IDRC-264e

Reservoir Fishery Management and Development in Asia

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

Proceedings

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE
CENTRE DE RECHERCHES POUR LE DÉVELOPPEMENT INTERNATIONAL
CANADA

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IDRC-264e

Reservoir fishery management and development in Asia : proceedings of a workshop held in Kathmandu, Nepal, 23-28 November 1987. IDRC, Ottawa, Ont., 1988. xii + 246 pp. : ill. (Proceedings series / IDRC)

/Fishery development/, /reservoirs/, /inland fishery/, /fishery management/, /Asia/ -- /fish production/, /freshwater fish/, /fishery resources/, /conference reports/, /lists of participants/.

UDC: 631.21:627.81(5) ISBN: 0-88936-515-6

Technical editor: W.M. Carman

A microfiche edition is available.

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

THE PRESENT STATUS OF THE RESERVOIR FISHERY IN INDONESIA

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Abstract *Three types of reservoirs exist in Indonesia: field, irrigation, and multipurpose. The annual production of fish in these reservoirs varies from 15 to 380 kg/ha. Capture fisheries are dominant in Indonesian reservoirs. Stocking programs have been managed by the government to sustain fish yields. Fish culture practices, conducted mainly in floating net enclosures, have been recently introduced in the Lido, Saguling, and Riam Kanan reservoirs and the natural lake Toba. Common carp (Cyprinus carpio) is the most important species cultured. Fish culture has shown good potential and should be pursued in the future. Physical and chemical characteristics of some major Indonesian reservoirs are outlined in the paper.*

Indonesia has three types of reservoirs: field, irrigation, and multipurpose (Table 1). Field reservoirs satisfy the water needs of the local community. In certain areas, these reservoirs act as water traps for the conservation of ground water. They are built by damming creeks or diking valleys. Irrigation reservoirs supply water for agricultural purposes. They are built by damming relatively small rivers. Multipurpose reservoirs are created for flood control, hydroelectric power generation, irrigation, and to supply water for industrial and municipal purposes. They are built by damming relatively large rivers.

Open-water fisheries, including reservoir fisheries, has an important role in Indonesia contributing 270,000 t to the total freshwater fish production (Anon. 1987). There is no specific data on the total fish production of all the reservoirs in Indonesia; however,

Table 1. Types of reservoirs in Indonesia.

Type	Size (ha)	Depth (m)	Authority
Field	20	5	Community
Irrigation	20-500	5-30	Local government
Multipurpose	500	30-100	Central government

the average annual production per hectare of some reservoirs is known (Table 2). The total area of reservoirs and natural lakes are about 1.8×10^6 ha, of which at least 53,000 ha is reservoirs.

Table 2. The major reservoirs of Indonesia and their characteristics.

Reservoir	Purpose[a]	Volume ($\times 10^6$ m^3)	Area (km^2)	Drawdown (m)	Annual fish yield (kg/ha)	Fish species[b]
			West Java			
Darma	I	40	4.0		270	T,C,L
Lido	I		0.3			T,C,L
Jatiluhur	F,E,I	2970	83.0	32.0	15	T,C,L,H,S,P,M
Saguling	E	982	53.4	20.0		T,C,L,J,S,M
Cirata	E	2165	62.0	20.0		
			Central Java			
Cacaban	I	86				
Sempor	E,I	52		29.0		
Wonogiri	F,E,I	736	90.0	9.0		T,C,L,H,S,P
Wadaslintang[c]	E,I	443	14.6	61.0		
Kedung Ombo[c]	E,I	723	46.0	25.0		
			East Java			
Prijetan	I	10	2.2		50	
Pacal	I	41	4.5		380	
Selorejo	F,E,I	62	4.0	24.0	250	T,C,L,P,S
Karangkates	F,E,I	343	15.0	26.0	50	T,C,L,H,M,S
Lahor	E,I	37	2.6	19.0	50	T,C,L,H,S,M
Wlingi	E,I	24	3.8	1.5	25	
Bening	E,I	37	5.7	12.0	150	T,L,S
Wonorejo[c]	E,I	122	3.8	42.0		
			Lampung (Sumatera)			
Way Jepara	I	50				
Way Rarem	I	72		6.8		
			South Kalimantan			
Riam Kanan	F,E,I	1200	92	8.0		T,C,L,H,S,M

(continued)

Table 2. Concluded.

Reservoir	Purpose[a]	Volume (x 10^6 m^3)	Area (km^2)	Drawdown (m)	Annual fish yield (kg/ha)	Fish species[b]
			West Nusa Tenggara			
Batujai	I	17	8.9	5.0		

[a]I, irrigation; F, flood control; E, electricity.
[b]T, Tilapia mossambica and Tilapia nilotica; C, common carp (Cyprinus carpio); L, lampam (Puntius gonionatus); H, hampala (Hampala macrolepidota); S, snakehead (Ophicephalus seriatus); P, pangasius (Pangasius pangasius); M, macrones (Macrones nemurus).
[c]Reservoir under construction.

Capture fisheries is dominant in Indonesian reservoirs, involving about 434,000 people. At least 34 fish species have been recorded, including the economically important species listed in Table 2. Fishing gear varies, ranging from static fish traps to floating gill nets. In certain areas, hook and lines, cast nets, or lift nets are also used.

Stocking programs, managed by the government, are also practiced. During the high-water period (rainy season), fingerlings of commercially important species such as common carp (Cyprinus carpio), lampam jawa (Puntius javanicus), and Nile tilapia (Oreochromis niloticus), are released into reservoirs. Mature fish are harvested during the low-water period (dry season). Any failure in a stocking program can usually be attributed to one or a combination of the following factors: unfavourable water quality, severe competition with indigenous species, high predation pressure by carnivorous species, prohibitive condition for fish development (e.g., unfavourable spawning grounds or habitat), or disturbance by the surrounding human community.

Reservoir fish culture is practiced in pens, cages, and floating nets. Pen culture is conducted in water less than 3 m deep; cage and net culture are practiced in deeper water. Floating-net culture has recently begun in the Saguling, Lido, and Riam Kanan reservoirs and in the natural lake Toba cultivating mainly common carp. In the Saguling Reservoir, there are now about 600 7 m x 7 m floating nets in operation. A stocking density of about 300 kg fish/net can produce 1.0-1.5 t of fish in a 3-month rearing period (Costa-Pierce et al., this volume; G. Wiraatmadja, personal communication) with food-conversion rates (commercial pelleted feed) varying from 1.5 to 2.0.

Many studies have examined various physical and chemical properties of the major reservoirs of Indonesia. The results for the Saguling, Jatiluhur, Pacal, Wonogiri, and Riam Kanan reservoirs are summarized in Table 3.

Table 3. Physical and chemical properties of five major reservoirs in Indonesia.

	Saguling	Jatiluhur	Pacal	Wonogiri	Riam Kanan
Temperature (°C)	23.0-29.0	28.2-30.5	27.0-34.0	26.0-29.0	28.0-29.5
Secchi disk transparency (cm)	80-240	26-230	129	-	220-300
Turbidity	11-62	3-300	-	68-350	-
Conductivity (µmho/cm)	110-500	108-155	-	269-364	-
Total dissolved solids (mg/L)	-	-	-	81-345	-
MEI[a]	6.3-28.6	3.0-4.3	-	31.6-42.8	-
Dissolved oxygen (mg/L)	2.0-6.5	4.7-7.1	8.0-9.0	3.8-4.6	6.9-7.2
CO_2 (mg/L)	0.5-4.5	1.7-4.1	-	-	4.7-7.5
pH	4.5-9.5	7.2-8.0	6.0-8.4	6.2-8.2	6.9-8.4
Alkalinity (mg/L $CaCO_3$ equiv.)	5-60	45-67	-	44-259	56-65
Phosphate (mg/L)	0.07-0.85	0.04-0.06	-	0.28-0.90	-
Nitrite (mg/L)	0-0.09	0.01-0.15	-	-	-
Nitrate (mg/L)	0.09-3.57	0.28-0.64	-	0.11-0.92	-
Ammonium (mg/L)	0.07-0.53	0.01-0.25	-	-	-
Sulphate (mg/L)	0.39-1.47	0.87-1.63	-	-	-
Calcium (mg/L)	33-79	40-47	-	34.5-42.0	-
Hardness (mg/L $CaCO_3$ equiv.)	48-135	59-72	-	91.5-157.0	-

Source: Saguling, Kartamihardja et al. (1986); Jatiluhur, Krismono and Hardjamulia (1986) and Dhahiyat et al. (1975); Pacal, Sarnita (1976); Wonogiri, Achmad (1976); Riam Kanan, Jangkaru (1975).

[a]Morphoedaphic index (MEI) = conductivity/mean depth.

Discussion

Most of the reservoirs in Indonesia are located in the most densely populated island of Indonesia, Java. It is difficult to obtain information on reservoir fisheries because much of the information is integrated with data on lake fisheries.

Field reservoirs are the oldest type of reservoirs. At present, most of these reservoirs are heavily infested with aquatic weeds. The degree of infestation depends on the degree of maintenance of the reservoir. Sporadic fishing is common in these waters. The main fish caught of commercial value include snakehead (Ophicephalus striatus), walking catfish (Clarias batrachus), dwarf gouramies (Trichogaster trichopterus and Trichogaster pectoralis), climbing perch (Anabas testudineus), and minnows (Puntius binotatus and Rasbora spp.). In well-maintained field reservoirs, a stocking program or confined fish culture are occasionally practiced.

Irrigation reservoirs received the maximum attention of the stocking program. They are relatively free of aquatic weed infestation because they are better maintained, and they can be fully drained during the dry season (low water) for easy harvesting. Depending on the kind of stocking program, public fishing may be prohibited. Confined fish culture is sometimes conducted in these reservoirs.

Multipurpose reservoirs are given the most attention with respect to fisheries development. The potential of their vast, relatively stagnant waters as a fishery resource is high. Public fishing is the prominent activity in these reservoirs; therefore, to prevent the deterioration of the fishery resource as a result of intensive fishing activities, rules and regulations must be strictly enforced. Stocking programs in multipurpose reservoirs are conducted mainly for the manipulation or rehabilitation of the fish population. Confined fish culture is occasionally practiced.

Conclusions

Although the reservoir fishery of Indonesia contributes only a small portion of the inland fish yield, it is an important source of food (protein) for the people. Capture fisheries play a prominent role in the production effort; to maintain a sustainable yield, fishing rules and regulations must be strictly enforced. The public should be encouraged to conduct their own stocking programs; at present, stocking programs are exclusively run by the government. Confined fish culture has shown good potential and should be pursued in the future.

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