Indian J. Fish., 62(3) : 14-20, 2015

Fisheries of Gumti (Dumboor) Reservoir in Tripura: production, performance and management

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ABSTRACT

Gumti (Dumboor) Reservoir, the only reservoir in Tripura, plays a very important role in fish production of the state. In 1978-79 fish production from the reservoir was 169 t from 1.64 lakh numbers of seed stocked. Currently the fish production is 313.2 t with stocking of 19.2 lakh numbers of seed (2011-12). The average stocking density of 712 nos. ha^{-1} in last 10 years (2002-12) is higher than the recommended stocking density of 400-500 nos. ha^{-1} for medium reservoirs. The farm gate price received by Gumti fishers is disproportionally low compared to the final consumer price at the terminal market, because of extended marketing channels. The Department of Fisheries (DoF) generates substantial revenue by way of license fees from the Gumti fishers at ₹75 per capita per year. It is observed that substantial gains in fish production could be achieved if the revenue generated from the license fee is ploughed back for development of the reservoir. Under the Rashtriya Krishi Vikas Yojana (RKVY) scheme, licensed fishers avail a compensation of ₹1200 per head during the 2 months ban period from 1st July to 31st August. The fishers also get nets and boats free of cost from the DoF. The number of licensed fishers increased from 285 in 1978-79 to 2027 in 2012-13. The DoF and Cooperative societies collect royalty on a 65:35 ratio from the fishers, which is used for development of the reservoir and the fishers. Preliminary analysis showed the total income could be ₹3000 per licensed fisher per month which is little above the income defined as cut off national poverty line (₹972). Better management strategies and policies supplemented by scientific culture practices will ensure sustainable and enhanced fish production in the reservoir.

Keywords**:** Gumti Reservoir, Management, Production, Reservoir fisheries

Introduction

Fisheries sector plays an important role in generating employment, income and development of rural and urban areas. Fish occupies a very important place in the family food basket as a safe and comparatively cheap source of animal protein with high consumer acceptability. Reservoir fisheries is one of the major contributor to inland fish production in India. Though reservoirs are never built for fisheries development, fishery is an important secondary use of these impoundments (Debnath, 2015).

The Gumti (Dumboor) Reservoir (lat. 23° 25' 45" N; long. 91° 49' 20" E), is the only reservoir in the state of Tripura, constructed across the river Gumti in South Tripura District in the year 1977 with a water spread area of 4500 ha. Due to decreased rainfall and high siltation problems the water spread area has come down to 3049.3 ha as per 2012 estimates (WRIS 2012). The reservoir draws water from Barak, Raima and Sarma river basins for generation of hydroelectricity. Table 1 presents the general attributes of the reservoir. The 30 m high dam generates 8.6 MW power and is now a source of livelihood to almost 2027 fisher families, who are directly or indirectly dependent on the reservoir.

About 47 fish species have been reported from the reservoir and the commercially important species among them are listed in Table 2. Besides, the Indian major carps and 3 species of exotic carps have been introduced successfully in the reservoir. Catla-rohu and rohu-catla hybrids have also been reported from the reservoir (Raha and Sarkar, 1990). For enabling better management practices, the fish species in the reservoir have been categorised into Grade-I, Grade-II, Grade-III, Grade-IV and Grade-V (Table 2).

Institutional arrangements and their functional efficiencies largely determine input-output relationships in any production system. Major and minor institutional arrangements, both physical and functional, evolved for management of the Gumti Reservoir are responsible for

Table 1. Morphometric and hydrographical details of Gumti Reservoir, Tripura

Particulars	Details and data
Name of dam	Gumti Hydro Dam
Nearest city	Amarpur
District	South Tripura
State	Tripura
River name	Gumti
Basin	Barak and others
Type of dam	Earthen + Gravity
Purpose of dam	Irrigation,water storage, Drinking water supply
Year of completion	1976
Catchment area (ha)	33.8
Length of dam (m)	103
Maximum height above foundation (m)	30
Maximum water level (m)	---
Full reservoir level (m)	93.55
Minimum draw down level (MDDL) (m)	25.48
Gross storage capacity (MCM)	235.7
Live storage capacity (MCM)	2.098
Length of spillway (m)	40
Number of spillway gates	7
Size of spillway gates (m*m)	12.00 X 4.000

Source: Water Resource Information System of India (2012)

Table 2. Commercially important fish species under different grades in Gumti Reservoir

Grades	Common name	Scientific Name
Grade-I	Mola	*Amblypharyngodon mola*
	Chanda	*Chanda ranga*
	Small prawns	*Macrobrachium choprai*
	Esomus	*Esomus danricus*
Grade-II	Channa	*Channa marulius*
		C. punctatus
	Punti	*Puntius* sp.
	Tilapia	*Oreochromis mossambicus*
Grade-III	Aor	*Aorichthys aor*
	Notopterus	*Notopterus notopterus*
	Gonia	*Labeo gonius*
Grade-IV	Catla	*Catla catla*
	Rohu	*Labeo rohita*
	Mrigal	*Cirrhinus mrigala*
	Silver carp	*Hypophthalmichthys molitrix*
	Grass carp	*Ctenopharyngodon idella*
	Carpio	*Cyprinus carpio*
	Calbasu	*Labeo calbasu*
	Shingi	*Heteropneustes fossilis*
	Magur	*Clarias batrachus*
	Anabas	*Anabas testudineus*
Grade-V	Macrobrachium	*Macrobrachium rosenbergii*
	Chitala	*Chitala chitala*

the current levels of fish production from the reservoir. This paper looks at fish production performance of the reservoir and also at forward as well as backward linkages established by institutional arrangements in the reservoir.

Materials and methods

Study area

Gumti Reservoir is located in Amarpur subdivision in South Tripura District, 120 km away from Agartala (Fig. 1).

Sampling technique

The data used in this study were collected from both primary and secondary sources. Primary data were collected directly from fishers and secondary information from the Department of Fisheries (DoF), its publications, Cooperative societies associated with the reservoir, FAO publications and other internet sources.

Methods of data analysis

Tabular and percentage analysis were employed. Besides, growth rates, operational area, productivity ratios and income of the fishers were also worked out as follows:

$$\text{Operating area} = \frac{\text{Total reservoir area}}{\text{NLF}} \quad \ldots\ldots\ldots\ldots (1)$$

$$Y = \sum\left(\frac{FPG * \text{ x } P*}{NLF}\right) \ldots\ldots\ldots\ldots (2)$$

where,

Y = Total income

FP G* = Fish production (of fish grades 1 to 5)

NLF = Number of licensed fishers

P* = Price of respective grades of fishes

Results and discussion

The results obtained on fish production from the reservoir and the information on price in the market furnished by the fishers, officials and previous studies are given in the following tables. Both women and men fishers' responses were taken into consideration.

Table 3 shows the fish production during the year 1978 to 1988 and the same during 2002 to 2012 is presented in Table 4. The production was achieved by regular and timely stocking of fish seed in the reservoir by Department of Fisheries, Tripura.

Total fish production in Gumti ranged from 41 t in 1984-85 to 322 t in 1987-88 (Majumder, 1987; Das, 1994). As reported by Sugunan (1995), contribution of dry fish in the total fish output of the reservoir is the

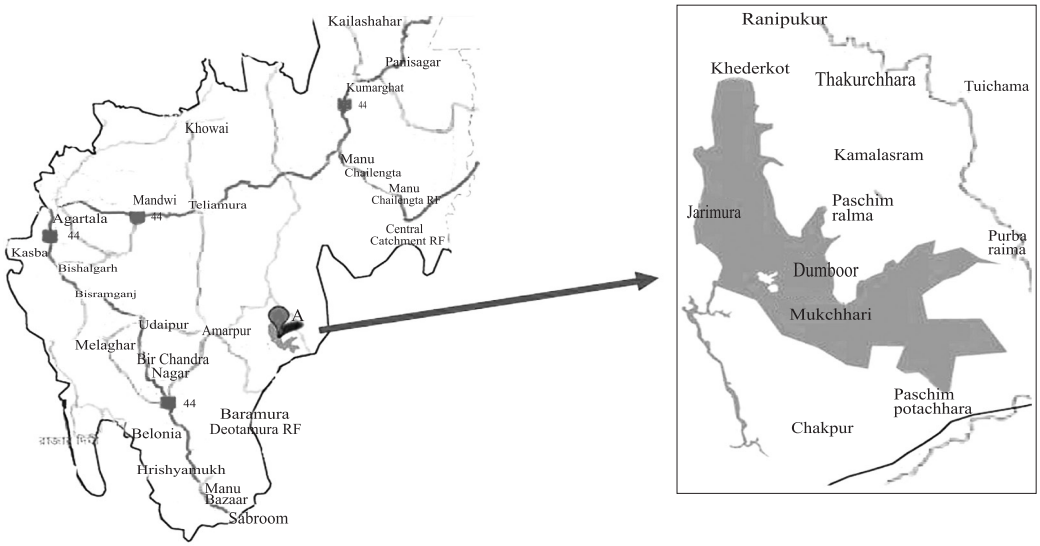

Fig. 1. Map showing the study area

Table 3. Fish production (gradewise) in the Gumti Reservoir (1978-88)

Year	Production (t)						
	G-I	G-II	G-III	G-IV	G-V	Dry fish	Total
1978-79	-	22	40	5.372	-	99.988	169.0
1979–80	26.2	-	56.5	0.6	0.2	101.31	191.7
1980–81	15.4	12.1	67.0	5.3	0.2	92.95	193.4
1981–82	35.0	22.8	37.8	3.9	0.5	144.1	246.6
1982–83	46.3	18.6	31.7	1.2	1.1	1	90.9
1983–84	25.1	23.2	34.4	13.9	3.3	12.6	117.5
1984–85	48.6	11.2	31.1	7.3	0.8	0	41.1
1985–86	35.0	14.0	41.9	8.2	0.9	5.1	105.1
1986–87	37.1	7.6	45.7	9.1	0.5	34	134.0
1987–88	50.6	4.6	28.9	15.3	0.5	222.1	322.0

Table 4. Gradewise fish production in Gumti Reservoir (2002-2012)

Year	Production (t)						
	G-I	G-II	G-III	G-IV	G-V	Dry fish	total
2002-03	127.92	34.12	82.4	83.88	10.78	6.56	345.66
2003-04	221.65	56.44	97.66	104.7	40.3	8.25	529
2004-05	147.21	37.12	92.45	68	10.37	18	373.15
2005-06	151.02	40.55	80	88.27	9.7	15.66	385.2
2006-07	130.91	35.95	87.98	79.63	7.23	1.85	343.55
2007-08	558.47	36.26	80.61	38.6	18.48	2.38	734.81
2008-09	630.99	84.77	64.62	70.78	14.84	7.37	873.37
2009-10	310.47	54.65	40.1	29.91	9.59	2.83	447.55
2010-11	316.48	40.99	54.59	34.1	6.08	4.43	456.67
2011-12	183.02	50.82	31.44	41.99	1.63	4.76	313.66

highest. During the year 1987-88, dry fish constituted 69% of the total fish production in Gumti Reservoir. In 1987-88 the relative production of Grade-I compared to the previous years was the highest, while in 1983-84 Grade-II fishes performed the best. In 1979-80 (56.5 t), Grade-III performed best and the performance of Grade-IV was the best in 1987-88. In the same year it is seen from the data that the performance of Grade -V (0.5 t) fishes were the least and the contribution of dry fish (222.1 t) to total fish production was the best.

Due to discontinuity in availability of the data, the time series analysis was carried out only from 2002-12.

The discontinuity of the data was caused by a change in the data management system of the DoF, Tripura. The total fish production in Gumti Reservoir during the period 2002-12 ranged from as low as 314 t (2011-12) and as high as 873 t (2008-09). In contrast to the earlier set of data described in Table 3, the contribution of dry fish to total fish production was very low during 2002-12, which ranged from 2 t in the year 2006-07 to 18 t in 2004-05. Again in a contrasting situation with the earlier set of data, the contribution of Grade-I fishes were consistently higher than the other grades including dry fish during 2001-12. As much as 72% of the total production were of Grade-I species in the year 2008-09.

Price and marketing

Grade-I species *Amblypharyngodon mola* (mola) commands an average price that ranged from ₹150 to 200 at the farm gate, while Grade-II fishes (channa) commanded an average price that ranged from ₹120-130 (Table 5). Similarly *Notopterus* spp. (Grade-III) commanded a farm gate price range of ₹120-150, while species like *Clarias batrachus* (magur) and *Heteropneustes fossilis* (shingi) (Grade-IV) commanded a price range of ₹250-300 at the farm gate level. Grade-V or the (*Macrobrachium*) commanded the highest price range of ₹300-400. During the period 2002-12, owing to the predominance of species belonging to Grade-I, whose price could be bracketed with species belonging to Grade-II and Grade-III, the relative income of the fishers at the farm gate was at comfortable level despite poor performance of species belonging to Grade-IV and Grade-V.

There is a huge gap between the farm gate price and the price paid by the consumers (Table 5). As far as *A. mola* is concerned, the marketing margins is as much as ₹100-150 kg^{-1}. In the case of IMC, shingi and magur, the prices are in the same range of ₹100-150 kg^{-1}. The marketing margins were higher for certain species like *Notopterus*, *Macrobrachium* and channa.

Fishes are sold on the dyke to the traders and wholesalers and after payment of royalty at the collection gate, packed and transported to various markets in different parts of the state and also to markets in neighboring states *viz*., Subroom, Gandacherra, Agartala and Karimganj (in Assam) (Fig. 2). Efficiency of the cooperatives in the marketing of fish harvested from the reservoir is questionable. The high marketing margins are largely due to the inefficiency of the cooperative societies. This could be attributed to a political governing system in the state. The influence of traders and wholesalers on the price paid to fishers is largely responsible for the substantial marketing margins. The indebtedness of the fishers to traders and wholesalers also play an important role for low farm gate prices realised. The marketing channels also indicate payment of royalty to the DoF for the fish that is taken out of the reservoir. This royalty is determined by the DoF at a periodical interval of three years. As far as the linkages established by institutional arrangements in the reservoir are concerned, the DoF and the cooperatives established at the reservoir have been instrumental in enabling a positive growth orientation for the fishers and fisheries of the reservoir.

Table 5. Farm gate and consumer price (2012)

Species	Farm gate price (₹ kg^{-1})	Consumer price (₹ kg^{-1})
Mola	150-200	200-300
IMC	150-200	250-300
Notopterus	120-150	180-250
Macrobrachium	300-400	400-600
Shingi	250-300	300-350
Magur	250-300	300-350
Channa	120-130	180-250

A definite link can be observed in the growth trends of fish production in Gumti Reservoir, prices and marketing of fishes and institutional arrangements. No substantial growth in fish production is happening in the Gumti Reservoir which has led to increase in fish prices and low gross income of the fishers over the years. Therefore, concerted development effort by the institutional agencies engaged in development of Gumti Reservoir is the need of the hour.

Marketing channels

The fishers in Gumti Reservoir follow the marketing channel presented in Fig. 2. Fishes are collected from the fishers on the reservoir dyke itself by the traders or wholesalers who passes through the royalty collection gates situated on the reservoir periphery. After paying the fixed royalty amount, fishes are transported to the cities.

Institutional arrangements

Licenses, royalties, institutionalised trainings, welfare programs of Department of fisheries (DoF) and cooperative

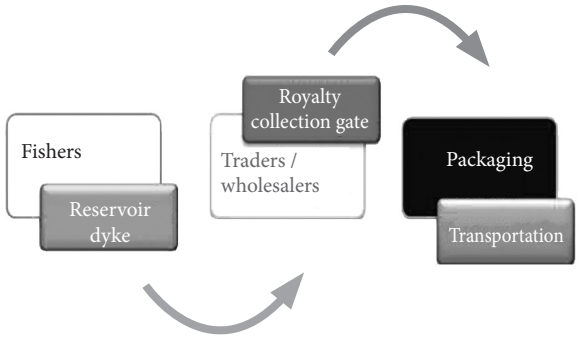

Fig. 2. Marketing channels of fishes from Gumti Reservoir

societies represent the institutional arrangements of the reservoir fisheries system in Tripura. DoF is the apex body involved in the overall development of both fisheries and fishers of Tripura (Fig. 3). The slogan of DoF "Fish for all-all for fish-all for fishers" represents the focus of the department. With limited manpower and materials, DoF along with its functional organisations is making all efforts in augmenting the production by exploiting the potential water resources and also through pisciculture.

DoF is also involved in propagation of improved technology for fish culture in Gumti Reservoir and to evolve various welfare programs which include

Fig. 3. Major objectives of the department of fisheries

training, awareness camps, ranching, licensing, paying of compensation, distribution of craft and gear as well as collection of royalties. Both male and female fishers are trained on areas like aquaculture technologies. Fish diseases, fish breeding and seed production, new culture practices like pen and cage culture, maintaining stocking density and adoption of post-harvest technologies are the areas in which trainings are given regularly. A total of 200 fishers are trained in these areas every year. Awareness camps related to the importance and usefulness of the fishing ban period are conducted 10-12 times a year. Reservoir ranching with carp fingerlings of both IMC and exotic carps are done every year. A total of 218 lakh seeds were stocked during 2002-12.

The legal rights of the fishers in the reservoir are protected by means of licensing. A total of 14515 fishers have been given license during 2002-12. Fishing ban period in the reservoir also involves the payment of compensation to the fishers. Fishers are given ₹1200 for two months during the ban period, which is shared on a 50:50 basis by the central and state Governments. The DoF also supplies fishing nets to at least 100 fishers during a given financial year. Collection of royalty for the fishes harvested from the reservoir is also another measure of financial responsibility of the DoF. A total of ₹17646141/- was collected towards royalty during 2002-12. Revenue generated from royalty and licensing is used for the development of the reservoir fisheries and fishers such as for renovation of the reservoir, seed stocking, gear distribution and for conducting training campaigns. DoF was also involved in the construction of the IMC hatchery near the Gumti Reservoir.

The second important category of organisations involved in the development of fisheries and fishers of the reservoir are the cooperative societies. Presently, there are six cooperative societies operating in the Gumti Reservoir *viz*., Gandacharra Matsyajibi Samabay Samiti, Amarpur Matsyajibi Samabay Samiti, Natunbazarkhudra Matsyajibi Samabay Samiti, Malbasakhudra Matsyajibi Samabay Samiti, Raisyabariupajati Matsyajibi Samabay Samiti and Gumtibariupajati Matsyajibi Samabay Samiti. The fourth and the fifth cooperative societies are tribal fishers cooperative societies. The various welfare schemes of DoF including training programs are generally organised by these cooperative societies. The cooperatives select beneficiaries for the DoF subsidies and benefits. Members of the cooperatives get priority in such nominations. Non-members also can be identified as beneficiary for a particular subsidy or welfare scheme of the DoF. The cooperative society is led by a newly elected president, who manages the day to day affairs of the society. The manager is responsible for various activities such as identification of the beneficiaries for various schemes as well as distribution of craft and gear.

Revenue is generated by the cooperative societies through collection of royalty. Responsibility for collection of royalty is jointly shared by the cooperative society and DoF. Of the total amount of royalty collected, 35% is retained by the cooperative and the rest by the DoF. About ₹95 lakhs has been collected as revenue during 2002-12 as royalty by the cooperative societies. Cooperative societies are also involved in distribution of craft and gear to the members free of cost.

Fig. 4 depicts organisational structure of the cooperative societies engaged in Gumti Reservoir. The highest position in the society is held by the society president followed by manager and cashier. Each society has two cashiers, one for the society office and the other for royalty for collection office situated in reservoir periphery.

Licensing system

The current license fee per fisher per year (2013) has been fixed as ₹75, which was only ₹5 in 1978 (Chakraborty, 1978). The number of licensed fishers in the

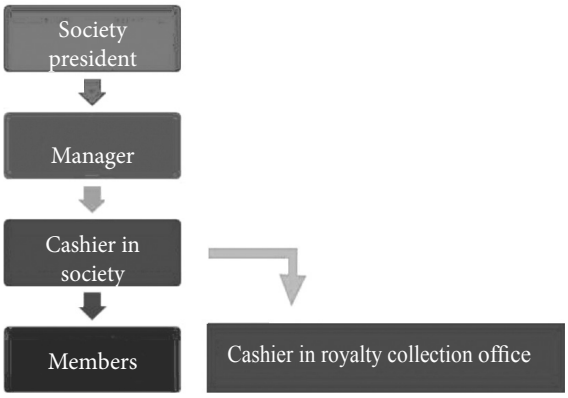

Fig. 4. Organisational structure of Gumti Reservoir Cooperative Society

Gumti Reservoir ranged from 210 in 1984-85 to 588 in 1987-88 (Table 6). During 2002-12, number of licensed fishers ranged from 824 in 2006-07 to 2573 in 2010-11. From the data it is obvious that there is an increase in the number of licensed fishers in the reservoir resulting from the incentives of ₹1200 per head for two months of fishing ban period (1st July to 31st August) provided under Rastriya Krishi Vikas Yojana (RKVY) from 2008-09.

The cross sectional yearwise per capita income of the licensed fishers in the Gumti Reservoir is given in Table 7. The price data for fishes were available only for the year 2012, therefore the income per licensed fisher, per year per capita and per month per capita have been calculated. It works out to ₹17968 per year or ₹1497 per month, per fisher. Based on the information furnished by the officials of the DoF Tripura, it was found that only 50% of the fishers are actively fishing in the reservoir. Therefore discounting 50% of the licensed fishers who are inactive, the yield maybe assumed to be 305 kg per licensed fisher per year and the total income could be ₹3000 per licensed fisher per month. This amount is little above the income defined as cut off national poverty line (₹972) (TOI, 2014).

The income per fisher per month is very low, (Table 7) which indicates that institutional arrangements have not necessarily borne fruit even after the establishment of the licensing system.

Royalties

The total royalty collected is shared on a 65:35 ratio between the DoF and the cooperative societies. Royalty is collected according to the gradewise catch. Fishers and the traders pay a nominal fee to transport the harvested fish to the markets at the royalty gate located on the reservoir periphery (Table 8). This collection office is operated by both DoF and cooperative societies.

According to Sugunan (1995), the fisheries potential of Indian medium reservoir is 39565 t. The above analyses indicate that the performance of the Gumti Reservoir in terms of fish production is much below the potential. Poor management of the reservoir has led to heavy siltation and loss of fishing grounds and the poor performance is compounded by weak institutional support. A careful monitoring of the licensing of fishers is necessary. The interest in registering as a fisher is limited to getting the compensation during the fishing ban period which actually causes a drain on the resources which could otherwise be used for development activities of the reservoir. The increase in number of fishers

Table 6. Licensed fishers in Gumti Reservoir during 1978-88 and 2002-12

Year	No. of License holders	Year	No. of License holders
1978-79	285	2002-03	820
1979–80	293	2003-04	900
1980–81	430	2004-05	875
1981–82	379	2005-06	890
1982–83	383	2006-07	866
1983–84	352	2007-08	824
1984–85	210	2008-09	2030
1985–86	198	2009-10	2105
1986–87	197	2010-11	2426
1987–88	588	2011-12	2573

Table 8. Gradewise royalty rate at the collection gate

Grade of fishes	1978 (paisa kg^{-1})	2013 (₹ kg^{-1})
Grade-I	0.75	4
Grade-II	1.50	5
Grade-III	3.00	7
Grade-IV	4.00	10
Grade-V	-	15

Table 7. Cross sectional yearwise per capita income of the licensed fishers

Year	Yield ($kg\ ha^{-1}$)	Yield (kg per fisher)	Area (ha) per fisher	Income per fisher per year	Income per fisher per month
1978-79	55.42	592.98	15.79	-	-
1987–88	105.6	287.41	7.65	-	-
2002-03	113.36	384.07	3.39	-	-
2011-12	102.86	154.74	1.5	₹17968.4	₹1497.37

also has a negative impact on the performance of the reservoir as it brings down the yield and therefore the per capita income of the fishers. Therefore it is necessary to observe prescribed stocking density, practice efficient management and to implement effective stakeholder involvement in order to achieve potential production from the reservoir.

Acknowledgements

The authors are grateful to Dr. W. S. Lakra, Director and Vice Chancellor, Central Institute of Fisheries Education, Mumbai for constant encouragement and support during the course of the work. We are grateful to the Director of Fisheries and staff of Department of Fisheries, Tripura for all the help rendered in collection of data relevant to the present study. Our sincere thanks also go to all the fishers for their help during sampling and data collection.

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Date of Receipt : 07.03.2014
Date of Acceptance : 22.01.2015