Fifty Years of Reservoir Fisheries in Mettur Dam, India: Some Lessons

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Abstract

The paper outlines briefly the history of the fishery in a dam reservoir in India. The reservoir was very productive in its early years, with support from a seed farm, ice plant, cold storage and regulated entry into the fishery. However, once entry restrictions were relaxed and "closed" fishing seasons no longer enforced, the yield of fish from the reservoir declined.

Introduction

Stanley Reservoir (Mettur Dam) is the only large reservoir in the state of Tamil Nadu, India and also the oldest. It is located at 11°50'N and 77°50'E. The waterspread area at FRL is 14 690 ha with a capacity of 2 646 million m^3. It has a maximum length of 53 km and width of 8.85 km. Maximum depth is 45.7 m and mean depth 18.3 m. It has multilevel outlets. The shoreline is 293 km. Simultaneously with the impounding of the Kaveri River, fisheries development planning was undertaken. The dam was sealed in 1934. Fish was stocked in the headwaters ahead of closure of the dam. The Gangetic carp *(Catla catla)* was introduced in 1928, while the other major carps like rohu *(Labeo rohita)*, mrigal *(Cirrhinus mrigala)* and calbasu *(Labeo calbasu)* were introduced from 1948 onwards. Gourami *(Etroplus suratensis)* and milkfish *(Chanos chanos)* were also stocked.

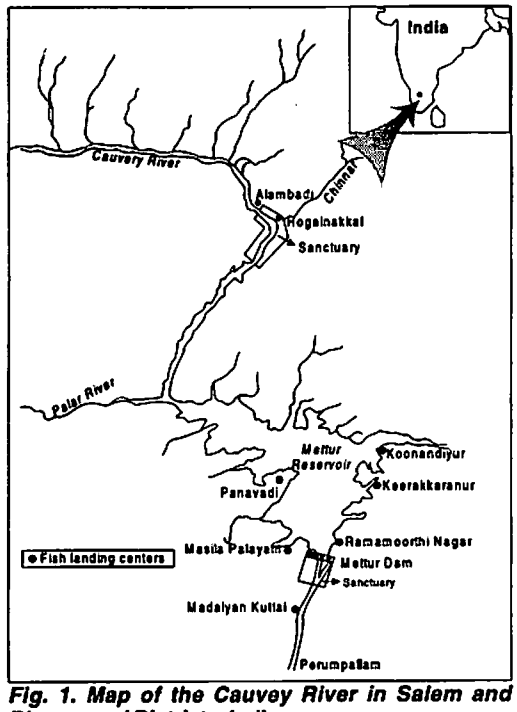

Fig. 1. Map of the Cauvey River in Salem and Dharmapuri Districts, India.

Reservoir

Dr. B. Sundera Raj, the reputed fish biologist, had anticipated changes in the population structure as a result of damming and had taken anticipatory measures to develop the fisheries of the reservoir (Raj 1941). A fish seed farm was established adjacent to the dam and subsequently the principle was adopted in all reservoirs of Tamil Nadu. These seed farms were used to rear the fry collected from natural sources to stocking size for release in the reservoir. After 1960, hatcheries were established to breed major carps by hypophysation and stocking inputs made available locally. Regulations were enforced (Indian Fisheries Act 1897 and Tamil Nadu Amendment 1927) to prohibit fishing in certain areas below the dam and also enforce mesh regulations to prevent the capture of fish below the spawning size. The mesh size was raised to 4-5" (10.0-12.5 cm) from 2" (5.0 cm) to allow the capture of only large sized catla and to give major carps a chance to breed at least once before being caught. Entry was regulated by issuing licenses for fishing with *coracles* - a local craft (Fig. 2). A daily catch of 4.5 t was anticipated in 1951 but later revised to 1.82 t /day. The actual catch in 1951-52 was 666.6 t from 400 licensees. A lot of fish was lost due to lack of access to markets and post harvest facilities for preservation. This led to the establishment of an ice plant and cold store at the dam site enabling chilling and transport of fish to distant markets like Calcutta some 2 000 km away. "Limited entry" policy was continued with 227 *coracles* in 1956-57 and 244 in 1957-58. In subsequent years, this restriction was relaxed and about 350 coracle units were licensed until 1973-74. After this, the number of licenses was increased without limit and exceeded 1 000 by 1991-92. Instead of increasing the catches, this resulted in a dramatic reduction (Table 1).

Population Structure

Detailed accounts of fish population changes were recorded by Sreenivasan (1976, 1984) and Ranganathan and Natarajan (1978). Among the indigenous species, *Barbus dubius* and *Cirrhinus cirrhosa* were the major species while *Labeo fimbriatus* and *L. kontius* were the minor ones in the earlier years. *B. dubius* accounted for 28% of the catch in 1943-44 but almost disappeared subsequently. *C. cirrhosa* constituted 55% in 1853-54 and considerably less at 16.42% in 1969-70. Subsequently it was less than 5% (except during 1984-85 and 1985-86, when it was 14.4% and 7.3%, respectively). Important game fish like the mahseer *(Tor khudree)* and *Barbus (Crossochilus hexagonolepis)* disappeared from the reservoir. So also did *L. kontius, B. carnaticus* etc. Among the major catfishes, *Mystus aor* and *Wallago attu* increased after the construction of the dam and together constituted not less than 35% of the catch in most years from 1964-65 onwards. However, by 1992-93 they decreased to less than 10% of the total. This coincided with the appearance of the tilapia *(Oreochromis mossambicus)*. In another reservoir, Bhavanisagar, the same catfish dwindled when the tilapia appeared and increased in the catches. Prior to damming, hilsa (*Hilsa ilisha*) used to ascend the river up to Mettur but this ceased. Introduction of catla, rohu, mrigal and calbasu more than made up for the loss of some species indicated above. Interestingly, *E. suratensis* was noticed in the catches in some years having established itself in the reservoir. It yielded 19 098 kg (5.46%) in 1982-83, 12 116 kg (4.1%) in 1985-86 and 4 935 kg (2.79%) in 1986-87. Spiny eels, *Mastacembelu armatus* and *Anguilla* sp., were also landed in noticeable quantities in some years.

Fig. 2. Coracle *(craft) used for fishing.*

Management System

The fishery is exploited by licensed fishers whose numbers are regulated by the Department of Fisheries. The main fishing gear is gill nets operated from a *coracle*. Rod and line, cast nets, shore nets, etc. are also in use. All the licensees are members of the Fishermen's Co-operative Marketing Society and their catches are handed over to the co-operative at prices fixed each year. They are collected from different landing centers in a boat carrying ice and brought to the assembly center. After making local sales, the major part of the catches are handed over to the middleman who is the highest bidder. The fish are gutted, iced, packed in baskets and transported to the railhead for onward dispatch to Calcutta by train. En route re-icing is done at a couple of stations.

Stocking of the reservoir is done regularly with major carps as well as with *L. fimbriatus, L. kontius*, common carp, etc. (Table 2). Seed is not a constraint. The entire cost of stocking is borne by the Department of Fisheries. Size at stocking is not regulated at present but good management suggests a minimum size of 12.5 cm. The numbers stocked are also on an *ad hoc* basis.

Table 1. Fish catches of Mettur Dam.

Quinquennium	Total catch (kg)	Average/yr (kg)	Range (kg)
1951-52* to 1958-59	2 006 705	401 341	251 343-666 600
1960-61 to 1964-65	1 858 386	371 677	222 647-443 450
1965-66 to 1969-70	1 430 466	286 093	215 263-325 458
1970-71 to 1974-75	1 664 226	332 845	254 896-555 157
1975-76 to 1979-80	2 091 915	418 383	158 375-** 628 824
1980-81 to 1984-85	2 076 459	415 292	280 715-552 743
1985-86 to 1989-90	901 345	180 269	120 176-295 977
1990-91 to 1994-95	911 835	182 367	110 520-252 260

* Data for 1954-55, 1955-56 and 1959-60 not available.

** Fishing suspended for 4 months (June-September) in 1976, conservation measure.

There are statutory regulations to conserve broodstock as well as the undersized fish. Sites where fish congregate (e.g., for breeding) are prohibited for fishing. Rules provide for a closed season though it is not enforced. The importance of a closed season is highlighted by one instance. During 1977-78, fishing was closed from May 1 to August 11 with spectacular results for the next three years: catches of catla increased to a record 139.6 t, 116.4 t and 126 t, respectively, while the total catch increased to 467.7 t, 628.8 t, 552.7 t and 551 t, respectively, in the next four years. The share of catla in the total catch was 29.88%, 22.80%, and 13.36%, respectively. Such closed seasons were not imposed subsequently, which resulted in lower catches (Table 3).

The increase in the number of licenses is not sustainable. The total catches were a low of 110.5 t in 1991-92, 231 t in 1992-93, 252.2 t in 1993-94 and 196.9 t in 1994-95. The CPU ranged from 110 to 231 kg/yr, the lowest in five decades. The average weight of the fish also declined. All indices of overfishing and depletion were evident despite the massive annual stocking of over 4 million carp fingerlings during these years. Recapture was very poor. Major carps contributed only 14.78% of the total in 1994-95 against a stocking of 67%. On the contrary, with only 400 units, the catch was 549 t in 1952-53, 406 t in 1956-57 with 227 units and 426.4 t in 1960-61. The inference is obvious - unlimited entry.

Table 3. Composition of major carps and catfishes (%).

Quinquennium	Major carps*	Catla alone	Catfishes**
1953-54 to1960-61	57.90 - 86.60	15.98 - 37.20	11.70 - 23.86
1961-62 to1965-66	49.60 - 81.90	17.50 - 39.60	17.30 - 50.10
1966-67 to1970-71	38.53 - 48.62	4.69 - 30.14	34.04 - 49.29
1971-72 to1975-76	31.33 - 69.43	5.77 - 18.27	17.20 - 43.71
1976-77 to1980-81	27.67 - 56.65	2.46 - 29.88	24.09 - 51.35
1981-82 to1985-86	22.50 - 68.20	6.10 - 13.36	23.47 - 36.83
1986-87 to1990-91	28.73 - 47.39	5.70 - 15.15	27.67 - 43.79
1991-92 to1993-94	30.68 46.48	10.02 - 18.46	5.84 - 28.26

* Catla, rohu, mrigal (*L. calbasu* not included)
** *Mystus (Osteobagrus) Aor; Wallago attu.*

Fish Stocking and Catches

Catches and stocking details are in Tables 1 and 2, respectively. Of the eight quinquennia, only in three did the average catches per year exceed 400 t. In the last two quinquennia, the catches recorded were the lowest with less than 180 t/yr. During this period fishing licenses were increased. Earlier, the stocking rate was less than 150 fingerlings/ha/yr. At that time neither infrastructure nor stable lucrative markets were available, as in the later years. Despite the removal of these constraints, fish catches declined in the last decade. Human factors, populist policies and large-scale poaching are the probable causes for this decline.

On the basis of primary production of 6.21 $g.0_2/m^2/d$ (Sreenivasan 1969), the fish yield should be a conservative 750 t/yr. Natarajan (1979) and Sreenivasan (1966) noted that 1% of GPP provides a dependable guidance for fish production. The above yield is close to the estimate of Jenkins and Morais (1971) of 90 kg/ha/yr.

Recommendations

The number of fishing units should be reduced to a third of the present number, i.e., about 350 *coracle* units. This is the first lesson that should be learnt. Size restrictions must be strictly enforced and fish below 9" (23 cm) should not be caught. Adequate breeding populations must be established by conserving the breeders. A closed season must be enforced between May and July or when water levels go down below a depth of 12 m. Extravagant stocking is not warranted. Stocking of catla and rohu may be continued but at sizes not less than 12.5 cm. *C. cirrhosa* may also be stocked to

Table 2. Mettur Dam - stocking levels ('000).

Year	Total	Catla	Rohu	Mrigal	Calbasu	*L. fimbriatus*
1952	3 000	N.D.	N.D.	N.D.	N.D.	N.D.
1956-57	2 649	N.D.	N.D.	N.D.	N.D.	N.D.
1967-68 to 1971-72	15 841	29	1 67	1 031	574	2 303
Average/yr	3 168	6	33	2063	116	461
1972-73 to 1976-77	9 321	74	1 459	1313	1100	2 945
Average/yr	1 864	17	292	261	220	590
1977-78 to 1981-82	8 997	127	3 105	825	658	1 091
Average/yr	1 800	25	621	165	132	220
1982-83 to 1986-87	20 366	842	8 820	4939	176	608
Average/yr	4 073	168	1764	988	35	122
1987-88 to 1991-92	20 230	1 600	11 486	2151	226	190
Average/yr	4 046	320	2 297	430	045	38
1992-93 to 1994-95 (3 yrs)	9 922	2 452	3 451	958	962	71
Average/yr	3 307	817	1 150	319	021	24

restore the native species to the system. Tilapia population has to be controlled. The good planning and management of the 1950s must be sustained by sound management strategies. A sustainable yield of 750 t/yr must be aimed at. Productivity being good, it must be translated into optimal yield.

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Marine Fisheries, Genetic Effects and Biodiversity

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Abstract

Preservation of marine biodiversity deserves serious consideration as almost 65% of the earth's organisms (excluding insects) are marine. There is little knowledge at present on the status of marine biodiversity. However, the seas are an important source of protein for human consumption and genetic diversity is a key factor in ecosystem functioning, stability and resilience. Overfishing and destructive practices may have unalterable impact on marine biodiversity. This paper discusses measures that can be adopted to protect the most productive areas of the marine ecosystem.

Introduction

The preservation of biodiversity has become a major concern at the end of the 20th century. Increased human intervention on different ecosystems has led to the extinction of a number of higher vertebrates and an unknown, but certainly much larger, quantity of extinctions in lower taxonomic groups. However, biological diversity cannot only be viewed from the narrow perspective of species extinction. The role of species richness and abundance in ecosystem functions and the role of intraspecific genetic diversity in the struggle for survival must also be considered within this context. In this paper we explore how fisheries may affect marine biodiversity at different levels from a population genetics and species interac-