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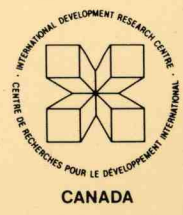
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# Reservoir Fishery Management and Development in Asia

Proceedings of a workshop  
held in Kathmandu, Nepal,  
23-28 November 1987

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Proceedings



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## **ABSTRACT**

This publication presents the results of an IDRC-funded workshop held in Kathmandu, Nepal, 23-28 November 1987. Representatives from 15 countries reviewed the status of reservoir fishery research in Asia under the following topics: existing fisheries, limnological aspects, biological and resource aspects, management aspects, and culture. Papers were presented on these topics, but the discussion sessions were the main element of the workshop. Summaries of these discussions as well as a series of general recommendations that were generated during the final discussion are presented in this book. The potential for increased fish production in reservoirs and the need for early involvement of fisheries scientists in the planning and preimpoundment studies before dam construction are emphasized.

## **RÉSUMÉ**

Cet ouvrage présente les résultats d'un atelier financé par le CRDI à Katmandou, au Nepal, du 23 au 28 novembre 1987. Des représentants de 15 pays ont examiné l'état de la recherche sur l'élevage du poisson en étangs en Asie, en particulier les aspects suivants : les systèmes actuels, les aspects limnologiques et biologiques, les ressources, la gestion et l'élevage. Des exposés ont été présentés sur ces sujets, mais les discussions ont été l'élément le plus important de l'atelier. L'ouvrage présente également un résumé des discussions ainsi que les recommandations générales issues de ces discussions. On met l'accent sur la possibilité d'augmenter la production de poissons en étangs et la nécessité pour les ichtyologistes de participer très tôt aux études de planification, notamment de la mise en étangs du poisson, qui précèdent la construction d'un barrage.

## **RESUMEN**

Esta publicación presenta los resultados de un taller auspiciado por el CIID en Kathmandu, Nepal, del 23 al 28 noviembre de 1987. Representantes de 15 países analizaron el estado de la investigación sobre pesquería asiática en embalses desde los siguientes ángulos: pesquería existente, aspectos limnológicos, aspectos biológicos y de recurso, aspectos de manejo y cultivo. Las ponencias versaron sobre estos temas, pero las sesiones de discusión fueron el principal elemento del taller. Este libro ofrece los resúmenes de estas discusiones, así como una serie de recomendaciones generales emanadas de la discusión final. Se subraya el potencial para incrementar la producción pesquera en embalses y la necesidad de una participación temprana de los científicos del área en la planificación y los estudios de apropiación que anteceden a la construcción de represas.

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## THE NEED FOR RESERVOIR FISHERY MANAGEMENT IN BANGLADESH

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**Abstract** Fisheries is second only to agriculture in the overall economy of Bangladesh, contributing 2.9% to the gross domestic product and accounting for over 9% of the nations' foreign exchange earnings. The total fish production of Bangladesh has declined over the past 10 years for the following reasons: increased fishing pressure and lack of proper management practices; sedimentation of rivers and elimination of fishing grounds; large-scale reclamation of land for agriculture; etc. The primary source of fish production is the open-water capture fisheries in rivers, estuaries, seasonal floodplains, and natural depressions and man-made reservoirs. It is estimated that open-water capture fisheries covers an area of 4,268,740 ha. Man-made reservoirs in Bangladesh have a surface of 58,300 ha and an average production of 46 kg/ha. There are 31 commercially important species of which 5 are exotic. Oxbow lakes cover an area of 5488 ha and have an average yield of around 150 kg/ha. In some oxbow lakes, fish production has been increased by blending aquaculture techniques with fisheries management. As the habitat is continuously reduced there is a need to formulate a sound management program. Important considerations include the following: enforcement of fishery legislation; environmental engineering to improve the habitat; introduction of fish stocking and biological management programs. Realizing the need for sustained, increased fish production, the Fisheries Research Institute, Mymensingh, Bangladesh, is undertaking a comprehensive research program.

Bangladesh is essentially a huge delta (143,998 km<sup>2</sup>) formed by three main rivers, i.e., the Padma (Ganges), the Jamuna (Brahmaputra), and the Meghna, and their tributaries. The watershed of these rivers exceeds 1 x 10<sup>6</sup> km<sup>2</sup>. In addition, the annual monsoons inundate approximately 49,000 km<sup>2</sup> from June to September, resulting in vast floodplains.

Fisheries, which is second to agriculture in the overall agrobased economy of Bangladesh, supports an estimated 1.1 x 10<sup>6</sup> full-time and over 10 x 10<sup>6</sup> part-time fishermen. Fisheries accounts for about 2.9% of the gross domestic product (GDP) and more than 9% of the nation's foreign exchange earnings. Fish account for about 6% of the per capita protein intake and about 80% of the animal protein intake of the people.



The total fish production in Bangladesh, in 1984/85 was estimated at 773,000 t, of which inland fisheries accounted for 588,000 t (76%). The daily fish consumption was estimated at 21 g/person in 1983/84; in 1963/64, the daily consumption of fish was 33 g/person. This decline in consumption is due to a decline in the total fish production (inland fisheries). There are four main reasons for this decline. First, there has been an increase in fishing pressure and a lack of management practices. Second, short-sighted leasing policies of public water bodies have led to overexploitation of fish resources. Third, sedimentation of rivers and canals has resulted in changes in water current velocity, the elimination of some spawning grounds, etc. Fourth, the ever-expanding flood-control and drainage programs have reduced the water area by 360,000 ha and, when fully implemented, will have diminished the total water area available by  $2 \times 10^6$  ha; it is estimated that this loss of water area would decrease fish production by 250,000 t. Despite these problems, the combination of tropical climate, alluvial soils, productive waters, and vast floodplains helps Bangladesh to rank third in the world in inland fish production.

Because of the limited protein sources in Bangladesh and the reliance on freshwater fish as the main source of fish for domestic consumption, increasing inland fish production has become a priority in fisheries planning. By the year 2000, the population of Bangladesh will reach  $128 \times 10^6$ , placing pressure on existing fisheries to increase production. If the present daily consumption of 21 g/person is maintained, an extra  $1 \times 10^6$  t will be required. Available information suggests that the potential for expansion of marine and estuarine fisheries is limited. Therefore, the bulk of the increase in production must come from inland waters (Table 1).

The objective of the second 5-year plan of Bangladesh (1980/81 to 1984/85) was to increase fish production from 650,000 to 1,000,000 t. The estimated total fish production of 773,000 t in 1984/85 indicates that only 35% of the targeted increase has been achieved. Realizing the need for optimizing the production and management of fisheries on a sound scientific basis, which was lacking in the past, the Government of Bangladesh established the Fisheries Research Institute in 1984 to develop fisheries techniques and management policies.

Table 1. Inland fisheries resources in Bangladesh.

|                            | Area (ha) | Total catch (t/year) |
|----------------------------|-----------|----------------------|
| Rivers including estuaries | 1031563   | 207000               |
| Beels and haors            | 114793    | 51660                |
| Kaptai Lake                | 68800     | 4057                 |
| Seasonal floodplains       | 2832792   | 202000               |
| Ponds                      | 163492    | 105000               |
| Oxbow Lakes                | 5488      | 862                  |
| Coastal aquaculture        | 51812     | 8228                 |
| Total                      | 4268740   | 578807               |

Source: Bangladesh (1985).

## Present Status and Research Needs

### Reservoir Fishery

There is only one major reservoir in Bangladesh, the Kaptai Reservoir. With a surface of 58,300 ha (Table 2), the Kaptai Reservoir is the largest man-made lake in Bangladesh. It was created in 1961 by damming the River Karnafuli in the Chittagong Hill Tracts (22°29' N, 92°17' E). Although, it was primarily created for hydroelectric power generation, as well as for navigation, flood control, and irrigation purposes, the reservoir contributes substantially to freshwater fish production.

Unfortunately, as is the case with most Asian reservoirs, no preimpoundment survey was performed and fishery scientists were not involved in the planning stages. As a result, the reservoir was not cleared before submergence. This is now hindering fishing activities.

Sandercock (1968) and Mahmood (1986) recorded 58 fish species on the reservoir, of which 31 are commercially important. Five of the exotic species (Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix, Oreochromis mossambicus, and Oreochromis niloticus) were introduced into the reservoir in recent years. Stocking the reservoir with fingerlings of catla (Catla catla), rohu (Labeo rohita), mrigal (Cirrhinus mrigala), silver carp (H. molitrix), grass carp (C. idella), and common carp (C. carpio) was initiated in small numbers in 1960/61 and has been continued sporadically.

Annual fish production ranged from 2145 to 4243 t from 1976 to 1985. In 1985, production drastically declined from 4243 to 2702 t. In 1976, carp (major and minor) accounted for 57% of total production; by 1985, this value had dropped to 18%. These data imply that the reservoir is being overexploited and, if appropriate measures are not implemented, fish production may further decline.

Except for a 1-year hydrobiological study of Kaptai Lake by the Aquatic Research Group of Chittagong University (Mahmood 1986), no studies have been carried out on the fisheries of the lake. Realizing the importance for adaptive research, the government established the Fisheries Research Institute in 1984. Identifying the need for

**Table 2. Morphometric details of the Kaptai Reservoir.**

|                                           | Mean value |
|-------------------------------------------|------------|
| Surface elevation (m)                     | 31.1       |
| Surface area (ha)                         | 58300      |
| Volume (hm <sup>3</sup> )                 | 524700     |
| Total annual discharge (hm <sup>3</sup> ) | 1707000    |
| Storage ratio                             | 0.31       |
| Mean depth (m)                            | 9          |
| Maximum depth (m)                         | 32         |
| Outlet depth (m)                          | 15.5       |
| Mean annual water level fluctuation (m)   | 8.14       |

increasing and sustaining fish production from the reservoir, the Institute has initiated a comprehensive research program aimed at the following topics:

- ° determination of maximum fish-production potential;
- ° augmentation of fish production to the maximum sustainable level through natural and artificial means based on biological and environmental studies;
- ° establishment of an ecosystem-monitoring system that will suggest required adjustments to management practices;
- ° application of modern harvesting techniques to achieve maximum harvests;
- ° improvement of handling, processing, transportation, and marketing to ensure efficiency and product quality;
- ° dissemination of relevant information to members of the fishing community; and
- ° formulation of guidelines for the national development and management of reservoir fisheries.

### **Oxbow Lakes, Beels, and Haors**

There is 5488 ha of perennial oxbow lakes in Bangladesh (see Table 1). These lakes have many uses: e.g., jute retting, irrigation water supply, and domestic use. The annual fish production from these lakes is around 862 t (157 kg/ha).

In addition to oxbow lakes, there are many water-filled depressions in the floodplain. These bodies of water, which are locally known as beels and haors, are flooded during the monsoon and are perennial. During the dry season, there is 114,793 ha of beels and haors (see Table 1), this area contributes 51,660 t (450 kg/ha) to the annual fish production of Bangladesh.

Beels, haors, and oxbow lakes can be managed in the same manner as a fishery reservoir. Fish production can be increased by blending aquaculture techniques of seed production and stocking with fisheries management. This style of management has been initiated in some areas and the annual production in three oxbow lakes has been increased from around 150 kg/ha to over 800 kg/ha.

### **Managment Needs**

The problems involved in increasing fish production are not only biological but also involve financing, marketing, and socioeconomics. Therefore, to sustain and increase fish production in Bangladesh, it is essential that research on various aspects of reservoir management be initiated. The area of appropriate fishing grounds in Bangladesh is constantly decreasing. Therefore, a sound management program is needed to maintain both reservoir and floodplain habitats. The most

important considerations in the formulation of such a program are the following:

- ° improvement and enforcement of fishery legislation;
- ° environmental engineering to improve fish habitats;
- ° introduction of fish stocking and net, pen, and cage culture;
- ° protection of fish habitats such as spawning and grazing grounds; and,
- ° gradual replacement of revenue-oriented management with biological management.

### Conclusions

Experience has shown that unmanaged fisheries almost always become economic and biological disasters. In a classic, one-species, capture fishery, with information on total catch and total effort, it is possible to manage the fishery and achieve the desired objectives. The fishery may be managed to maximize either production, economic yield, or employment. Additional information on year-class size, particularly before the year-class enters the fishery, growth rate, and natural mortality rate would permit fine tuning of the management scheme. The critical requirements to any management scheme is the basic information. Given the basic information, some additional research may be necessary to determine the relevant relationships in the particular resource fishery. In the absence of adequate information, interim management measures have to be developed on a pragmatic basis.

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