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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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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'etat 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 recommendations 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 trés tôt aux études de planification, notament 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 lomnológicos, 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 ls 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.

CONTENTS

NONCONVENTIONAL FISH RESOURCES IN SRI LANKAN RESERVOIRS

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Abstract *In most of tropical Asia (approx. 15°N to 15°S), reservoir fisheries are mostly dominated and dependent on exotics. Various reasons have been attributed to the success of exotics in tropical Asian reservoir fisheries. Experimental fishing with multimesh gill nets in Sri Lankan reservoirs have indicated the presence of populations of appreciable size of indigenous minor cyprinids. Studies have shown that these minor cyprinid populations could be exploited without any apparent detrimental effects on the existing commercial fishery, based predominantly on the exotic cichlid, Oreochromis mossambicus. The initial multimesh gill net trials were extended when commercial-size nets (50 m by 1.5 m) of two mesh sizes (15 and 30 mm), shown to be suitable for the exploitation of minor cyprinids, were used by the survey team and commercial fishermen. The results have confirmed the earlier findings. The limitations of a fishery based on minor cyprinids and the potential of introducing two-tiered exploitation methods are discussed.*

In Southeast Asia in general, there is a paucity of lacustrine water bodies as compared with the rest of the world (Fernando 1980). This paucity is reflected in the fish fauna of the region (Fernando and Furtado 1975; Fernando 1980), with only 20 lacustrine species as compared with an estimated 1600 riverine species. The number of lacustrine species in the region is dismally low when compared with tropical regions in the rest of the world.

Reservoirs or man-made lakes have existed for over 6000 years. In some countries of Southeast Asia, e.g., Sri Lanka, man-made lakes have been an important component of ancient civilizations (Fernando and De Silva 1984; De Silva 1988a). The development of fisheries in man-made lakes in the region, however, has been recent (Fernando 1977; Bhukaswan 1985; De Silva 1985). Moreover, most of these fisheries have developed around exotic cichlids, which were introduced into the region in the late 1940's. The success of these exotics has been mostly attributed to the paucity of the lacustrine fish fauna in the region (Fernando 1980; Fernando and Holick 1982); in effect, there are only a few reservoir fisheries in the tropics of Southeast Asia that are dominated by indigenous species. Some Thai reservoirs, for example, have indigenous species such as Barbus gonionatus, Cirrhinus jullieni, and Osteochilus sp. as major constituents (Chookajorn and Bhukaswan, this volume).

This paper reviews the recent studies on alternative, indigenous fish resources in Sri Lankan reservoirs. The development of such fisheries is discussed.

Present Status

The present status of Sri Lankan reservoir fisheries has been documented by Fernando and Indrasena (1969), Fernando (1977), Fernando and De Silva (1984), and De Silva (1983a, 1985, 1988a). Briefly, the reservoir fishery is essentially a monospecific, gill net fishery of which the main constituent species is the exotic, Oreochromis mossambicus. Annual yield is now estimated at 27,000 t, approximating an annual production of 283 kg/ha (De Silva 1988a).

In the perennial reservoirs of Sri Lanka, stocking major Chinese and Indian carps has met with only limited success (De Silva 1988b). All the evidence gathered to date indicates that the stocking of perennial Sri Lankan reservoirs with subtropical riverine Chinese and Gangetic carp species is neither commercially viable nor scientifically justified. Similarly, the success of such practices is still to be proven for most tropical, reservoir capture fisheries in the region (Sreenivasan 1984; Chookajorn and Bhukaswan, this volume).

The general trend in the establishment and development of most reservoir fisheries in Sri Lanka has revolved around exotic cichlids and the use of gill nets of uniform mesh size (De Silva 1983a, 1988a; Amarasinghe and Pitcher 1986); this is also the case in Thailand (Bhukaswan 1985; Chookajorn and Bhukaswan, this volume). There are two reasons for this trend: first, the bottom topography and numerous obstacles such as decaying tree trunks prohibit the use of any dragging gear and, second, the most effective gear for a majority of the reservoir fish species in the region is, in fact, a passive gear such as gill nets.

New Resources

The paucity of lacustrine species and the uniformity of the fishing gear have unintentionally imposed limitations on the utilization of reservoir fish resources. The data from experimental gillnetting and commercial scale trials indicate that protein sources could be more effectively utilized through the introduction of well-managed fisheries for the exploitation of minor cyprinid resources in reservoirs.

In Sri Lanka, as elsewhere in the region, the piscine fauna has a significant number of riverine cyprinid species that do not grow above 15 cm and some species that reach only 7-10 cm in length. Of the riverine minor cyprinids, however, only about eight species have effectively colonized the vast acreage of lacustrine habitats created by man over the last 2000 to 2500 years (Table 1).

Schiemer and Hofer (1983) found that some minor cyprinid species were abundant in a reservoir that has been intensively exploited for O. mossambicus for nearly 30 years. Based on this observation, De Silva (1983a) hypothesized that these minor cyprinids could be effectively exploited without harming the commercial fisheries.

Table 1. Indigenous minor cyprinids that have been recorded in reservoirs of Sri Lanka.

Species	Comments and occurence[a]	Reference[b]
Barbus dussumieri, B. sarana	Contribute to the existing commercial fisheries of most reservoirs	1,2
B. chola	B	1,2
B. dorsalis	A	1,2,3,4
B. filamentosus	Restricted colonization (C?)	3
B. ticto	Confined to reservoirs in central and eastern Sri Lanka	5 4
Rasbora daniconius	A	3,5
Danio aequipinnatus	Not recorded in large numbers; rare in reservoirs in southern Sri Lanka	3
Amblypharyngodon melettinus	Common in most reservoirs throughout Sri Lanka	1,2,3,4

Note: There are 28 recorded minor cyprinids in Sri Lanka (Munro 1955; De Silva et al. 1981).

[a]Occurrences: A, throughout Sri Lanka; B, throughout Sri Lanka, restricted to certain reservoirs; C, throughout Sri Lanka, very restricted.

[b]1, Fernando and Indrasena (1969); 2, De Silva and Fernando (1980); 3, De Silva and Sirisena (1987); 4, Amerasinghe and Pitcher (1986); H.K.G. Sirisena and S.S. De Silva, personal observation.

This hypothesis has been tested by using multimesh gill nets in five reservoirs in southeastern Sri Lanka. Initial observations indicate that gill nets below 30 mm mesh size do not catch sizeable numbers of young or prerecruits of O. mossambicus (De Silva and Sirisena 1987). Therefore, the introduction of gill nets with mesh sizes below 30 mm is unlikely to have a detrimental effect on the O. mossambicus population and, hence, the existing commercial fishery.

According to Sirisena and De Silva (1987), catches of minor cyprinid species by weight in experimental gill-net surveys exceeded 50% in all reservoirs. Based on these surveys, the potential catch of minor cyprinids using 20- and 30-mm mesh gill nets exceeds that of O. mossambicus. This is true for the experimental surveys or the existing fishery (Table 2). Therefore, there is clear evidence that substantial minor cyprinid resources exist in Sri Lankan reservoirs (Fig. 1) and that this resource has the potential to support a viable fishery.

Table 2. The weight (kg) of minor cyprinids and Oreochromis mossambicus with other presently commercially exploited species caught per unit gill net (75 m x 1.8 m) of appropriate mesh size based on commercial catches (CC) and experimental gill net (EG) catches.

Reservoir	Minor cyprinids			Others[a]	
	15[b]	25[b]	30[b]	CC	EG
Muruthawela	0.30	3.80	1.04	0.15	0.70
Ridiyagama	5.76	0.23	1.75	0.38	0.49
Tissawewa	7.56	3.98	5.48	0.52	1.81
Yodawewa	10.91	0.58	2.67	0.39	1.29

Source: Sirisena and De Silva (1987).
[a]Mesh size 75 mm.
[b]Mesh size (millimetres).

Single-mesh, commercial-size gill-net surveys were carried out (Table 3). These surveys include only three of the five reservoirs in which the original survey was performed. A newly impounded reservoir, Lungamwehera, was also surveyed. The results include the catches made by commercial fishermen and by the survey team.

Discussion

The uniformity of gear has prevented the optimal utilization of the available resources in the man-made lacustrine habitats of Southeast Asia. The minor cyprinids may constitute one such available

Fig. 1. A sample catch of minor cyprinids from the multimesh gill-net experimental gear.

Table 3. Catches (kg/net) from gill-net surveys carried out with 15- and 30-mm mesh commercial nets (50 m x 1.5 m) in four Sri Lankan reservoirs.

Reservoir	No. of surveys		Minor cyprinids				*O. mossambicus*				Others			
			15 mm		30 mm		15 mm		30 mm		15 mm		30 mm	
	S[a]	F[a]	S	F	S	F	S	F	S	F	S	F	S	F
Badagiriya	2	-	1.3	-	0.95	-	0.004	-	0.006	-	0.12	-	0.09	-
Ridiyagama	2	3	2.5	1.7	0.17	0.36	-	-	-	0.02	0.04	-	0.09	0.15
Muruthawela	2	4	-	-	2.46	2.94	-	-	-	-	-	-	-	-
Lunagamwehera	2	1	4.7	4.6	0.11	-	-	-	0.004	-	0.16	0.37	0.02	0.01
Average			2.83	3.15	0.92	1.65	-	-	0.005	0.06	0.11	-	0.05	0.02

Note: In some reservoirs, fishermen were given survey nets.
[a]S, survey team; F, fishermen.

resource and this paper clearly shows the potential of exploiting this resource. As most of these species are likely to migrate upstream for breeding (De Silva 1983b; Silva and Davis 1986), however, it is necessary, at least in the initial stages, to ascertain whether the exploitation of this resource should be limited to specific times of the year.

The introduction of small-mesh gill nets on a commercial scale must be subjected to strict managerial controls. The use of these nets in areas within the sublittoral and littoral regions or adopting them as seines would undoubtedly have undesirable effects on the existing fishery. The increased exploitation of minor cyprinids must be carried out in stages under strict managerial control. The manageable size of a single piece of small-mesh netting would be about 50 m and a number of such pieces must be utilized on a commercial scale by a single boat.

In one respect, this study contradicts the hypothesis of Fernando and Holcik (1982), that it is essential to make cichlid introductions into the region to utilize the resource as a protein source. The cichlid introductions have undoubtedly paid rich dividends and will continue to do so, at least in most countries of the region (De Silva and Senaratne 1988). However, as outlined in this paper, there may be an extensive supply of indigenous species in the reservoir that could support an artisanal fishery without the introduction of exotics.

Minor cyprinids are unlikely to be utilized for direct human consumption, at least in the initial stages of a fishery. However, this resource could provide a raw-material base for a rural fish-meal industry. In view of the high density of reservoirs in Sri Lanka, such a rural, small-scale industry could be developed without much difficulty. Reservoirs could also provide other protein sources, such as carnivorous species, that are minimally exploited in most countries of the region.

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