

Reservoir Fisheries Management

Experience of Tawa in Madhya Pradesh

In developing economies, open water inland fisheries not only play an important role in the nutrition for the poor, but also provide livelihood for many people engaged in the sector. In the case of reservoir fisheries we identify various types of institutional regimes. The Tawa reservoir in Madhya Pradesh is a classic case that has experienced various management regimes in the last three decades. It provides an ideal opportunity to comprehend the performance of different regimes and their implications for productivity (efficiency criterion), wages and employment (equity criteria) and fingerlings stocking and technology use (resource sustainability criteria) across different regimes. Further, the paper details the management practices under the Tawa Matsya Sangh and emphasises that these practices should be integrated with an understanding of the resource base.

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In a developing economy context, open water inland fisheries not only plays an important role in the diet and health of the population, but is also the livelihood of many people engaged in this activity. Broadly, open water inland fisheries can be divided into five categories, namely, riverine fisheries, reservoirs, aquaculture water bodies, estuaries, and flood plain lakes. The fishing practices vary in these ecosystems. Usually, riverine fisheries are based on capture activities where regeneration of fish is left to nature. The large and medium reservoirs are generally managed as stocking-cum-capture fisheries resources, whereas, small reservoirs and aquaculture water bodies are usually managed through culture practices. Estuaries are based on capture fisheries and flood plain lakes have the components of both culture as well as stocking-cum-capture fisheries.

India is one of the countries in south Asia that has a large share of open water with rich and complex fisheries. It has around 340 million hectares of riverine catchments for fisheries; another six million hectare area are under open water fisheries in different reservoirs, aquaculture in small ponds, estuaries and flood plain system. Over the last 50 years, the extent and share of inland fisheries in total fish production has increased manifold. Despite the significant increase in inland fish production, it seems impossible to meet the projected demand of 14 million tonnes by the year 2005, more than twice current production [Bhattacharya 2002]. Inland fisheries need specific attention in India due to the following reasons. First, fish production through inland fisheries largely caters the needs of domestic consumption as against marine fisheries, which is primarily produced for export. An estimate of the resource potential by the fisheries division of ministry of agriculture, government of India, suggests that the inland sector has a potential of 4.5 million tonnes as against 3.9 million tonnes of the marine sector (*Fisheries Statistics*, 1993). Therefore, an increase in the production of inland fisheries would bridge the gap between domestic supply and demand, while catering to the nutritional requirements of the populace. Second, inland fisheries are an important source of employment. There are about 2 million people in India engaged full-time in fishing and another 4 million people as part-time or occasional fisherwomen or men (*Fisheries Statistics*, 1993). A third dimension

relating to open water inland fisheries is that the relative importance of inland capture fisheries is declining with a corresponding increase in culture fisheries. Government policies are partly responsible for such a trend. Fourth, India has a vast potential of open water fisheries, which with proper institutional, technical and financial support could contribute to the fulfilment of multiple developmental goals.¹ The learning process of institutional arrangements and requirements for open water fisheries would provide a substantive understanding of the management of this sector, which for a long time has been neglected.

Indian Scenario

In the last 50 years the extent and share of inland fisheries in total fish production has increased manifold. Figure 1 shows the movement of fish production in last five decades.

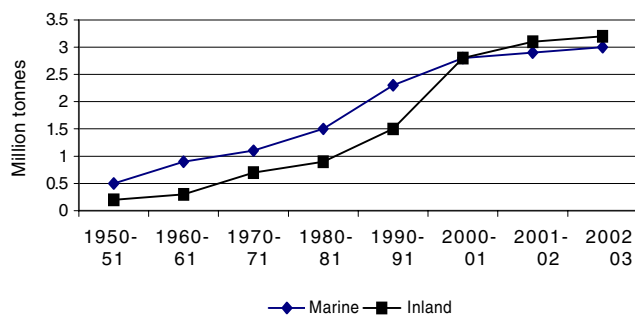
If only domestic consumption is taken into account the deficit in production is evident from 2003 onwards. In this context, inland fisheries play an important role due to its rising share in the composition of total production. To bridge the gap between the supply and demand, it is essential to evolve effective policy instruments to boost production.

Inland fisheries need specific attention in the Indian context due to two reasons. First, its share in total fish production is increasing over the years and, second, the potential is high compared to marine fisheries. Within inland fisheries, reservoirs have a high potential of productivity compared to their present productivity levels. Therefore, this resource system needs a closer observation.

Issues in Reservoir Fisheries

Rivers, reservoirs and aquaculture are the main sources of inland fisheries. Riverine fisheries being capture-based, productivity largely depends on natural regeneration of fish resources. Often, an open access system describes its institutional form. At the other extreme, aquaculture bodies are often privately owned and productivity depends on private initiatives in investment and economic efficiency factors. Reservoir fisheries, or

Figure 1: Trend in Inland Fish Production and Its Share in Total Fish Production



Sources: Handbook of Fisheries Statistics (1994), Economic Survey 2003-2004, government of India.

stocking-cum-capture fisheries, which have all the attributes of common pool resources, is placed between these two extremes.² Reservoir fisheries are analytically a complex issue; yet, physically they are manageable unlike riverine fisheries. In the case of riverine fisheries, the spread of river and flow nature of fish resource makes it difficult to manage the resource base directly, which is not the case with reservoir fisheries. Reservoirs (specifically, medium and large ones) are too large to manage in an individual capacity as in the case of aquaculture water bodies. Therefore, reservoir fisheries are classic examples of common pool resources, which have the characteristic of rivalry in consumption on the one hand, and non-excludability of resource extraction on the other. In this context, reservoir fisheries assume importance to understand the common property resource (CPR) nature and requires analytical framework to describe the management of the resource towards an equitable, efficient and sustainable end.

Physical characteristics, the socio-cultural environment and the institutional arrangements for managing fish production and associated activities are the most important factors in determining the productivity of the reservoirs. On an average, small reservoirs have a better average yield compared to medium and large ones. In some small reservoirs, culture fisheries is followed against usual stocking-cum-capture fisheries in medium and large reservoirs. Therefore, small reservoirs in general are not strictly comparable with the other two types due to differences in the nature of fishing.

Fishery scientists also believe that the present low level of fish production in Indian reservoirs can be attributed to poor management in as much as many of them have high propensities of production [Sugunan 1995]. Proper management system can enhance the productivity of the Indian reservoirs from an average 20kg/ha/year to 100, 75 and 50 kg/ha per year in small, medium and large reservoirs respectively [Sugunan 1995]. Table 2 shows the yield variation in different sizes of reservoirs in India. The average level of production in small, medium and large reservoirs is far below the expected productivity level. Only in small reservoirs, have some achieved the average expected productivity level. This, however, has not happened in medium and large reservoirs.

Given the biophysical constraints, the socio-cultural environment like consumption behaviour, traditional knowledge of fishing techniques, historical presence of fishing communities all add to productivity of a reservoir. Therefore, it is important to understand the institutional characteristics of reservoir fisheries to evaluate

factors responsible for productivity of the reservoirs and consequent formation of collectives to manage the fishery resource.

Since reservoir fisheries are based on capture-cum-culture practice and the fact that reservoir fisheries show the CPR characteristics, institutional initiative is a prerequisite. The following aspects play an important role in the evolution of collective action in the case of reservoir fisheries:

- Technological extension services and innovation in technology to enhance production.
- Preventing catch of certain kinds and size of fish to sustain the reproductive capacity.
- Adequate storage, transportation, and marketing facilities for efficient disposition of fish and enhancing revenue.
- Mechanisms to distribute revenues equitably.

A system, which delivers or ensures the above-mentioned services, becomes a reliable response to the institutional requirements in CPR types of resources in general and reservoir fisheries, in particular specific. In the case of reservoir fisheries, we identify various types of institutional regimes. Each regime has its advantage and disadvantages in terms of allocation of rights, appropriation of fish resources and distribution of income. In India, these institutions can be broadly framed into three categories: state, private and cooperative managed regimes. Each regime has diversified activities relating to stocking, production, collection, transportation, marketing and distribution of income and profit. These factors are again driven by opportunities and uncertainties. For example, if there is a private regime for an uncertain period, the party may intend to maximise its profit in the short-run. Therefore, it may continue with high fish catch irrespective of type and size. Similarly, the private party may not have the incentive to drop the required numbers of fingerlings in the reservoir. On the other hand, the state regime may turn out to be inefficient due to systemic indifference and absence of incentives to perform. The cooperative regime may also fall under the control of the state regime. Therefore, these systems may not be foolproof in terms of efficiency, equity and sustainability of the resource base. In a private regime, the contractor or private

Table 1: Projected Demand Supply Situation of Fisheries in India

Year	Fish Production	Inland Contribution	Total Demand	Domestic Consumption	Export	Difference (3-1)
	(1)	(2)	(3)	(4)	(5)	(6)
2001	5909	2648 (44.81)	11030	5745	5285	5121
2002	6094	2739 (44.95)	11732	6065	5667	5638
2003	6279	2829 (45.05)	12548	6500	6048	6269
2004	6463	2920 (45.18)	13386	6955	6431	6923
2005	6648	3010 (45.28)	14127	7315	6812	7479

Note: Figures in brackets are percentage share of inland fisheries to total fish production.

Source: Compiled from Bhattacharya (2002).

Table 2: Yield Variation in Reservoir Fisheries in India According to Size

Yield*	Small	Medium	Large	Total
Average	49.90	12.30	11.44	18.12
Standard deviation	54.62	7.38	10.69	12.45
Coefficient of variation	109.46	59.99	93.47	68.68
Maximum	188.00	24.47	35.55	36.48
Minimum	3.91	1.90	0.11	0.05

Note: * Yield in kilogram per hectare per year.

Source: Computed from Sinha and Katiha (2002).

party develops its own device to monitor the reservoir from others to catch fish. It employs the fisherfolk from the region or from outside on wage basis.

In the state managed systems, fish catching traditionally was on the basis of rights to communities of fishermen settled near the water body and in some cases rights were conferred even on individual fisherfolk. Of late, however, the formation of cooperatives is being emphasised in the state managed systems. These cooperatives could either be on a wage or (catch) share basis. Many of the state governments also involve themselves directly in marketing (under the wage-based system). There are instances now of privatising some or all these stages. Some of these are true for cooperative regimes too. However, cooperatives function strictly through the formation of a primary society whose representatives and others form the federation of the primary societies. Both the state and cooperative regimes are likely to have high overhead costs leading to inefficiency. On the other hand, cooperatives, if and when managed well, provide better returns to fisherfolk. The CPR nature of the resource therefore requires a model, which can optimise efficiency in production, equitability in distribution of income and sustainability of the resource. We attempted to understand a few of these factors in the case of Madhya Pradesh. A point to be emphasised is that the resource and institutions governing it are intertwined and inseparable and found to jointly affect outcomes. Before getting into the specifics of the case, the institutional arrangements in reservoir fisheries in various states in India is discussed.

Institutional Arrangements of Reservoir Fisheries in India

Institutions in reservoir fisheries are of a varying nature in different states of India. The system of leasing rights and fishing rights also varies from state to state. Even within a state, leasing and fishing rights vary between reservoirs. Usually, in most of the states, the department of fisheries or state fisheries development corporations obtain the fishery management rights from the reservoir authorities by paying a nominal amount or royalty (and in some cases without any payment at all). Fishery departments or corporations either manage the system themselves or lease-out the reservoir for a definite period ranging from a few months to a few years and receive royalty. The leasing arrangements of fishing rights are different in different states, though. These include departmental fishing, fee-based or free licence fishing, share system, open auction to cooperatives or private parties with or without rendering any fisheries development services [Sinha and Katiha 2002, for details see, Appendix Table 2].

In fact, many states follow multiple systems of leasing and fishing rights (Appendix Table 2). To appreciate the implications of different management regimes a few factors should be understood. First, stocking is an integral part of reservoir fisheries, which follows a stocking-cum-capture pattern, evidently if stocking is neglected output is adversely affected. On an average, a two-year time lag is followed for fingerlings to mature into a well-grown fish. The second factor is the output and productivity of the reservoir. The third is associated with marketing and income from the fisheries and the fourth is of income distribution; i.e., the number of days of employment fishing activity could generate and the share of income of fisherfolk. While the first factor is associated with sustainable resource use, the other three represent efficiency in production and equity in distribution of

income. All these factors have to be understood under different institutional domains in order to develop a meaningful perceptive of the institutions involved in fisheries management of the reservoirs. We attempt to understand these factors in Madhya Pradesh reservoir fisheries.

Reservoir Fisheries Management in Madhya Pradesh

Madhya Pradesh³ with 32 medium dams and five large dams has more than 32 and 10 per cent surface area of medium and large dams in India, respectively. Fisheries activity in the state is largely based in the reservoirs. Madhya Pradesh has undergone various management regimes in the last three decades.

There were four different regimes, which encompassed the Madhya Pradesh fisheries management at different points of time. Before 1979, it was the state fisheries department that used to manage fisheries – stocking, leasing and providing fishing rights to fisherfolk or primary cooperatives. In 1979, Madhya Pradesh Fisheries Development Corporation (MPFDC) was formed which became the nodal agency for fisheries management in reservoirs. It also extended its services in providing extension services and marketing. In initial years MPFDC itself used to procure the fish and transport it to distant markets. However, due to recurring losses in transportation, MPFDC started calling for tenders from private parties to lift the fish from different sites of the reservoirs. In early 1990, MPFDC went a step ahead and leased out fishing rights too. During this period, it called for tenders and contracted out the catching to private parties on royalty on a yearly basis. Madhya Pradesh Matsya Mahasangh (Fish Federation) replaced MPFDC in 1999 and this fish federation is now responsible for management of fisheries activities in all the reservoirs except Tawa. Thus, the fisheries department, MPFDC, cooperative federations and private contractors formed the four major regimes in different reservoirs. In one year, 1995-96, there was no institutional regime in the Tawa reservoir. This can be treated as a period of open access, which formed another dimension of the property regime in the fisheries history in the reservoirs of Madhya Pradesh.

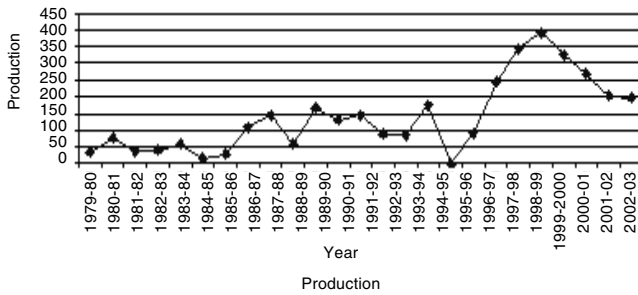
Among the different regimes, the fisheries department and MPFDC regimes broadly represent the public sector; the cooperative regime people's management and the contractor regime private sector in fishing management. An understanding of these three domains, i.e., public, private and cooperatives, would give a comparative perspective of the functioning of the regimes in terms of productivity, financial management, wages and employment and sustainability of the management system. This may further enable one to identify the institutional strengths and shortcomings of different regimes, which can be borne in mind while designing institutional needs for management of reservoir fisheries.

Tawa

The Tawa reservoir was constructed on the river Tawa, a tributary of the Narmada. The construction of Tawa Dam was started in 1956 and completed in 1974, the state government began fish production in the reservoir in 1975. The responsibility was transferred to the MPFDC, which continued until 1994.

The local community was not involved in fishing during these periods and fishing was carried out mostly by employing fishermen hired from outside. In 1994, the reservoir was auctioned to

Figure 2: Fish Production in Tawa under Different Regimes



Note: Production in metric tonnes.

Source: Sunil and Smita (1996) and various Annual Reports of Tawa Matsya Sangh.

a private contractor from Bhopal (the state capital), who brought workers from the city and excluded local villagers from fishing in the reservoir. The local communities were not even allowed to catch fish from the reservoir for their self-consumption. Such denial of access to the natural resource and other displacement related problems due to declaration of the surrounding forest areas as wildlife sanctuaries, the presence of an ordnance factory, and an army firing test range created unrest among local communities, which organised protests under the leadership of a non-government organisation called the Kisan Adivasi Sangathan (Tribal and Peasants' Association). Being displaced from their homeland and in search of their livelihood, the tribals who were settled in upper lands gradually learned the art of fishing.

Under the leadership of Kisan Adivasi Sangathan, the local communities demanded exclusive fishing rights to the Tawa reservoir. As a result of a prolonged struggle, the government agreed to their demands and an agreement was signed in October 1996 between the MPFDC and the Tawa Visthapit Adivasi Matsya Utpadan Evam Vipanan Sahakari Sangh Maryadit (Tawa Displaced Tribal Fish Production and Marketing Cooperative Federation). This gave birth to the Tawa Matsya Sangh (TMS) or the Tawa Fisheries Cooperative. Initially the TMS got exclusive fishing rights for five years from 1996, which was further extended in 2001.

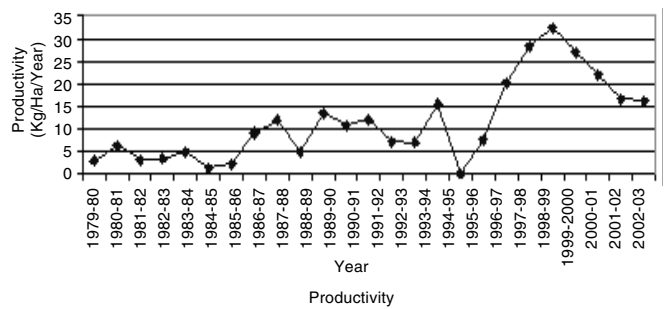
There are a few major locations where fishing activities are prominent. The main reservoir area is the major fish hunting ground for all fisherfolk round the year. However, the patches with backwater flows contribute to fishing activities when the reservoir level is high. Therefore, in years of low rainfall, or, in relatively dry seasons, fisherfolk abandon these areas and move towards the main reservoir area. The right bank of the Tawa reservoir falls amidst two protected areas. Therefore, the interference of the forest department is high in restricting fishing activities in this region. This again compels fisherfolk to move towards the main reservoir for fishing.

With these sets of information, it would be interesting to analyse the management of Tawa reservoir under different regimes. As we have stated earlier, our analysis is guided by three important issues relating to efficiency, equity and sustainability. We are attempting to understand some of these issues in the following sections.

Production Efficiency and Sustainability Issues

It is difficult to identify any specific trend associated with specific regimes in Tawa reservoir, since adequate information on stocking, production and distribution of income over a longer

Figure 3: Fish Productivity in Tawa under Different Regimes



Source: Sunil and Smita (1996) and various Annual Reports of Tawa Matsya Sangh.

time frame corresponding to different regimes is not available. However, the available data shows a fluctuating trend of production under the MPFDC regime. On the other hand, the cooperative regime under TMS shows a high level of production (Figure 2).

An overall analysis of different regimes from 1989 to 2004 shows that private or cooperative regimes performed better than the MPFDC regime. It is therefore essential to understand the factors that would have led to these outcomes. Though the existing micro level scenario would be different for the reservoir, the poor performance during MPFDC can be attributed to three factors. First, there was no consistent level of stocking (Figure 4), which is essential for maintaining the production level. Second, due to irregularity in marketing and a lower wage, the fisherfolk were forced to pass on the catch to the illegal marketing networks [Sunil and Smita 1996]. Therefore, the reported level of production may be an underestimate of actual production. Third, the average number of fishing days was much lower than what otherwise would have been possible in a normal year. All these factors point toward the inefficient management system of the regime.

Illegal fishing in the reservoirs was stopped during both the private and TMS regimes. However, approaches to stop illegal fishing were different. While the private contractor used musclemen to monitor fishing activities in the reservoir, under the cooperative system of TMS the primary cooperative societies undertook the responsibility. Therefore, a part of the increase in production can be attributed to accuracy in reported production. During both these regimes, arrangements were made for collection, transportation and marketing along with the increasing days of fishing added to the efficiency level in production.

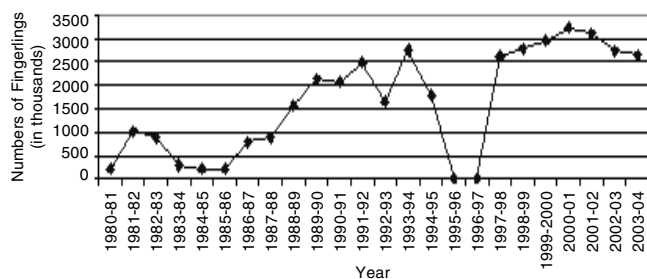
Table 3: Basic Features of Tawa Reservoir

Reservoir	Tawa
River	Tawa on the Narmada
District(s)	Hoshangabad
Number of displaced villages	44
Reservoir area in ha (at full tank level)	20,050
Reservoir area in ha (at minimum level)	4,240
Average reservoir area in ha	12,145
First year of fishing	1979
Management regimes of fishing	Fisheries department (1975-79) MPFDC (1979-94) Contractor (1994-95) Free fishing (1995-96) Cooperative federation (1996 onwards)
Average productivity* (1990 to 1995)	10.60

Note: * Productivity in (kg/ha/year).

Source: Sunil and Smita (1996).

Figure 4: Stocking Scenario in Tawa from 1980-81 to 2003-04



Note: Stocking in thousands of fingerlings.
Source: Sunil and Smita (1996) and various Annual Reports of Tawa Matsya Sangh.

However, as discussed earlier there were inherent dangers in continuing with the private system for a longer period of time. In order to maximise profits, fisherfolk were encouraged to fish even of a smaller size, which are prohibited under the contract. Nets used for fishing were also replaced during this regime. Monofilament yarn (MFY) nets replaced the earlier nylon nets. MFY nets are more expensive compared to nylon nets and last for only a few months as compared to two years for the nylon nets. This led to higher cost for the fisherfolk. Therefore, a high but unsustainable income accompanied by a higher cost of production characterised the private regime.

Employment and Income Distribution Issues

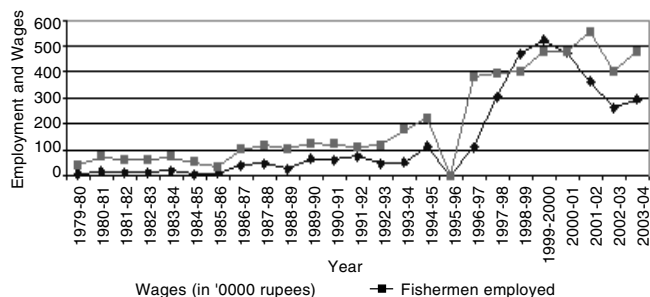
Efficient and sustainable production accompanied by more equitable distribution of income is what is required for a desirable institutional arrangement. On the income and employment generation front too, private and cooperative regimes performed better than the MPFDC regime. Though the private regime yielded a very high per capita income, it also enhanced the cost of production due to change in the quality of the net. Secondly, contractors in the private regime employed outsider fishing-communities. Therefore, income did not accrue to the local folk. On these aspects cooperatives seem to be a better alternative. The wage level as well as employment both in terms of number of days and people was consistent and high in the cooperative regime.

Emergence of New Institutions in Tawa

The present cooperative structure of the Tawa federation is two tiers. At the local level there are primary cooperatives and at the apex level the federation manages various activities associated with fishing. The primary cooperatives work at the village level. Each primary cooperative is run by a 13-member committee including a president. Each primary cooperative has one representative in the federation and the federation chooses its board of directors from these representatives. In addition to the elected/selected members the board of directors of the federation also include ex officio members such as the district collector, assistant director of fisheries of Hosangabad district, executive engineer of the Tawa dam and representatives from MPFDC. Activists from the Kisan Adivasi Sangathan, are also office-bearers in the Federation.

The TMS, which started with 31 primary cooperatives and three affiliated cooperatives, has now increased to 34 primary cooperatives and six affiliated cooperatives spread across Kesla and Sohagpur blocks of Hosangabad district. There are about 1,300

Figure 5: Wages and Employment Scenario in Tawa from 1979-80 to 2003-04



Source: Sunil and Smita (1996) and various Annual Reports of Tawa Matsya Sangh.

primary members of the cooperative of which 477 members actively participate in the fishing activities. Twenty-nine out of 34 primary cooperative villages belong to gond and korkus communities (both scheduled tribes). Remaining five cooperative villages inhabit heterogeneous communities, including the scheduled castes, other backward classes and scheduled tribes. The six affiliated societies largely constitute of traditional fishing communities of dhimar and kahar.

The total labour days created during the TMS regime shows an increasing trend in the initial three years after which it started declining. While comparing total production with the total labour

Table 4: Membership and Labour Days Created during Cooperative Regime of TMS

Year	No of Primary Societies	Affiliated Societies	Functional Societies	Number of Members (Approx)	Max No of Fishermen	Average Fishermen in a Day	Total Working Days	Total Labour Days Created
1997-98	33	03	33	1000	393	171	267	45750
1998-99	33	05	34	1042	400	205	257	52749
1999-00	33	05	36	1042	479	213	262	55880
2000-01	33	05	36	1242	477	209	250	52191
2001-02	34	04	37	1250	554	183	270	49394
2002-03	34	06	39	1250	400	156	272	42435
2003-04	34	06	38	1300	477	159	289	46039

Source: Various Annual Reports of Tawa Matsya Sangh.

Table 5: Stocking Scenario in Tawa Reservoir during TMS Regime

Year	Proportion of Varieties of Fingerlings			Total Fingerlings (in 000s)	Fingerlings from TMS Own Source (in 000s)	Per Ha Fingerlings
	Katla	Rohu	Mrigal			
1997-98	52.75	18.40	28.85	2614	20	215
1998-99	42.90	28.86	28.24	2791	20	230
1999-00	45.73	33.04	21.23	2948	477	242
2000-01	41.01	35.23	23.76	3220	545	265
2001-02	54.12	26.73	19.15	3111	596	256
2002-03	39.25	33.13	27.61	2734	861	225
2003-04	42.98	26.40	30.62	2655	980	219

Source: Various Annual Reports of Tawa Matsya Sangh.

Table 6: Fingerlings Sources and Costs in the Year 2003-04

Source	Number of Fingerlings	Value (in INR)
Madhya Pradesh Fish Federation	3,74,500 (14.11)	80,450.00 (11.89)
Prayash Fish Firm	6,00,000 (22.60)	1,48,500.00 (21.95)
Ganesh Fish Firm	7,00,000 (26.37)	1,85,500.00 (27.42)
Tawa Fish Federation	9,80,200 (36.92)	2,62,100.00 (38.74)
Total	26,54,700 (100)	6,76,550.00 (100)

Note: Figures in the parentheses are percentage to column total.
Source: 8th Annual Report (2003-2004) of Tawa Matsya Sangh, 2004.

days created, we find a positive correspondence between both (for production data see Table 7). However, the causal link between the two is yet to be understood. In contrast, in spite of reducing labour days in the later years, the total working days in the reservoir has increased.

Stocking Scenario under TMS Management

Stocking of fingerlings is the most important factor in determining production. In the absence of an adequate availability of fingerlings in the region, future production remains unknown. During the new institutional regime of TMS, dropping of fingerlings increased in the initial four years after which it declined marginally. Among the three types of fingerlings that are dropped in the reservoir, namely, 'katla', 'rohu' and 'mrigal', the first two are considered major crops and the last one a local (major) crop. Fingerlings of local minor crops are not dropped into the reservoir. Over the last eight years, the proportion of each variety of fingerling is changing with the 'katla' having the largest share.

In the initial two years of the TMS, fingerlings were largely purchased from the Madhya Pradesh Fish Federation (MPFF) or other private firms. Over the years, however, the TMS has developed capacity among the local communities to harvest fingerlings that has significantly reduced the dependency on external sources. From a meagre percentage in the initial years, production of 37 per cent of total fingerlings is a quantum jump, which shows the internal institutional capability to manage and sustain fish production of the reservoir.

The enhanced production of fingerling by TMS not only shows a reduced dependency on external sources but also reflects the additional livelihood and employment opportunities created in the periphery of the Tawa reservoir. In 2003-04, nearly 37 per cent of total fingerling stocks and 38.7 per cent of the value of stocking was procured from TMS' own source (Table 6).

Production Scenario in New Regime

The overall production scenario shows that total production had an increasing trend in the initial four years of the regime and started declining afterwards. However, there were some significant changes in fish composition. Major crops (e.g. rohu and mrigal) constitute a substantial portion of total fish catch.

With a fluctuating trend for the first six years, production of the major crops sharply declined in 2002-03 and 2003-04. On the other hand, production of local major crops showed a fluctuating trend throughout, though their share has increased in the last two years. The share and production of local minor crops shows a consistent increase in the last eight years.

The effect of production can be easily seen in the total income from fish selling. Total income from fish selling as well as per capita per day income for the fisherfolk (in current prices) show an increasing trend in the initial three years followed by a decrease in income. However, in the last year there is a nominal increase in income in spite of a decrease in production.

While comparing the simple growth rate of production and income from fish selling, there is an interesting discrepancy in the growth rates of both. Except for 1997-98 to 1998-99 and 2001-02 to 2002-03, growth of income is better than production. This also means that fish produced from Tawa got a better price all these years.

Summarising Institutional Regimes in Tawa Fisheries

As mentioned, in Tawa, the MPFDC managed the resource for a long period, whereas other management regimes were in force for a brief period. As a result, a strict comparison of management regimes is difficult. In Tawa, the dam-displaced people, who traditionally did not belong to the fishing communities, got fishing rights through a sustained struggle. Therefore, the implications of such cooperatives in terms of fishing rights are different from the usual cooperative regime. The local people, who do not belong to traditional fishing communities, get a larger stake in the resource and hence a share in the revenue generated. Besides, by taking the initiative in rearing fingerlings, a large number of people from Tawa region have got additional employment

Table 9: Comparison of Growth Rate of Production and Income
(In per cent)

Between the Years	Growth Rate of Production	Growth Rate of Income
1997-98 to 1998-99	40.10	28.75
1998-99 to 1999-00	14.17	25.53
1999-00 to 2000-01	-16.80	-6.89
2000-01 to 2001-02	-17.75	-16.71
2001-02 to 2002-03	-24.87	-26.68
2002-03 to 2003-04	-3.09	4.39

Source: Computed from various Annual Reports of Tawa Matsya Sangh.

Table 7: Production Scenario in TMS Regime

Year	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Major crops	74.719	202.809	288.170	312.193	243.547	206.638	119.931	107.325
(Per cent to total)	(80.14)	(82.50)	(83.69)	(79.40)	(74.43)	(76.79)	(59.34)	(54.79)
Local major crops	13.284	23.715	33.444	36.133	42.653	26.66	34.844	36.675
(Per cent to total)	(14.24)	(9.64)	(9.71)	(9.20)	(13.04)	(9.91)	(17.23)	(19.23)
Local minor crops	5.225	19.224	22.761	44.830	40.975	35.762	47.360	50.890
(Per cent to total)	(5.60)	(7.84)	(6.60)	(11.40)	(12.53)	(13.29)	(23.43)	(25.98)
Total production (in tonnes)	93.229	245.811	344.375	393.163	327.125	269.054	202.136	195.891
Targeted production (in tonnes)	—	240.000	264.000	350.000	425.000	425.000	350.000	350.000
Per ha productivity (in kgs)	7.680	20.240	28.350	32.370	26.940	22.150	16.643	16.129

Source: Various Annual Reports of Tawa Matsya Sangh.

Table 8: Income Scenario during TMS Regime

Year	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04
Income from fish sell (thousand rupees)	7756	9986	12535	11671	9721	7127	7440
Total Income of the fisherfolk (thousand rupees)	3045	4715	5212	4746	3637	2664	2943
Royalty (paid to fish federation) (thousand rupees)	1180	1653	1887	1570	1291	970	940
Per capita per day earning in current price (in rupees)	65.56	89.39	93.27	90.93	73.64	62.79	63.92

Source: Various Annual Reports of Tawa Matsya Sangh.

and income. Fingerlings, being one of the major inputs in reservoir fisheries, production of this input within the system also has implications for sustainability of the institution and resource base. However, declining production in the early 2000s is a matter of concern.

Appendix

Table 1: Nominal Catch by Countries in Asia – Inland Waters
(in '000 tonnes)

Countries	1988	1989	1990	1991
China	4551.9 (49.42)	4857.2 (50.44)	5237.6 (50.56)	5528.1 (50.49)
India	1319.0 (14.32)	1381.1 (14.34)	1573.9 (15.19)	1700.8 (15.53)
Indonesia	711.6 (7.73)	763.1 (7.92)	792.4 (7.65)	806.0 (7.36)
Bangladesh	585.1 (6.35)	592.0 (6.15)	594.4 (5.74)	633.8 (5.79)
Philippines	547.0 (5.94)	553.7 (5.75)	585.5 (5.65)	612.4 (5.59)
Total	7714.6 (83.76)	8147.1 (84.60)	8783.8 (84.78)	9281.1 (84.77)
Total of south and south-east Asia	9210.9 (100.00)	9630.2 (100.00)	10360.2 (100.00)	10948.7 (100.00)


Note: Figures in the brackets are percentage of total.

Source: Computed from *FAO Year Book on Fisheries Statistics*, 1991 as cited in *Handbook on Fisheries Statistics* (1993).

Table 2: Reservoirs Leasing System and Fishing Rights in Different States

State	Leasing System and Fishing Rights
Andhra Pradesh	Department fishing, licensed fishing, free licensing system, share system.
Bihar	Department fishing with 50 per cent share of fishers, open auction with 10 per cent concessions for cooperatives society and first year stocking by fisheries department.
Gujarat	Leased to Gujarat Fisheries Development Corporation or Gujarat Fisheries Central Cooperative Association with varying rate of royalty and target quota. These bodies either conduct yearly auction to contractors or give their own fixed rates to fishermen. The fisheries department monitors the fish harvesting to control overexploitation.
Haryana	Open auction for fishing only in the month of May.
Himachal Pradesh	Annual lease to local cooperatives on the basis of 15 per cent royalty to department.
Karnataka	Licensing with fee based on types and quantity of nets used.
Madhya Pradesh	Leased to Madhya Pradesh State Fisheries Development Corporation on some fixed royalty per tonne. Corporation collects royalty from fishermen at a fixed rate for their catch. Annual contract for fishing based on tenders with highest royalty.
Maharashtra	For leasing, priority is for cooperatives @ maximum water spread x fixed rate per ha for three years; otherwise the department stocks the reservoir and issues monthly licence to fishermen of different cooperatives; department issues free permit to members of cooperatives and charges royalty on some fixed rate.
Orissa	Leased to cooperative at some fixed rate per sq mile; in absence of cooperatives open auction.
Punjab	Departmental fishing
Rajasthan	Open auction for one year with 12.5 per cent concession to cooperatives, long-term lease with 5 per cent annual increase in lease amount.
Tamil Nadu	Departmental fishing, lease to state fisheries corporation based on royalty or share basis, licensing to fishermen on monthly/yearly basis.
Uttar Pradesh	Open auction for (i) one year with size <100 ha, (ii) three years for 100-150 ha, (iii) five-year for 500-1,000 ha and (iv) 10 years for > 1,000 ha.
West Bengal	On lease to West Bengal State Fisheries Development Corporation (WBSFDC) on nominal rent. WBSFDC engages fishermen of cooperatives on 50 per cent share basis.

Source: Sinha and Katihia (2002).

The Tawa case points out that natural resources in effect offer a vector of management options. In the macro environment context where the state is increasingly withdrawing from both day-to-day management and maintenance of local infrastructure, the contextual importance of this historical analysis is obvious. What makes Tawa a case by itself is the experience of the reservoir under different management regimes in a relatively short time. As expected, the government system appears weak while the private option exhibits the much-debated issues of sustainability and equity. Cooperatives seem to be the best bet. It should be noted that the strength of the cooperative is not only from within the reservoir activities, but largely owing to establishment or claims of aboriginal rights. Therefore, to claim the success of cooperative purely on the merits of the use and management of the resource alone would be an overstatement. This is also evidenced by some of the concerns of sustainability over the future resource (fingerlings production). What the study does signal is the need for an arbitrator who could take into account not only production-trade-marketing related functions but also scientific analysis of resources base planning. 

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Notes

- 1 These goals include reducing poverty by generating employment and income, promoting sustainable development by sustaining the resource base, enhancing the welfare of society with an equitable distribution of income, and creating efficiency in production through proper technical and institutional services which can ensure that output caters to increasing demand.
- 2 Technically, aquaculture bodies and reservoirs are not comparable. Aquaculture bodies are those water sources where fish culture is practised. Even in the case of small reservoirs aquaculture could be practised. On the other hand, in medium and large reservoirs, stocking-cum-capture fisheries is practised. This also can be practised in large water bodies like tanks that are not necessarily reservoirs. Therefore, we assume aquaculture bodies are usually small which may include small reservoirs as well. Similarly, medium and large reservoirs are comparable with large water bodies like tanks as far as stocking-cum-capture fisheries is concerned.
- 3 Chhattisgarh, which was earlier part of Madhya Pradesh, became a separate state in the year 2000. Here we have considered both Madhya Pradesh and Chhattisgarh together.

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