of the 461 herbal practitioners located and interviewed, were below 30 years of age, 52% were between 31 to 50 years and 41% were above 50 years. The herbals often reported that they do not have candidates either within or outside their family willing to continue their profession.

It is useful to note the socioeconomic condition of traditional practitioners. Preliminary results of field surveys indicate that of 461 herbals interviewed, 33% are illiterate, 57% have primary education and 10% have completed school. Of all the herbals, 80% have another major profession and 57% are farmers. As many as 45% are landless and 26% own land less than 1.5 acres in area. More than 39% live below the poverty line, 29% are poor and only 32% consider themselves economically solvent. Of these 461 herbals, 30% have families with 2 to 4 members, 51% have 5 to 8 and 18% have more than 8 members. Thus in socioeconomic terms the practitioners of indigenous knowledge based traditional medicine are in a marginal position. Due to their poverty and neglect by the government and the Bangladeshi elite, the herbals are ignored in their own villages and their livelihood is under threat. The material and social poverty of the herbals is one factor that adds to the ascendancy of western allopathic medicines and medical practices.

Potential of the traditional system: The indigenous knowledge based traditional practices, especially the primary healthcare system, offer great potential for sustainable development. Poor, rural people would be the primary beneficiaries. Indigenous approaches are more appropriate, cheaper, readily available and easier to adopt than foreign alternatives. Moreover, according to local demand, indigenous knowledge based practices can be improved, modified or even blended with outside technologies if considered necessary. Unfortunately appreciation of indigenous knowledge and the role of traditional practices is yet to be generated among development planners, policy makers and NGO workers. Our state run (or private) medical training and delivery systems, NGO run development and community healthcare efforts, the formal animal

care system and village-based poverty alleviation projects do not include any indigenous knowledge based traditional approaches. No research projects have been undertaken to evaluate the potential role of indigenous knowledge based traditional systems in sustainable development.

Documenting and revitalising indigenous knowledge and conserving biodiversity is of critical importance if we are to continue to benefit from the wealth of affordable, locally appropriate healthcare they provide to the rural poor (Zuberi 1997*b*). We know that present-day herbals are generally elderly, most of them are in remote villages with no apprentices. There is a grave danger that much indigenous knowledge will be lost with them. It should be noted that the existing knowledge based traditional healthcare system has an extensive network in all villages linking poor, rural communities. This can be easily used to develop an inexpensive but effective community based service delivery system of primary healthcare and education. Additional training of these herbals will affirm and conserve their own indigenous knowledge and skills, will add to and improve their ability to address the needs of the local community and will protect their livelihoods.

By the early 1970s the value of indigenous healthcare had been realised and some of the shortcomings of the modern system, such as dangerous side effects, were noted. This realisation generated a high demand for natural products for use as drugs, cosmetics, health food, dyes etc. A new worldwide wave of research and intervention activities is taking place with ethnobotanical, pharmaceutical and medical research. The World Health Organisation has recently published guidelines for the assessment of herbal medicine, taking into account its long presence. Intellectual property rights is an important related issue, which has direct implications on indigenous knowledge and biodiversity. India, for example, has very recently forced the US Patents and Trademarks Office to revoke a contentious patent it had granted to an American research group concerning the use of powdered turmeric (*halud*) for wound healing. Bangladesh should follow India in recognising the importance of protecting our indigenous knowledge. In its successful challenge of this patent claim, India backed up her arguments with documents from ancient *ayurvedic* literature on home remedies using turmeric. Documenting our indigenous knowledge can help to prevent biopiracy.

The conservation of our indigenous knowledge, biodiversity and natural heritage should assume paramount importance with the relentless pressures resulting in the vanishing of species, loss of genetic diversity, the disappearance of indigenous knowledge and destruction of livelihoods. There is a renewed interest in herbal systems all over the world. It is acknowledged that accessible and efficient healthcare systems are urgently needed, with the World Health Organisation launching the "Health for all by the year 2000" programme, and its adoption by national governments of less-developed countries. The age-old traditional healthcare system can partly fill this gap, if biodiversity and indigenous knowledge are preserved. This paper now goes on to report some of the results of efforts in north-western Bangladesh to introduce a participatory approach to the documentation, conservation and utilisation of medicinal plants. This programme concentrates on the under-utilised lands of villages, and aims to provide additional income to the poor with support from the International Development Research Centre and local NGOs. The programme recognises that a strong local knowledge base and rich biodiversity are valuable resources upon which a community can draw, and takes these features as a foundation for further developments.

Participatory approaches to medicinal plant conservation and use

Since over-population, agricultural expansion and over-exploitation have destroyed most of the habitats and natural populations of medicinal plants, the conservation of biodiversity should involve village, homesteads and farms. People should be reminded of the importance of biodiversity, especially the usefulness of the medicinal plants growing in and around their farmland, homesteads and roadsides. These plants should not be treated as 'weeds' and used as fuel. Indeed, the FAO Commission on Plant Genetic Resources has long recognised the role of farming communities in biodiversity and genetic resource conservation. Moreover, more than 50% of village farmers live below the poverty line and conservation should attempt to improve their subsistence and financial support through the sale of cultivated medicinal plants. This will give programmes sustainability. The team of conservationists and local NGO workers at Rajshahi have been involved in participatory documentation and conservation of local medicinal plant diversity as well as the indigenous knowledge associated with herbal medicine.

The Grameen Bank experience: We think we have something to learn in biodiversity conservation from the Grameen Bank success. Driven by a strong desire to help the poor, Dr Yunus, a lecturer in Economics at Chittagong University, in 1967 lent US$27 to 42 individuals. By May 1997 the resulting Grameen Bank had lent in micro-credit US$2 billion! About 94% of the loan recipients are poor women. It is reported that about 98% of the 4.5 million borrowers have paid their loans on time. Some salient features of the Grameen Bank system are:

- borrowers form a group;
- they have to pay a weekly instalment;
- they pay the loan as they earn;
- a defaulter is charged additional interest;
- a defaulter is persuaded by the rest of the group to be regular;
- a way out is provided if there is a valid reason for default.

The participatory biodiversity conservation programme has adopted some of these features. The advantages realised are:

- solidarity of group formations;
- conservation activities demand hard work and dedication, individuals who become fed-up can be positively influenced by others in the group;
- everyone monitors others' activities and achievements; all encourage one another;
- members share knowledge and resources, exchange seeds and seedlings;
- group activity is enjoyable and makes the work more attractive.

Sites selected: The indigenous knowledge relating to traditional medicine and medicinal plant diversity has a 'location specific' component: a particular agroecological region may have characteristic natural vegetation and a distinctive pattern of need or use of a species of medicinal plant. The customs of the inhabitants may have an impact on medicinal practice as well. Thus, it was intended that several distinct agroecological regions be included in the programme, including the Old Ganges Floodplains, the Recent Ganges Floodplains, the Tista Floodplains and the Barind Tract with its alluvial deposits.

Steps involved: As a first step, Rapid Rural Appraisal was adopted to collect first-hand information about traditional herbal practitioners and the state of the medicinal

plant diversity in each village. The names and addresses of the 'herbals' were collected. Next, a Focus Group Discussion was arranged in villages with the herbals and the medicinal plant users. As the aim is not only the collection of information and creation of a database but also to involve the villagers in long-term conservation activities, several workshops were arranged. During the workshops informal discussions and group meetings were held to introduce the concept of participatory environment and biodiversity conservation. Those villagers who were interested in working without any direct financial benefit were recruited. Groups were formed with the herbal practitioners and poor farmers of the villages. The key persons identified were trained to motivate others and to collect, identify, document and propagate medicinal plants. The idea of marketing the cultivated medicinal plants was new and should hopefully promote conservation practices. The village group suggested land suitable for medicinal plant cultivation without affecting existing cropping; mostly fallow lands in and around homesteads, crop-field edges, graveyards, roadside verges and the banks leading to ponds were selected. Some much-needed seeds/seedlings of plants were arranged as gifts or exchanged to attract villagers and to help practitioners. In several villages some herbals were provided with support to establish "demonstration gardens". These familiarised the villagers with the medicinally important plant species and also supplied plant parts and propagules (seeds, cuttings) needed by users. The gardens acted as a source of enthusiasm for the activists and provided a forum for the discussion of indigenous techniques and knowledge. By collecting different species of medicinal plants they also played the role of a 'starter' for the conservationists. Also, large-scale cultivation of medicinal plants for sale or as a source of material for agro-based small industries began in these gardens. It is expected that the growers from the villages will pool their produce to satisfy the demand of the growing market for herbal products.

Difficulties encountered: During various stages of the project's implementation different types of difficulties had to be overcome. A few of these are discussed below:

- the approach had to be initiated on a small scale and gradually expanded to give it sustainability, the village situation made it difficult to realise this in practice;
- most of the villagers and field workers found the participatory, self-help approach hard to adopt. The usual idea of working for money prevails and many immediately lost interest upon seeing no promise of cash;
- other NGOs working in the villages usually provide the villagers with cash or other direct benefits. This has conditioned the poor villagers to expect cash or kind from projects. When they heard of the different approach of this programme the villagers wondered whether the biodiversity people were taking the money. However, though it was difficult in the beginning, many came to appreciate the idea, especially the sustainability aspect;
- the logic behind the idea of conserving the environment and biodiversity for present and future generations, and providing some cash as well, only won villagers over after a long period of interaction and rapport building. They adopted the approach when they realised that we meant to have a lasting association with them;
- early on progress was slow and many workers and participants lost patience. This proved to be an obstacle to keeping 'team spirit';
- the dry season climate and the low fertility of the fallow land made growing plants difficult. Many seedlings died and seeds failed to germinate. Extra expenditure for fertilising and watering was needed;

- in some areas women are very conservative and getting them involved in the initial stages was difficult. Homestead based production in particular needs women volunteers;
- the lack of a market for the small amounts of medicinal plants produced made conservation efforts difficult. The poor villagers did not believe that their produce would find a market, resulting in a low level of input;
- the traditional herbal practitioners are not recognised by the authorities (Government or Health Department), have no opportunity for training, or any support from the government or NGOs, and thus fail to meet the needs of contemporary society.

Conclusion

Social prejudice and ignorance often account for erroneous beliefs about the inefficacy of traditional healthcare systems. The dominance of the scientific medical system has undermined and eroded the once popular herbal system. But it has now been established that many indigenous medical practices are cheaper, more appropriate, readily available and lack any side effects. There is an urgent need to document and popularise herbal medicine and conserve plant diversity. In the face of rapid loss of indigenous knowledge and biodiversity in Bangladesh, the programme reported here adopted a grassroots level approach like the Grameen Bank, to document, conserve, cultivate and utilise medicinal plants. It thus provides primary healthcare to the poor villagers, whilst supplementing their income through better management of natural resources, and preserving biodiversity in homestead gardens.

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PART 4 INDIGENOUS KNOWLEDGE AND FISH RESOURCES

15 Indigenous Knowledge of Fish and Fisheries: A Pilot Study

Nurul Islam, Antonia Reihlen, Paul M. Thompson[1]

FISH FEATURE PROMINENTLY in the lives of Bengalis. Large parts of their deltaic land disappear under the annual monsoon floods and large numbers of people turn to fishing to supplement their diets and incomes. At other times of year professional fishers, traditionally members of the *jele* Hindu fishing caste, exploit perennial waterbodies and rivers. This chapter summarises and assesses the findings of a pilot study into indigenous knowledge of fish, fisheries and aquatic ecology. Field research was carried out at two sites, both are flowing rivers located in Kishoreganj District and the fishers have free (open) access to these rivers. One is Moisharkandi-Boronpur section of the Ghora Uthra River in Mithamoin Thana. The area of this river section extends seasonally between 75 and 200 ha. The other is the Kali Nodi, which is a permanent side branch of the Meghna River. The water area extends seasonally between 800 and 1200 ha.

The study is part of the Community Based Fisheries Management (CBFM) project carried out jointly by a partnership of the International Centre for Living Aquatic Resources Management, the Department of Fisheries and several NGOs, and is funded by the Ford Foundation (CBFM 1998). The main objective of the CBFM project is to test community based fisheries management arrangements and determine if this ensures sustainable exploitation of openwater fish resources and a more equal distribution of benefits (Hossain *et al.* in press). Indigenous knowledge of fish and their ecology forms the basis for the existing pattern of exploitation and is thus the starting point for CBFM.

Methods

We employed two different methods for data collection in this pilot study: group interviews and participatory rural appraisal involving the drawing of maps. We worked with 11 groups of people, of these four comprised full-time fishers, six comprised part-time fishers (all were men as only men fish professionally in Bangladesh), the other group comprised women from a traditional Hindu fishing community who are involved in fish processing. Discussions lasted about one hour. First we asked the participants to name all the fish species they knew from their catches in the study area and to organise them into groups of fish that belonged together. The respondents usually described 5-10 different groups or categories of fish. After establishing these groups we asked the participants to tell us what the fish within each group had in common. Similarities of fish and reasons for groupings given by respondents were not restricted to biological features; economic, technical and other factors were also considered. The groups also gave information concerning spawning, fishing times, extinction of species, and sanctuaries.

In the participatory mapping we asked the fishers to map their area on large sheets of paper. They indicated the locations of the villages, fishing grounds, breeding places of fish, aquatic plants, *kata* (brushpile fish shelters — a traditional system used for attracting and catching fish), and any fish sanctuaries on the maps. The depth of water was also indicated in most of the maps. Different groups drew maps of the waterbodies representing either the monsoon or the dry season. Three groups also indicated on cross-sections of the river the depths at which fish were found. While the mapping exercises achieved their main objective of helping the fishers explain their knowledge of the linkages between fish habitats, fish, fishing and fishers, they were not a source of accurate maps (nor was this expected). Trying to make the waterbody outlines more accurate depends on the drawing skills of individuals, is time consuming, and is not critical to the fishers explanations of their fishing grounds.

Classification of fish

The participants were fully aware of the concept of classification. Nonetheless we needed to repeat several times at first what we were seeking in the grouping of the fish. The participants could see a list of fish they had reported to which they could refer when they forgot species. In Mithamoin, illustrations of common fish provided by the Thana fisheries officer proved helpful, either in remembering species or in pointing them out when local names were not known to the interviewer. Each group of fishers listed all of the species known to members in their river and then categorised them. The lists and answers were discussed constantly by the fishers. In most of the groups one participant tended to take the lead in answering after some time. We included the rest of the group by asking questions directly to persons who had not spoken recently. Progress by the groups could be confusing as fish were moved between categories when previously forgotten species were included. After some discussion the list of species seemed very clear to the fishers. However, the reasons for the classifications were more difficult to elicit and their validity is limited since possible reasons for categories were suggested (e.g. where do they live? what do they look like?) by the interviewer. In some cases the reasons appear unconvincing for the formation of a class.

Table 15.1 gives the number of species named by the different groups and the number of categories into which they were divided. The reasons for category assignment are listed broadly as ecological, economic or other. Identification to species of fish reported by local name was made using Ahmed (1953), Doha (1973) and Rahman (1989).

The different groups of fishers reported 23 to 67 different species compared with some 260 known from inland waters of Bangladesh (Rahman 1989), and categorised them into 4 to 10 groups. A comparison of the Mithamoin responses with the Kali Nodi ones shows that the Mithamoin groups gave more detailed information. The number of species and categories of fish exceed those obtained at Kali Nodi as do the reasons given for the classes. However, results of monitoring of catches in two years (1997 and 1998) indicate the reverse: 68 species recorded in Kali Nodi and only 55 species recorded in Mithamoin (CBFM project unpublished data). The traditional fishers of Kali Nodi based their categories more on technical (catch related) reasons. Muslim fishers tended to give ecological reasons for categorising fish, whereas traditional Hindu fishers also used economic and other reasons. The responses of the group of women suggest that their knowledge is comparable to men's in that they identified a similar number of species and categories.

Table 15.1: Number of species and categories of fish named by fishers with reasons for groups

Village	Group participants	No. of species	No. of categories	Reasons for grouping fish[a]		
				ecological	economic	other
1. Mithamoin	Hindu, full time fishers	23	4	9	1	0
2. Mithamoin	Hindu, full time fishers	45	9	14	11	5
3. Mithamoin	Hindu, full time fishers	51	7	14	5	6
4. Mithamoin	Muslim, part time fishers	61	10	20	14	4
5. Mithamoin	Muslim, part time fishers	67	9	20	10	12
6. Mithamoin	Muslim, part time fishers	58	9	14	8	13
7. Kali Nodi	Muslim, part time fishers	60	5	20	0	4
8. Kali Nodi	Hindu, full time fishers	50	5	9	6	6
9. Kali Nodi	Hindu, part time fishers	50	5	9	2	4
10. Kali Nodi	Muslim, part time fishers	46	4	9	2	2
11. Kali Nodi	Hindu, wives of fishers, some dry fish	47	7	6	6	6

Note: [a]Numbers in the columns under 'reasons for grouping fish' are the number of times each group used that type of reason.

Table 15.2 summarises the groups of fish. Numbers indicate the frequency with which species was placed into the category. Fish named only once are not included in the table. The fishers' classes are in some cases similar to those of science, others are not. Where morphological aspects are a major factor in the categorisation, the classes are similar to the scientific order. Channiformes, for example, were always placed in the same group; similarly eels were grouped together. They usually put shrimps into one group, but some (*Gura icha*, *Katta icha*) appear in the "*Chela/Chapila*" group.

Table 15.2: Categories of fish and their characteristics

Group	Species and number of times it was put into this group[a]	Reasons for grouping fish		
		Ecological	economic	Other
1.	***Chela, Chapila*** (11) ***Puti*** (10) ***Chanda, Dhala, Mola*** (9) ***Kachki*** (8) ***Kajoli, Kaikka*** (7) ***Shubol*** (6) ***Gura icha*** (5) *Kolisha, **Boicha**, **Aluni**, **Khorsula*** (4) *Potka, Darkina, Poa, Baila, Katari* (3) *Rani, Laacho, Bojuri, Taka, Bacha, Ghaura, Hilsha* (2)	Small size and found in floodplains, *beels* and rivers Available throughout the year	Low market price Can be sold mixed Sold in local market High demand by local consumers	Can be dried Caught by wide range of gears e.g. seine net, fencing, traps, current net, *mosari jal* (mosquito net)
2.	***Golsha*** (7) ***Batachi*** (5) ***Bojuri, Tengra, Poa, Ghaura, Bacha*** (4) *Baila, Katari* (3) *Aluni, Kanla* (2)	Poisonous spines Look similar Found at surface, in shallow water, at riverbank and	High price and exported from area. Easy to sell. Can be sold mixed. Sold dried or alive.	Tasty. Always cooked on their own.

(Contd.)

(Continued)

Group	Species and number of times it was put into this group[a]	Reasons for grouping fish		
		Ecological	economic	Other
		floodplains. Plenty during monsoon. Some live in holes.		
3.	***Tara baim, Bara baim*** (10) ***Gutl, Chikra baim*** (8) *Rani, Bel, Ghora* (2)	Live in holes and clay. Eat clay and live at bottom level. Poisonous spines. Found in *haors*, ditches, bushes, *katas*, shallow water, riverbank and floodplains.	Fetch high price as dried fish.	No processing before drying. Damage other fish when stored together.
4.	***Shol, Kal, Shing, Magur*** (10) ***Taki, Gajar*** (9) ***Baila*** (5) ***Kolisha, Mani*** (4)	Found in floodplains, *beels*, ditches. First fishes affected by fish disease (most likely Epizootic Ulcerative Syndrome). Some have poisonous spines. Live at bottom, hide in mud. Same breeding time, big, Shelter in *kuas* (ditches).	High price and easy to sell – exported from area.	Can be kept alive in very little water. Easy to catch with spear, hook, cast net, trap, seine net, and fencing. Tasty.
5.	***Bacha, Ghaura*** (8) ***Laacho*** (6) ***Pabda*** (5) ***Golsha, Shilong*** (4) *Batashi, Tengra, Kanla, Rani* (2)	Live at surface and at medium level. Some have poisonous spines. Look similar (two spines at head, white). Bottom feeder. Live together only in rivers.	High priced and exported from area. Medium market price.	Tasty and beautiful. Caught by seine net, cast net, current net.
6.	***Guchiair*** (10) ***Ayre, Boal*** (8) ***Rita, Ghagot, Chital, Pangas*** (5) *Shilong, Pabda, Rui, Catla, Mrigel, Baghair* (4) *Kural* (3) *Mohashol, Behushi, Ghagla, Nandil,* Grass carp, *Karpoo, Baush, Ghainna* (2)	Big size. Live at bottom in rivers, canals and floodplains. Bottom feeder. Some have scales. Some have poisonous spines. Some are predators.	High priced and exported from area. Price in market depends on weight of individual fish.	Caught by seine net. Always cooked separately.
7.	***Rui, Mrigel*** (10) ***Catla*** (9) ***Baush*** (8) ***Karpoo*** (7) ***Ghainna, Chital*** (6) Grass carp, ***Kural,***	Big size. White scales. No spines. Live in rivers, canals and floodplains.	High priced and exported from area. Almost similar market price. High local demand.	Caught with spear, seine net, gill net. Do not have to be sorted from other fishes when stored.

(Contd.)

(Continued)

Group	Species and number of times it was put into this group[a]	Reasons for grouping fish		
		Ecological	economic	Other
	Kanla, *Boa* (5) ***Mohashol, Nandil, Guchi baim*** (4) *Rita, Pangas, Ayre, Sarputi* (3) ***Khaila***, Mirror carp, *Baghair* (2)	Bottom feeder. Shelter in *kata*.	Price in market depends on weight of individual fish.	
8.	*Hilsha, Sarputi, Ghainna*, Silver carp (2)	Migratory, live in sea and river.	Exported.	Tasty.
9.	***Dima icha*** (9) ***Sharong icha*** (7) ***Tenga icha*** (6) *Gura icha* (4) ***Temba icha, Chata icha*** (3) ***Boiragi icha*** (2)	Need shelter. Plenty in monsoon. Live in riverbanks, floodplains, and *beels*. Can walk and eat garbage. Some live in holes.	High price and export.	Caught with traps. Shelter in *kata* (brushpiles). Can be cooked with many different vegetables.

Note: [a]species names in bold indicate the most frequent placement of that species. Only species reported by more than one group are included in table.

Some fisher groups combined classes 2 and 5, and 6 and 7. Some fish (e.g. *Rani*, *Laacho*) appear in many different categories, as different fishers gave different reasons for their categorisation. Overall the fish categories could be summarised as: category 1-small fish; category 2-medium sized fish; category 3-eels; category 4-"live fish"; category 5-medium sized fish; category 6-larger fish (mainly catfish); category 7- larger fish (mainly carp); category 8-miscellaneous fish including *Hilsha* (which is rare in these rivers), and category 9-shrimps.

Fish breeding time and places

The fishers did not have detailed knowledge of the breeding times of fish. This may be because they rarely see the eggs of the fish. If they do see them, which is more probable with small fish that seem to spawn in more accessible shallow water, they do not know to which species they belong. Only group one gave detailed information about breeding times of different categories of fish, although all were asked (Table 15.3). The breeding places are derived from the maps drawn by the fishers.

Threatened species

All groups mentioned *Pangas*, *Nandil* and *Taka* as extinct or endangered (Table 15.4). Some named fish that have been extinct for a long time (e.g. *Kural* 20-30 years, *Mohashul* 25 years). This shows that knowledge of fish reaches back at least to when the fishers were young, and that knowledge passes on from parents to children. Extinction is mainly associated with environmental causes, largely the falling water level. No group mentioned over-fishing, and use of destructive gear was cited as a cause only once.

Table 15.3: Fish breeding times and breeding places

Group	Breeding times	Breeding places
1. Mithamoin	Catfish (medium-large): Feb.-Apr. Catfish (small): Apr.-Jun. Snakehead: Apr.-Jun. Shrimp: May-Jun. Small fish: May-Jul.	—
2. Mithamoin	Spawning at full-moon.	Small fish breed mostly in floodplains close to the river and in areas with plants, also in shallow water of *beels* and riverbanks.
4. Mithamoin	—	Small fish breed close to the river in areas with plants.
1. Kali Nodi	All species: Mar.-May.	Large fish spawn in deep water.
2. Kali Nodi	—	Close to riverbanks, places with little current.
4. Kali Nodi	—	Small fish breed in shallow water in plant clusters.

Table 15.4: Extinct fish species and reasons given

Group	Extinct species	Time extinct	Reasons
1. Mithamoin	*Pangas*	5 years	Lack of food (snails/*shamuk*) because the riverbed is shallower.
	Taka	20 years	New seasonality of *beels* and floodplains (water-loss because of irrigation, siltation etc.)
	Shilong		Tides now weaker in the monsoon due to reduced depth and current in rivers (deep-water fish).
	Nandil		
	Mrigel		
6. Mithamoin	*Nandil*	15 years	
	Taka	12 years	
	Mohashul	25 years	
	Kural	30 years	
	Pangas, Koi, Meni		Very few are caught.
	Guchi-Ghagot		Very few are caught.
2. Kali Nodi	*Nandil, Mohashul*	20 years	
	Boro Potka	25 years	
	Kural	10 years	
	Ghora, Pangas		Few are caught, declining for 8 years.
3. Kali Nodi	*Pangas, Nandil, Taka, Ghora*		They are deep water fish and the water level is decreasing.
4. Kali Nodi	*Pangas, Nandil, Taka, Ghora, Potka*		Due to the Farakka barrage at the Indian border and use of destructive gear (gill nets with small mesh).

Fish habitats

The information in Table 15.5 was derived using a standardised cross-section of a river and by asking the fishers to indicate where the fish live, not where they are caught or where they feed. Probably the fishers based their groupings of fish by preferred water depths from the gears they use and the depths reached with those gears. Different groups of fishers had conflicting ideas about which parts of the river they found fish in. Only a few species were placed into the same habitat by all the groups (e.g. *Kaikka, Puti, Chital*). More data is needed to verify the trends indicated here.

Table 15.5: Preferred water depths reported for different fishes

Top level[a]	Medium level	Bottom level
Kachki, Chela, Darkina, Chanda, Kaikka, Puti, Poa, Mola, Batashi, Pabda, Ghaura, Baush, Tenga icha, Dima icha, Sharong icha, Gura icha, Boal, Kajoli, Kolisha, Koi, Ghainna, Rani, Laacho, Kanla, Meni, Magur, Shing, Tara baim, Shilong, Baila, Taki, Chikra baim, Guti	*Bashpata, Laacho, Catla, Sarputi, Ghainna, Karpoo, Golsha, Icha, Poa, Baush, Catla, Boal, Mola,* Grass carp, *Ayre,* Silver carp, *Shol, Pabda, Ghaura,* Common carp	*Kajoli, Rani, Gila Kani, Baila, Shing, Koi, Magur, Chital, Ayre, Guchiair, Ghagot, Pangas, Shilong, Rita, Mrigel, Guti, Tara baim, Chikra baim, Icha, Kural, Dima icha, Kachki, Batashi, Tenga icha, Hilsha, Potka*
(Chapila, Bacha, Rui, Tengra, Gajar, Golsha, Chanda, Boro baim)	*(Chapila, Bacha, Rui, Tengra, Gajar, Golsha, Chanda, Boro baim)*	*(Chapila, Bacha, Rui, Tengra, Gajar, Golsha, Chanda, Boro baim)*

Note: [a]Species in parenthesis were placed in all three depth categories.

Fishing gears

Information about gear use was derived from maps. The groups pointed out places where they used each gear (e.g. *katas*). Only the most frequent gears were listed (Table 15.6), and categories (types) have been cross-checked with Ahmed (1970). A wide range of gears was used in the two areas. For fishing in the floodplains, fishers in both Mithamoin and Kali Nodi use different gears from those they employ in the rivers. The types of gear used differed between groups in the same river, but it is not clear if this is the result of traditions, lack of money to buy new gears, or a tactic for exploiting local fishing niches.

Table 15.6: Local names of fishing gears used in floodplains and rivers

Type of gear	Rivers		Flood plains	
	Mithamoin	Kali Nodi	Mithamoin	Kali Nodi
Seine/Drag net	*Goira jal, Pine jal, Pine ber, Khuna ber, Ghana ber, Gaitta jal, Dhani jal, Sandi jal, Jhapa jal, Gumaber, Katchitana jal.*	*Moshari jal, Konaber, Patan jal, Pine jal, Harhari jal, Ghana jal, Kachiber, Pine jal, Rana jal, Patni jal, Moi jal*	*Goira jal, Pine jal, Pineber, Khuna jal, Dhani jal, Gunaber, Katchkata jal, Sandi jal.*	*Atra jal, Ghana jal/Atta jal, Kachber, Pine jal, Rana jal.*
Gill net	*Pera jal, Current jal*	*Patni jal, Moi jal*	*Pera jal, Current jal*	*Fash jal, Current jal, Patni jal, Moi jal*
Cast net	*Uthar jal, Jhaki jal*	*Ram jal*	*Uthar jal, Talla jal*	
Hook and Line	*Borshi*	*Borshi*	*Borshi*	*Borshi*
Trap	*Chai*		*Chai*	
Set bag	*Harhari, Bhim, Baim jal*			*Harhari jal*
Lift net	*Jali*		*Jali*	
Spear			*Juita, koach*	
Fencing			*Patibund*	

Experience with sanctuaries

There was a fish sanctuary in the river in Mithamoin from 1994 to 1996. The fishers reported that it benefited them; they caught more large fish than before (e.g. *Ayre, Boal, Baush, Icha, Chital, Ghagot*) and more shrimp in areas outside the sanctuary. The sanctuary ceased when governmental support ended, but an aim of the CBFM project is for fishers to themselves take up such initiatives where they perceive a benefit. The fishers reported that *katas* are good shelters for big fish, but small fish are seldom found there. The fishers suggested that a sanctuary in future should be located at a place with little current and shallow water. In Kali Nodi there had also been a sanctuary, but the fishers did not obey the rules requiring them to only harvest it once a year. Few of the fishers had any idea about fish sanctuaries, but they agreed that sanctuaries result in an increase in large fish nearby. The fishers recommended areas with weak currents, deep water and little disturbance by river traffic for future installation of a sanctuary, and indicated that the main purpose of a sanctuary should be to protect fish breeding grounds.

Fishing times

Most of the survey participants said they fish at night because fish then come to the surface of the water (Table 15.7). Here they can be caught more easily using shorter nets. Full moon is believed to bring fish to the surface even more. However, one group of fishers did not agree with that and said that fish are afraid of too much light. During the day bigger fish are caught. Fishing between high and low tide in the dry season and at low tide during the monsoon indicates that better catches are achieved at low water levels.

Table 15.7: Fishing times

Group	Fishing time	Reason
Mithamoin	Night Full moon, low tide, thunderstorms, moonshine	Fish gather at top level at night: no disturbance by boats, it's quiet, fish "enjoy leisure time", small fish eat at night, plenty of fish.
Kali Nodi	Night Full moon (between high and low tide in dry season, at low tide in monsoon) Little moonlight Jun.-Oct.	No boats, no disturbance by people: fish come to the top (nets of short length can be used). Fish surface when they see the light, and there are plenty at the top. Fish are at the bottom at full moon because they are afraid of the light. *Kachki, Chapila*, and *Puti* caught using *ram jal, felun, atra-jal*. Plenty of small fish at the top which do not come to the upper level in sunlight.

Conclusions

Participatory rural appraisal can help document and promote the use of existing traditional knowledge (e.g. local ideas on conservation, fishing, and sanctuaries). Regarding the methodology used, we make the following observations for future studies. It would be more efficient if researchers draw the outline of any waterbody on large sheets of paper before the group meeting. They can explain the map to the fishers and this would allow more time to add detailed information, and would help standardise for drawing skills. On the outline map the fishers could be asked to indicate villages, *beels*, fishing grounds, aquatic plants, fish breeding places (which

species, when?), *katas* and sanctuaries, gears used (specific places), and other water uses (such as irrigation pumps, bathing places etc.).

A visual approach could be tested to simplify and hasten the classification of fish. Images of the most common species copied from books and posters could be cut out and pasted on card. This would help the fishers in categorising fish by moving around the cut-outs, would help ensure more equal participation of all fishers, and would make the process more efficient. Discussion of indigenous knowledge of fish could be structured around four main issues:

- Biological, relating to habitat, physiology, breeding etc.
- Economical, relating to prices, marketing etc.
- Technical, relating to fishing methods, processing, conservation etc.
- Other, relating to cooking methods, other uses of fish (medicine) etc.

There is a need for similar studies in a wide range of waterbodies and fisheries since there are large variations between regions, fisher communities, and other factors such as NGO activities. More importantly, indigenous knowledge also includes any unwritten rules and rights that traditionally govern access to and use of the fisheries. Involving local fishers in participatory planning for improving and formalising management systems should be based on an understanding of these traditional practices and local knowledge (Berkes 1998). Understanding traditional fishing practices and ecological knowledge will be useful in reaching local agreements to ensure sustainable fishing. It would be valuable to involve NGOs at the grass roots level in playing a role, from which they can go on to further community development and resource management. We should encourage communities to share their knowledge with participating organisations, so that improvements in planning and resource management of fisheries can advance from local ecological knowledge, practices and institutions. Development organisations also need to be flexible in incorporating local arrangements and indigenous knowledge in any projects and management improvements. Projects should have provision to exchange results of monitoring of catches, species diversity, disappearing species, indicator species and other biological aspects of the fisheries and their development with fishers, in addition to coming to grips with related indigenous knowledge, to give this a scientific reference.

Notes

1 ICLARM Contribution No. 1525.

16 Fresh Water Fisheries of Bangladesh: Issues of Sustainability

D. Mazumder, Z. Samina and T. Islam

IN THE AGRO-BASED ECONOMY of Bangladesh fish and fisheries play an important role in determining food security, nutrition and the income of marginal people. Due to intensive pressure on open water areas for food and income the total catch has declined and the habitat changed. Development initiatives to increase production are a potential cause of further ecological degradation. Aquaculture is considered to increasingly meet demand for food, though the technological constraints, as well as the growing presence (60%) of non-native species in ponds, need to be carefully considered to ensure the sustainable use of resources.

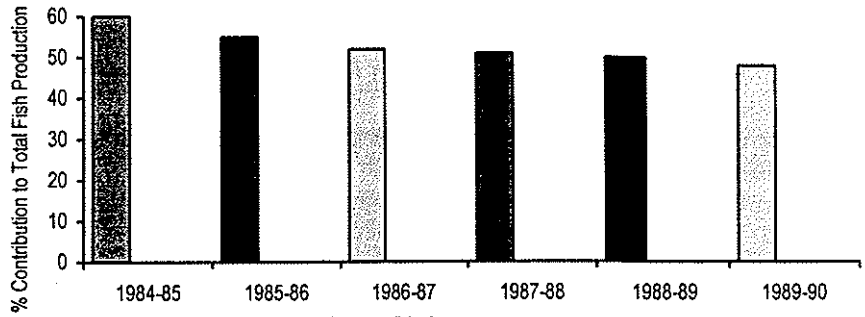
Fish is the world's fifth largest food resource and account for 7.5% of total global food production. About 100 million people in the developing world depend on fishing as their primary source of protein (Seshu *et al.* 1994; FAO 1995). Bangladesh has highly diversified fishery resources, with many species. The fisheries account for 80% of Bangladesh's total protein intake. The sector provides full-time employment for about 1.4 million people, and an additional 11 million people are involved in part-time fishing. The necessity for sustainable fisheries is now recognised with the decline in open water fish production due to resource depletion. The gap between supply and demand for fish has widened with a decline in production and an increasing human population. The per capita fish consumption has decreased and the fisher community has become impoverished.

Inland open water fisheries

Inland open water includes rivers, canals, flood plains, *beels,* lakes and reservoirs. In the past fish were abundant in open water. Rahman (1989) describes 260 species of fresh water fish in Bangladesh, the majority of small and medium size, widely distributed in the open water systems. The country has one of the largest floodplains in the world. Some 2.8 million ha. retain water for 4-7 months of the year. These floodplains provide good breeding and grazing grounds for many species and play an important role in repopulating the open water fish systems, including those of rivers and estuaries. The open water fisheries contribute substantially to fish production, and to the income of the rural poor of Bangladesh who are heavily reliant upon these for their subsistence (Ahmed 1997). The fishing communities have evolved highly effective technologies and knowledge systems over generations for the efficient exploitation of this resource. They were largely sustainable. Detrimental changes have occurred due to outside interference and ignoring indigenous knowledge and experience of fisheries.

Over the last decade the country's population has risen rapidly. Consequently the need to increase crop and fish production has become a priority. The pressure on open

water resources has increased tremendously in the absence of diverse economic activity in the country. Resources have been exploited heavily and fish production from the open water systems has seriously declined due to overuse and the range of species has changed (Tsai and Ali 1985; see Figure 16.1). Over the same time period fish habitats have decreased with people bringing floodplain areas into crop production. In addition, the use of pesticides and chemical fertilisers has increased, keeping pace with crop production, the cumulative effect adversely affecting open water fisheries. Annual fish production from the floodplains fell causing a decline in riverine fish populations as their breeding stock was disrupted with the intense pressure placed on open water systems (Mazid and Gupta 1995). The social impact of these ecological changes has been considerable. For example, Mazumder (1998) reported that a fisher community was displaced from the *beel* area of Churamonkathi in the Jessore region due to a decline in the availability of small, native species of fish.



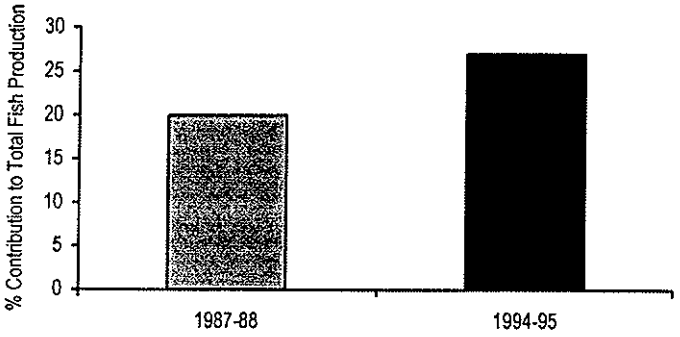
Source: *Department of Fisheries, Dhaka*.

Figure 16.1 *Decline in open water fish production*

In recent years, the Government has initiated programmes to boost fish production from open water systems through stocking fingerlings. The species selected for this were exotic and indigenous carp. The idea was to ensure the optimum utilisation of all the food niches in the open water system. Various reports have suggested that open water fish production increased slightly after the introduction of these fish species. Data from Hail Haor in Sylhet shows that the carp content in fish catches increased from 16.7% in 1990-91 to 30.8% in 1991 and 28% in 1992-93 (Jhingran 1997). This increase indicates that stocking can improve open water fish production, although the issues surrounding the long-term impacts of introducing exotic species into open water systems has yet to be assessed. It remains unknown whether these exotic fish species will harm native species over time. The impact of such introduction depends on the numbers of fish introduced, their size, and their ability to adapt to the new ecosystem and develop a breeding pattern in open water. In open water ecosystems the aquatic vegetation provides an ideal breeding ground for many of the native fish species. These habitats could be damaged by grass carp (*Ctenopharyngodon idella*), for example, due to its herbivorous feeding habits, or silver carp (*Hypophthalmichthys molitrix*) which feed on plankton, thereby competing with the native *catla* (*Catla catla*) for food and space. Both exotic fish have been introduced into open water systems to boost production. More attention should be paid to local knowledge of these issues and observations of changes in fisheries over time, and peoples' explanations of them.

Aquaculture

Aquaculture has been looked to, to help meet an increasing demand as open water catches are failing to meet fish requirements. In Bangladesh there are 146,890 ha. of ponds, 5,488 ha. of ox-bow lakes, 140,000 ha. of brackish water and 8 million ha. of paddy fields in which aquaculture could be undertaken. The potential of aquaculture in these water bodies is considerable (Mahabubullah 1983; Ahmed 1992; Shah and Townsley, this volume). Aquaculture is now considered an increasingly important source of protein and income for the people of Bangladesh. It is not a new technology however; people have maintained ponds for generations and have a rich heritage of knowledge pertaining to cultured fish production.



Source: *Department of Fisheries, Dhaka.*

Figure 16.2 *The contribution of aquaculture to national fish production over the past decade*

The issues of concern surrounding the further development of aquaculture include equity, technological constraints, the stunted growth of cultured carp and the use of exotic fish species. Aquaculture depends heavily on the supply of fish from hatcheries, but due to inbreeding, stocked fingerlings often fail to grow well in ponds. This reduces production and income generation from aquaculture. Small indigenous species are generally considered "weed fish" in culture ponds and are invariably eradicated because they are thought to compete with stocked species for food and space. The present introduced techniques of pond preparation have an adverse effect on these small species. Small indigenous species were found in 97% of ponds where only netting, the indigenous technique, was used to eliminate unwanted fish species, while they were found in only 22% of ponds where pesticides were used (Mazumder 1998). The introduction of exotic species of fish into ponds is another concern. About 60% of the stocked fish species are exotic and dominated by silver carp (Mazumder 1998). While aquaculture has the potential to increase food supply and help improve nutritional intake in Bangladesh, it is important to consider all related issues to ensure appropriate and sustainable use of resources. Where indigenous techniques are less harmful to the ecosystem and maintain a balanced and productive habitat, it seems reasonable that they should be used. We need to learn more about these indigenous practises and how they might be advanced upon to improve sustainable production.

Conclusion

An increase in fish production is not necessarily an indicator of sustainability. Fish production may increase through introduction of foreign species to an aquatic system, but the costs may be high due to the resulting loss of biodiversity. The careful screening of the ecology of fish is an important prerequisite for any development initiative relating to aquaculture. It is necessary to consider whether the increasing presence of exotic fish in the ecosystems disadvantages farmers by reducing the species available to them. In order to ensure the sustainable use of aquatic resources it is important to consider the knowledge of the local people whose livelihoods have depended on these resources for generations. The involvement of the local people in the planning and management processes is integral to the success of any intervention.

17 An Indigenously Developed Pond Aquaculture System

Wajed A Shah and Philip Townsley[1]

THE POTENTIAL FOR INCREASING fish production in Bangladesh through aquaculture development in the country's many under-utilised ponds, ditches and small waterbodies has often been noted. Estimates put the total area of "culturable" waterbody at about 150,000 ha. of which only about 50% is utilised for aquaculture (Nuruzzaman 1992). An attractive feature of many of these waterbodies is that they are located close to people's homesteads and may be owned by families that are otherwise landless (FAP 17, 1993). In spite of considerable efforts by development and extension agencies, the great potential of aquaculture for increasing the protein consumption and incomes of rural households has not been realised. The case study presented below describes an aquaculture system developed without intervention from extension agencies, by a community on the floodplain of the Jamuna River. The system is responsive to local conditions, indigenous knowledge and to the technical capabilities and requirements of its practitioners. In particular, it appears to overcome some of the technical, social and economic constraints commonly identified as impeding aquaculture development.

Study site

Saturia Thana, located about 50 kilometres Northwest of the capital, Dhaka, is one of the most densely populated areas in Bangladesh. In a predominantly agricultural economy, levels of landlessness stand at over 50%. The twin villages of Bhatara and Char Bhatara, connected by road with the main Dhaka highway, support approximately 300 households made up of several distinct groups. About 200 households live primarily by farming, but a large group of about 100 households have worked for several generations as *nikari* 'fish traders'. It is within this latter group that aquaculture has, over the past decade, taken root. This development began in the 1950s when many of the traditional Hindu caste-fishermen in the area left the country for India. An employment niche was left vacant which Bhatara people, already involved in the fisheries sector, were quick to fill. The complex of wetlands which surround the village are still extensively fished by villagers, but are steadily disappearing due to siltation and changes in flooding pattern caused by roadways and settlement.

The fish culture system

In the 1980s a more or less chance combination of events initiated the development of aquaculture in the community. A villager with previous experience of fish culture whilst living in another district was repaid a loan in the form of fish fingerlings. Although early experiments met with limited success, a system was developed which functioned remarkably well, given the types of waterbody available in the area, and has since spread not only within the community but also to neighbouring villages.

Like most pond aquaculture systems in Bangladesh, the system in Bhatara is based on the polyculture of the Indian major Carps (*Labeo ruhita, Cirrhinus marigala, Catla catla*). It is notable for the degree to which it makes intensive use of existing water resources and integrates the production potential of some waterbody types with the input requirement of others. While some households have been able to carry out all stages of the fish culture cycle in a variety of ponds and ditches, others have specialised in particular stages of the cycle. Such activity, whether producing fingerlings or fish for consumption, integrates well with the fish trading activities that constitute the "traditional" livelihood of many of the households in the community.

The fish culture system in Bhatara can be divided into two stages: the nursery stage, which produces fish fry or fingerlings for stocking in other ponds; and the subsequent grow-out stage, aimed at the production of fish for the consumer market. The nursery stage is further divided into a primary stage (raising fish spawn to fish fry) and secondary stage (raising fish fry to fingerlings).

The primary nursery system generally utilises very small ponds located close to homesteads. The average size is 0.032 ha. Often these ponds are simply the borrow-pits from which soil for the raised homestead mounds was excavated to render them suitable for habitation. Most nurserers carry out multi-species fry production at the primary nursery stage although some concentrate on single species. The most commonly followed steps for primary nursery production are as follows:

- ponds are drained in early April at the end of dry season and left dry for about 15-20 days;
- where irrigation is available, water is pumped into the pond to a depth of 1.5-2 feet, (otherwise nurserers must wait for the first rain in late April or early May);
- ponds are poisoned for predatory insects and the following day limed at a rate of 16.46 kg/ha., fertilised with urea at 110 kg/ha. and manured with oil cake at 38.42 kg/ha.;
- one week after fertilisation, the pond is netted to remove frogs and insects;
- after netting fishermen collect wild spawn to stock ponds from the Jamuna River, about 25 kilometres west of Bhatara;
- fries are fed and reared for 16-20 days in the primary nursery, then sold to other culturists or used for stocking the owner's secondary ponds.

Villagers use numerous variations on these steps. Nurserers experiment to identify the best methods for their particular ponds, and establish relationships between rates of stocking and mortality, depth of water and survival, feeding patterns and the growth of fries. Some nurserers experienced serious losses in fry production. However, the number of nurserers is increasing steadily in response to demand as more local people take up aquaculture and because nursery systems can be established in smaller, more commonly available ponds. Fingerlings grown out from wild-collected spawn are generally regarded as superior to hatchery-produced fry.

Local methods of fingerling production in the secondary nursery system are not those generally recommended by extension agencies. Nurserers reported that the 'recommended' nursery technology is expensive and technically difficult to implement in rural conditions. The management methods used in secondary nursery production have developed through experience and observation. Secondary nursery production in Bhatara follows the same methods as the primary nursery system, but stocks fry,

caught wild or bred in primary nursery ponds, and raises them to fingerling size to stock in grow-out ponds. Pond preparation is the same as in the primary nursery system. The size of secondary nursery ponds ranges from 0.08 to 0.16 ha. with a greater water depth than primary nursery ponds. Secondary nurseries produce stock both for the owner's grow-out ponds and for sale to other fish culturists. Villagers are aware of the risks associated with nursery production. The high mortality in fry/fingerling production has taught culturists the importance of adequate pond preparation. If successful, the returns are higher than crop production from the equivalent area of land, but if unsuccessful a considerable investment is lost. Despite the risks few culturists have abandoned this activity and two-stage nursery production has expanded so that the village has become an important local centre for fish, fry and fingerling supply.

The grow-out stage of the fish culture cycle is widely practiced in Bhatara and is conducted using a variety of input levels, stocking and management regimes. The methods employed are determined as much by the economic circumstances of a household as by their technical knowledge. Multi-species pond culture, stocking fingerlings from local nursery ponds and those caught by fishermen, is most common. Overstocking seems to be the rule but no set standards are followed. Results seem to satisfy those involved even if they do not represent the optimal yield from the available resources.

Table 17.1 shows the cost and returns for one pond operator carrying out all these stages of the culture system in different ponds (primary and secondary nursery and grow-out).

Table 17.1: Cost and return analysis of integrated primary/secondary nursery and grow-out operation in Bhatara village, 1993

Fry production	Taka/acre	Fingerlings	Taka/acre	Grow-out	Taka/acre
Clean & de-watering	577	Pond preparation	1,250	Pond preparation	1,707
Poison & liming	375	Fries	8,756	Fingerlings	8,176
Fertiliser & netting	756	Feed & fertiliser	634	Feed & fertiliser	3,300
Spawn egg	4,000	–	–	Netting & caring	2,200
Feeding	346	–	–	Rent	10,000
Rent of pond	1,900				
Total cost	**7,954**	**Total cost**	**10,640**	**Total cost**	**26,184**
Gross benefit	18,900	Gross benefit	24,000	Gross benefit	159,950
Gross Margin	**10,944**	**Gross Margin**	**13,360**	**Gross Margin**	**133,766**
BC Ratio	1.37	BC Ratio	1.25	BC Ratio	5.0
Rearing 1 month	–	Rearing 1 month	–	Rearing 9 months	–

Constraints and local solutions

Following years of research and extension work in aquaculture (Rahman 1986; Mazid 1993; Gill and Motahar 1982), it is widely accepted that the primary constraints on aquaculture development are social and economic rather than technical. A recent workshop on NGO involvement promoting pond fisheries and aquaculture identified the following constraints to widespread fish culture development: the supply of fish fry and fingerlings at the farm level; technology transfer; access to ponds and

waterbody resources and multiple ownership of ponds. These constraints are discussed below:

Supply of fish fry and fingerlings: Villagers in Bhatara seem to have overcome this obstacle. Their experience in fisheries may have enabled them to acquire the necessary understanding of the biological cycle of cultivable species. Whilst a good local supply of wild spawn as a primary input is important, long-term dependence on natural sources of fish spawn seems unlikely. It is likely that similar development will occur in other areas as demand increases. In some areas of Bangladesh, small-scale hatcheries have developed in response to the growing demand from fish culturists.

Transfer of technology: Since its introduction eight years ago, aquaculture in Bhatara has steadily increased. The success of the technology and improved earnings for aquaculturalists has encouraged the transfer of technology.

Waterbody access: In Bhatara, as elsewhere in Bangladesh, the spread of aquaculture is limited by a lack of available waterbodies. This seems to contradict the widely believed idea of many unutilised waterbodies. Floods affect large areas of lowland Bangladesh and discourage investment in aquaculture. This is not to say that flooded ponds or ditches are not exploited, as when the flood recedes, leaving waterbodies stocked with wild fish, local people are quick to take advantage. In some cases, these stocks are improved by adding fish feed, providing artificial shelters for fish and by additional stocking of fingerlings. Flood prone ponds aside, the number of available waterbodies are few. In villages like Bhatara, there are scarcely any ponds available for further development. When the first household took up fish culture in the village, there was a choice of ponds. Today, owners of ponds realise the potential of these resources. Consequently terms of leasing are becoming less advantageous with lease-periods becoming shorter. Often owners will only lease ponds to local fish culturists for one year so that the pond is re-excavated and improved after which time the owners will take it over themselves. In the long term many small and medium landowners will probably acquire the necessary skills to manage their ponds themselves. But experience in Bhatara suggests that possibilities for experienced non-pond owners to become involved in aquaculture activities may exceed available resources. The tenure arrangements discussed below highlight this point.

Multiple ownership: Outsiders commonly perceive the multiple ownership of ponds as a potential constraint since disagreements over sharing of benefits and management responsibilities are common. While problems have undoubtedly occurred in Bhatara with regard to both these, it seems that local people are generally able to work out arrangements that overcome tenure problems. Although some 16 different tenure arrangements for culturable ponds and ditches were encountered in the village of Bhatara alone, in terms of their essential characteristics, they can be reduced to four principle systems:

1. *Share system*: The share system for pond fisheries essentially mirrors sharecropping in agriculture. All the production costs and labour is provided by the fish culturist/share-cropper. The harvest is then shared between him and the pond/landowner. There is no cost involved for the pond-owner. The exact rate at which the crop is shared between the two parties varies considerably depending primarily on the condition of the pond. If it requires much work in order to make it usable for culture the owners share decreases. The maximum and minimum shares going to the pond owner are generally 50% and 25% respectively.

2. *Kot system*: The word *kot* is a local term for 'contract'. Contract periods range from one to six years and the pond owner or owners decide the terms. *Kot* holders reported that, under this arrangement, pond owners rent out only those ponds that require investment like re-digging, pond embankment raising and so on before stocking. The pond owners' interest is essentially to have the pond prepared for them so that at a later date they can take up aquaculture activities themselves. The length of these contracts is steadily reducing, as mentioned above.
3. *Lease system*: In this system, government-owned *khas* ponds are given on lease to private parties, generally through an open auction. Preferential bidding rights can be given to special groups, such as co-operatives, community groups or landless associations, but they usually go to the highest bidder. In bidding, contacts with local bureaucrats and political influence tend to dictate who may obtain the lease. While much has been made of the potential to redirect the benefits from aquaculture towards disadvantaged groups such as the landless (and some very successful programs have been instigated) the scope for this is limited by the relatively small number of *khas* ponds available.
4. *Dow ani system*: This system appears to be a local innovation by the fishermen and fish traders of the study area. The word *dow* means two, and *ani* comes from *anna* meaning one-sixteenth of a taka. Thus *dow ani,* meaning one-eighth, refers to the share taken by the fish culturist under this arrangement. In this system, the fish culturist essentially sells his expertise and labour in return for a 12.5% share of the total harvest while the pond owner bears all the costs of production. The *dow ani* share holder guides and advises the pond owner as a consultant. This system seems to be gaining popularity in neighbouring villages.

Prospects and Opportunities

The Bhatara case study illustrates several important points regarding the development of aquaculture in rural Bangladesh. Firstly, in spite of technical and social problems, where there is a market for fish, and an availability of inputs and suitable environmental conditions, aquaculture will probably develop. Concern about the "slow pace" of aquaculture development may reflect an unrealistic set of expectations among development workers rather than reluctance or tardiness among potential fish farmers. Secondly, while social problems such as pond tenure and multiple ownership have correctly been identified as important constraints, such problems can be overcome when the people involved can clearly see the benefits to be gained. Local fish culturists in Bhatara recognise the problems citing the political and social manoeuvres sometimes necessary to obtain access to waterbodies. In the long run the problem of access may create difficulties for landless people and non-pond owners who want to become involved in fish culture. As the potential benefits of aquaculture become apparent, pond owners are liable to become directly involved in culturing their own ponds. Thirdly, the development of the *dow ani* system in Bhatara shows that potential may exist for trained and experienced landless people to make a living through their technical expertise in aquaculture. The potential for using such experienced local people as extension agents should also be considered. While many of the factors influencing the development of aquaculture in Bhatara are probably specific to the region and its people, the case has implications for the development of aquaculture in the country as a whole and illustrates the resourcefulness of rural people and their

capacity to build on indigenous knowledge when they perceive clear benefits from a new activity.

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