FISHERS' LIVELIHOOD AND FISHERIES GOVERNANCE IN BARGI RESERVOIR OF MADHYA PRADESH

Dissertation submitted in partial fulfillment
of the requirements
for the degree of

M.F.Sc. (Fisheries Extension)

by

NIDHI KATRE, B.F.Sc.
(FEX-MA8-04)

ICAR-CENTRAL INSTITUTE OF FISHERIES EDUCATION

(University Established Under Section 3 of UGC Act 1956)

Panch Marg, Off Yari Road, Versova,

Andheri (W), Mumbai – 400 061

AUGUST, 2020

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DEDICATED TO

MY FAMILY

&

RESPECTED GUIDE

भा.कृ.अनु.प. - केन्द्रीय मात्स्यिकी शिक्षा संस्थान
ICAR-CENTRAL INSTITUTE OF FISHERIES EDUCATION

Dated: 30 August, 2020

CERTIFICATE

Certified that the dissertation entitled "**FISHERS' LIVELIHOOD AND FISHERIES GOVERNANCE IN BARGI RESERVOIR OF MADHYA PRADESH**" is a bonafide record of independent research work carried out by **Ms. Nidhi Katre** during the period of study from August, 2019 to August, 2020 under our supervision and guidance for the degree of **Master of Fisheries Science (Fisheries Extension)** and that the dissertation has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or any other similar title.

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DECLARATION

I hereby declare that the dissertation entitled **"FISHERS' LIVELIHOOD AND FISHERIES GOVERNANCE IN BARGI RESERVOIR OF MADHYA PRADESH"** is an authentic record of the work done by me and that no part thereof has been presented for the award of any degree, diploma, associateship, fellowship or any other similar title.

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सारांश

जलाशय मत्स्य पालन का विकास पारिस्थितिकी, मत्स्य पालन, आजीविका और प्रौद्योगिकी के साथ शासन का एक समग्र कार्य है। केवल सीमित अध्ययनों ने इन मुद्दों को समग्र रूप से संबोधित किया है, क्योंकि अधिकांश शोधकर्ताओं ने केवल मत्स्य पाल, पारिस्थितिकी या सामाजिक-अर्थशास्त्र का अध्ययन किया है। वर्तमान अध्ययन मध्य प्रदेश के बरगी जलाशय (ईडब्ल्यूएसए 16648.5 हेक्टेयर) में किया गया है, जिसमें जलाशय मत्स्य उत्पादन पर निर्भर मछुआरों की आजीविका, मछुआरों द्वारा सामना की जाने वाली बाधाओं, संभावित समाधानों और मत्स्य प्रशासन पर ध्यान केंद्रित किया गया। अध्ययन बरगी जलाशय के छह मछली पकड़ने वाले गांवों में किया गया। जबलपुर जिले के 2 और मंडला जिले के 4 गांवों को चुना गया था। प्रत्येक गांव से 30 उत्तरदाताओं का चयन किया गया, कुल 180 उत्तरदाताओं को चुना गया। जानकारी को संरचित साक्षात्कार अनुसूची के माध्यम से मछुआरों और प्रमुख मुखबिरों द्वारा एकत्र किया गया। मत्स्य महासंघ से सहायक डेटा भी एकत्र किया गया था। क्रुस्कल-वालिस परीक्षण से सामाजिक प्रोफ़ाइल (उप-जाति, शिक्षा) और जीवन स्तर (घरेलू आय, संपत्ति और सुविधाओं) में अध्ययन किए गए 6 गांवों में काफी अंतर था। बरमैया उप-जाति (ओबीसी) के Ghaghagwari मछुआरों की वार्षिक मछली पकड़ने की आय नंदा उप-जाति (ओबीसी) के Manadei मछुआरों (₹ 2990) की तुलना में उच्च (₹ 3760) थी, जिसका मुख्य कारण कम मात्रा में मछली जाल की मात्रा और आंशिक भागीदारी है क्योंकि Manadei समिति अक्रियाशील नहीं है। स्पीयरमैन रैंक सहसंबंध आयु और मत्स्य अनुभव, घर के सदस्यों और परिवार के प्रकार , विस्तार संपर्क, और सामाजिक भागीदारी के बीच मजबूत सहसंबंध दिखा है। जनरल रेखा मॉडल ने बताया कि मछली पकड़ने के अनुभव और सहकारी समिति में सामाजिक भागीदारी की मछली पकड़ने से प्राप्त आय में महत्वपूर्ण भूमिका है। क्रुस्क्कल-वालिस परीक्षण ने सामाजिक श्रेणी, योजनाओं तक पहुंच, बरगी जलाशय के छह गांवों के बीच संपर्क विस्तार में अत्यधिक अंतर का पता लगा है। आजीविका पूंजीयों से पता चला कि वित्तीय पूंजी पांच पूंजीयों में से सबसे कम (0.40) थी, जबकि प्राकृतिक पूंजी सबसे अधिक (0.57) थी। जलाशय का प्रबंधन पांच सरकारी प्राधिकरणों के अधीन है, मत्स्य महासंघ, पावर जनरेटिंग कोर्प लिमिटेड, राज्य पर्यटन विकास निगम, सिंचाई विभाग और जल आपूर्ति विभाग के बीच समन्वय की कमी का पता चला है। मछुआरों, मत्स्य महासंघ, और निजी ठेकेदार के बीच टकराव का पता चला। मछुआरों की प्रमुख बाधा कम आय, वित्तीय समस्याओं, अवैध शिकार, संरक्षण के उपायों का उचित कार्यान्वयन न होना, विनाशकारी गियर और समितियों का क्रियाशील न होना हैं। जलाशय से 19 प्रजातियाँ की मछलियाँ दर्ज की है IMC, चीतल, कालबसु, मिस्टस और मछली की विदेशी प्रजातियाँ । 2017-18 में 35.16 किग्रा/ हेक्टेयर की उपज के साथ मछली उत्पादन 585.42 टन और 2019-20 में 5.70 किग्रा /हेक्टेयर की पैदावार के साथ उत्पादन घटकर 94.82 टन रह गया। अध्ययन में मछुआरों के लिए बरगी जलाशय को लाभदायक बनाने के लिए मत्स्य कृषक उत्पादक संगठन के गठन की अनुशंसा की गई है क्योंकि सहकारी समितियों में सामुदायिक शिथिलता हावी हैं।

ABSTRACT

The development of reservoir fisheries is a holistic function of ecology, fisheries, livelihoods, and governance. Only a limited number of studies have addressed these issues holistically, as most have studied only fisheries and ecology or socio-economics separately. The present study was undertaken in the Bargi reservoir (EWSA 16648.5 ha) region of Madhya Pradesh, focusing on the livelihood profile of fishing communities, governance systems, and problem identification. The study was conducted in six fishing villages of the Bargi reservoir. The selection of fishing villages was based on covering the entire stretch of the reservoir. Based upon it, two villages were selected, each from the upper, middle, and lower stretch of the reservoir. Out of these, two villages of Jabalpur district and four villages of Mandla district were selected for the study, with 30 respondents from each fishing village making a total of 180 respondents. An interview schedule was used to collect primary information. Secondary data was collected from M.P. Fish Federation. Percentage analysis, Graphical representation, Kruskal-Wallis test, Spearman rank correlation and General Linear Model were used for the analysis of the primary data. It was found that the reservoir has diverse fisheries with 19 species and IMC, cheetal, calbasu, Mystus spp. and exotic spp. were economically predominant species. Fish production of the reservoir reached as high as 585.42 tons in 2017-18 with a yield of 35.16 kg/ha under leasing system to the private contractor due to intensive effort in stocking and revenue generation purposes. The production declined in 2019-20 to 94.82 tons with a yield of 5.70 kg/ha. The study revealed that social profile (sub-caste, education) and living standards (household income, assets, and amenities) had a statistically significant difference among six sample fishing villages studied across the entire stretch of the reservoir. The monthly fishing income of Gaghagwari fishers belonging to the Barmaiya sub-caste (OBC) was high (₹3760) as compared to the Nanda sub-caste (OBC) Manadei fishers (₹2990). General Linear Model revealed that fisheries experience and social participation had a significant role in fishing income. Kruskal-Wallis test revealed a significant difference in the social category, access to schemes, and extension contact among the fishing villages. Amongst the livelihood capitals, financial capital was lowest (0.40), while natural capital was the highest (0.57). Concerning the governance of the reservoir, it was found that the management is under five government authorities. These are the M.P. Fish Federation, M.P. Power Generating Corporation Limited, M.P. State Tourism Development Corporation, Department of Irrigation, and Department of Water Supply. The study revealed the fisheries governance is poor due to lack of coordination between fishers, contractor, and M.P. Fish Federation and lack of proper functioning of cooperative societies. Also, a lack of coordination between government authorities was found. The major constraints of the fishers were low income from fishing, financial problems, fish poaching, less implementation of conservation measures, use of destructive gears, and non-functioning of cooperative societies. The study recommends the formation of Fish Farmer Producer Organization to make the Bargi reservoir fisheries profitable for fishers as community dysfunctionists are dominating the cooperative societies.

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1.INTRODUCTION

Inland fisheries in the world account for almost 9% of total fish production, and of these, Asia accounts for approximately 60% of world production. Indian fisheries hold the second position in aquaculture and seventh in capture fisheries production. India has a coastline of 8118 km. The inland water resources of the country are vast in terms of 195210 km of rivers and canals, 3.15 million ha (19,386 numbers) of reservoirs, 2.36 million ha of tanks and ponds, 0.79 million ha of flood plain lakes/derelict water bodies, and 1.24 million ha brackish water (DAHDF Annual report, 2016-17).

Inland fisheries is increasingly contributing to the nutritional security of the country, with annual fish production of 89.02 Lakh tonnes and an average yearly growth rate of 14.05% (more than marine fish production of 36.88 Lakh tonnes with an annual average growth rate of 1.73%) (Handbook of Fisheries Statistics, 2018).

Inland fisheries and aquaculture provides gainful employment to more than 14 million people. During 2017-18, the total fish production was 12.60 million metric tonnes, of which about 65% contribution was from the inland sector, and approximately 50% of the total output is shared from culture fisheries and contributes about 6.3% of the global fish production (NFDB, 2019).

The largest group in agricultural exports from India are the fish and fish-based products with 13.77 lakh tonnes in terms of quantity and Rs. 45,106.89 crores in value. It contributes to around 10% of the total exports and about 20% of the agricultural exports. It provides a share of about 0.91% to the GDP and 5.23% to the country's Ag-Gross Value Added (GVA) (NFDB, 2018).

Reservoirs, the human-made impoundments with an assemblage of both lacustrine and fluviatile characters with huge, untapped potentials and are said to be called ‘fish mines’ (Das *et al.,* 2008). Small reservoirs occupy 1.49 m ha, followed by large 1.14 m ha and medium reservoirs 0.52 m ha (Ekka *et al.,* 2012).

Many river valley projects' primary objective is to utilize the rivers for irrigation and hydro-electric power generation. In India, the human-made reservoirs carry the immense potential for inland fisheries development. However, this vital resource is not contributing to the country's inland fish production to the extent it should. Increasing

productivity in inland fisheries depends hugely on the reservoirs (NFDB, 2011). However, the inland fishers live in extreme poverty and constitute one of the most vulnerable rural population sections.

Reservoirs are known as “sleeping giant” and “man-made lakes,” which cover more than 1% of the country’s land surface, contribute to the bulk of inland fisheries production. Irrigation, water supply, and power generation are the primary purpose of reservoir construction. However, the secondary use of impounded waters for fisheries is becoming an increasingly important activity. Though the present low level of production from the reservoirs may be related to the lack of fish seed for stocking, inappropriate crafts and gears, low marketing channels, ineffective community organizations (i.e., SHG, cooperatives), the involvement of intermediaries in the supply chain, different fishing management regimes (various agencies involved) and poor governance. There are many social and economic advantages associated with reservoir fisheries (Sugunan 1995, Ayyappan *et al*., 2011, NFDB 2011).

The Ministry of Agriculture, Government of India, has classified reservoirs as large (>5,000 ha), medium (1,000 to 5.000 ha) & small (<1000 ha), and for fisheries management (Sugunan, 1995). The average annual fish productivity from the small, medium and large reservoirs in the country was very low (50, 12, and 11 kg $ha^{-1}yr^{-1}$ respectively, the average being about 20 kg $ha^{-1}yr^{-1}$ against the annual potential yield of 100, 75, and 50 kg $ha^{-1}yr^{-1}$ (Sugunan, 1995). However, the fish yield from Indian reservoirs has improved over the years through fingerling stocking and adopting improved management practices, and the average productivity increased to 174, 94, and 33 kg $ha^{-1}yr^{-1}$ from the small, medium, and large reservoirs, respectively. The production potential has been revised to 100, 200, and 500 kg $ha^{-1}yr^{-1}$ from the large, medium, and small reservoirs, respectively (Sarkar *et al.,* 2018).

However, the average fish productivity of Indian reservoirs is almost 30 kg/ha and is not enough to counterpart the ever-doubling frequency of population demands (Paul *et al.,* 2017).

Reservoirs provide income and livelihoods to a large section of the economically underprivileged population in India. Reservoirs fisheries have played a vital role in the country's socio-economic upliftment (FAO, 1997; Thilsted *et al.,* 1997). Despite the

paramount importance of reservoirs, documentation of this vital resource is grossly inadequate. The absence of a reliable database is the main restricting factor for the rapid development of reservoir fisheries in India (Sugunan, 1995).

The two most common forms of enhancement followed in Indian reservoirs are culture-based fisheries and stock enhancement. Culture-based fisheries are generally practiced in the small reservoirs, while the medium and large reservoirs are managed based on stock enhancement, also called enhanced capture fisheries. (Ayyappan *et al.,* 2011).

Tamil Nadu had the highest area of small reservoirs with 8,895 units, followed by Karnataka with 4,651 units, and Andhra Pradesh with 2,898. Karnataka has the maximum number of large reservoirs (12 units). Madhya Pradesh is at the top in the area (169,502 ha) under medium reservoirs units (Ayyappan *et al.,* 2011).

In the present scenario, reservoirs are significant for increased fish production for the following reasons (Sarkar *et al.,* 2018).

a. Unlike the rivers, which are under the increasing threat of environmental and anthropogenic habitat degradation, and the stagnant fish production from marine resources, the reservoirs provide adequate scope for fish yield expansion.

b. The aquaculture enterprises are capital-intensive while the management of common-pool resources is highly labor-intensive, having the potential to provide substantial employment to the weaker sections, dam displaced people, and the stakeholders

c. The only expenditure involved in the reservoir fisheries is the stocking of seeds, which is less as compared to the financial investment needed for the construction of ponds and other activities for aquaculture practices.

d. The aquaculture venture's profit goes to an entrepreneur or investor, whereas all the stakeholders share the increased fish production from the reservoir (under a good governance regime).

It is essential to study fisheries and fishers' development in the reservoir to identify gaps and problems.

Madhya Pradesh is an inland state located in India's center, often nicknamed as “Central India/Heart of India” due to its geographical location. The total inland water bodies of Madhya Pradesh covered over 4.05 lakh hectares area from which water area under reservoirs is 3.38 lakh hectares, and the area under rural ponds and tanks is 0.67 lakh hectares. The total area under fisheries is 3.97 lakh hectares with total fish production of 1,38,693 tons, which includes reservoirs of 3.33 lakh hectares with fish production of 30,842 tons and 0.64 lakh hectares area of ponds and tanks with fish production of 92,820 tons and 17,088 km length of rivers with fish production of 15,030 tons (DoF, 2018-19).

Presently, Madhya Pradesh Fish Federation controls 22 reservoirs covering over 2.13 lakh hectares. For fish seed production, five fish seed area of 27.50 hectares, and about 197 rural augmented puddles at the periphery of the reservoir, having the water area of about 351.50 hectares was constructed (M.P. Fish Federation, 2015-16 & DoF, 2017-18). Twenty reservoirs spread over 0.047 lakh hectares are subject to the DoF, and 3017 irrigation reservoirs, spread over 1.060 lakh hectares with an average of 1,000 hectares, have been transferred to Panchayat Raj Institutions. (DoF, 2017-18).

Madhya Pradesh has significant reservoirs resources, the extent of their utilization for fisheries and its potential for creating sustainable livelihood in distress conditions and remote areas need to be understood. There are 3,059 reservoirs in Madhya Pradesh (DoF, 2017-18). Bargi reservoir is one of the most important reservoirs regarding fish production and provides livelihood to around 1875 fishers (M.P. Fish Federation, 2019-20). However, few studies have done like ‘’fishery management practices of the major reservoirs in Madhya Pradesh’’ (Ninan, 2002) and ‘’state, private or cooperatives? The governance of Tawa reservoir fisheries, India’’ (Jyotishi *et al.,* 2020) in Madhya Pradesh. Very little information exists about the reservoir fisheries in Madhya Pradesh; details like fisheries governance systems, fish production trends, utilization patterns, and socio-economic status of fishing communities are not available. In most reservoirs, fisheries developed as a tertiary activity. Also, during the planning phase of reservoir construction, the fisheries part was not considered (Sarkar *et al.,* 2018). However, the technological interventions, the institutional framework, and socio-economic status of fishing communities around the dam play an essential role in reservoir fisheries development.

Due to this, the present study was conducted in the Bargi reservoir with the following objectives:

Objectives

1. To assess the livelihood profile of fishing communities in Bargi reservoir
2. To assess the patterns of the governance system in the Bargi reservoir
3. To identify the problems and suggest possible solutions from the fishers' perspective

2. REVIEW OF LITERATURE

A literature review is a central part of the entire research process, as it gives an idea of earlier studies and provides clarity and focus to your research problem, improves the methodology, broadens the knowledge base in your research area, and contextualizes your findings. An attempt has been made in this chapter to present a brief review of available literature related to relevant variables selected, which have a meaningful relation to the objective of the study. The review is presented under the following broad headings.

1. Reservoir fisheries governance
2. Socio-economic profile
3. Livelihood aspects
4. Sustainable Livelihood Approach framework
5. Cooperative societies
6. Constraints/problems encountered by the fishers

2.1. Reservoir fisheries governance

FAO (2016) defines fisheries governance as a continuing process through which governments, institutions, and stakeholders of the fishery sector – administrators, politicians, fishers, and those in affiliated sectors elaborate, adopt, and implement appropriate policies, plans, and management strategies to ensure resources are utilized sustainably and responsibly.

Bavinck *et al.,* (2005) define governance as the whole of public and private interactions initiated to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them.

Chandra (2009), while describing fisher management regimes and fisheries governance in floodplain wetlands of Assam, stated that wetlands are the common property resource and under different management regimes like private management, cooperative management, community-based fisheries management, and open access.

Keshvae (2013) documented fisheries governance of two remotely located reservoirs in the Vidarbha region of Maharashtra and assessed the socio-economic profile of predominantly tribal communities. Management regimes in both reservoirs differed significantly with Itiadoh reservoir being managed by fishers' cooperative society while the Isapur reservoir is given on lease to a private contractor who engages fishers for wages. Also found to be reservoir fishery providing stable and continuous employment in remote tribal areas supports fishers' livelihood.

Chandra *et al.,* (2014) studied the institutional arrangement and governance of Indira Sagar, M.P, noted that ownership of the reservoir was in the hand of the Narmada Valley Development Authority, M.P. and fisheries management in these reservoirs has been traditionally under the cooperative governance system, members of any fisheries society can do fishing in any area. However, their fish catch shall be entered under the respective cooperative society.

Palita (2014) study that the fisheries department has leased the Hirakud reservoir to primary fishers cooperative society (PFCS) sector-wise. A lease value was collected from the PFCS amount of Rs. 300/ha/year. She also observed that poor management of DoF and PFCS illegal use of zero mesh size and conflict for allocating fishing rights among sectors is responsible for the reservoir's low production.

Angela *et al.,* (2015) found that the Department of Fisheries (DoF), Tamil Nadu, has taken a lead role in managing the reservoir. Fishers do fishing through a license from the Department of Fisheries. She also observed that the mesh size regulation and closed season are not strictly enforced in reservoirs of Tamil Nadu.

Das *et al*., (2015) explained that the government should take some essential steps by providing some sort of management policy as well as providing some extra providence during the ban season of the fishing in Batiaghata Upazila of Khulna district, Bangladesh that may be provided by the *Vulnerable Group Feeding* (*VGF*) card.

According to NAAS (2016), Indian governance issues in reservoir fisheries relate to low utilization of resources as well as low productivity levels, multiple ownership and management of inland water bodies, varied leasing and licensing regulations, ineffectual fisheries cooperatives, underdeveloped inland fish markets, lack of comprehensive policy for cage culture technology in reservoirs, etc.

A study by Llyod *et al*., (2016) revealed that with an increase in fish seed stocking and fishing effort, total fish catch also increased through the shared fishing system in the Pechiparai reservoir of Kanyakumari district, Tamil Nadu. In fishing effort coracle and 3 to 4 sets of monofilament, gill nets were predominantly operated in the reservoir.

A study by Tyagi *et al.*, (2017) revealed that local communities and their organization (fishing cooperative societies/federations) could play an essential role in the collective management of Tawa reservoir fisheries in Hoshangabad district, Madhya Pradesh. They also suggested that governance and management of reservoir fisheries need to be viewed in light of the recent developments and empirical evidence made by social scientists in natural resource management.

Jyotishi *et al.,* (2020) stated equity, economic efficiency, and resource sustainability dimensions as the significant parameters for assessing the appropriate institution type. The study used a blended analytical approach between descriptive statistical and qualitative analysis for equity and sustainability and production frontier for efficiency analysis. The results suggest community management through a cooperative system as the appropriate institution for fisheries management among the different management regimes, i.e., state, private, and cooperative management, underwent in the Tawa reservoir, Hoshangabad district, Madhya Pradesh.

2.2. Socio-economic profile

Socioeconomic status (SES) is defined as a measure of one's combined economic and social status and tends to be positively associated with better health. It focuses on the three standard measures of socioeconomic status; education, income, and occupation (Baker, 2014). Socio-economic status (SES) denotes an individual's position in a community with respect to the amount of cultural possession, adequate income, material possession, prestige, and social participation. The factors, which accounts for the SES of Individual in society, are determined by society.

Ali *et al.,* (2008) stated that the fish farming sectors played a vital role in uplifting the livelihood and socio-economic conditions of fish farmers of Bangladesh through employment generation by increasing fish production.

Angela (2011) inferred that fishing as an occupation had not attracted the young age group people in Stanley reservoir in Salem District of Tamil Nadu. The high literacy rate among the younger age group in her study could also be a reason for their non-involvement in fisheries. Around 40% of the middle age group (26-35 years and 36-45 years) indicated that fishing provides income to meet the basic needs of their family. A higher percentage (58%) of the old age group may be attributed to their years of experience and the lack of interest in shifting the occupation.

Basavakumar *et al.,* (2011) revealed that only 13.5% of fishers are literate out of 57 sample fishers of a village in Dharwad district, Karnataka. The majority (56%) of fishers' income shows that they are earning less than Rs. 3000 per month. The study suggested that fishers' general socio-economic status could be improved by adopting improved fishing and farming methods.

Nikumbe (2011) stated the three distinct occupational groups: active fishers, non-active fishers, non-fishers, and their socioeconomic status in Girna, Yedgaon, and Manikdoh reservoir region, Maharashtra**.** He found that the socio-economic relationship among these groups was complicated and sometimes non-linear.

Ekka *et al.,* (2012) studied the socio-economic status of fishers of reservoirs in India; the result indicated that an average literacy rate of 63.32 % was recorded among the sampled fishers, school dropouts were more at the secondary level of education, and average monthly expenditure of the households was Rs. 3148.3 only, which is very low to sustain a livelihood, often leads to indebtedness.

Salim *et al.,* (2013) has assessed the levels of literacy, health, income, and livelihood security of the fisherfolk in India, the age profile of the fisher household revealed the dominance of the young -one, literacy rate was relatively high, about 80 percent on overall. It was found that for better livelihood security, the fishers have diversified their income sources beyond fisheries (agriculture, and business and non-farm activities), average monthly income across all sectors was about Rs 6500, in which about 73 percent were from fisheries. For economic security, a considerable number (around 40%) of fisher households had savings, the average amount being Rs 4200 per fisher household, and microfinance enterprises like self-help groups (SHGs) should be promoted to help the fishers to address their problem of indebtedness.

Palita (2014) stated that fishers of the Hirakud reservoir region, Odisha, spent less of their income on education and health but more on food as compared to non-fishers. She also found that the depth of poverty among fisher's was greater among non-fishers, indicating the greater inequality in income distribution among the poor non-fishers than fishers.

Yunus (2014) confirmed two occupational groups, namely fishers' and non-fishers, in the region distinguishable by various social and economic parameters, poverty status, and occupational profile. His study shows that the fishers were better in average annual household income than non-fisher.

Qayoom *et al.,* (2019) studied that the two fisher communities in district Baramulla of Jammu & Kashmir are illiterate and economically poor. A very meager return from the capture fisheries has forced them to switch over to other professions. They were facing the problem of credits taken by them, which was a hurdle for their upliftment.

Rizwana *et al.*, (2017) reported that the fishers of district Bandipora in Kashmir valley faced constraints in their personal and professional life that pushed them towards backwardness. Low housing, less road connectivity, lack of technological interventions, institutional credit, market, and marketing channels were some of the fishers' significant constraints.

Sharma *et al.,* (2018) studied the socio-economic profile of fish farmers, Amethi, Uttar Pradesh. Results reveal that the farmers in this block (60%) were engaged in full-time aquaculture and (30%) have participated in part-time aquaculture, and farmers were from the age group of 45-50-year-old, have primary education followed by secondary educations. Some old farmers have good experiences in fisheries activities for 15-20 years.

2.3 Livelihood aspects

Allison (2001) studied the livelihood approach and management of small-scale fisheries and explained the livelihood approach and its insights into conventional fisheries management policies in developing countries are explored. It is argued that both state-led management and some of the newer, community, or territorial use rights approaches if predicated on an incomplete understanding of livelihoods, can result in

management directives incompatible with both resource conservation and the social and economic goals of management.

Farrington *et al.,* (2002) studied the livelihoods approaches in urban areas, London and stated that the livelihoods approaches have the advantage of placing the poor at center stage and of exploring aspects of their livelihoods and the livelihood related programs and projects help to improve their articulation of knowledge of poor people's.

Arjjumend (2004) studied governance and participation in community-initiated associations and its implications for sustainable livelihoods, Madhya Pradesh, and found that fisherfolk *samitis* have got 2-5 years lease for fish rearing from Gram Panchayat, this fishers' community have capabilities, values, and innovations to mutually organize, make livelihood arrangement and survive with age-old traditions. Community-initiated institutions, mainly based on livelihood, development, or social justice-related functions, could better bargain with the panchayat bodies and government-promoted associations and NGO-promoted groups.

Jyotishi (2004) studied fisheries resource and the production scenario of the Tawa reservoir, Madhya Pradesh, which has undergone different management regimes. The finding suggests that among different regimes in Tawa fisheries management, the cooperative form under Tawa Matsya Sangha (TMS) 's performance was better.

Smith *et al*., (2005) reviewed existing explanations of livelihood outcomes in artisanal inland fisheries of developing countries and extended them by considering a more comprehensive range of factors that may influence fishing effort and fisher incomes.

Salagrama and Koriya (2008) assessed the opportunities for livelihood enhancement and diversification in coastal fishing communities of southern India, Chennai, and used LED strategies for livelihood analysis of fishers.

Manasi *et al.,* (2009) identified that fisheries in the Tungabhadra sub-basin (TBSB) support the livelihoods of a significant proportion of the fishermen population and development initiative plan implemented by the Department of Fisheries.

Nandi *et al.,* (2014) stated that the livelihood status of Nigeria fish farmers improved in terms of socio-economic conditions, quality of food consumed, housing condition,

and saving. The positive social and environmental attributes of aquaculture make it an attractive entry point to improve the livelihood and exterminate poverty among the low rural fishing households.

Sarwer *et al.,* (2016) conducted a study to examine pond farming and livelihood status of fish farmers in Subarnachar, Noakhali, Bangladesh. They have identified the living condition of rural fish farmers' livelihood status was found positive, and 94% of the farmers improved their status through fish farming.

Gautam *et al.,* (2018) assessed the present status of fisheries in the Rihand reservoir, reported that the fish catch and yield had increased moderately during the last 40 years with a marginal increase in annual growth rate and species composition has also declined during this period. Department of fisheries Uttar Pradesh holds the fishing management and leasing rights of the Rihand reservoir. Interested fishers living in the vicinity of the reservoir are given annual licenses or fishing permits to fish in the reservoir.

Mir (2019) studied the livelihoods and governance in Dal and Manasbal Lake of Kashmir and found that financial capital was least among all the five capitals in both the lakes. The management of two lakes was under Lake and Waterways Development Authority, Department of Tourism and Department of Fisheries and Human Development Index of fishers was found to be 0.50, which was lower than that of Jammu & Kashmir (0.68).

Velumani T. (2017) reported that the annual fishing income in Meenakshipura fishers belonging to the Sembadavar sub-caste (OBC) was high (Rs. 66,909) as compared to K.R. Nagar fishers (Rs. 42,452). Human Development Index of fishers was found to be 0.56, which was slightly lower than Karnataka’s and India’s average HDI (0.62).

2.4 Sustainable Livelihood Approach framework

Chambers & Conway (1992) has explained the sustainable livelihoods framework and defined relation to five key indicators of livelihood assets (human, social, physical, natural, and economic capitals), which are combined with the pursuit of different livelihood strategies (agricultural intensification or extensification, livelihood diversification and migration).

Ashley and Carney (1999) reported that sustainable livelihood aims to promote development that is sustainable not just ecologically, but also institutionally, socially, and economically and to produce genuinely positive livelihood outcomes (rather than concerning themselves with narrow project outcomes, with resources or with output).

Bebbington (1999) studied the livelihood approach in Andes, Latin America, and revealed that the livelihood approach is concerned first and foremost with people. So an accurate and realistic understanding of people's strengths (here called "assets" or "capital") is crucial to analyze how they endeavor to convert their assets into positive livelihood outcomes.

Farrington *et al.,* (1999) conducted a study on the sustainable livelihood (SL) approach in rural areas, London, and concluded that the sustainable livelihood (SL) approach might appear excessively micro-focused, time-consuming, and complex, with only limited value-adding. It does not obviate the need for existing methods and tools, yet requires an investment of time and resources to implement broader perspectives and achieve a degree of synergy among existing initiatives.

Kebe *et al.,* (2009) studied the coastal fisheries communities in Liberia and identified future interventions aimed at assisting fisheries communities for the improvement of human and social capital, as well as the political and institutional environment, could help to make physical, financial, and natural capital more efficient.

Moustapha *et al*., (2009) studied the livelihood status of the Liberian fishers community by using the sustainable livelihood approach (SLA) and reported that the vulnerability to poverty in fishing communities was high. This was due to seasonality and absence of safety at sea; conflicts between industrial fisheries and between migrant and local fishers; high prices of inputs and commodities, and high prevalence of diseases are the cause of the fisherfolk's vulnerability. Weak livelihood capital assets and an unfavorable political and institutional environment contribute to exposure to poverty.

Vulnerability is defined as a high degree of exposure to risks, shocks, and stresses and leads to issues and insecurity (Ellis 2000). It fundamentally affects livelihoods and the availability of and access to assets. Shocks include natural shocks, economic shocks, marketing rights, disease, non-regulation of mesh size, poaching activities, and conflict. Seasonality such as employment opportunities, food availability, seasonal

fluctuations in the catch, understocking of fingerlings, close season, and decline in fish production. Trends such as depleting resources and economic crisis. Livelihood assets provide the activities of the fisher and capital and illustrate the interaction or interrelationship between them to generate livelihood outcomes. Different forms of capital from the five assets-categories (human, natural, financial, social, and physical) combine to generate livelihood outcomes. These multiple and varied influencing factors influence the resources to which fishers have access, which depends on their livelihood strategy options. Policies, institutions, and processes are the policies or welfare schemes implemented by the government, financial or fisheries institution, i.e., M.P. Fish Federation. During the close season, fishers are engaged in seasonal or migratory labor and part-time or full-time throughout the year for alternative and supplemental diversified livelihood, respectively, under the central government's national rural employment guarantee act scheme. M.P. Fish Federation provides a saving cum relief scheme for close season, deferred wages on total fish catch throughout the year, and boat-net subsidy to active fishers. Livelihood strategies that are adopted include decisions made by the fishers and the policies of institutions. The four dimensions of livelihood strategies (diversity, adaptation, incentives, vulnerability) are essential to understand the prospects for fishers' livelihood. Diversity implies the diversity of the fishers & fishing communities to their livelihood strategies. Adaptation is how households adapt to minimize their risks, incentives that derive resource users' decisions, and the sources of their vulnerability. Livelihood outcomes are an increase in income, improved food security, health, and reduced vulnerability.

2.5 Cooperative Societies

Gosari *et al.,* (2019) studied the role of cooperatives as a catalyst for the economy at Juku Lele Cooperative in Somba Opu District, Gowa Regency. They stated that active participation in fisheries cooperatives is one catalyst for an increase in the economy. Fishers of fisheries cooperatives get more value than fishers who are not members of cooperatives.

Motamed *et al.,* (2011) studied the Fisheries Cooperative Societies of Guilan Beach. His study revealed that members' participation has a positive relationship with literacy, participation in educational-extensional classes, satisfaction from cooperative

management, and awareness about cooperative principles. Also, it has a negative relation with the age of beach seine cooperative members (P>0/05). Regarding the effect of participation on social-economic conditions, it was found that participation affects the decrease of labor cost, anxiety, and danger.

Dorgi and Gala (2016) stated that lack of feasibility study, low awareness about cooperative principles and values, inadequate access to training & markets, low credit systems, incapable leaders, lack of audit and inspection, seasonal change, and conflicts are the factors affecting members' participation in fishery cooperatives of Gambella, Ethiopia.

Pegu (2018) studied the Fishermen's Cooperative Societies of Tripura and reported that among perceived functional weaknesses,' unsatisfactory economic performance' was ranked highest, followed by 'inadequate water area,' lack of financial support,' lack of transparency,' lack of proper pond embankment,' casual approach towards timely disbursement of dividend, etc.

2.6 Constraints/Problems faced by fishers

Rahman (2020) studied various problems faced by Bangladesh's fishing communities, such as the siltation of rivers, wetlands, the involvement of non-indigenous fishers in fishing, lack of appropriate entrepreneurship development policies, and mass shifting of traditional occupation by the indigenous fishermen at an alarming rate.

Karki (2016) studied the major problems faced by Nepal's fish farmers, such as the shortage in fingerlings supply, lack of marketing infrastructure, disease problems, and lack of skilled human resources.

Kimani *et al.,* (2020) stated that financial capital was ranked as the most severe constraint by fishers, intermediaries, and small-scale processors. Market-related constraints were ranked as the second most persistent problem amongst fishers and intermediaries, while processors identified scarcity of fish. Other constraints identified were the resource, equipment and infrastructure, training, costs, governance, trust, and labor dimensions. The study was conducted on Kenya's coast at Malindi, Mayungu, Mombasa, Shimoni, and Vanga study sites.

Sau *et al.,* (2012) stated that fishers of the societies perceived the social constraints with the highest intensity among all the five broad areas of constraints, i.e., social, economic, technical, marketing, and general constraints, selected for the study. The non-availability of an assured market under marketing constraints and lack of water during summer, and lack of soil and water testing facilities under technical constraints were also the essential constraints. The study was conducted in Kharagpur subdivision of Paschim Medinipur district of West Bengal.

3. RESEARCH METHODOLOGY

This chapter details the different phases of the research process from a pilot study to sampling procedure, data collection, processing, and analysis. It also deals with the research design used and the procedure's description to collect valid and reliable data. The procedure adopted in the primary data collection and statistical methods followed in the analysis are described below:

3.1 Locale of the study

3.2 Brief description of the study area

3.3 Sampling procedure

3.4 Operational definition and measurement of variables

3.5 Data collection

3.6 Statistical tools used

3.1 Locale of the study

The present study was conducted in the Bargi reservoir region of Madhya Pradesh. The reservoir covers three districts of Madhya Pradesh – Mandla, Jabalpur, and Seoni. Out of 41 fishing villages of the reservoir, six fishing villages like Magardha, Durga Nagar, Gaghagwari, Narayanganj, Patha, and Manadei were selected for the study. During the selection of villages, it was ensured that these villages represent all stretches of the reservoir (head, middle, and tail) and include different communities of fishers living along the reservoir periphery. Again, fishermen and fisherwomen population of cooperative societies, major fishing activities, and fishers' membership in cooperative society were also considered during the selection of villages for study.

Reasons for selecting the Reservoir

- It is among the largest reservoirs (4^{th}) in Madhya Pradesh having an area of around 27,296 ha

- Around 41 fisher villages (more than 1875 fishers) depend on the Bargi reservoir for their livelihood.
- Few studies have ever been carried out on fisheries governance and fishers' livelihood in the reservoir region.
- The ease of conducting fieldwork (local language and familiarity) also influenced the selection of this reservoir.

3.2 Brief description of the study area

3.2.1 General description of Madhya Pradesh state

Madhya Pradesh is the second-largest Indian state by area and the fifth largest state by population. The state is located in the center and has an area of 308,244 square kilometers. It accounts for 9.38 % of the land area of the country. The state is divided into 51 districts. The state of Madhya Pradesh has its geographical location at 22.42 N, and 72.54 E. According to the 2011 census of India, the total population of Madhya Pradesh is 72,626,809, of which 37,612,306 are male, and 35,014,503 are female or 930 females per 1000 males. The population density is 236 per $Km^{2.}$ The literacy rate is 69.32%, with 78.73% of males and 59.24% of females being literate, according to the 2011 census. Inland water resources of varied type, constituting about 4.05 lakh hectares area includes 3.38 lakh hectares of water reservoirs and 0.67 lakh hectares of ponds and tanks. In the state, the reservoirs are classified based on the mean water spread area for management purpose under different government agencies: Small reservoir (Category-A is <10 ha under Gram panchayat, Category-B is 10-100 ha under Janpad panchayat, and category-C is 100-1000 ha under Zila panchayat), medium reservoir (1000 ha to 2000 ha) under DoF and medium (2000 ha to 5000 ha) and large reservoirs (over 5000 ha) under M.P. Fish Federation (DoF, 2018-19).

The total fish production (inland production) and the fish seed production was 1.43 Lakh tonnes and 1117.23 million fry, respectively (Handbook of Fisheries Statistics, 2017-18).

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, the state fisheries

department managed fisheries, stocking, leasing, and fishing rights to fisher-folk or primary cooperatives. In 1979, Madhya Pradesh Fishery Development Corporation (MPFDC) was formed, which became the nodal agency for fisheries management of reservoirs. In early 1990, MPFDC leased out the fishing rights to private firms. During this period, it called for tenders and contracted out fishing to the private parties on a yearly royalty basis. Madhya Pradesh Fish Federation (*Matsya Mahasangh*) replaced MPFDC in the year 1999. Among the different regimes, the Fisheries Department and MPFDC regimes broadly represent the public sector; the cooperative regime reveals the people's management, and the contractor regime the private sector's role in fishing management. (Jyotishi and Parthasarath, 2004).

The resource-wise contribution to inland fish production is presented in Table 3.2.1

Table 3.2.1 Resource-wise contribution to inland fish production

Water Resources	Water Area	Water area under fisheries	Fish production (tons)
Total inland water bodies (Lakh Ha)	3.45	3.36	1,38,693
Rivers & canals (Km)	17,088	N/A	15,030
Reservoirs (Lakh Ha)	2.88	2.86	30,842
Tanks & ponds (Lakh Ha)	0.57	0.50	92,820

Source: DoF, Madhya Pradesh (2018-19)

3.2.2 General description of Jabalpur and Mandla districts

Table 3.2.2 Information about Jabalpur and Mandla districts

Features	Jabalpur	Mandla
Total area	5,198 km^2	8,771 km^2
Population (Census,2011)	2,463,289	1,054,905
Density	1,200/sq. m	310/sq. m

Source: DoF, Madhya Pradesh (2011)

3.2.3 General description of Bargi Reservoir

Bargi reservoir is the first reservoir constructed on river Narmada among the series of 30 major dams built on river Narmada- the lifeline of Madhya Pradesh. The construction started in 1974 and was completed in the year 1990. It is constructed across the river Narmada near the village Mankhedi in Jabalpur district, (M.P.). The reservoir was constructed under the two major irrigation projects, named Bargi Diversion Project and Rani Avantibai Lodhi Sagar Project, supervised by Narmada Valley Development Authority (NVDA). It is a multipurpose project for irrigation, hydro-power generation, domestic water supply, tourism, and fish production and located 43 km south-east of Jabalpur city at Barginagar. The reservoir has a water spread area of 27,696.5 ha. Besides having a 105 MW power generation capacity, an annual irrigation capacity of 2198 lakh hectare of land in four districts viz., Jabalpur, Narsinghpur, Satna, and Rewa and also serves as a rich source of fish production. The reservoir provides livelihood to around 1875 fisher families living around the reservoir. During its construction, 162 villages in 3 districts- Mandla (95), Seoni (48), and Jabalpur (19) were affected, submerged about 82 villages completely. The *Bargi Bandh Visthapit Matsya Utpadan Avam Vipanan Sahakari Sangha Maryadit*, Jabalpur, is a regional federation organized by the dam displaced people in 1994 which initially comprised of 54 primary fishers' cooperative societies of over 2000 members belonging to 3 districts, namely Mandla, Seoni, and Jabalpur (NVDA, 1999). At present, 41 fishing villages are having 41 primary cooperatives societies consist of about 1875 fishers. (DoF, MP 2017 & M.P. Fish Federation).

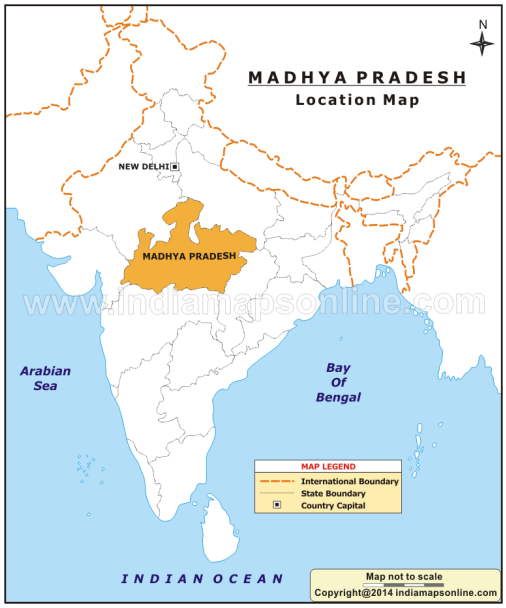

Figure 3.2.1 Location of Madhya Pradesh in India

Figure 3.2.2 Location of Jabalpur and Mandla districts in Madhya Pradesh

Figure 3.2.3 Location of sampling villages around Bargi reservoir

3.3 Sampling procedure

Bargi reservoir is located in three districts of Madhya Pradesh, namely Jabalpur, Mandla, and Seoni. Initially, an exploratory field visit was conducted in the study area. During this visit, information regarding the total number of fishing villages in the three districts on the periphery of the reservoir, their fisher population details, market distance, and caste details were assembled to build a sampling methodology. As per the available data of the M.P. Fish Federation, there are a total of 41 fishing villages in the three districts of the Bargi reservoir. The total number of villages is 8, 12, and 21 of Jabalpur, Seoni, and Mandla districts. Out of these, six fishing villages were selected by considering all the three stretches of the reservoir, i.e., lower (tail), middle and upper (head), to cover the entire reservoir region geographically**.** The selection of fishing villages was based on location, fisher population/membership in a cooperative society, sub-caste, and fishing activity. Pre-survey revealed that local fishers' belonged to- Manjhi, Nanda, Barmaiya, Barman, Kurmi (Patel), Gond (ST), Dalit (SC) and others (including Muslim) community, so the sample selection included fishers from all the communities to ensure heterogeneity.

The multi-stage sampling method was employed in selecting six fishing villages, namely Magardha, Durga Nagar, Manadei, Gaghagwari, Narayanganj, Patha, to collect data from the respondents. The sampling units of the first stage are known as primary or first stage units, and subsequently, units of the second stage are termed as secondary units and so on. The advantage of the multi-stage sampling is that only the part of the population selected at any stage needs to be recorded to sample the next stage. In the current study, the two districts of the Bargi reservoir have been considered the first stage units, the fishing villages as second stage units, and the fishers in each fishing village as third stage units.

The Bargi reservoir covers the area of Jabalpur, Mandla, and Seoni districts. Therefore, at the first stage, two districts, namely Jabalpur and Mandla, were selected out of three districts based on less inland fish production than the Seoni district. The selection of two fishing villages was made each from the head (upper), middle, and tail (lower) stretch of the reservoir based on diversity in fishing practices, sub-caste, occupation, landing centers, and cooperative society's functioning. The underlying reason behind this is to select fishing villages to cover the entire reservoir region to

make the study more comprehensive. The study was conducted in six fishing villages/cooperative societies, namely Magardha, Durga Nagar, Manadei, Gaghagwari, Patha, and Narayanganj. Out of the six fishing villages, two villages are of the Jabalpur district, and four belongs to the Mandla districts. The selection of four villages from Mandla district was based on the fact that the maximum number of villages are under Mandla district. Thirty respondents from each fishing village were selected randomly, which accounts for 180 sample size.

Table 3.3.1 Fishers operational definition

S.N.	Category	Operational definitions
1	Fisher	Respondents whose primary occupation is fishing and who are continuously engaged in that occupation regularly (more than 15 fishing days in a month)

Table 3.3.2 Sampling plan for Bargi reservoir

S.N.	Sampling villages	Stretch of reservoir	Samples (180) Fishers (180)
1	Magardha	Head region (Upper)	30
2.	Durga Nagar		30
3	Narayanganj	Middle region	30
4	Patha		30
5	Manadei	Tail region (Lower)	30
6	Gaghagwari		30
	Total		**180**

Note: The sampling plan was to include at least 30 respondents from each village for statistical rigor

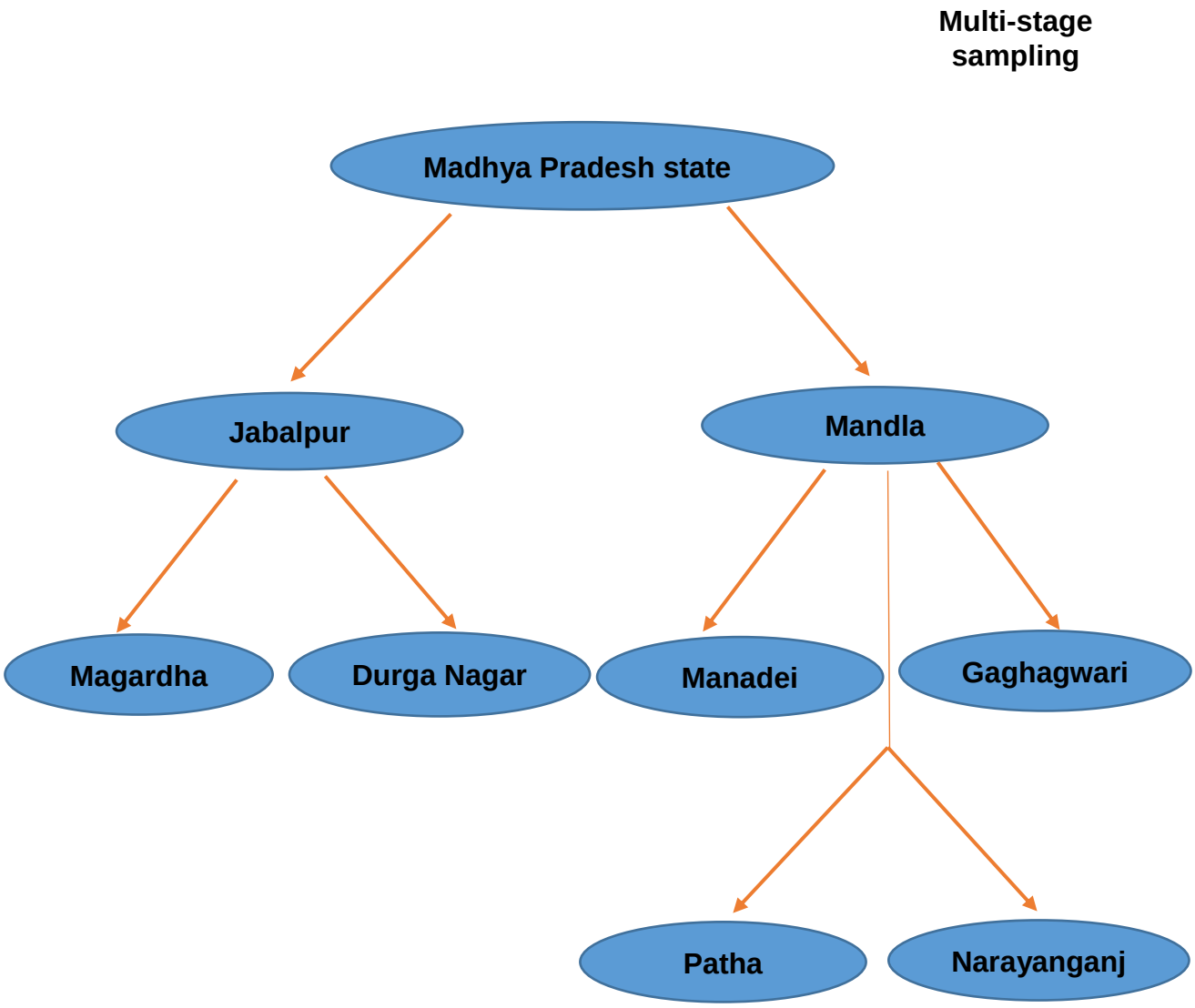

Figure 3.3.1 Sampling design used at Bargi reservoir

3.4 Status of fisheries development in Madhya Pradesh

3.4.1 Details of fish production of Madhya Pradesh

The total fish production of Madhya Pradesh has shown an increasing trend over the years. Only the inland fish production contributes to total fish production due to the absence of marine fisheries resources in the state. In the year 2011-12, the total or inland fish production was 0.75 Lakh tonnes, and it increased to 2.01 Lakh tonnes in 2019-20 (Handbook on Fisheries Statistics 2018, New Delhi & DoF, 2019-20, Bhopal). This is presented in Table 3.4.1.

Table 3.4.1 Details of fish production of Madhya Pradesh (in Lakh tonnes)

S.No.	Year	Inland/Total
1.	2011-12	0.75
2.	2012-13	0.85
3.	2013-14	0.96
4.	2014-15	1.09
5.	2015-16	1.15
6.	2016-17	1.39
7.	2017-18	1.43
8.	2018-19	1.62
9.	2019-20 (till 30-03-2020)	2.01

Source: Handbook on Fisheries Statistics 2018, New Delhi & DoF, 2019-20, Bhopal

Table 3.4.2 Details of fish seed (fry) production of Madhya Pradesh (in million)

S.No.	Year	Fry production
1.	2011-12	1500.99
2.	2012-13	798.01
3.	2013-14	963.08
4.	2014-15	1001.88
5.	2015-16	952.05
6.	2016-17	1111.33
7.	2017-18	1117.23
8.	2018-19	1287.20
9.	2019-20	1421.99

Source: Handbook on Fisheries Statistics 2018, New Delhi & DoF, 2019-20, Bhopal

It is clear from the Table 3.4.2 that the state seed production initially decreases from the year 2011-12 (1500.99 million) to 2015-16 (952.05 million) and increases onwards till 2019-20 to 1421.99 million fry.

Table 3.4.3 District wise inland fish-seed production of Madhya Pradesh, 2019-20 (till 31-03-2020) (in lakhs)

S.No.	District	Spawn production	Fry production
1.	Rewa	420	269.30
2.	Sidhi	196	102.87
3.	Singrauli	0	66.76
4.	Satna	555	225.44
5.	Shahdol	206	180.84
6.	Anuppur	388	153.09
7.	Umariya	490	165.02
8.	Maihar	3335	215.99
9.	Sagar	0	150.20
10.	Damoh	87	205.18
11.	Tikamgarh	1189	590.10
12.	Chhatarpur	200	340.51
13.	Panna	273	81.27

14.	Naogaon	0	15.64
15.	Jabalpur	453	256.45
16.	Katni	844	303.21
17.	Narsinghpur	340	72.99
18.	Mandla	1605	420.10
19.	Seoni	2679	321.13
20.	Chhindwara	1094	308.08
21.	Balaghat	5550	692.38
22.	Dindori	384	77.74
23.	Gwalior	430	107.87
24.	Datia	307	95.02
25.	Shivpuri	0	160.16
26.	Bhind	0	10.38
27.	Morena	500	171.54
28.	Sheopur	100	49.00
29.	Guna	0	93.99
30.	Ashoknagar	0	72.90
31.	Indore	521	163.75
32.	Dhar	11662	3500.07
33.	Khargone	5505	1005.22
34.	Barwani	128	104.00
35.	Khandwa	266	92.00
36.	Burhanpur	123	47.00
37.	Jhabua	280	65.75
38.	Alirajpur	0	15.50
39.	Ujjain	1030	131.53
40.	Dewas	80	110.58
41.	Shajapur	40	58.00
42.	Agar Malwa	0	95.00
43.	Mandsaur	1000	159.02
44.	Neemuch	0	41.63
45.	Ratlam	587	105.40
46.	Bhopal	3772	629.55

47.	Raisen	1822	317.24
48.	Vidisha	362	98.50
49.	Sehore	372	96.67
50.	Rajgarh	0	96.13
51.	Hoshangabad	4570	856.00
52.	Harda	921	217.00
53.	Betul	1435	239.20
	Total	56101	14219.89

Source: DoF, 2019-20, Bhopal

The Table 3.4.3 depicts that the total spawn production and fry production of the state was 56101 lakhs and 14219.89 lakhs, respectively. The contribution of Jabalpur, Mandla, and Seoni districts (of Bargi reservoir) was 2679 lakhs spawn and 321.13 lakhs fry production from Seoni district. The spawn and fry production of Mandla districts was 1605 lakhs and 420.10 lakhs, respectively, while that of Jabalpur district is 453 lakhs seeds and 256.45 lakh fry. Of the above three districts, the Seoni district takes more seed production while Mandla has more fry production.

Table 3.4.4 District wise inland fish production of Madhya Pradesh (in tonnes)

S.No.	District	2019-20 (till 30-03-2020)
1.	Rewa	7923.00
2.	Satna	9487.60
3.	Sidhi	3341.00
4.	Singrauli	2170.80
5.	Shahdol	7970.15
6.	Anuppur	5475.10
7.	Umariya	4877.56
8.	Jabalpur	3434.22
9.	Katni	5745.00
10.	Narsinghpur	1155.00
11.	Seoni	5488.72
12.	Chhindwara	3106.57
13.	Balaghat	12609.00
14.	Mandla	3185.62
15.	Dindori	2110.00
16.	Sagar	2904.88
17.	Damoh	4671.00
18.	Panna	3077.90
19.	Chhatarpur	5163.29
20.	Tikamgarh	5965.39
21.	Gwalior	1276.64
22.	Datia	781.14
23.	Shivpuri	4367.33
24.	Guna	2625.30
25.	Ashoknagar	2094.99
26.	Morena	1167.71
27.	Sheopur	0.00
28.	Bhind	657.28
29.	Bhopal	10262.53
30.	Raisen	4183.41
31.	Sehore	3708.50

32.	Rajgarh	5190.53
33.	Vidisha	2966.21
34.	Hoshangabad	1880.00
35.	Harda	1733.00
36.	Betul	3085.52
37.	Indore	6656.60
38.	Dhar	13378.84
39.	Jhabua	3695.90
40.	Alirajpur	2430.10
41.	Khargone	5522.50
42.	Barwani	1911.00
43.	Khandwa	3618.86
44.	Burhanpur	475.74
45.	Ujjain	3445.00
46.	Dewas	3874.45
47.	Shajapur	1213.76
48.	Agar Malwa	1601.27
49.	Ratlam	2224.58
50.	Mandsaur	3264.58
51.	Neemuch	1501.34
	Total	200656.41

Source: DoF, 2019-20, Bhopal

The total fish production of the state is 200656.41 tons (2019-20), as presented in Table 3.4.4. Out of this, the fish production of Jabalpur district is 3434.22 tons, Mandla district is 3185.62 tons, and the Seoni district is 5488.72 tons. Seoni district is having higher fish production than the other two districts. Bargi reservoir is in the districts of Jabalpur, Mandla, and Seoni. The contribution of the reservoir to the fish production of three districts in 2019-20 (till 30-03-2020) is 94.82 tonnes (M.P. Fish Federation, 2020).

3.5 Status of fisheries development in Bargi Reservoir region

The hydrographical and demographical profile of the Bargi reservoir is given in table 3.5.1 and 3.5.2, while tables 3.5.3 and 3.5.4 summarises fisheries and fishers' profiles of the Bargi reservoir region.

3.5.1 General description of hydrographical features of Bargi Reservoir

The information related to the hydrography of the Bargi reservoir is presented in Table 3.5.1.

Table 3.5.1 Hydrographical profile of Bargi reservoir

General Information	**Bargi reservoir**
Dam site	43 km away from Jabalpur
Name of the river	Narmada
Year of impoundment	1990
Location of reservoir	Jabalpur, Mandla and Seoni (Madhya Pradesh)
Villages submerged	162 (22 total & 140 Partial)
Project	Bargi Diversion Project, Rani Avanti Bai Lodhi Sagar (RABLS) Project
Operated by	Narmada Valley Development Authority (NVDA)
Reservoir	
Catchment area	14,556 km2
Full water level	422.76 m
Dam top water level	426.90 m
Dam water level	424.28 m
Lowest water level	403.55 m
Total reservoir area	27696.5 ha
Average fish producing area of the reservoir	16648.5 ha
Annual irrigation capacity	2198 lakh ha

Proposed hydropower generation capacity	105 megawatt
Dam	
Length of the dam	5385.5 m
Height of the dam	69.80 m
Spillway Gates	21

Source: M.P. Fish Federation, Bargi, Dam site (2018-19)

3.5.2 General description of demographic features of Bargi Reservoir

District-wise information on population, literacy rate, fishing villages, and landing centers is presented in Table 3.5.2.

Table 3.5.2 Demographic features of Bargi reservoir

Particulars	**Bargi Reservoir**		
Districts	Jabalpur	Mandla	Seoni
Fishing villages on the periphery	8	21	12
Total district population (Census 2011)	24.6 lakhs	10.5 lakhs	13.8 lakhs
Literacy rate (Census 2011)	81.07%	66.87%	88.87%
Major Fishing Villages	Barghat Magardha Binjha Badhaiyakheda Kathotiya Khamariya K.G.N. Durga Nagar	Hinotiya Lakhanpur Musakhoh Chaurai Kiruhu Pipariya Mul Dongri Paudi Maldha Sahajpuri Tatighat Patha	Gadaghat Chamarwah Lahdikol Karhaiya Bijasen Sarangpur Kudwari Bakhari Tikariya Budhera Payli

		Singodha Mohgaon Khamariya Pipariya Padmi Kikariya Ghaghagwari Manadei Narayanganj Sikosi	Bagdari
Fish landing centers	Zerotanki Papri Kala	Patha Retatek	_
Religion	Hinduism, Islam (in the minority)	Hinduism, Islam (in the minority)	Hinduism
Major occupations involved in	Fishing, labor	Fishing, labor, agriculture, construction	Fishing

Source: M.P. Fish Federation, Bargi, Dam site (2018-19)

Table 3.5.2 depicts that there are 41 fishing villages. Out of these, the majority (21) of villages belong to Mandla district while Jabalpur and Seoni district have 8 and 12 fishing villages. However, landing centers are 4 in number.

3.5.3 General description of fisheries of Bargi Reservoir

The major and minor species details along with fish spawn, fry, fingerling production and per day and annual fish production of Bargi reservoir is presented in Table 3.5.3.

Table 3.5.3 Fisheries profile of Bargi reservoir

S.No.	Particulars	Bargi Reservoir
1.	Effective Average Water Spread Area (ha)	16648.5
2.	Major Fish Species	*Catla catla, Labeo rohita, Cirrhinus mrigala, Ctenopharyngodon idella, Labeo calbasu, Cyprinus carpio, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis, Ompok pabda, Notopterus chitala, Wallago attu, Channa punctata, Mastacembelus armatus*
3.	Minor Fish Species	*L. gonius, L. bata, L. calbasu* etc.
4.	Fish production (tonnes/yr)	213 tonnes (2018-19)
5.	Average fish production/day	666.2 Kg
6.	Spawn production (lakhs)	858.00 lakhs
7.	Fry production (lakhs)	203 lakhs
8.	Fingerling production (lakhs)	43.25 lakhs
9.	Fingerling stocked	96.61 lakhs
10.	Stocking density of fingerling/ha (Size 71-120 mm)	580

Source: M.P. Fish Federation, Bargi, Dam site (2018-19)

Table 3.5.3 depicts the major species major carps (*Catla catla, Labeo rohita, Cirrhinus mrigala*), exotic species (*Ctenopharyngodon idella, Hypophthalmichthys molitrix, Cyprinus carpio*), and catfishes include *Mastacembelus armatus, Ompok pabda, Notopterus chitala, Wallago attu,* and *Channa punctate*. In contrast, the minor species are *L. gonius, L. calbasu,* and *L. bata.*

3.5.4 General description of fishers of Bargi reservoir

The fishing villages, membership, active members, income, and fish production details of fishers are mentioned in Table 3.5.4.

Table 3.5.4 Information about fishers' profile of Bargi reservoir

S. No.	Particulars	Bargi Reservoir
1.	Location	Jabalpur, Mandla, Seoni
2.	Number of fishing villages	41
3.	Number of functional fishers' cooperatives	41
4.	Number of registered members/fishers	1875
5.	Number of active members/fishers	1324
6.	Average working members (No.)	139
7.	Fishing working days	320 days
8.	Fish production/fisher/day	4.79 kg
9.	Income/fisher/day	126.90 Rs.

Source: M.P. Fish Federation, 2018-19

Table 3.5.4 revealed that 70.61% of the registered fishers belonging to 41 cooperative societies are active fishers, while the remaining 29.39% are non-active fishers.

3.5.5 Details of production and productivity of the Bargi Reservoir

The fish production and productivity details of the Bargi reservoir over the years is presented in Table 3.5.5

Table: 3.5.5 Year-wise fish production and productivity of the Bargi reservoir

Year	Target (ton)	Fish production (ton)	Percentage of target (%)	Productivity (kg/ha)
2014-15	400.00	209.93	52	12.61
2015-16	300.00	207.65	69	12.47
2016-17	300.00	194.98	65	11.71
2017-18	350.00	585.42	167.26	35.16
2018-19	300.00	213.18	71	12.80
2019-2020 (till 31-03-2020)	225.00	94.82	42	5.70

Source: M.P. Fish Federation, Bargi, Dam site, 2018-19.

From Table 3.5.5, it can be inferred that fish production is declining over the years in the reservoir. The present study has revealed that destructive fishing practices operated for catching juveniles and brooder fishes have increased manifold over the years, which is one of the main reasons for the declining trend of fish production in the reservoir as reported by M.P. Fish Federation. This resembles the study on the "environment and fisheries of river Narmada" which also documented the use of destructive fishing measures, particularly for mahseer catch. (CIFRI, 2009).

The reservoir's fish production peaked in the year 2017-18 with the production of 585.42 tons with a yield of 35.16 kg/ha. However, the production declined in 2019-20 to 94.82 tons with a 5.70 kg/ha yield due to a very low stocking of 67.13 lakh fingerlings in 2019-20. The reason, as reported by M.P. Fish Federation officials and representatives of cooperative societies, is that fishing was stopped several times in the reservoir due to delay in payment of the lease amount by the contractor followed by a fishing ban during monsoon season.

3.5.6 General description of selected villages

The details of total registered, active and inactive members of the selected fishing villages from Jabalpur and Mandla district are presented in Table 3.5.6.

Table 3.5.6 Sampling villages selected in Bargi reservoir region

Village	District	Registered members/ fishers' population	Active member	Inactive members	Distance from main town (km)
Magardha	Jabalpur	37	28	09	49 km
Durga Nagar	Jabalpur	47	27	20	20 km
Manadei	Mandla	62	10	52	05 km
Patha	Mandla	36	32	04	22 km
Narayanganj	Mandla	31	31	0	0.5 km
Ghaghagwari	Mandla	91	85	06	19 km

Source: Interview of representatives of sampled fishing villages on membership & distance from the nearest main town

Table 3.5.6 depicts that all the registered members of Narayanganj are active, while only 16.67% of Manadei village are active fishers. Magardha is the remotest village from the main town (49 km). Narayanganj has almost no distance from the main town as the place is itself a town (0.5 km).

3.6 Operational definitions and measurement of variables

3.6.1 Operational definitions

Livelihood

A person's livelihood refers to their "means of securing the necessities of life." Livelihood is defined as a set of economic activities involving self-employment and or wage employment by using one's endowments (both human and material) to generate adequate resources for meeting the requirements of the self and household on a sustainable basis with dignity (DFID 2000).

Fisheries Governance

Fisheries governance is a continuing process through which governments, institutions, and stakeholders of the fishery sector – administrators, politicians, fishers, and those in affiliated sectors elaborate, adopt, and implement appropriate policies, plans, and management strategies to ensure resources are utilized in a sustainable and responsible manner (FAO 2016).

Conflict management

The conflict management involves the diagnosis of and intervention in affective and substantive conflicts at the interpersonal and intragroup levels and the styles or strategies used to handle these conflicts. (Rahim, 2002).

Focus group discussion

Focus group discussions are facilitated group discussions in which a researcher raises issues or asks questions that stimulate discussion among the group members.

Cooperative societies

A cooperative society is an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise. (FAO, 2016).

3.6.2 Demographic and social parameters

Table 3.6.1 Empirical measurement for demographic and social parameters

Variables	Operationalized definitions	Categories	Coding
Demographic parameters			
Gender	Gender referred to the sex of respondents	Male Female	1 2
Family type	Type of family the respondent lived in or belonged to	Nuclear family Joint family	1 2
Family size	The number of normally resident members of a family is its size	<4 4 to 6 >6	1 2 3
Social parameters			
Nativity	The respondent is residing in the area as a native person or as a migrant, who has come from outside during one in lifetime	Native Migrant	1 2
Religion	The religion of the respondent	Hindu Muslim	1 2
Caste	The name of the Sub-Caste to which the respondent claims to belong to	Nanda (OBC) Barmaiya(OBC) Barman (OBC) Kurmi (OBC) Gond (ST)	1 2 3 4 5
Community	The name of the community to which the respondent claims to belong to	OBC ST	1 2
Education	Refers to whether the respondent attended formal educational institutions; and how	Illiterate Read & write Primary	1 2 3

	many years one has completed therein	Middle Secondary Higher secondary Graduate & above (PG)	4 5 6 7
Marital status	Whether the respondent is married or not	Married Unmarried	1 2
Social participation	The degree of involvement of respondents in the number of social and political organizations		
	Membership status	Cooperative society Gram Panchayat NGO SHG Political party Any fisheries organization	1 2 3 4 5 6
	Degree of participation	Daily Weekly Fortnightly Monthly Occasionally Yearly Never	1 2 3 4 5 6 7
	Leadership	Yes No	1 2
	Benefit from social participation	Economic Social Political No benefits	1 2 3 4

	Satisfaction	Yes	1
		No	2
Extension system contact	The degree to which an individual contacted formal change agents for getting information	Local officer	1
		Cooperative society	2
		Panchayat president	3
		V.L.W.	4
		Fisheries Extension Officer	5

3.6.3 Living conditions

Living conditions are operationalized as the standard of living of the respondents. It is measured in terms of house description, basic household amenities, and physical assets. The coding procedure followed by population census (2011) is adopted, and these parameters with their operationalized definitions and categories are given in Table 3.6.2.

Table 3.6.2 Living conditions with their operationalized definition and categories

Parameters	Operationalized definitions	Categories
House description		
House Type	Type of house possessed by respondent	Pucca 1(*roof & wall concrete,5rooms*) /pucca 2(*roof &wall burned bricks, three rooms)/*Semi Pucca 1 *(wall and floors are burned brick, human-made roof tiles)/*Semi Pucca 2 (*wall and floors are cement, roof asbestos sheet)/* Kuccha
Ownership status	Ownership status of the house possessed by respondent	Owned / rented
Household amenities		
Sanitation facility	Toilet facility available in the house of the respondent	Available in house / public toilet / open defecation
Source of lighting	Source of lighting available in the house of the respondent	Electricity / solar light / kerosene lamp /others
Sources of Drinking water	Sources of Drinking water available for the respondent	Tap water treated / Municipality water / Bore well / Public tap / river water/ others
Cooking fuel	Cooking fuel available in the house of the respondent	LPG/Electricity/Coal/Firewood/others
Physical assets		
Land ownership	Land owned by respondent	a) Yes b) No
Access to basic public service		
Citizenship photo I.D.	Citizenship photo I.D. possessed by respondent	Ration card/ Voting card/Aadhar card/BPL card/PAN card/Driving license/Bank passbook/post office passbook/Any other

3.6.4 Access to different schemes and programs of M.P. Fish Federation

This refers to the support services provided by the M.P. Fish Federation, Madhya Pradesh, in terms of different schemes and programs to benefit fishers.

Table 3.6.3 Access to different schemes of M.P. Fish Federation, their categories & coding

Schemes	Categories & coding
Any social-welfare scheme (NREGA scheme)	Yes/No
Craft and gear subsidy (80:20) & (50:50)	Yes/No
Accident insurance	Yes/No
Saving cum relief scheme	Yes/No
Fishers housing scheme	Yes/No
Other schemes/state packages (Ujjwala Yojana)	Yes/No
Deferred wages	Yes/No
Training on technologies (Netting/Net making/Net repairing)	Yes/No
Sustainability oriented (Mesh size regulation/Closed season)	Yes/No
Changed socio-economic condition	Yes/No

3.6.5 Economic parameters

Fishing income (Primary occupation)

Primary occupation is any activity in which a person is regularly engaged and derives from his primary income source. Secondary occupation refers to the supporting activity to the main occupation for achieving additional income. Based on the primary data collection, all fishers were involved in full time in fishing. Income was categorized keeping ₹3405/month (₹40,860/yr) as the minimum one should earn to provide a minimum standard of living and below which is considered low (poor). However, total income and mean incomes were calculated.

Household annual income

Household annual income refers to the income earned by all the family members of the respondents from different sources per year, i.e., from primary and secondary occupation.

3.6.6 Occupational details

Occupation

It referred to the extent to which the respondent is involved in fisheries and other activities. It can be intellectualized as any activity in which a person derives an income of more than 50 percent.

Table 3.6.4 Occupation and coding

Occupation	Coding
Fishing alone	1
Fishing + wage labourer	2
Fishing + agriculture	3
Fishing + others	4
Fishing + wage labourer + agriculture	5
Fishing + wage labourer + others	6

Fishing occupation profile

The fishing occupation profile covers detailed information about the fishery occupation of the respondent. The parameters covered under it are given below in the Table 3.6.5.

Table 3.6.5 Variables and operationalized definitions

Variables	Operationalized definitions	Categories	Coding
Fishing practice	The fishing practice, the respondent, is involved	The culture-based capture fisheries	1
		Only capture fisheries	2
		Any other fishing activity	3
Engagement in fishing	Engagement of respondent in fishing	Fully	1
		Partially	2
		Not at all	3
Experience in fishing	The completed years of experience of a respondent as a member in the Fisheries cooperative society	Absolute number in years categorized as	
		<10 yrs	1
		10-20 yrs	2
		20-30 yrs	3
		>30 yrs	4
Ownership of craft	Ownership of craft of respondent	Yes	1
		No	2
Type of craft	Type of craft the respondent possesses	Tin Boat	1
		Kishti	2
		Wooden Boat	3
Number of craft	Number of craft the respondent possesses	Absolute number	_
Ownership of gear	Ownership of gear of respondent	Yes	1
		No	2
Type of gear	Type of gear the respondent possesses	Cast net	1
		Gill net	2
		Cast net + Gill net	3
Fishing days per month	No. of days the respondent goes for fishing	Absolute number of days	_

Average catch per day (in kg)	Average catch by respondent per day	Absolute number in kg	_
Kinship towards fishing activity	The no. of generations the respondent's family is involved in the fishing occupation	1st generation 2nd generation 3rd generation 4th generation	1 2 3 4
Source of learning to fish	Respondent has learned fishing from	Own Brother Father Grandfather Relatives	1 2 3 4 5
Fishing method	Respondent fish individually or in group	Individual Group	1 2
Activity (employment) during the closed season	The activity in which the respondent is involved during the closed season	No work Agriculture Labour	1 2 3

Household Assets

Four parameters were viz. house type, house ownership status, transport facilities, and communication facilities are considered for household assets. All the variables are assigned codes, and equal weightage has been given for all four variables. While coding the different categories of each variable of household assets, it is taken care that the highest code is given to the better facility.

The variables such as house type, ownership status of the house, transport facilities, and communication facilities are presented along with codes assigned below in Table 3.6.6.

Table 3.6.6 Variables of household assets and their categorization

Variable	Category	Code
House type	Pucca	3
	Semi-pucca	2
	Kuccha	1
House Ownership	Owned	2
	Rented	1
Transport facilities	None	0
	Man pooled rickshaw	1
	Public transport	2
	Bicycle	3
	Bike	4
	Four-wheeler	5
Communication facilities	Radio	1
	TV	2
	Newspaper	3
	Internet	4
	Normal phone	5
	Smart phone	6

Household Amenities

Five variables selected to measure the household amenities are sanitation facility, drinking water, fuel used for cooking, lighting source, and drinking water location, which are assigned codes. The same procedure, as followed for the household assets, is adopted for household amenities.

These variables of Household amenities are presented along with assigned codes in the below Table 3.6.7.

Table 3.6.7 Variables of housing amenities and their categorization

Variable	Category	Code
Sanitation facility	Available in house	1
	Open defection	2
Drinking water	Tap water treated	1
	Municipality water	2
	Borewell	3
	Public tap	4
	River water	5
Fuel used	LPG	1
	Electricity	2
	Coal	3
	Firewood	4
	Others	5
Lighting source	Electricity	1
	kerosene lamp	2
	solar light	3
	others	4
Location of drinking water	Within premises	1
	Near premises	2
	Others	3

3.7 Data Collection

3.7.1 Tools of primary data collection

Primary data was collected using the following procedures/methods.

Primary observation

The primary observation method was used to get information about fishers' fishing village and their livelihood aspects, using an interview schedule.

Key-informant interviews

Key informant interviews are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a wide range of people, including community leaders, professionals, or residents- who have first-hand knowledge about the community. Key informant interviews were carried out to get a first-hand idea about the village, quality of life in each occupational group, and general social, cultural, and economic features of these groups and understand the institutional arrangement aspects of reservoirs. Two key informants were selected from each fishing village for the interviews. Information was collected by key informants Parmulal Barman (leader of cooperative society-Gaghagwari), Rajesh Patel (leader cooperative society- Magardha), Pavan Barman (leader cooperative society-Narayanganj), Subhash Barman (leader cooperative society-Patha), Sukratlal Nanda (leader cooperative society- Manadei), Durgesh Barmaiya (leader cooperative society-Durga Nagar), Sunil Tekam (Fishery Technical Manager, M.P. Fish Federation, Bargi Nagar), Divya Kirkatta (Fishery Technical Manager, M.P. Fish Federation, Narayanganj) and C.V Mohany (Regional Director, M.P. Fish Federation, Jabalpur). The remaining three key-informants were the residents of the fishing villages.

Personal interview with respondents

The data is collected from fishers in six sampled fishing villages with the help of well-structured interview schedules incorporating all parameters on which information is required. The two interview schedules for data collection *viz.,* interview for fishers, and interview for M.P. Fish Federation officials (Fishery Technical Manager & Regional Director) is mentioned in the annexure.

Focus Group Discussion (FGD)

It is a form of strategy in quantitative research in which attitudes, opinions, or perceptions towards an issue, product, service, or program are explored through a free and open discussion between members of a group and the researcher (Kumar,2001). Two focused group discussions were carried out with fishers in the village. First, FGD was conducted to get a clear picture of fisheries governance in the reservoir, including the leasing system to private contractor workings of cooperative

society and marketing arrangements. The second FGD was conducted with six selected fishers from Magardha, Gaghagwari, Durga Nagar, Patha, Narayanganj, Manadei village, and M.P. Fish Federation staff to understand possible alternative livelihood options.

Triangulation

Triangulation is a powerful technique that facilitates data validation through cross verification from a group of two or more sources. This technique has been used to verify the data collected, e.g., fishing income was collected directly from fishers and estimated indirectly for authentication through their daily catch records maintained by the representative of the cooperative societies. Likewise, access to welfare schemes was cross-checked through M.P. Fish Federation records maintained by the officials'.

3.7.2 Tools for secondary data collection

The details of the selected study areas' population were collected from the Census report 2011 (Madhya Pradesh), Government of India, and village panchayat offices. The details of the reservoir, fish production, and fisheries governance of the reservoir were collected from the State M.P. Fish Federation, Madhya Pradesh, and M.P. Fish Federation of Jabalpur and Mandla districts, fisheries cooperative societies, and the contractor-wholesaler.

3.8 Statistical tools used in the study

3.8.1 Percentage analysis

Frequency and percentage analysis describe most of the social and economic parameters having nominal and ordinal scale values in the study.

3.8.2 Kruskal-Wallis t-test

The Kruskal-Wallis t-test (sometimes also called the "one-way ANOVA on ranks") is a rank-based non-parametric test used to determine if there are statistically significant differences between two or more groups of independent variables on a continuous or ordinal dependent variable. Here, the Kruskal-Wallis t-test has been used to test one of the hypotheses whether there is a significant difference in terms of several socio-

economic profiles of the six sampled fishing villages as no study is made on this aspect earlier.

The following was the assumptions for the Kruskal-Wallis t-test

Ho: There is no significant difference between the characteristics of different fishing villages.

H1: There is a significant difference between the profile characteristics of different fishing villages.

If the null (Ho) hypothesis is rejected, there is a significant difference between the six sampled fishing villages of the reservoir. The formula of the Kruskal-Wallis t-test.

$$H = \frac{12}{n(n+1)} \sum \frac{R_i^2}{n_i} - 3(n+1)$$

3.8.3 Spearman rank correlation

Spearman Rank Correlation was used to find out a measure of association among various categorical variables such as age, gender, social category, household members, family type, occupation, education, mass media, fisheries experience, access to schemes, social participation, extension contact, women contribution in fishing and household income of all the selected six fishing villages around the Bargi reservoir using SPSS version 25. The equation for correlation used was

$$r_s = 1 - \frac{6\sum D^2}{n\left(n^2 - 1\right)}$$

Where
r = correlation coefficient
n = no. of samples
D = difference in the sum of ranks of two sample

3.8.4 General Linear Model

The General Linear Model (GLM) is a useful framework for comparing how several categorical variables affect the continuous dependent variable. The change in the continuous variable is measured with a unit change from one category to another categorical variable category. The general linear model requires that the response variable follows the normal distribution. The GLM Univariate procedure provides regression analysis and analysis of variance for one dependent variable by one or more independent categorical variables. The keyword in the general linear model is *general*; the procedure can handle various variables, including a non-numerical one. During the procedure, the GLM changes the non-numerical variable to a number before any calculations are made.

The formula for the general linear model is given below as follows:

$$\hat{Y} = \beta_0 + \beta_1 X$$

Where,

$\hat{Y}$ = the dependent variable (also called the predicted, explanatory, or response variable).

β_0 = the intercept — always a constant (i.e., the value never changes within the model).

β_1 = a weight or slope (also called a *coefficient*). Determines how much weight one variable contributes to the model. If everything in the equation holds constant, β_0 gives the predicted change in Y for a unit change in X.

X = an independent variable.

3.8.5 Rank Based Quotient

Rank Based quotient (RBQ) was used to quantify the data collected by a preferential ranking technique by first ranking the parameters and then calculating the rank based quotient (RBQ) given by Sabarathnam (1998), which is as follows;

$$\text{R.B.Q} = \frac{\sum fi(n+1-i)}{(N \times n \times 100)}$$

Where,

fi= number of fishers reporting a particular problem under i^{th} rank.

N= number of fish fishers.

n= number of problems identified.

3.8.6 Livelihood approach

The concept of sustainable livelihood was studied using the broad philosophy of the Sustainable Livelihood Approach Framework of DFID, UK (Department of International Development). A livelihood encompasses the assets (Physical, Human, Social, Natural, and Financial), the activities, and the access to these (mediated by institutions and social relations) that contribute to the standard of living gained by the individual fisher (Allison and Ellis, 2001). A livelihood is sustainable when it can cope and recover from stress and shocks and regulate or enhance its capabilities and assets at present or shortly. Livelihoods are influenced by institutions, policies, and processes, and are affected by external influences such as trends, shocks, and seasonality, e.g., natural hazards, the decline in fish catch, change in climatic conditions. (Carney, 1998).

3.8.7 Livelihood resilience of fishers' based on capitals of Sustainable Livelihood Approach

In this study, the fishers' livelihood resilience developed by DFID, 1999, was used. It is based on the principles of the Sustainable Livelihood Approach. The livelihood resilience is evaluated by assessing the five livelihood capitals of the Sustainable Livelihood Approach using 42 attributes that enable or constrain fishers' livelihoods (Nanda, 2018) and (Mir, 2019). These attributes were grouped into five "capital" used in the Sustainable Livelihood Approach, as briefed below:

Physical Capital: Availability of crafts, gears, types of equipment, access to market infrastructure that support livelihoods are studied under the capital. Six attributes were used to assess the capital, including fishing boat & net ownership, physical assets ownership, fishing, processing/value addition, housing, and market.

Natural Capital: Five attributes were used to assess the capital, including distance to the nearest town, distance to nearest water resource, sources of drinking water, ownership of land, and natural hazard (shock).

Social Capital: Social capital is assessed based on attributes like social norms and networks (Woolcock, 1998). The relationships between community members that facilitate strengthening livelihoods. Twelve attributes were used to assess the capital which includes leadership capabilities, participation in social works, leadership desire, participation in social meetings, social relationships with neighbors, women contribution in fisheries work, social relationships with other fishers, contact with government & non-government institutions, the attitude of working together in community, the contribution of women in decision making, the trustworthiness of fishers and helping behavior of community leaders.

Human Capital: Attitudes, skills, and experience that shape behavior and competency in directing livelihoods are studied. Twelve attributes were used to assess the capital which includes fisheries knowledge, skill, information, schemes awareness, desire to learn new activities of fisheries, participation in training, attitude towards fisheries development, availability of labor for fisheries, availability of time & potential to do extra work, entrepreneurial spirit/behavior, occupational diversity/multiplicity, fisherwomen contribution to household income.

Financial Capital: The monetary aspects of livelihoods are covered under financial capital. Seven attributes were used to assess the capital, including saving, access to credit, repayment ability, money arrangements, and supplementary income.

Each respondent has questioned each of these 42 attributes of five livelihood capitals: Natural capital, Human capital, Physical capital, Social capital, and Financial capital through an interview schedule. The interview data were entered into an excel sheet. Each response on attributes was scored using predetermined five points Likert scale and then normalized.

The points of the Likert scale are as follows:

- Very low- 0
- Low- 1

- Medium- 2
- High- 3
- Very high- 4

After normalizing, the score ranged from 0 to 1 for each attribute. The normalized values of the attributes for each capital are added, and it is then divided by the number of attributes, it will give the index value for the respective capital. (Mir, 2019). To get the average index value of all the five capitals, all the index value of individual capitals is sum up and divided by 5.

The Index value for each capital is calculated by the formula-

$$\text{Index value} = \frac{\text{Actual score-Minimum score}}{\text{Maximum score-Minimum score}}$$

3.8.8 Perceptions of respondents about the impact of M.P. Fish Federation interventions

The respondents are interviewed on their perception about the impact of M.P. Fish Federation interventions on fish catch, fishing income, fish seed stocking, Cage culture, Fishers' cooperative society benefits of fishers' welfare schemes. The responses are categorized as "agree," "disagree," and "not sure" The parameters studied under the perception of the impact of interventions of M.P. Fish Federation are as follows:

- Fish caught from the reservoir is decreasing over the years
- I am getting less and less income from fishing
- My cost of fishing is increasing over the years
- Assistance from M.P. Fish Federation has contributed to an increase in my income
- My knowledge about fishing and fisheries has increased due to M.P. Fish Federation interventions
- Cage culture in the reservoir will result in increased fish production and income

- I may get a higher catch and income if I fish independent of the fishers' co-operative society
- I am sure fish production is going to increase in the future
- Fishers' cooperative society is truly a democratic organization, and all of us feel like equal partners
- I do not feel stocking of fish seed in the reservoir will be of any use
- I feel M.P. Fish Federation support has benefited but only a few people, not all of us

4. RESULTS AND DISCUSSION

The findings of the present study have been discussed in the subsequent sections.

4.1 To assess the fisheries, development, socio-economic, and livelihood profile of fishing communities in Bargi reservoir

4.1.1 Fish Fauna of river Narmada

Fish fauna of Bargi reservoir and Narmada (parent river) constitute both plain and hill stream species, including an abundance of major carps, minor carps, and catfishes. The fish fauna of the Narmada river is presented in Table 4.1.1

Table 4.1.1 Fish Fauna of the Narmada river

S.No.	Order	Family	Genera
1.	Cypriniformes	Cyprinidae	*Catla catla*
			Labeo rohita
			Labeo bata
			Labeo calbasu
			Labeo fimbriatus
			Cirrhinus mrigala
			Cirrhinus cirritosa
			Cirrhinus reba
			Cyprinus carpio
			Puntius sarana
			Puntius choca
			Tor tor
			Tor putitora
2.	Siluriformes	Siluridae	*Ompak bimaculatus*
			Ompak pabda
			Wallago attu
		Pangasiidae	*Pangasius pangasius*
		Bagridae	*Mystus bleekeri*
			Mystus seenghala
			Rita rita

		Schielbeidae	*Clupisoma garua*
		Heteropneustidae	*Heteropneustes fossilis*
3.	Clupiformes	Clupeidae	*Gadusia chapra*
		Notopteridae	*Notopterus chitala*
4.	Beloniformes	Belonidae	*Xenthadon cancila*
5.	Ophiocephaliformes	Ophiocephalidae	*Channa marulius*
			Channa punctatus
			Channa striatus
6.	Perciformes	Centropomidae	*Chanda nama*
		Nandidae	*Nandus nandus*

Source: Key informant interviews by the Researcher

Table 4.1.1 depicts that the fishery of the entire stretch of river Narmada comprises 30 species of fish belonging to 12 families and six orders recorded in the present study.

It was dominated by the order Cypriniformes with 13 species. Shukla and Sharma (2015) documented 25 species of fishes in river Narmada at the Jabalpur region in which major carps, minor carps, and catfishes were found in abundance. Azad and Shukla (2015) found 23 species belonging to 10 families in the Jabalpur region of river Narmada. Saini and Dube (2017) reported 29 species belonging to 5 orders. Cypriniformes with 22 species recorded were found to be the most dominating order. Bakaware *et al.,* (2013) recorded 51 species belonging to 7 orders and 15 families. Vyas *et al.,* (2013) also recorded the dominance of order Cypriniformes in river Narmada.

Presently, the mahseer fish, which is the native fish of river Narmada, is mostly represented by *T. tor* only, which was earlier contributed by *T. khudree* and *T.putitora* (CIFRI, 2009). The main reasons behind the decline are habitat destruction, overfishing, the introduction of exotic species, and pollution (Bakawale and Kanhere, 2013).

4.1.2 Fish fauna of the Bargi Reservoir

The fish species of the Bargi reservoir with local and common names are presented in Table 4.1.

Table 4.1.2 Details of the fish fauna of the Bargi reservoir

Scientific name	Common name	Local name
Catla catla	Catla	Katla
Labeo rohita	Rohita	Rohu
Labeo calbasu	Orangefin labeo	Kriya/Kalot
Cirrhinus mrigla/cirrhosis	Mrigal carp	Naren
Cyprinus carpio	Common carp	Common carp
Ctenophyringodon idella	Grass carp	Grass carp
Hypophthalmichthys molitrix	Silver carp	Silver carp
Ompok bimaculatus	Butter catfish	Pabda
Notopterus chitala	Indian featherback	Chital
Hypophthalmichthys nobilis	Big head carp	Tongsan
Wallago attu	Wallago	Padhin
Mystus seenghala	Indian glassy fish	Singharh/Katia
Labeo bata	Bata	Bhana
Channa punctate	Spotted snakehead	Sambhal
Mastacembelus armatus	Zig-zag eel, Spiny eel	Baam
Labeo gonius	Kuria labeo	Kursa
Tor tor	Mahseer	Mahseer

Source: Species identification by the Researcher, key informants, and M.P. Fish Federation

Table 4.1.2 shows that around 19 species of fishes have been recorded in the present study. The major fish abundance noticed was viz., major carps, minor carps, and catfishes.

The fish seed production (spawns, fry, and fingerlings) details of the Bargi reservoir in the last five years are mentioned in Table 4.1.3.

4.1.3 Seed production of Bargi Reservoir

The number of fish spawn, fry, and fingerlings produced by the M.P. Fish Federation in the reservoir over the years is presented in Table 4.1.3.

Table: 4.1.3 Year & stage-wise fish seed production details of Bargi Reservoir

Year	Fish seed production		
	Spawn number (lakh)	Total standard fry number (lakh)	Fingerling number (lakh)
2015-16	604.00	155.62	77.80
2016-17	784.00	168.14	84.72
2017-18	752.00	120.00	_
2018-19	858.00	181.00	43.25
2019-20	920.00	51.17	10.93

Source: M.P. Fish Federation, Regional office, Jabalpur

It is clear from the Table 4.1.3 that the spawn production increased from 604.00 lakh in 2015-16 to 920.00 lakh in 2019-20. However, fingerling production (84.72 lakh) was maximum during 2016-17, which has reduced to 10.93 lakh in the year 2019-20. The spawn production is maximum during 2019-20, while the number of fry and fingerlings reduces in 2019-20 due to poor management in fry and fingerling stages.

4.1.4 Stocking management in the Bargi Reservoir

Since 1995-2000, the Madhya Pradesh Fisheries Development Corporation has given the fishing rights on a royalty basis to the regional federation of dam displaced people in the reservoir region. The regional federation was responsible for stocking the reservoir with the seeds. The reservoir is leased out to a private contractor since 2000, along with the responsibility of seed stocking.

Seed source: The seed production is carried out in the hatcheries and is cultured until the fingerling stage in the fish seed farm of the M.P. Fish Federation at Bargi near the dam's periphery. Seeds (fingerlings) are purchased and stocked by the contractor under the M.P. Fish Federation's supervision.

The year-wise details of the size and quantity of fingerlings stocked are presented in Table 4.1.4.

Table: 4.1.4 Details of fish seed stocked over the years

S.No.	Year	Fingerlings stocked	
		Size	Quantity (No./ha)
1.	2015-16	76-85 mm	467
2.	2016-17	76-85 mm	529
3.	2017-18	_	_
4.	2018-19	71-120 mm	580
5.	2019-20	70-85 mm	403

Source: M.P. Fish Federation & contractor.

Table 4.1.4 depicts the stocking density of fingerlings within the last five years since the 2015-2020. The fingerlings' stocking density was highest (580 no./ha) in the year 2018-19 while it is least in the year 2019-20 with 403 no./ha.

Table: 4.1.5 Year & species-wise seed stocked details of Bargi reservoir

Year	Species-wise fingerling stocking				Total fingerling stocked (lakh)
	Catla	Rohu	Mrigal	Common carp/Grass carp	
2015-16	29.56	26.45	21.78	_	77.80
2016-17	35.16	25.13	24.99	2.87	88.16
2017-18	_	_	_	_	_
2018-19	34.53	33.64	28.43	_	96.61
2019-20	29.28	20.02	17.82	_	67.13

Source: M.P. Fish Federation, Regional office, Jabalpur

The fingerlings stocked was 96.61 lakh (highest) in the year 2018-19, while in the year 2019-20, it is 67.13 lakh (lowest) within the last five years, as depicted in Table 4.1.5.

Table 4.1.6 Cooperative society wise fish catch (kg) details of Bargi reservoir in 2019-20

Cooperative society/fishing village	Catla (kg)	Rohu (kg)	Mrigal (kg)	Local major (kg)	Calbasu (kg)	Local minor (kg)
Barghat	342.00	50.5	80	533.5	98.5	836.5
Magardha	107.5	54.5	53.5	114.5	61.0	688.5
K.G.N.	103	4.0	4.0	56.5	9.5	93.5
Binjha	357.0	_	6.5	38.0	19.5	187.0
Durganagar	125.0	8.0	21.0	300.0	96.5	852.0
Lakhanpur	10.5	3.0	2.0	58.0	23.0	109.0
Khamariya	176.0	8.0	17.0	235.0	56.5	202.5
Chourai	45.5	_	6.5	9.5	_	20.5
Hinotiya	558.0	46.5	115.0	414.0	81.5	1277.0
Kathotiya	_	_	_	_	_	_
Badhaiyakheda	269.5	15.5	30.5	212.5	16.5	636.0
Kirhu Pipariya	512.5	4.0	28.5	67.5	_	63.0
Mul dongri	428.0	2.0	26.0	77.5	23.0	110.5
Poundi	3207.5	47.0	158.0	615.5	80.0	268.0
Maldha	652.0	40.0	96.5	700.0	96.0	740.5
Sahajpuri	1563.5	54.0	105.5	555.5	126.5	666.5
Karhaiya	1577.0	38.0	106.0	616.0	68.0	1445.0
Kudwari	1862.0	111.5	135.5	574.5	51.5	890.5
Sarangpur	1860.0	127.5	225.0	776.0	119.0	504.0
Bijasen	842.5	29.0	43.5	265.5	82.0	360.0
Gadaghat	203.0	2.0	5.0	148.5	65.5	253.0
Bagdari	658.5	4.0	17.5	97.0	_	93.5
Chamarwah	38.0	_	_	36.0	27.5	136.5
Lahdikol	139.0	_	3.5	30.5	_	48.5
Musakhoh	_	_	_	2.0	_	6.5
Payli	147.0	2.5	_	12.5	8.5	91.0
Tatighat	802.5	42.5	6.0	182.5	5.0	1234.5
Pipariya	2220.5	489.5	35.5	1063.0	58.0	2245.5
Padmi	587.5	175.5	62.0	387.5	24.5	1683.0

Bakhari	582.5	32.0	43.5	322.0	52.0	1002.0
Singodha	2154.5	65.5	18.5	262.5	11.5	886.5
Khamariya	3006.0	544.5	116.5	1075.5	95.5	2837.5
Tikariya	86.5	6.0	7.0	68.0	17.5	104.0
Patha	1378.5	52.0	74.0	390.5	12.0	1548.5
Gaghagwari	1200.5	1653.0	394.0	1553.0	12.0	1633.5
Kikariya	573.5	120.5	3.5	160.5	4.0	1420.5
Budhera	228.5	126.5	78.0	121.5	8.5	304.0
Narayanganj	183.5	30.5	43.5	520.0	7.0	996.0
Sikosi	22.5	31.0	4.0	19.0	_	65.0
Manadei	6.0	207.0	_	169.0	_	438.0
Total	28,817.5	4,227.5	2,172.5	12,840.5	1,517.5	26,978

Source: M.P. Fish Federation, 2019-20

The Table: 4.1.6 depicts that the production of catla is 28,817.5 kg, rohu is 4,227.5 kg, mrigal is 2,172.5 kg, local major fish is 12,840.5 kg, calbasu is 1,517.5 kg, local minor fish is 26,978 kg. Thus, the total fish production was 76,553.5 kg in the year 2019-20. The fish catch composition shows 46% major carps, 16.77% local major, and 35.24% local minor, 1.98% calbasu.

However, in the year 2002-03, the catch comprises 83% major carps, 8.2% local major, and 8.8% local minor (CIFRI report, 2002-03). Therefore, it is stated that the IMC catch had declined over the years from 83% in 2002-03 to 46% in 2019-20. IMCs are the native fish of river Narmada whose decline shows a disturbance in the reservoir's ecology.

Table 4.1.7 Details of fishers' cooperative societies

Cooperative society	Registered fishers			Inactive members	Active member	Craft no.	Gear weight (kg)
	Male	Female	Total				
Barghat	53	11	64	22	42	42	1680
Magardha	38	_	38	1	27	27	1080
Binjha	38	06	44	14	30	30	600
Badhaiyakheda	29	02	31	1	30	30	300
Kathotiya	31	_	31	1	30	30	300
Khamariya	30	_	30	_	30	30	600
K.G.N.	27	03	30	_	30	30	900
Durganagar	40	06	46	5	41	41	1640
Hinotiya	55	07	62	32	30	30	1200
Lakhanpur	15	05	20	_	20	20	1000
Musakhoh	27	_	27	17	10	10	100
Chourai	27	_	27	15	12	12	240
Kirhu Pipariya	20	01	21	6	15	15	300
Mul dongri	35	_	35	25	10	10	200
Paudi	36	04	40	14	26	25	780
Maldha	55	02	57	35	22	22	100
Sahajpuri	33	04	37	2	35	35	750
Gadaghat	38	03	41	1	40	40	1000
Chamarwaha	18	02	20	8	12	12	360
Lahdikol	25	_	25	20	5	5	50
Karhaiya	26	04	30	5	25	25	250
Bijasen	32	15	47	17	30	30	500
Sarangpur	32	08	40	_	40	40	2000
Kudwari	38	06	44	_	44	44	1200
Payli	29	03	32	17	15	15	750
Bagdari	25	03	28	16	18	18	900
Tatighat	38	04	42	_	42	30	500
Patha	33	01	34	9	25	20	500
Singodha	31	17	48	4	43	16	350

Khamariya	30	15	45	_	45	30	850
Pipariya	51	05	56	34	22	35	650
Padmi	117	08	125	39	86	55	1200
Kikariya	52	04	56	30	26	30	1100
Ghaghagwari	74	04	78	28	50	40	550
Manadei	60	02	62	50	10	25	75
Tikariya	55	12	67	25	30	25	300
Budhera	54	11	65	25	40	30	500
Bakhari	71	07	78	7	78	50	1000
Sikosi	27	01	28	8	20	15	225
Narayanganj	28	03	31	8	23	8	175
Total	1,573	189	1,762	541	1,209	1,077	26,755

Source: M.P. Fish Federation, 2019-20

Table: 4.1.7 depicts that the total number of registered members is 1762, out of which 1573 are males while 189 are female. From the total, 36 fishers belong to the SC category, 414 belong to the ST category, and 1,300 are OBC category fishers. The total number of active members are 1209, and inactive members are 541. The total number of fishing crafts available for fishing by the members of cooperative societies is 1,077, and the weight of fishing gears is around 26,755 kg.

4.1.5 Infrastructure facilities available in the reservoir periphery region

Magardha village is located near to the dam and Jabalpur city. Magardha village has an average networked transport facility for public transport, including the connectivity through public bus service within >10 km distance and private taxi available within <5 km. For getting bus transport, fishers have to walk 5 km to reach the bus stop point. Infrastructure like school, private hospital, small markets, and M.P. Fish Federation regional office is available in the Narayanganj town. Fishers have to visit either Jabalpur or Mandla city for accessing large markets, health care facilities, and secondary occupations. A private taxi is the only option available for fishers of Manadei and Gaghagwari, almost nearby (14 km). However, only a bus and a taxi run once in a day to Patha. Durga Nagar is well connected to the roadway with a public bus, city bus, and taxi. Both the Magardha and Durga Nagar villages have

middle school till eight classes and no hospital facility. They are entirely dependent on the nearby district, Jabalpur.

4.1.6 Catchment area of river Narmada

River Narmada has its origin from Amarkantak Plateau near Anuppur district Madhya Pradesh, and it flows between the Vindhyan range and Satpura range. It is one of the three major rivers that flow from east to west. It is the longest west flowing river of the country & also known as the 'Lifeline of Madhya Pradesh.' The catchment area of the entire Narmada Basin is 98,796 sq. Km. Its left tributaries are Burhner, Banjar, Sher, Shakkar, Dudhi, Tawa, Ganjal, Chhota Tawa, Kaveri, Kundli, Goi, Karjan, and right tributaries are Hiran, Tendoni, Choral, Kolar, Man, Uri, Hatni, Orsang. Major reservoirs built across the Narmada River Valley are Sardar Sarovar, Indira Sagar, Omkareshwar, Maheshwar, Bargi, Maan, Jobat, Tawa, Kolar, Barna, Sukta, Goi, and Upper Beda. The river finally confluences with the Arabian Sea through the Gulf of Khambat near the Bharuch city, Gujarat.

4.1.7 Demographics of the population of Madhya Pradesh state, Jabalpur and Mandla districts

The details of the total male and female population and density, population growth, literacy rate, and sex ratio of Madhya Pradesh state, Jabalpur, and Mandla districts are presented in Table 4.3.1.

Table 4.1.8 Demographic profile of Madhya Pradesh state, Jabalpur and Mandla districts

Population	Madhya Pradesh	Jabalpur	Mandla
Total population	72,626,809	2,463,289	1,054,905
Total population (male)	37,612,306	1,277,278	525,272
Total population (female)	35,014,503	1,186,011	529,633
Density/square km of population	236	473	182
Proportion to the state's population (%)	NA	3.39	1.45

Decadal population growth (2001-2011) %	20.35	14.51	17.97
Sex ratio	931	929	1008
Child sex ratio (0-6 Age)	918	923	970
Literacy rate (%)	69.32	81.07	66.87
Male literacy rate	78.73	87.29	77.52
Female literacy rate	59.24	74.37	56.39

Source: Census of India, 2011

4.1.8 Demographics of fishers in the Bargi Reservoir region

Age: In the Bargi reservoir region, 66.66% (120) of fishers belonged to the middle age group, i.e., 30-50 years. Only nine respondents (5%) of fishers are found working in the young age group (<30), whereas 51 respondents (28.33%) are old age group. The mean (average) age of fishers is 45 years. Kruskal-Wallis t-test revealed that village wise there is a significant difference in fishers' age among the sampled fishing villages. Except for Durganagar and Narayanganj having the same mean rank *(X)* of 80.78, the remaining villages like Magardha, Gaghagwari, Manadei, and Patha have a significant difference in fishers' age with mean ranks *(X)* of 90.18, 82.28, 108.87, and 102.71, respectively and a value of $p<0.05$.

Gender: Among the respondents, 95% (171) are male, and 5% (9) are female. This is because males run all the fishers' co-operative societies. Males being head of the family and the primary breadwinner from fishing occupation, are the registered members of co-operative societies. Females are only observed as members when their husbands are already a registered member, or is a widow or just to fulfill the ST/SC category seat explicitly reserved for females. However, many women are involved in fishing operations such as smoking, marketing, and boating. The Kruskal-Wallis test has shown no significant difference in the gender of fishers among the six fishing villages with mean ranks *(X)* of 86.00 of Magardha, 95.05 of Durga Nagar, 89.02 of Gaghagwari, 89.02 of Manadei, 98.07 of Narayanganj and 88.92 of Patha and a value of $p>0.05$.

4.1.9 Social Profile

Nativity: All the respondent fishers are the displaced people during dam construction, and so are native to the region.

Religion: In the Bargi reservoir region, all the respondents are Hindus.

Sub-Caste: In the Bargi reservoir region, 90% (162) of the fishers are Patel, Barmaiya, Barman, Nanda (OBC). Patel subcaste is mainly found to live in Magardha village, Barman fishing community is found in Durga Nagar, Barmaiya fishing community is found distributed mainly in three villages like Narayanganj, Patha & Gaghagwari, and Nanda fishing community is found in Manadei. The other 10% (18) belonged to the Gond sub-caste and are found in two fishing villages, namely Patha and Ghaghagwari village.

Social category: None of the fishers belong to the general category and Schedule Castes (SC). 90% of fishers belong to Other Backward Class (OBC), and the remaining 10% are Scheduled Tribes (ST).

Education: The majority of 47.77% (86) of fishers have never attended formal schooling, i.e., illiterate, whereas 19.44% (35) and 18.88% (34) of fishers undergone middle and primary education. Whereas 6.11% (11) can read & write, another 6.11% (11) had secondary education. The remaining, 1.11% (2) attended higher secondary education, and only one respondent had completed post-graduate. The Kruskal-Wallis test indicated a significant difference in fishers' education among the sampled fishing villages with $p<0.01$. Almost none of the Durga Nagar fishers had formal education with a mean rank *(X)* of 57.85, while Ghaghagwari fishers have many fishers with secondary education and mean rank *(X)* of 113.85.

The fishers' literacy rate in the present study is 46.12%, which is less than India's general literacy rate as a whole, which was 73.52% (Census-2011) and a literacy rate of 64.64% (Census-2011) among the fisherfolk of India. The literacy rate is also less than that of fishers of Inland capture fishery of the country (70.99%) and overall literacy rate from all sectors including marine, mariculture, inland capture, cold water fisheries, freshwater aquaculture, brackish water aquaculture, and marketing & processing which was 79.37%. (Salim *et al.,* 2014).

Social participation: In the reservoir region, 93.5% of fishers are members in a cooperative society, and 67 persons having memberships in gram panchayat. Nearly 44.44% of the cooperative society members are getting some economic benefit from the cooperative society. On average, 38% of the members participate weekly in a cooperative society. Around 81.11% of fishers are not satisfied with the functioning of the cooperative society.

Language: All the fishers speak Hindi since they are native to the reservoir region and live for generations.

Marital status: All the respondents are married.

Table 4.1.9 Social profile of fishers in the study area

Social Profile	**Fishers(n=180)**	
	Frequency	**%**
Gender		
Male	171	95
Female	9	5
Religion		
Hindu	180	100
Muslim	0	0
Sub-caste		
Patel (OBC)	28	15.55
Barman (OBC)	32	17.77
Barmaiya (OBC)	72	40
Nanda (OBC)	30	16.66
Gond (ST)	18	10
Social category		
OBC	162	90
ST	18	10
Family type		
Joint	47	26.12
Nuclear	133	73.88

Family size		
<4	97	53.8
4 to 6	58	32
>6	25	14

Table 4.1.10 Age and Education status of fishers in the study area

Social profile	**Fishers (n=180) Frequency**	**%**	**Kruskal-Wallis test of significance (among sampled fishing villages)**
Age			
Young (<30)	9	5	*X* = 90.18 Magardha *X* = 80.78 Durganagar *X* = *80.78* Narayanganj *X* = *82.28* Gaghagwari
Middle (30-50)	120	66.66	*X* = 108.87 Manadei
Old (50-60)	51	28.33	*X* = 102.71 Patha
The average age of fishers is 45.00 years			
Education			
Illiterate	86	47.77	*X* = *100* Magardha
Read & write	11	6.11	*X* =*57.85* Durga Nagar
Primary	34	18.88	*X* =*113.85* Gaghagwari
Middle	35	19.44	*X* =*71.50* Manadei
Secondary	11	6.11	*X* =*104.10* Narayanganj
Higher secondary	2	1.11	*X* =*98.16* Patha
Graduate & above	1	0.55	**p=<0.01**
The mean year of schooling is 4.71			

Note: *X* = Mean rank

Table 4.1.10 depicts that most of the fishers belong to the middle age group (30-50 years). The mean rank *(X)* of Durga Nagar and Narayanganj fishers is 80.78, which is least meaning that most fishers of these villages belong to the young (<30) age group. However, most of the Manadei fishers are old (50-60) with the highest mean rank *(X)* of 108.87. Around 47.77% of fishers are illiterate, and the mean year of

schooling is 4.71 years. Gaghagwari fishers have the highest mean rank *(X)* of 113.85, meaning that most of the village's fishers are literate while Durga Nagar fishers have a minimum mean rank *(X)* of 57.85, which means more fishers are illiterate in the village.

4.1.10 Economic Profile:

Occupation: Around 63.33% of respondents are full-time fishers, and 36.66% are partially engaged in capture fisheries of Bargi reservoir. Most of the fishers are not involved in any secondary activity; however, some are involved in some additional activities ranging from labor (19.45%), agriculture (13.88%), and remaining 3.33% in construction, vegetable sellers, etc.

Monthly fishing income of fishers: Table 4.1.11 shows that 41.11% of fishers have very low income (<4166), and 34.44% of fishers have low income (4166-6666). Around 11.11% have medium (6666-9166), and 13.33% have high (>9166) income. The average monthly fishing income is found to be ₹3405, while the average annual fishing income of fishers is ₹40,860.

The income difference among villages is significant, with Gaghagwari village having more fishers in medium and high-income levels while the Manadei fishers have many fishers with very low fishing income. This is because the fishers in this village have additional nets for fishing while comparative less net is used in other villages. Also, the efficient functioning of cooperative society and more active fishers are the reason for the high fishing income of Gaghagwari fishers.

Table 4.1.11 Monthly fishing income of fishers in the study area

Income (₹)	Frequency	Percentage
Very low (<4166)	74	41.11
Low (4166-6666)	62	34.44
Medium (6666-9166)	20	11.11
High (>9166)	24	13.33
Range	₹ 1500-₹ 9400	
Average Income	₹ 3405	

Table 4.1.12 Average monthly fishing income of fishing villages

S. No.	Fishing village	Monthly fishing income (₹)
1.	Magardha	3165
2.	Durga Nagar	3275
3.	Manadei	2990
4.	Gaghagwari	3760
5.	Patha	3690
6.	Narayanganj	3550

Monthly household income of fishers: Table 4.1.13 depicts that 35% of fishers having very low monthly household income (<4166), and 37.77% of fishers having a low monthly household income (4166-6666). The other 8.88% of fishers have medium household income (6666-9166), while 18.33% have high household income (>9166). The average monthly household income is ₹5675. The average annual household income of fishers is ₹67,380.

The average monthly household income is high in Gaghagwari compared to other villages as the fishers are also engaged in a secondary occupation, which contributes to household income. There is a statistically significant difference in the average annual household income of fishers of six sample fishing villages of the Bargi reservoir with a p-value of .007, which is significant at 0.007 % Level of Significance.

Table 4.1.13 Monthly household income of fishers in the study area

Income (₹)	Frequency	Percentage
Very low (<4166)	63	35
Low (4166-6666)	68	37.77
Medium (6666-9166)	16	8.88
High (>9166)	33	18.33
Range	₹1380-₹10250	
Average Income	₹ 5675	

Table 4.1.14 Average monthly household income of fishing villages

S. No.	Fishing village	Monthly household income (₹)
1.	Magardha	5775
2.	Durga Nagar	5545
3.	Manadei	5400
4.	Gaghagwari	5900
5.	Patha	5605
6.	Narayanganj	5825

4.1.11 Livelihood assets

Social Assets

Table 4.1.15 Social participation of fishers in the study area

Social participation	Fishers (n=180)	
	Frequency	%
Membership		
No membership	12	6.5
Co-operative society	168	93.5
Gram Panchayat	67	37
SHGs	5	2.5
Fisheries organization	21.6	12
Degree of participation in cooperative societies		
Daily	34	19
Weekly	58	32
Fortnightly	57	31.5
Monthly	18	10
Occasionally	5	2.5
Never	9	5
Leadership position		
Yes	7	3.88
No	173	96.11
Benefit from Cooperative membership		

Economic	80	44.44
Social	137	76.11
Political	5	2.77
No benefits	7	3.88
Satisfaction from Cooperative membership		
Satisfied	34	18.88
Not Satisfied	134	81.11

Extension system contact: Table 4.1.16 depicts that 35.55% of fishers have contact with M.P. Fish Federation staff for availing 80% subsidy of craft, gears, or housing scheme. About 70.88% have contacted cooperative societies representatives for any support, while 27.77% of fishers have some contact with gram panchayat president for rural schemes.

Table 4.1.16 Extension system contact

Extension Contact	**Fishers (n=180)**	
	Frequency	**%**
Local Officer	30	16.66
Representative of cooperative society	128	70.88
Panchayat president	50	27.77
M.P. Fish Federation staff	64	35.55

Physical assets

Basic household assets: Table 4.1.17 depicts that the majority (52.22%) of the fishers lived in kaccha houses. All (100%) of fishers have their own house. Many of these houses are provided by Pradhan Mantri Aawas Yojana or Indira Aawas Yojana.

Transport facilities: In the reservoir region, 58.88% of fishers depend on public transport, and only 14.44% have their motorcycle.

Communication facilities: Nearly 45.55% of fishers have a basic phone for communication, and 13.88% of fishers having a television in their home for access to news & entertainment. Access to news and other information through mass media shows a favorable interest in gaining information instead of having a low education level of fishers.

Table 4.1.17 Basic household assets of fishers in the study area

Basic household assets	**Fishers (n=180)**	
House type	**Frequency**	**%**
Kaccha	93	52.22
Semi-pucca	21	11.66
Pucca	66	36.66
Ownership of house		
Owned	180	100
Transport facilities		
Public transport	106	58.88
Bicycle	48	26.66
Bike	26	14.44
Communication facilities		
Radio	3	1.66
TV	25	13.88
Internet	3	1.66
Normal phone	82	45.55
Smartphone	24	13.33

Basic household amenities

Sanitation facility: In the reservoir region, 68% of fishers have toilets in households, and 32% of fishers indulge in open defecation. Manadei, Gaghagwari, and Patha have a high degree of open defecation, compared to the other three villages. The reason might be the remote location, vast space, and no benefit from the Panchayat toilet scheme.

Source of Lighting: Nearly 96.66% of fishing households have electricity for lighting. Only 3.34% of the fishers' households depend on kerosene for lighting.

Cooking fuel: Most of (56.93%) the fishers use firewood for cooking purposes, and 43.06% of people rely on LPG. Most of the LPG connections are provided through Pradhan Mantri Ujjwala Yojana. Compared to other fishing villages, Patha and Manadei fishers mostly depend on firewood as cooking fuel.

Source of drinking water: Most of the fishers (71.11%) access public tap (hand pump) water and other 36.11% depending on dam water, and about 14.44% depend on treated tap water in the reservoir region. It is observed that 82.47% of the fishers have access to water near the premises, and only 17.53% have the availability of drinking water within the premises. Overall it could be inferred that the respondents do not have access to drinking water.

Table 4.1.18 Basic household amenities of fishers in the study area

Basic household amenities	**Fishers (n=180)**	
Sanitation Facility	**Frequency**	**%**
Available in house	122	68
Open defecation	58	32
Source of Lighting		
Electricity	174	96.66
Kerosene	6	3.34
Cooking Fuel		
LPG	78	43.06
Firewood	102	56.93
Source of Drinking water		
Tap water	26	14.44
Municipality water	8	4.44
Borewell	7	3.88
Public tap	128	71.11
Dam water	65	36.11
Location of drinking water		
Within premises	32	17.53
Near premises	148	82.47

Table 4.1.19 Access to basic entitlements

Public service	Fishers (n=180)	
	Frequency	%
Aadhar card + Voter card	176	97.77
BPL card	116	64.44
Bank passbook	179	99.44
Driving license	40	22.22
Pan card	12	6.66

Natural assets

Occupation

Type of fisheries: Culture cum capture fisheries are prevailing in the reservoir. Though all the fishers are engaged in capture fisheries as the other function, i.e., stocking is undergone by the contractor.

Fishing types: Most of (75.55%) the fishers fish individually using a boat, and around 24.44% of fishers fish in the group using *kishti.*

Engagement in fishing activities: 63.33% of the fishers involved fully in fishing activities, i.e., not involved in any secondary occupation, and 36.66% of fishers are partly involved in fishing. Secondary occupations are labor, agriculture and construction works, etc.

No. of generations in fishing occupation: 62.22% of fishers are involved in fishing for two generations, and 30% of fishers are involved since 1 generation.

Ownership and type of craft: All the fishers possess their craft. However, the number of craft vary from fisher to fisher. All are having one craft except a few having two crafts. Two types of boats are operated. About 76.66% of the crafts operated are plank-built boats (*Nao),* and the remaining 23.33% of crafts operated is a wooden frame tin sheet boats *(Kishti). Kishti* is used in the upper stretch (Jabalpur district) while *Nao* is operated in the middle and lower stretch (Mandla district) of the reservoir.

Ownership and type of gear: All the Bargi reservoir fishers are mostly operating gillnet for fishing. However, the quantity of gear (in kg) varies from fisher to fisher. The operation of gillnet varies with different mesh size based on the target size of fish. The cast net is operated when the water level is low in the reservoir. The majority (83.88%) of the fishers use both gill net and cast net.

Source of learning to fish: Around 70.55% of fishers learned fishing from their fathers. Other 24.44% of respondents learned from their own. Only a few of them learned from relatives and grandfather.

Table 4.1.20 Fishers occupation details

Fishers occupation	**Fisher (n=180)**	
	Frequency	**%**
Type of fisheries		
Capture fisheries	180	100
Fish individually or in group		
Individual	136	75.55
Group	44	24.44
Engaged in fishing activities		
Fully	114	63.33
Partially	66	36.66
No. of generations in fishing occupation		
One	54	30
Two	112	62.22
More than two	13	7.21
Ownership of Craft and gear		
Yes	180	100
No	0	0
Type of Craft used		
Nao	138	76.66
Kishti	42	23.33
Type of Gear used		
Cast net	4	2.22

Gill net	25	13.88
Gill net, Cast net	151	83.88
Source of learning to fish		
Self	44	24.44
Relatives	7	3.88
Father	127	70.55
Grandfather	2	1.11
Activity during the closed season		
No work	3	1.66
Ag	6	3.33
Labor	171	95

Closed season, peak fishing season, and fishing days per month: Closed season is followed for two months from 15 June to 15 August in the reservoir and is implemented by M.P. Fish Federation. However, many fishers & outsider poachers did not seem to follow the closed season regulation. The average fishing days are 22.50 days in a month. Peak fishing season starts in September and continues till the end of December. In peak fishing season, the catch ranges from 5 to 15 kg with an average catch of 8 kg/fisher.

Catch and consumption details: The average fish catch per day is 3.96 kg/fisher. The total fish catch per month is 89 kg/fisher. So, the average annual catch of a fisher is 890 kg. Fish consumed by fisher's family is around 1.73 kg/week.

Human assets

Training programs and grant: The majority of fishers (69.44%) did not receive any training program conducted by the M.P. Fish Federation. Around 30.55% of fishers successfully attended any training program within ten years and received grants and no training charges.

Fisherwomen involvement in fisheries: Table 4.1.21 depicts that 73.88% of fisherwomen contribute to fishing activity, and the remaining 26.11% of women are not involved in any fishing activities.

Experience in fishing: About 32.22% of fishers have a fishing experience of 20-30 years, and 28.88% of fishers have experience of 10-20 years. 27.22% of fishers have experienced more than 30 years, and only 12.77% of fishers have experienced less than ten years.

The training attended, fisherwomen involvement in fisheries and fishers' fishing experience, is presented in Table 4.1.21.

Table 4.1.21 Trainings attended, fisherwomen involvement, and fisheries experience of fishers

	Fisher (n=180)	
	Frequency	**%**
Training programs attended		
Yes	55	30.55
No	125	69.44
Grant or exemption for training		
Yes	55	30.55
No	125	69.44
Fisherwomen involvement in fisheries		
Yes	133	73.88
No	47	26.11
Experience in fishing		
<10 year	23	12.77
10-20 year	52	28.88
20-30 year	58	32.22
>30 year	49	27.22

Table 4.1.22 The extent of availing schemes of M.P. Fish Federation by fishers

Schemes	Availed		Not availed	
	Frequency	Percentage	Frequency	Percentage
Any social-welfare scheme	123	68.2%	57	31.8%
Craft & gear subsidy	79	43.88%	101	56.12%
Accident insurance scheme	161	89.44%	19	10.56%
Saving cum relief scheme	120	66.66%	60	33.34%
Fishers housing scheme	55	30.55%	125	69.45%
Other scheme /state packages	7	3.88%	173	96.12%
Deferred wages scheme	180	100%	_	_
Training on netting, net making	24	13.33%	156	86.67%

The extent of availing schemes of M.P. Fish Federation by fishers: The Table: 4.1.22 depicts that 68.2% of fishers are accessing socio-welfare schemes (National Rural Employment Guarantee Act). Around 89.44% of fishers have accidental insurance coverage. Nearly 66.66% of fishers are taking advantage of saving cum relief schemes. Approximately 43.88% of fishers are getting craft and gear subsidy. 30.55% of fishers got money for a house under PM/CM Aawas Yojana. However, only 3.88% of fishers access benefits from other schemes (Ujjawala Scheme/Meenakshi Marriage Scheme).

Table 4.1.23 Participation of fisherwomen in fisheries activities

Fishing activities	Frequency	Percentage
Involvement in Fishing		
Yes	133	73.88
No	47	26.11
Smoking	69	51.88
Marketing (at market/home)	27	20.30
Fish netting (along with fishermen)	20	15.04
Net repairing	17	12.78

Fisherwomen participation in fisheries: Nearly 73.88% of the women are involved in fishing. Out of which, most of (51.88%) of them are involved in smoking fish. 20.30% of the women participate in marketing either at home or at a nearby local market.

Around 15.04% are engaged in netting operation along with their husbands, who are registered members of cooperative societies. Another 12.78% of women are involved in net repairing at home, and the remaining 26.11% of household women are not involved in any fishing activities.

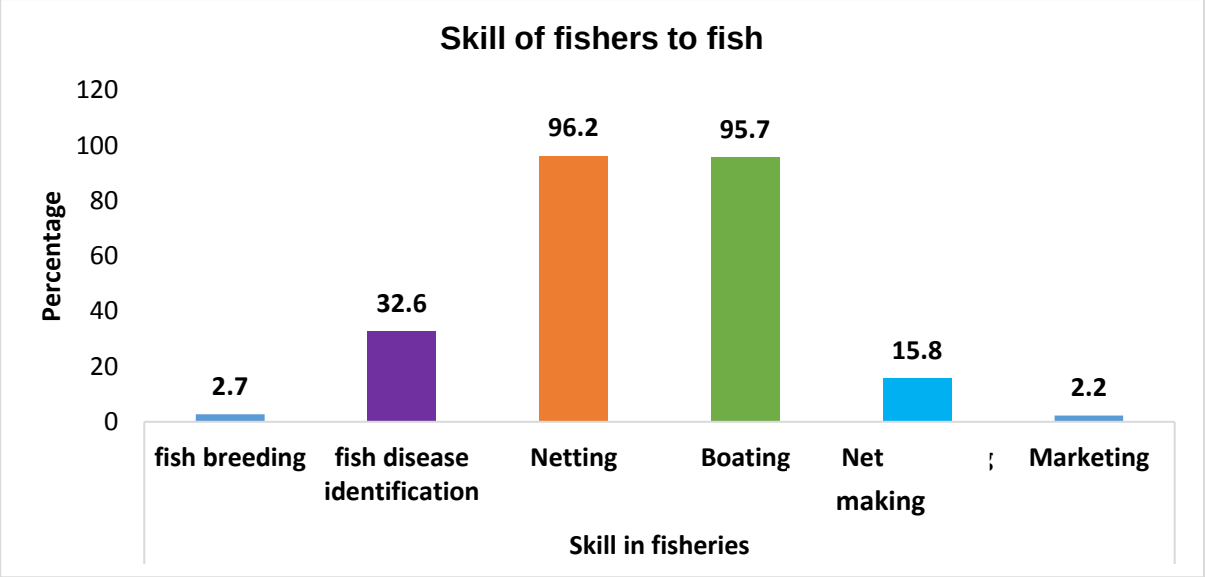

Figure 4.1.1 Skill of fishers in fishing

Skills of fishers in fishing: Figure 4.1.1 depicts that 96.2% of fishermen are skilled in netting, and 95.7% are experts in boating. Around 32.6% of the respondents can identify fish diseases. 15.8% of fishers learned net making, and few of them know fish breeding and marketing.

Financial assets

Table 4.1.24 Debt details of fishers

The details of debt including the debt amount, credit source, purpose and saving is presented in the Table 4.1.24.

Financial aspects	**Fishers (n=180)**	
	Frequency	**%**
Debt		
Yes	29	16.11
No	151	83.88
Credit source		
Relatives	2	1.11
Bank	14	7.77
Cooperative	9	5
Money lender	1	.55

SHGs	4	2.22
Purpose		
Family	21	11.66
Fishing	7	3.88
Personal	2	1.11
Debt amount		
Range		5000-120000
Average		10538.89
Type of saving		
Daily	4	2.22
Monthly	101	56.11
Yearly	19	10.55
Social/cultural/festive expenses meet by		
Income	32	17.77
Saving	37	20.55
Loan from bank	10	5.55
Loan from money lender	3	1.66
Other	15	8.33
Saving		
Yes	124	68.88
No	56	31.11

Table: 4.1.24 depicts that only 16.11 % of fishers of the study have debt, which is less than 48.73% of fishers indebted found in inland capture of India (Salim *et al.,* 2014).

Around 1.11% of the fishers have taken loans from relatives, 7.77% have taken from the bank, 5% from cooperative society, 0.55% from a moneylender, and 2.22% from SHGs. While the study by Salim *et al.,* 2014 reported the source of lending was banks (27.13%), cooperative (13.95%), private money lender (36.69%), friends/relatives (4.13%), jewel loans (0.52%) and SHG (17.57%) in the inland sector of the country.

Table 4.1.25 Health details of fishers

Health details	Fishers (n=180)	
	Frequency	%
Disease type		
No disease	147	81.66
Non-Life threatening diseases	33	18.33
Access to the health facility		
PHC	76	42.22
Civic hospital	8	4.44
Private hospital	95	52.77
Satisfaction with the present status of healthcare facilities		
Satisfied	113	62.77
Not satisfied/ Not dissatisfied	59	32.44
Dissatisfied	5	2.77
Distance to the nearest health facility		
<3 km	37	20.55
4-10 km	71	39.44
>10 km	73	40.55

From Table 4.1.25, it is clear that most of the fishers are healthy, i.e., not suffering from any disease, while the majority are dependent on the private hospital for medical treatment.

Table 4.1.26 Details of average per capita monthly expenditure (₹) of fishers

Item group	India*	Fishers (n=180)
Egg, fish, food, and meat	68	1046.21
Clothing	100	863.72
Education	50	683.33
Medical	95	516.66

***NSSO report (2012)

Table 4.1.26 shows that the maximum monthly expenditure is on food, fish, and meat ₹1046.21, while the least expenditure is on medical treatment ₹516.66 as most of the fishers are not suffering from any disease.

4.1.12 Sustainable Livelihood Approach framework

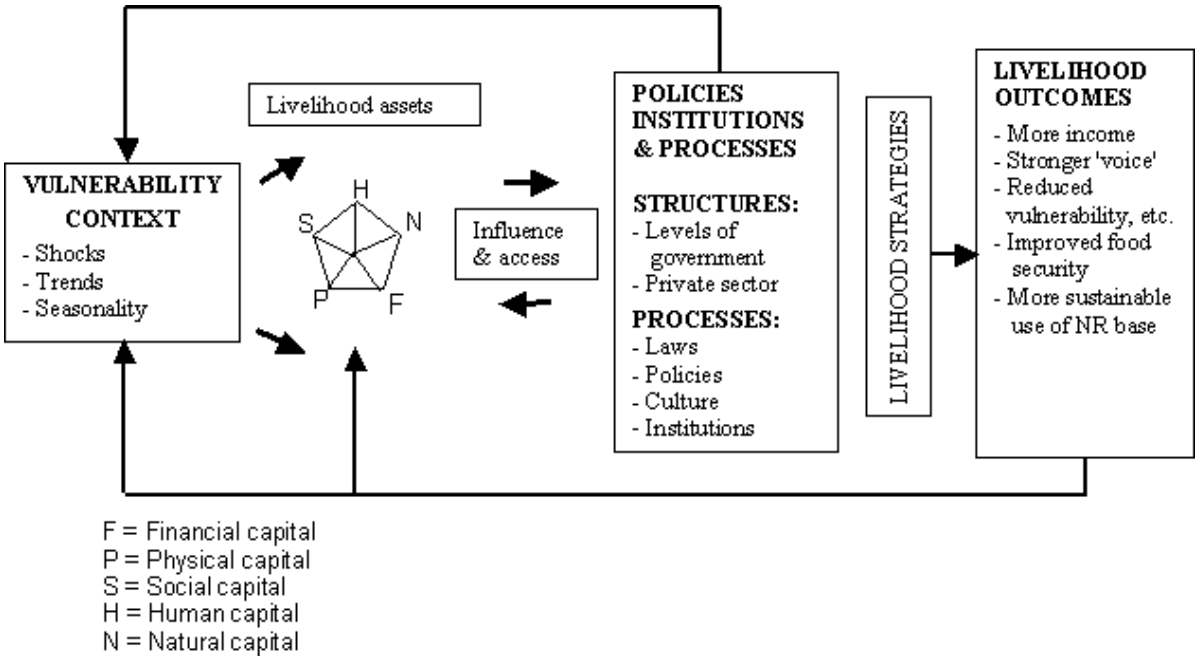

Figure 4.1.1 Sustainable Livelihood Approach framework

Source: DFID (1999) Sustainable Livelihood Framework

4.1.13 Livelihood resilience of fishers based on capitals of Sustainable Livelihood Approach

The livelihood capitals of the Sustainable Livelihood Approach is employed to evaluate the livelihood resilience of fishers.

Table 4.1.27 Index value of each livelihood capital

Livelihood capital	Index value
Natural	0.57
Human	0.46
Physical	0.45

Social	0.45
Financial	0.40
Average of 5 capitals	0.47

Note: Range lies from 0 = Lowest to 1 = Highest

Financial capital: Financial capital includes the flow of capital, contributing to both consumption and production. From the study, it is found to be lowest (most vulnerable) among all capitals with an index value of 0.40 as the livelihoods of fishers are mostly dependent on the fisheries of the Bargi reservoir as most of them have no secondary occupation such as labor, mainly due to residing in the remote location. Therefore, fishing is the only income source for most of them. The fishers owned traditional & non-mechanized boats, and the income is not sufficient to manage their daily expenditures, especially during the monsoon season when fishing is banned in the reservoir. The majority have taken credit from banks, which is not paid yet. The loan money is spent on family expenses instead of purchasing or repairing of boats & nets.

The attributes and their index values under Financial capital are as follows:

- Money-saving habit/ ability (0.29)
- Access to credit from various sources (0.48)
- Repayment capacity of the respondent (0.3)
- Arrangement of money to deal with different situations (0.43)
- Supplementary livelihood source besides fishing (0.66)
- Change in the catch, over the last 20 years (0.34)
- Change in revenue generated over the last 20 years (0.32)

The study by Abeyrathne *et al.,* (2020) on giant freshwater prawn culture-based systems in two selected reservoirs in Puttalam District, Sri Lanka suggests that financial capital was lowest (58.2%).

Physical capital: Physical capital of fishers is analyzed based on boats and gears possessed. Six attributes are considered under the capital. The capital has an overall index value of 0.45. However, the market infrastructure is not well organized. Fishers do not have access to local/distant markets for selling fish as the marketing rights

are with the contractor. Almost all of the fishers interviewed owned a boat. Most of the fishers often smoke the fish as a part of processing.

The attributes and their index values under Physical capital are as follows:

- Possession of boat by the fisher (0.75)
- Availability of fishing gears (0.57)
- Ownership of assets (0.17)
- Value addition/processing of the catch by the household (0.39)
- Housing condition (0.33)
- Marketing of the catch (0.47)

Natural capital: Natural capital of fishers is found to be the highest (resilient) among the five capitals with an index value of 0.57. Most fishers do not possess land other than their homestead land because their land was submerged during the reservoir construction. Also, the fishers are not able to access additional land due to poverty. Almost all the fishers have access to the drinking water resource nearby.

The attributes and their index values under Natural capital are as follows:

- Distance to nearest water resource (0.93)
- Possession of land by the household (0.04)
- Loss due to natural disaster (0.60)
- Sources of drinking water (0.71)
- Distance to the nearest town (0.58)

The study of Nissa *et al.,* (2018) on 'Livelihood analysis of floating net cages fish farmers at Sendang village sub-district of Gajah Mungkur reservoir of Wonogiri regency' also suggested the natural capital was highest and provides the easiest way to the farmer in fish cultivation.

Social capital: The index value of the capital is 0.45. The result showed that all the six fishing villages have a mediocre social relationship with other fishers & neighbors, the attitude of working together, and community leaders' helping behavior, making fishers less vulnerable to the social field.

The attributes and their index values under Social capital are as follows:

- Leadership capabilities (0.04)
- The desire to be a leader (0.06)
- Participation in social meetings (0.42)
- Participation in social works (0.48)
- Social relationships with neighbours (0.57)
- Social relationships with others fishers (0.65)
- Women participation in fisheries work (0.6)
- Contact with Government and Non- government institutions (0.16)
- Contribution of women in decision making (0.53)
- An attitude of working together in community (0.59)
- The trustworthiness of the people in the community (0.6)
- Helping behaviour of community leaders (0.67)

Human capital: The result demonstrated that all the fishers had a relatively higher level of human capital consisting of abilities, knowledge, and skills (Ellis, 2000) and is the next capital with the highest index value after natural capital with the index value of 0.46.

The attributes and their index values under Human capital are as follows:

- Fisheries skill (0.42)
- Fisheries knowledge (0.43)
- Fisheries Information (0.5)
- Awareness about Govt. fisheries Schemes (0.67)
- Desire to learn new tasks related to fisheries (0.59)
- Participation in the fisheries training program (0.25)
- Attitude towards fisheries department (0.14)
- Availability of Labour for fisheries work (0.48)
- Availability of time & potential to do extra/supplementary work (0.68)
- Entrepreneurial behaviour (0.53)
- Occupational diversity (0.17)
- Women contribution to household income (0.62)

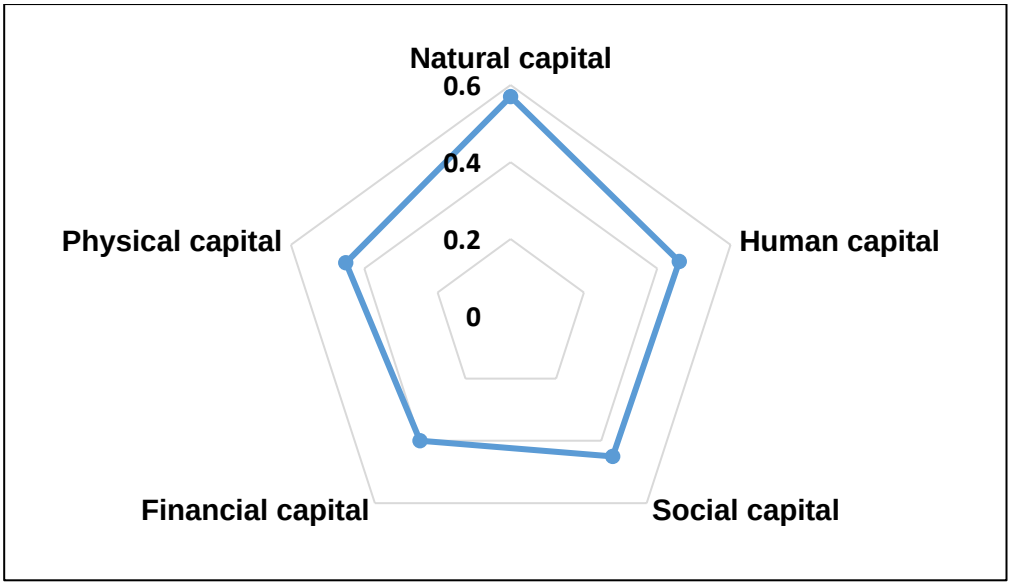

Figure 4.1.2 Radar diagram depicting all capitals

Figure 4.1.2 depicts that natural capital is highest (0.57), followed by human capital (0.46), social capital (0.45), physical capital (0.45), and financial capital (0.40) in descending order.

4.1.14 Livelihoods and poverty: The quantification of the above five livelihood capitals of fishers of the Bargi reservoir revealed that natural capital (natural resource) is highest while the financial capital as the lowest. A broad spectrum of the natural resource and causes of low financial capital is needed to understand the role played by fisheries resource in household livelihood strategies.

The low-income level is a significant determinant of poverty among fishers. So the consequence behind livelihoods dependent on fishing is that fishers may be poor due to lack of proper institutional arrangements, marketing rights, reduced wages, leasing policy of reservoir in support of contractor, and lack of opportunities for fishers to meet basic needs and create a sustainable livelihood.

4.1.15 Perception of respondents about the impact of M.P. Fish Federation interventions

Table 4.1.28 Perception of respondents about the impact of M.P. Fish Federation interventions

Perceptions of respondents about the impact of various M.P. Fish Federation interventions	Bargi Reservoir		
	Agree	Disagree	Not sure
Fish caught from the reservoir is decreasing over the years	100	-	-
I am getting less and less income from fishing	79.44	11.12	9.44
My cost of fishing is increasing over the years	65	16.11	19.44
Assistance from M.P. Fish Federation has contributed to an increase in my income	1.66	80.55	17.77
My knowledge about fishing and fisheries has increased due to M.P. Fish Federation interventions	23.33	46.11	30.55
Cage culture in the reservoir will result in increased fish production and income	56.66	15	28.33
I may get a higher catch and income if I fish independent of the fishers' co-operative society	55	15	30
I am sure fish production is going to increase in the future	37.77	23.33	38.88
Fishers' cooperative society is truly a democratic organization, and all of us feel like equal partners	63.33	25	11.66
I do not feel stocking of fish seed in the reservoir will be of any use	5.5	83.33	16.66
I feel M.P. Fish Federation support has benefited but only a few people, not all of us.	52.22	17.22	30.55

4.1.16 Inter-relationships among different demographic and socio-economic parameters

For identifying the interrelationship between different socio-economic parameters, Spearmen rank correlation is done, and the results are discussed below.

It is found that age is correlated positively with fisheries experience. It means that fishers with the age group of 50-60 years have more years of fisheries experience. Also, the family type is correlated positively with household members, which means more number of family members are found in joint family and *vice versa*

Similarly, extension contact has a positive association with social participation (degree of participation in cooperative societies). It means that the contact of fishers with representatives of cooperative societies or the M.P. Fish Federation for seeking information have a positive association with their degree of participation in cooperative societies, or it can also be assumed that if the participation in the cooperative societies is less, the extension contact would also be less.

The analysis of Spearman rank correlation is presented in Table 4.1.29.

Table: 4.1.29 Spearman rank correlation among various socio-economic variables

Variables	Age	Gender	Social category	Household member	Family type	Occupation	Education	Mass media	Fisheries experience	Access to schemes	Social participation	Extension contact	Women participation in fishing	House-hold income
Age	1.000	.076	.087	.142	.033	.085	-.191*	-.033	**.561****	-.151*	-.034	-.132	.038	-.001
Gender	.076	1.000	.081	.031	-.073	.023	.075	-.077	.027	-.156*	-.036	-.004	-.047	-.042
Social category	.087	.081	1.000	.045	.075	-.139	-.035	.213**	.066	.136	-.019	-.131	-.155*	.016
Household member	.142	.031	.045	1.000	**.643****	.041	-.030	.052	.162*	-.008	-.056	-.107	.028	.103
Family type	.233**	-.073	.075	**.643****	1.000	.105	-.018	.071	.162*	-.099	-.108	-.210**	.107	.085
Occupation	.085	.023	-.139	.041	.105	1.000	.084	-.071	-.121	.029	-.002	-.060	-.062	-.028
Education	-.191*	.075	-.035	-.030	-.018	.084	1.000	.298**	-.217**	.165*	.143	.057	.115	-.016
Mass media	-.033	-.077	.213**	.052	.071	-.071	.298**	1.000	.022	.110	.148*	.110	-.143	.022
Fisheries experience	**.561****	.027	.066	.162*	.162*	-.121	-.217**	.022	1.000	.027	-.057	-.107	.095	.093
Access to schemes	-.151*	-.156*	.136	-.008	-.099	.029	.165*	.110	.027	1.000	.000	-.087	.203**	-.025
Social participation	-.034	-.036	-.019	-.056	-.108	-.002	.143	.148*	-.057	.000	1.000	**.525****	-.120	-.007
Extension contact	-.132	-.004	-.131	-.107	-.210**	-.060	.057	.110	-.107	-.087	**.525****	1.000	-.161*	.080
Women participation in fishing	.038	-.047	-.155*	.028	.107	-.062	.115	-.143	.095	.203**	-.120	-.161*	1.000	-.001
Household income	-.001	-.042	.016	.103	.085	-.028	-.016	.022	.093	-.025	-.007	.080	-.001	1.000

* Indicates Correlation is significant at the 0.05% level (2-tailed) of significance

** Correlation is significant at the 0.01% level (2-tailed) of significance

There is no correlation found among gender, social category, occupation, education, mass media, access to schemes, fisherwomen participation in fishing, and household income.

4.1.17 General Linear Model for determinants of household income

For getting the relationship between the household income of fishers and other categorical variables, an analysis of the general linear model in SPSS version, 25 is done. The variables considered in the spearman rank correlation but not taken in the general linear model are age, family type, and extension contact due to a strong correlation with fisheries experience, household members, and social participation, respectively, as studied in Spearman rank correlation. Therefore, the later three are not considered in the model.

The General Linear Model demonstrated that fisheries experience influenced the household income as with the shift from >30 years of fishing experience to <10 years of fishing experience, income decrease is found to be ₹1107, which is significant at t value .098. The biggest change in household income is when the fisheries experience changes from >30 years to <10 years. The change in household income is also found with the shift in fisheries experience of 10-20 years and 20-30 years to <10 years, but the change is not significant, which means it does not affect the income much.

Similarly, social participation, i.e., the degree of participation in cooperative societies, positively influenced household income. With the increase in participation from no participation to fortnightly participation, the household income increases by ₹1383, which is significant at t value .049 while changes in household income are also observed in case of daily, weekly, monthly, occasional, and yearly participation in cooperative societies, but the changes are not significant.

The analysis of the general linear model is presented in Table 4.1.30

Table 4.1.30 General Linear Model analysis

Parameter	B	Std. Error	T	Sig.
Intercept	5906.794	3971.092	1.487	.139
[Gender=1]	836.299	781.443	1.070	.286
[Gender=2]	0[a]	.	.	.
[Socialcategory=2]	-684.355	650.983	-1.051	.295
[Socialcategory=3]	0[a]	.	.	.
[householdmembers=1]	-247.970	580.730	-.427	.670
[householdmembers=2]	478.616	619.218	.773	.441
[householdmembers=3]	0[a]	.	.	.
[Occupation=0]	1668.336	1771.000	.942	.348
[Occupation=1]	2302.718	1732.860	1.329	.186
[Occupation=2]	1997.143	1695.580	1.178	.241
[Occupation=3]	1591.904	1715.656	.928	.355
[Occupation=4]	0[a]	.	.	.
[Education=0]	-1749.129	2362.009	-.741	.460
[Education=1]	-1289.756	2562.875	-.503	.616
[Education=2]	-976.490	2388.991	-.409	.683
[Education=3]	-1157.007	2354.244	-.491	.624
[Education=4]	-1085.106	2529.271	-.429	.669
[Education=5]	-15.450	2955.656	-.005	.996
[Education=7]	0[a]	.	.	.
[Massmedia=0]	1193.794	2060.998	.579	.563
[Massmedia=1]	889.326	2055.902	.433	.666
[Massmedia=2]	1353.468	2010.824	.673	.502
[Massmedia=3]	780.035	2075.476	.376	.708
[Massmedia=4]	0[a]	.	.	.
[AccesstoSchemes=0]	-1352.745	1960.790	-.690	.491
[AccesstoSchemes=1]	-1533.703	2739.578	-.560	.577
[AccesstoSchemes=2]	-20.098	1342.092	-.015	.988
[AccesstoSchemes=3]	16.661	1273.469	.013	.990

[AccesstoSchemes=4]	-957.051	1295.687	-.739	.461
[AccesstoSchemes=5]	-305.048	1309.650	-.233	.816
[AccesstoSchemes=6]	0[a]	.	.	.
[Fisheriesexperience=1]	-1107.469	665.079	-1.665	.098
[Fisheriesexperience=2]	101.092	529.992	.191	.849
[Fisheriesexperience=3]	-29.225	516.134	-.057	.955
[Fisheriesexperience=4]	0[a]	.	.	.
[Socialparticipation=0]	778.553	1189.612	.654	.514
[Socialparticipation=1]	-1846.135	1775.228	-1.040	.300
[Socialparticipation=2]	1383.647	697.350	1.984	.049
[Socialparticipation=3]	1052.997	897.230	1.174	.243
[Socialparticipation=4]	1004.321	712.832	1.409	.161
[Socialparticipation=5]	631.465	968.420	.652	.515
[Socialparticipation=6]	0[a]	.	.	.
[Womencontributioninfishing=0]	-1021.053	814.368	-1.254	.212
[Womencontributioninfishing=1]	-2200.394	1513.439	-1.454	.148
[Womencontributioninfishing=2]	-1209.671	821.897	-1.472	.143
[Womencontributioninfishing=3]	-1122.674	774.398	-1.450	.149
[Womencontributioninfishing=4]	-911.981	1051.867	-.867	.387
[Womencontributioninfishing=5]	0[a]	.	.	.

From Table 4.1.30, it is inferred that other categorical variables like gender, social category, household members, occupation, education, mass media, access to schemes, and fisherwomen contribution in fishing did not influence household income.

4.1.18 Kruskal-Wallis t-test

The Kruskal-Wallis test revealed a significant difference in the independent categorical variables like social category, access to schemes, education, fisherwomen participation in fishing, and extension contact among the six sampled fishing villages of the Bargi reservoir. It is statistically significant at 0.001% level of significance with a p-value of .000.

Also, there is a significant difference in other variables such as age group, household members, family type, household income, mass media, and social participation among the six sampled fishing villages of the Bargi reservoir. These are statistically significant with p values of .036 (age group), .022 (household members), .003 (family type), .007 (household income), .007 (mass media), .001 (social participation) and at 0.003%, 0.007% and 0.001% level of significance.

The analysis of the Kruskal-Wallis test is presented in Table 4.1.31.

Table 4.1.31 Difference in profile characteristics of fishers of different cooperative societies

Parameters	Cooperative societies	n=180	Mean rank	Asymptotic Significance (p) value (2 tailed)	Decision
Age	Magardha	30	90.18	.036	Ho Rejected
	Durganagar	30	80.78		
	Gaghagwari	30	82.28		
	Manadei	30	108.87		
	Narayanganj	30	80.78		
	Patha	30	102.71		
Gender	Magardha	30	86.00	.204	Ho Accepted
	Durganagar	30	95.05		
	Gaghagwari	30	89.02		
	Manadei	30	89.02		
	Narayanganj	30	98.07		
	Patha	30	88.92		
Social category	Magardha	30	72.85	.000	Ho Rejected
	Durganagar	30	96.98		
	Gaghagwari	30	96.98		
	Manadei	30	100		
	Narayanganj	30	100		
	Patha	30	79.56		
Household member	Magardha	30	93.10	.022	Ho Rejected
	Durganagar	30	98.17		
	Gaghagwari	30	82.70		
	Manadei	30	86.80		
	Narayanganj	30	72.17		
	Patha	30	112.35		
Family type	Magardha	30	82.08	.003	Ho Rejected
	Durganagar	30	79.07		
	Gaghagwari	30	85.10		

	Manadei	30	94.15		
	Narayanganj	30	88.12		
	Patha	30	116.63		
Occupation	Magardha	30	84.87	.057	Ho Accepted
	Durganagar	30	87.50		
	Gaghagwari	30	101.67		
	Manadei	30	87.70		
	Narayanganj	30	82.03		
	Patha	30	101.87		
Household income (Annual)	Magardha	30	93.97	.007	Ho Rejected
	Durganagar	30	73.38		
	Gaghagwari	30	94.42		
	Manadei	30	93.87		
	Narayanganj	30	73.38		
	Patha	30	116.15		
Education	Magardha	30	100	.000	Ho Rejected
	Durganagar	30	57.85		
	Gaghagwari	30	113.85		
	Manadei	30	71.50		
	Narayanganj	30	104.10		
	Patha	30	98.16		
Mass media	Magardha	30	95.83	.007	Ho Rejected
	Durganagar	30	92.23		
	Gaghagwari	30	88.20		
	Manadei	30	75.37		
	Narayanganj	30	119.25		
	Patha	30	76.27		
Experience in fisheries	Magardha	30	83.10	.010	Ho Accepted
	Durganagar	30	78.23		
	Gaghagwari	30	80.98		
	Manadei	30	100.63		
	Narayanganj	30	83.47		

	Patha	30	118.86		
Access to Schemes	Magardha	30	66.98	.000	Ho Rejected
	Durganagar	30	97.13		
	Gaghagwari	30	112		
	Manadei	30	69.43		
	Narayanganj	30	114.43		
	Patha	30	86.18		
Social Participation	Magardha	30	126.57	.001	Ho Rejected
	Durganagar	30	84.68		
	Gaghagwari	30	85.53		
	Manadei	30	83.78		
	Narayanganj	30	86.15		
	Patha	30	79.66		
Extension contact	Magardha	30	156.25	.000	Ho Rejected
	Durganagar	30	125.92		
	Gaghagwari	30	65.30		
	Manadei	30	70.45		
	Narayanganj	30	68.15		
	Patha	30	60.94		
Fisherwomen contribution to fishing	Magardha	30	69.87	.000	Ho Rejected
	Durganagar	30	96.63		
	Gaghagwari	30	116.60		
	Manadei	30	76.28		
	Narayanganj	30	64.87		
	Patha	30	120.76		

The Kruskal-Wallis test revealed no significant difference between fishers' experience in fisheries, occupation, and gender of six sampled fishing villages of the Bargi reservoir.

4.2 To assess the patterns of the governance system in the Bargi Reservoir

4.2.1 Craft and Gears in Bargi Reservoir

Traditional fishing crafts and gears of the Reservoir

The most popular crafts are 'Dug-out canoe,' 'Wooden frame tin sheet boat,' 'Plank-built boat.' The most common types of gears are ‘Gill net,’ ‘Cast net,’ ‘Hook and Line,’ ‘Zero-mesh net.’ All the fishing crafts are non-mechanized and operated through manual paddling.

Dug-out canoe: Dug-out canoe is locally named as *‘Donga’* or *‘Dongi.’* The overall length and width of 3-4 m and 0.5-0.6 m, respectively, are standard. It can accommodate only 1 or 2 fishers at a time. These crafts are appropriate for shallow water to carry and set gears, especially cast nets, mainly used by traditional fishers for small-scale, non-commercial fishing. The canoe is mostly found to be used by poachers or non-fishers for fishing along with cast net around the bank of the reservoir.

Wooden frame tin sheet boat: Wooden framed boats with tin sheets are locally known as *‘Kishti.’* The length of 3-5 m and width of 1.5-2 m are standard. It can accommodate only 1 or 2 fishers at a time. One person hauls the net, and another operates the boat with oars. These are generally used in shallow water for low volume fishing. It is found mostly used in the head region of the reservoir. Fishers of the upper stretch of the reservoir region, i.e., Jabalpur district, operate the boat. Generally, fishermen and fisher-women were observed to fish together with fishers hauling the net and fisherwomen operating the boat.

Plank-built boat: It is commonly called *‘Nao,’ ‘Lauka,’* and *‘Nauka.’* The length of the Plank-built boats varies from 5-7 m with a width of 1-1.5 m. The wooden boat is locally manufactured. It usually requires 2-4 fishers for the operation to fish in a group. The boat is operated by manual paddling. The boats' inner side is painted using synthetic paints while outside; they are coated with dammar for protection against water. The average age of a plank boat is nearly ten years. Fishing gears such as cast net gill net may operate through the boat. The plank-built boat is the most widely used fishing craft in the reservoir periphery. It is mostly used in the middle and tail stretch of the reservoir, i.e., Mandla district.

Gill net: Gill net is the most common fishing gear used by the fishermen in the reservoir. It contributed to around 98-99 percent of the total commercial catch in the Bargi reservoir. The gill nets are locally known as *'Phansa Jal'* or *'Phanda Jal.'* It is operated in all depths, extending from shallow to deep waters. Gill nets of different mesh sizes are observed in use in the reservoir periphery. The mesh size of the net shows variations and depends on the different targeted groups' species and size. The net is just set free in the water (for short time operation). The wide use of monofilament gill nets with thicker nylon nets was observed. A gillnet is woven themselves by te fishers or purchased from the local market.

Cast net: Cast net is locally well-known as *'Phenka Jal'* or *'Ghumaua Jal.'* The length of the net is generally 2-2.5 m. The mesh size is 8-15 mm. The net can be operated anywhere, either using a craft in shallow or even from the reservoir's bank. Cast nets are generally operated in still waters throughout the year. It is used especially near the dam site and can be operated single-handed by a fisher. These are by and large used in still waters throughout the year. Usually, small fishes such as minor carps, catfishes, and other small species were caught through cast net. These nets are not crucial from the commercial point of view as it contributes only 1-2 percent of the total commercial catch by fishers of cooperative societies in the Bargi reservoir. The non-fishers generally use it for illegal fishing.

Hook and Line: The fishes are being lured through live bait attached to the hook for getting them hooked. The earthworm as living bait and snail flesh as dead bait are traditionally used as baits. This is usually done by placing the bait along with hooks at the end of the line. The lines can be left drifting or anchored or fixed in any position from the surface to the bottom. Poachers mostly use this for quicker harvest and consumption purposes.

Destructive fishing gears operated in the reservoir

Various unauthorized and illegal fishing gears such as *Jhulli Jal, Phasla Jal, Bahav Jal,* and *Bansi* are exploiting the reservoir's fish-fauna.

Jhulli Jal

Fishers and poachers operate zero mesh nets (locally known as Jhulli Jal) throughout the year for catching the stocked fingerlings of IMCs or juveniles of native fishes. The net is operated in the entire reservoir region.

Phasla Jal

The *Phasla Jal* is illegally used during the close season to fish brooder fishes in the monsoon at the upper stretch of the reservoir.

Bahav Jal

The *Bahav Jal* is operated by poachers at the lower stretch, especially at Sahastradhara (a natural breeding ground of fishes) in Mandla district for capturing brooder fishes during the close season.

Bansi

The fishing rod (locally known as *Bansi*) made of the bamboo stick having only one hook is used for recreational fishing or poaching.

4.2.2 Fisheries Governance in reservoirs of Madhya Pradesh

Ownership: The reservoirs of the Madhya Pradesh are controlled under different property rights regimes by different departments of state government. In the state, small and medium reservoirs are owned by the Water Resources Department, and large reservoirs constructed on Narmada or its tributaries are owned by Narmada Valley Development Authority (NVDA). Fisheries of water area above 2000 ha and less than 2000 ha are under the Madhya Pradesh Fish Federation and Department of Fisheries, respectively.

Fishing Rights and leasing of different water bodies in Madhya Pradesh: According to the new M.P. Inland Fisheries policy 2008, the top priority for fishing in the village ponds is given to the traditional fishing communities followed by scheduled tribes, scheduled castes, backward class and others of the state. The traditional fishing castes are *Dheevar (Dheemar), Bhoi, Kahar (Kashyap, Singraha, Sondhiya, Raikwar, Batham), Mallah, Navda, Kevat (Mudha, Mudaha, Nishad, Keer, Manjhi* (DoF, 2008). However, in small, medium, and large reservoirs, fishing rights are given to the fishers displaced due to irrigation projects.

The main features of the policy are:

- The lease duration is increased from 7 years to 10 years.
- The minimum number of members in a co-operative society should be 20 & 33% membership reserved for women members.
- The lease is valid for the culture of fish, water chestnut, lotus, and other aquatic crops/aquaculture.

Community ponds with a size of <10, 10-100,100-1000 ha are vested with respective Gram panchayat, Janpad Panchayat, Zila Panchayat, respectively. These ponds are given on lease to either traditional fishers or cooperative societies formed by them depending upon size. The fishing rights of reservoirs 1000-2000 ha are vested with DoF. These reservoirs are disposed of for fisheries by DoF to cooperative societies on lease. The fishing rights of the reservoirs >2000 ha are vested with the M.P. Fish Federation. The reservoirs are disposed of for fisheries by M.P. Fish Federation on lease either to co-operative societies or to private contractors depending upon the water area. Medium reservoirs (2000-5000 ha) are leased to fishers' co-operative societies. Large reservoirs (>5000 ha) are leased out to a private contractor for stocking management & revenue purposes. Though the fishers of cooperative societies do the fishing & are paid for netting by the contractor of the reservoir.

4.2.3 Fisheries Governance in Bargi Reservoir

The Bargi Reservoir is owned by Narmada Valley Development Authority (NVDA). The fishing in the reservoir started in the year 1990. In the initial stage, the management was on a departmental basis (DoF). From 1990-1994 the reservoir was auctioned to a private contractor. Since 1995, the management came under the control of a regional federation of fishers' cooperatives, Bargi Dam Displaced & Fish Product Marketing Co-operative Federation Limited, Salibada, District Jabalpur, which continued till 2000.

The regional federation of dam displaced people in the reservoir was formed in 1994 and got the fishing rights for five years on a royalty basis. However, due to some conflicts on the royalty payment, the regional federation's fishing rights were ceased by the government from 2000. Later in 2001, the reservoir's fishing rights were transferred from MPFDC to Madhya Pradesh Fish Federation, leasing the reservoir to private contractors.

The M.P. Fish Federation is undertaking the commercial fishing with the fishers of cooperative societies. The fishers' present fishing wages are ₹32 per Kg for major fish and ₹19 per Kg for minor fish, while the deferred wages for the closed season is ₹4 per Kg. However, they were paid the fishing charges of ₹14.50 per Kg and ₹0.50 per Kg as deferred wages for the closed season (CIFRI-1998-2003).

The M.P. Fish Federation is responsible for seed production in hatcheries near the periphery of the dam site and monitoring of fish seed stocking done by the contractor, besides working as a leasing agency. Presently, there are 49 nursery ponds, four brood-stock ponds, one breeding unit, four incubation units, and two spawn collection units in the fish seed farm of M.P. Fish Federation near the dam site. There is no licensing system (providing a license to fishers by charging a certain amount of money for fishing using gears) prevailing in the reservoir. Fishers whose residence is located within a 1 km radius of the reservoir periphery and are also the registered members of fisheries cooperative societies are only allowed to fish in the reservoir.

At present, the reservoir is leased out to a private contractor for fishery purpose for seven years from 2017-18 to 2023-24. The total lease amount is ₹7,73,73000, with an average lease amount of ₹11,053,286 per year. (Table 4.2.1). The mesh size

regulation is implemented though not strictly followed, with the minimum mesh size of 50 mm in the commercial fishing with cooperative societies' fishers.

At present, a fishing effort of 139 units/day is employed in the year 2018-19. One unit comprised of 1 boat, two fishers, and 20 Kg of nets. However, a fishing effort of 125 units/day was employed in the year 2002-03 (CIFRI, 2002-03). It can be revealed that the fishing effort has been increased over the years due to more number of fishers' households depending on reservoir fisheries. The reservoir is stocked every year with major carp seed.

Table 4.2.1 Lease amount paid by a private contractor to M.P. Fish Federation

S. No.	Year	Lease amount (₹)
1.	2017-18	95,00,000
2.	2018-19	10,000,000
3.	2019-20	1,05,00,000
4.	2020-21	1,10,00,000

Table 4.2.2 Fisheries management regimes in Bargi reservoir

S.No.	Year	Fishing right	Agency leased to
1	1990 to 1994	M.P. Fishery Development Corporation	Private contractor
2	1995 to 2000	M.P. Fishery Development Corporation	Bargi Dam Displaced & Fish Product Marketing Regional Co-operative Federation
3	2001-2016	M.P. Fish Federation	Private contractor
4.	2017-2024	M.P. Fish Federation	Private contractor

Source: M.P. Fish Federation, Bargi, Dam site

Table 4.2.3 Functioning of M.P. Fish Federation/Private contractor in Bargi reservoir

S.No.	Activities	Remarks
1.	Leasing by M.P. Fish Federation	Leased out to Private contractor
2.	Seed production in hatcheries	Done by M.P. Fish Federation near the periphery of the dam. Spawns are reared till the fingerling stage in ponds and are sold to the contractor
3.	Stocking	Done by a private contractor
4.	Monitoring & Regulation	Inadequate management (no mesh size regulation, poaching by non-members of co-operative societies & in closing season fishing of brooders by non-members)
5.	Training	Imparted by M.P. Fish Federation (but only to the members having maximum production annually
6.	Conservation	These are implemented by M.P. Fish Federation but are not strictly followed by members (monsoon ban from 15 June- 15 August), a ban on broodstock catch, though the brooders are offered for sale by non-members in nearby markets.
7.	Marketing	Done by contractor
8.	Collection of lease value	Done by M.P. Fish Federation

Figure 4.2.1 depicts that the Bargi reservoir's ownership is with the Narmada Valley Development Authority (NVDA). However, the management collaborates with five key stakeholders, such as the M.P. Fish Federation, M.P. State Tourism Development Corporation, M.P. Power Generating Corporation Limited, Department of Water Supply, and Department of Irrigation. However, there is a lack of coordination and collaboration between the managing agencies

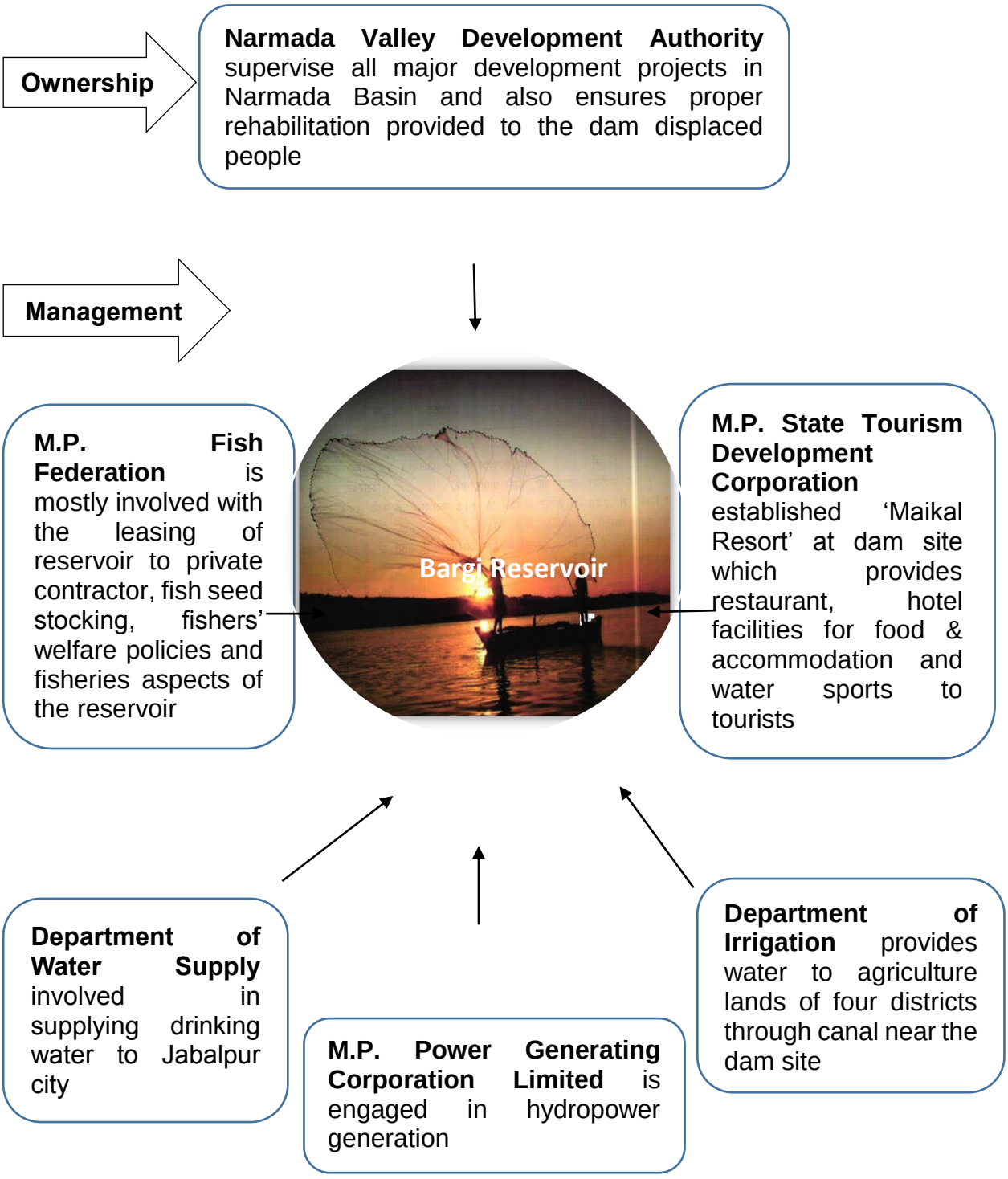

Figure 4.2.1 Governance network in Bargi Reservoir

Figure 4.2.2 showed that in the Bargi reservoir fisheries, the key stakeholders are the M.P. Fish Federation, Fishers' Cooperative Societies, and the Private Contractor. However, the fisheries governance is unsatisfactory due to lack of proper monitoring of destructive fishing practices, not following properly of fish ban season, lack of coordination, and unsolved conflicts between the three key stakeholders of fisheries governance. Conflict among fishers and between fishers and non-fishers is also reported during the present study. Most of the fishers' cooperative societies are non-functional or defunct due to the majority of non-active fishers contributing to the non-functioning of cooperative society.

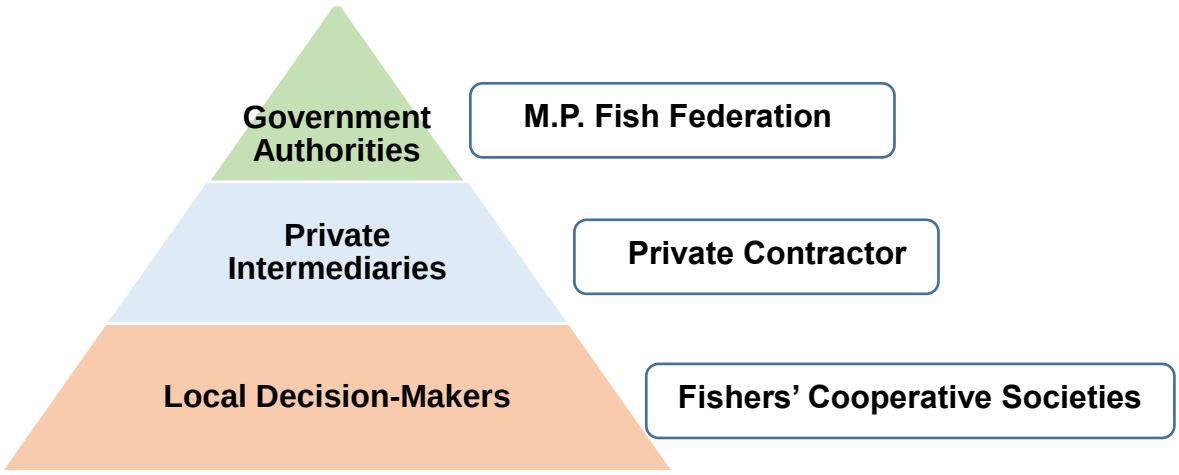

Figure 4.2.2 Fisheries Governance Hierarchy in Bargi Reservoir

Figure 4.2.3 showed that the M.P. Fish Federation has the fishing right of the reservoir and is involved in taking participatory actions on conservation (mesh-size regulation and fishing ban season), management & leasing to a private contractor, and implementation of fishers' welfare schemes.

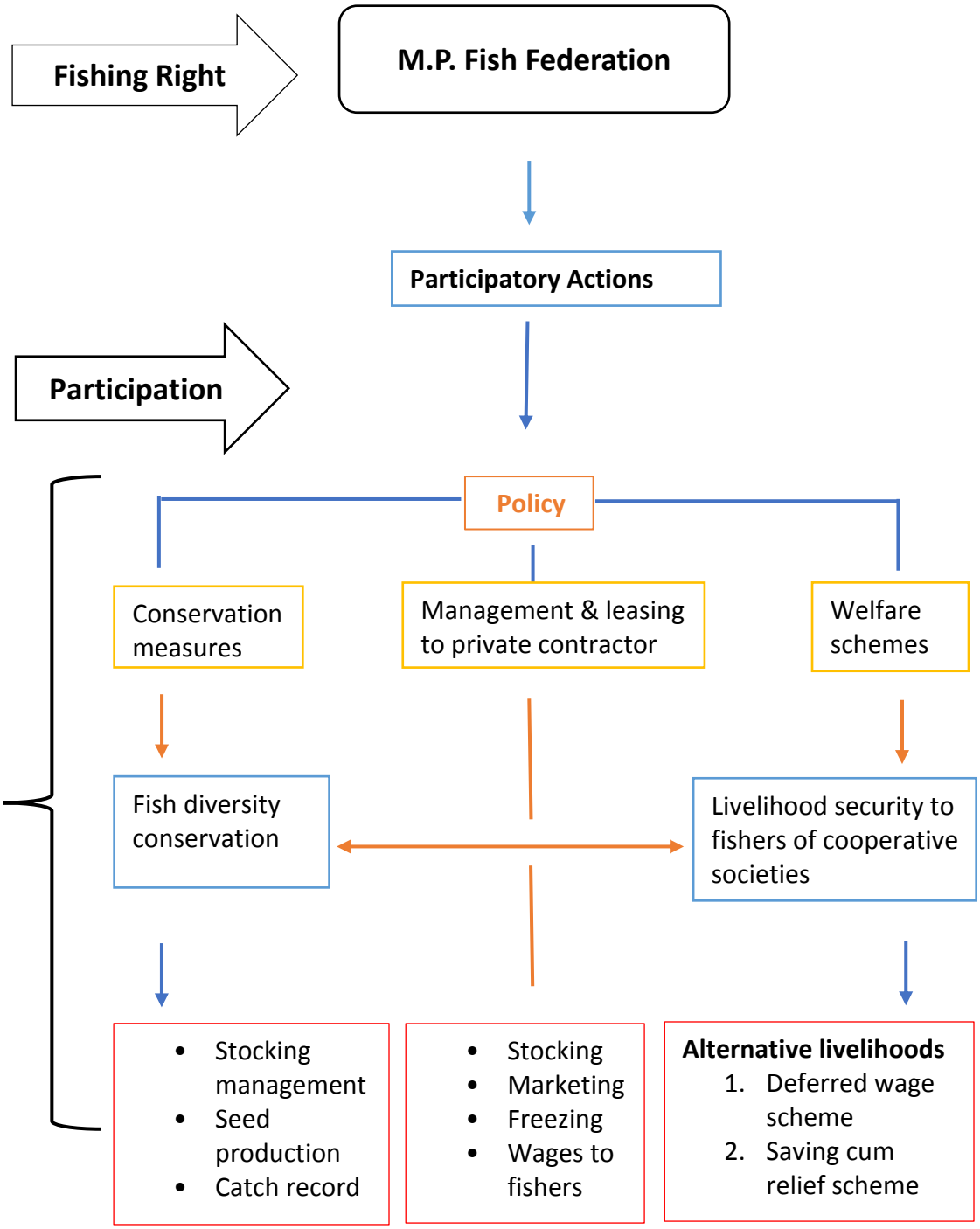

Figure 4.2.3 Fisheries Governance in Bargi Reservoir

4.2.4 Fishing Arrangements

There are mainly two types of fishing followed in the reservoir, namely gill netting & cast netting. Non-members of the co-operative societies also fish in the reservoirs illegally. For fishing, the gill net is set at 3-5 PM and hauled in the next morning 6-9 AM. Cast net fishing is done in shallow water and near the shore (both by members & non-members).

Fish Marketing: The fishing right is provided to a private contractor who arranges to collect catch from all the Bargi and Narayanganj regions' landing centers. The contractor purchases fish from the fishers and pay to them. At present, the fishers are paid as ₹32/kg by the contractor for catching IMCs and exotic species including *Catla catla* (> 4 kg), *Labeo rohita*, *Cirrhinus mrigla*, *L. calbasu, Hypophthalmichthys nobilis, Cyprinus carpio,* and *Hypophthalmichthys molitrix* (> 1 kg), local major (more than ½ kg), and catfishes *Ompok bimaculatus, Channa punctate, Notopterus chitala* (of any size and variety). The wage rate paid for minor carps, including *L. gonius, L. bata, and L. calbasu* and local minor (less than ½ kg), is ₹19/kg. There is an annual increment of ₹2/kg for major fish and ₹1/kg for minor fish in the wage rate every year by the M.P. Fish Federation. The wage payment is made every week in their bank accounts.

The fish is sold to commission agents and fish traders of distant markets of Howrah (West Bengal) and local markets of Jabalpur, respectively. Fish are collected from different landing centers by personal vehicles of the contractor. The contractor owns two vehicles (one taxi and another truck) for collecting fish catch from the four landing centers of Bargi and Narayanganj regions, respectively. Fish are assembled at the Salibada based fish depot (cold storage), stored under ice, frozen using crushed ice, and packed in thermacol boxes. The boxes are sent to Howrah/Kolkata through the railway route. About 70% of fish marketed is IMC’s, and the rest are catfishes.

Fish marketing is also done illegally by some fishers who sell fish to get quicker and high prices. The fishermen either sell the fresh fish to intermediary/trader at the local markets or fisherwomen (non-member) sell the smoked fish at home or local market.

The price of IMC’s in local markets reaches ₹150/Kg. Fishers of Mandla district are found selling local smoked fishes at ₹100/kg and fresh IMC’s at ₹120-150/kg in the

Mandla market. However, fresh IMC's found to be sold at ₹100-120/kg by fishers of Jabalpur district from their home.

Table 4.2.4 Fish sold by fishers to local markets of the reservoir region

Large fish markets	Small fish markets
Mandla	Narayanganj
Jabalpur	Karikun (Mandla)

Source: Fisheries cooperative societies

Marketing channel: There are four types of marketing channels followed at the Bargi reservoir to market fish. The first direct channel followed for fish marketing is the fishers supply the fish to the contractor, who, in turn, sell the catch to the wholesaler or to retailers than it is sold to consumers. The second channel followed for fish marketing is the fishers supply the fish to the contractor who supplies the fish to the commission agents, and then it is sold to other consumption centers. In the third shortest channel, the fishers directly sold fish to consumers. In the fourth channel, fishers supply the fish to the middlemen who, in turn, sold the fish to the consumers.

- Fishers → Contractor → Wholesaler → Consumers
- Fishers → Contractor → Commission agent → Consumers
- Fishers → Consumers
- Fishers → Middlemen → Consumers

Table 4.2.5 Sale rate of fish in different market places

Category of fish	Purchased rate from fishers (₹/kg)	Name/place of market	Price at the distant market (₹/kg)
Catla catla	32	Howrah	220 for size > 10 kg 160 for size < 10 kg
Labeo rohita	32	Howrah	190 for size > 10 kg 130 for size < 10 kg
Notopterus chitala	32	Howrah	550
Hypophthalmichthys molitrix	32	Howrah	60-70
Wallago attu	32	Howrah	250
Mystus seenghala	32	Howrah	400
Channa punctate	32	Howrah	500
Labeo bata	19	Jabalpur	110
Minor carp species	19	Jabalpur	80

Source: Contractor, fishers, and key informants

Table 4.2.5 depicts the price spread of fish from fishers to consumers. Especially, *Notopterus chitala, Mystus seenghala,* and *Channa punctate* have a high market value in the Howrah market of West Bengal. IMCs and catfishes are marketed at Howrah (distant market). The commission agent charges a 10% commission on the price of marketed fish/kg from the contractor, while minor carps of size 1-1.5 kg are sold at Jabalpur (local market) by the contractor.

4.2.5 Fishers' welfare measures:

There are twelve M.P. Fish Federation schemes operated for the welfare of the reservoir fishers. The names of schemes, its description and benefits is presented in Table 4.2.6.

Table 4.2.6 Fishers' welfare schemes implemented by M.P. Fish Federation

S.No.	Schemes	Description and benefits
1.	Deferred wages scheme	Deducting ₹4/kg from the wage rate of fishers and adding ₹4/kg by M.P. Fish Federation and providing Rs.8/kg on the annual production to fishers in ban season
2.	Saving Cum Relief Scheme	An amount of ₹4500 provided to the BPL and active fishers during ban season in which fishers submit ₹ 1500, ₹1500 each contributed by state and central government.
3.	Severe disease treatment grant scheme	The financial assistance up to ₹40,000 and ₹20,000 is provided for very severe diseases and severe diseases, respectively.
4.	Nishadraj Scholarship scheme	An amount of ₹20,000, and ₹10,000 or scholarship according to the actual expenditure paid every year to the students taking admission on technical courses and non-technical courses
5.	CM Meenakshi Girl Marriage Scheme	Financial assistance of ₹20,000 are provided to active fishers for the marriage of 2 girl child and widow remarriage
6.	Grace scheme	A grant of ₹7500 provided urgently on the sudden death of registered fishers to the members of their family
7.	Jaldeep scheme	Health inspection, checkup, vaccination, free medicine & nutritional supplement distribution facilities provided by the Health Department, Women and child development department, and M.P. Fish Federation works as the nodal agency.
8.	Fishers training	Training of 2 days is provided to active fishers under the scheme. Fishers are paid for travel rental charges and either food or about ₹100 each day. Training is imparted on mesh size regulation of nets or fishing techniques.

9.	Education promotion scheme	A promotion grant of ₹2000 and ₹1000 provided to the students of standard 8th, 10th, and 12th after securing first and second division. However, ₹5000 is provided for securing >80% marks to the children of fishers.
10.	Incentive award scheme	Top co-operative societies and fishers in terms of fish production are awarded ₹8000-₹50,000, and ₹5000-₹30000 respectively.
11.	80:20 and 50:50 boat-net subsidy scheme	Fishers are provided with an 80% and 50% subsidy by M.P. Fish Federation. Fishers fishing for 100 days or more and 150 days or more are subsidized annually with ₹6400 (50:50) and ₹9600 (80:20) respectively on boat-net purchase by M.P. Fish Federation. Also, for the purchase of 1 boat, a subsidy is provided once every 5 yrs to each co-operative society. For purchase of 12 feet boat ₹6400, for 15 feet boat ₹8000, and 18 feet boat ₹9600 is subsidized by the M.P. Fish Federation.
12.	Naya Savera Scheme	Instrument subsidy scheme for progressive business Electricity bill lapse scheme Funeral assistance scheme Education promotion scheme Employment oriented training scheme Accidental insurance scheme and grace assistance Free treatment delivery assistance scheme

Source: M.P. Fish Federation and Key informants

Information dissemination on fisheries schemes

All the six villages were of the prevailing view that either leader did not adequately inform them of cooperative societies or fisheries officers of the M.P. Fish Federation about the details of existing and newly introduced schemes or subsidies. The M.P. Fish Federation has taken a few measures to disseminate information on fisheries schemes by distributing booklets and pamphlets containing information on schemes to FCS representatives. However, fishers interviewed stated that the information shared through these media was inadequate, inappropriately communicated by the

representatives, and often merely impractical to help an average number of fishers understand how to proceed for availing the schemes.

It was noticeable that many of these dissemination activities are not carried out each year. For example, regarding the distribution of a booklet with necessary information on all fisheries schemes is recognized by the fishers of villages/cooperative societies like Gaghagwari, Narayanganj, Magardha, and Patha. However, fishers from Manadei and Durga Nagar were unaware of its existence. These advertisements provided only the schemes' title and features without providing any information on the procedure to avail them. The M.P. Fish Federation relies mainly on the FCS to inform fishers about newly introduced schemes and hands out pamphlets or information booklets to FCS representatives. Respondents (35%) stated that their source of information on schemes are FCS representatives, and 25% directly depend on fisheries officers of the M.P. Fish Federation for seeking information on schemes. (Fig. 4.2.4). Detailed interviews revealed this dissemination strategy to be problematic.

The quality of relations between FCS representatives and its members plays an essential role in disseminating information. The relation between the representatives and fishers seems to be quite worthy though the fishers complained that the officers of the M.P. Fish Federation implement partiality in disseminating information and selecting names of fishers for availing schemes.

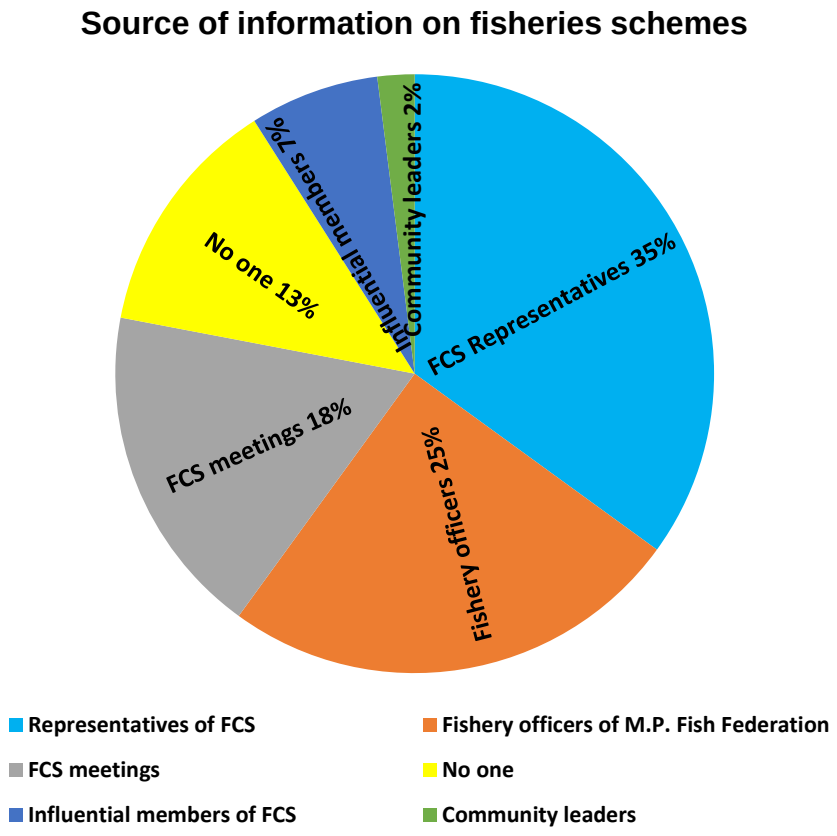

Fig. 4.2.4 Sources of information on fisheries schemes

The information dissemination efforts mentioned above seem to have provided fishers with a general idea about schemes; they were uninformed about these schemes' content, namely the eligibility criteria, documents required, where to avail them, and possibilities for compensation. There is also a marked noticeable social divide amongst those aware of the schemes and those who are not. People with some levels of education and social standing in the village know more about the schemes than those lower in the hierarchy, and the former are the ones who avail the schemes (Fig. 4.2.5). Fishers stated that by the time information about a new scheme trickled down to the average number of members from these information intermediaries (FCS leaders or influential members), either the deadlines for submitting scheme applications had lapsed or the allotment of beneficiaries for that financial year had reached its limit.

It is found that fishers were aware of the fact that some were better informed than others, and they stated that in future attempts at dissemination, the information

should be made available in a printed form that they could keep and refer to, rather than having to rely on other community members to inform them.

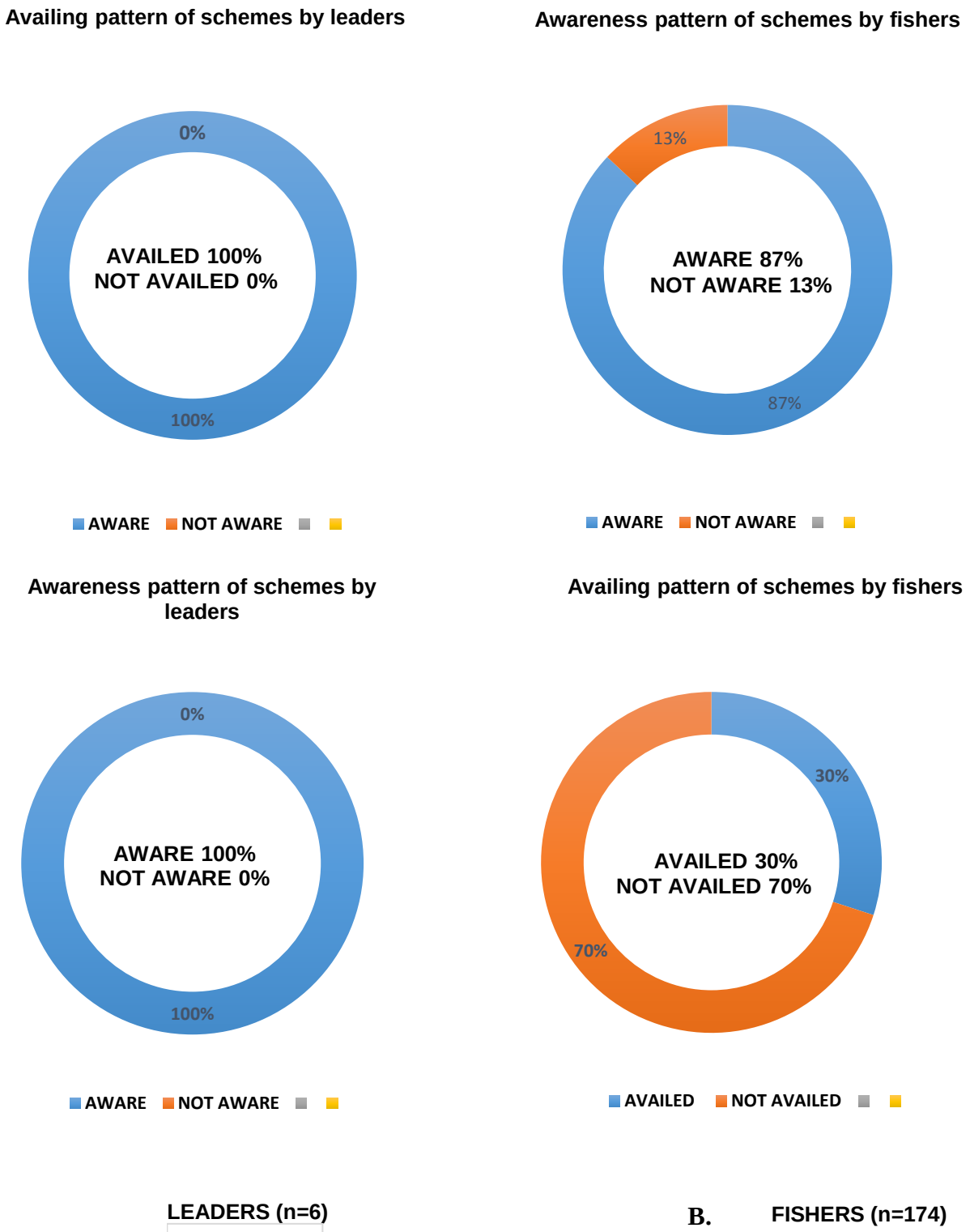

Fig. 4.2.5 Awareness and availing pattern of schemes by leaders and fishers

In some cooperative societies, the M.P. Fish Federation distributed a limited number of booklets with information on existing and newly introduced schemes and subsidies, which did not get passed on further. Some of the intermediaries had lost it, and no replacement copies were available. At the same time, the remaining representatives did not pass the information due to the irresponsible attitude. Of the total sampled fishers, 48% preferred printed media for information dissemination (Fig. 4.2.6A), and 64% did not want to rely on their local FCS representatives to get information on the schemes but wanted it passed on to them personally (Fig.4.2.6B).

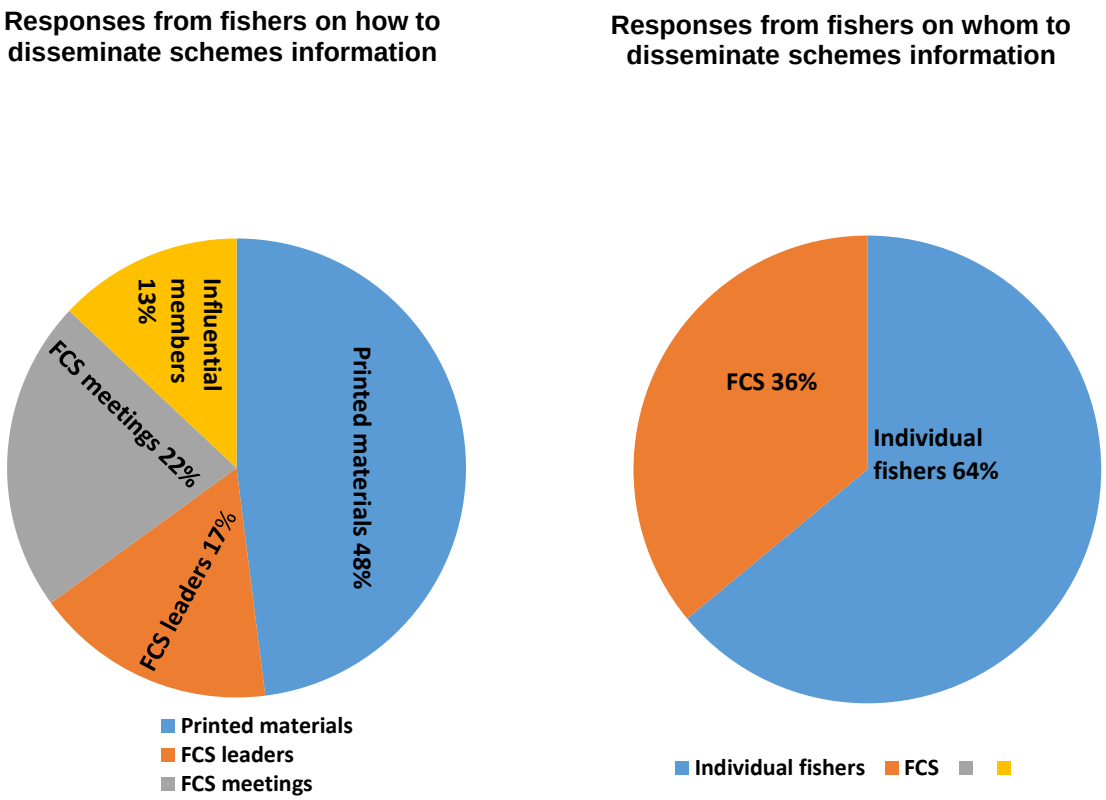

Fig. 4.2.6 Responses from fishers on how (A) and whom (B) scheme information should be disseminated (n=180)

Reasons for not availing schemes

Apart from problems with information dissemination and diffusion to the fishers, respondents mentioned other factors that prevent them from accessing schemes. These include cumbersome legal procedures associated with the procurement of schemes (which lead to loss of fishing time and hence income and partiality. For instance, a scheme like the “Meenakshi girl marriage scheme” and “housing scheme” requires a letter of recommendation from the local elected political representative (Member of the Legislative Assembly-MLA) and a plan of the proposed marriage or house and land in the name of the fisher. These requirements are challenging to meet for illiterate fishers as it requires a series of steps via online mode.

The process of getting the letter of recommendation often requires having some personal connection with the political representative. Often fishers do not have proper legal documents for making land claims as all of them lost their land during the dam construction. Some fishers own illegal captured land in the periphery of shore areas where the law prohibits construction. Lack of coordination between government agencies is another problem fishers perceive. The fishers stated that they did not get the housing scheme's loan benefits because the banks have not yet disbursed the money to the fishers (registered members of cooperative societies) approved by the M.P. Fish Federation. For a fisher to avail scheme, he or she must be a registered member of a FCS. One village can have only one FCS. In a heterogeneous village dominated by one particular fishing caste, the dominant caste monopolizes the FCS, and other caste members find it difficult to obtain membership. Moreover, fishers found obtaining documents of proof, identity card, registration certificate of fishing crafts, registration certificate of membership in a cooperative society (all required to access schemes) a frustrating and time-consuming process.

Respondents also pointed out that lack of community fishers' involvement in designing the schemes is a major factor affecting its success. The approach for designing schemes follows a top-down approach where the authorities play a central role. The fishers stated that reservoir fishing is not profitable anymore, and outward migration to pursue other jobs is lucrative. Such responses propose the

imperfections in the designing of schemes. It suggests fishers' participation in the planning, designing, and disseminating schemes and accountability and transparency concerns.

The achievement of welfare goals through schemes is dependent on a variety of factors. The study on the implications of the M.P. Fish Federation sponsored social security and welfare schemes on the socio-economic status of fishers of the Bargi reservoir shows that most fishers are unaware of welfare schemes. The study revealed a simple positive correlation between the amount of information available to fishers on schemes and their direct uptake. However, the detailed findings suggest that other factors are far more critical in deciding whether schemes will finally be availed by fishers or not. The reasons affecting availing of schemes include the degree of government formalities attached to the schemes (legal documents, letters from government officials, etc.), political interference, minority caste in the heterogeneous fishing village, and seasonal migration of fishers for labour. However, schemes and subsidies play a crucial role in providing livelihood security to marginalized fishing communities. The present study shows that many fishers did not avail of even these minor support systems. Thus, there is a necessity for the appropriate dissemination of practical information involving the sequence of protocols for their active involvement in fisheries management. There emerges a possibility of introducing new schemes by modifying the existing schemes that would support their movement in such a direction. It is recognized that all the schemes either directly or indirectly contribute to resource depletion by selective fishing gears using motorized/mechanized crafts in marine fisheries. However, the present study's concern is to understand the meaning schemes hold in the inland capture/reservoir fisheries, including its access by fishers in terms of an increase in socio-economic conditions. Incentivising and supporting sustainable fisheries practices through schemes can lead to better fisheries management.

Moreover, other conservation schemes like mesh size regulation and close/ fishing ban season are appropriately implemented by the M.P. Fish Federation, though properly not followed by the fishers or outsider poachers. The introduction of new schemes that facilitate the phasing out of small mesh size nets and destructive/selective gears and provide alternative or supplemental livelihood can

encourage better management of depleting resources. Such new schemes should be accompanied by institutional reforms that draw from fishing community expertise to design and implement fisheries schemes and make the process of availing these more transparent and time-bound. The designing of schemes must follow a bottom-up approach, which is fishers centred by keeping in mind the existing & felt needs. Empowering communities with information and developing a feedback mechanism by positioning an authority (cooperative department) over the M.P Fish Federation can check on the practice of partiality and information dissemination patterns. It is well observed in public hearings and public information display boards as authorized by other laws. The informal nature of the fisheries with various stakeholders, multiple entries, and exit points makes monitoring by the state difficult, as it is a capital and labor-intensive process. Attempts can be made by encouraging the communities to introduce checks in the system and be a part of resource access and resource control, conservation, and proper extraction. The policymakers can start this direction by acknowledging the serious problems with the present status of information dissemination.

4.3 To identify the problems and suggest possible solutions from the fishers' perspective

The problems/constraints faced by the fishers of cooperative societies were studied using Rank Based Quotient. The five main problems reported by fishers were common for fishermen, household women, and representatives of cooperative societies, which are assigned ranks based on the RBQ score. However, the constraints faced by women and cooperative leaders are also studied individually.

4.3.1 The problems/constraints faced by fishers, fisherwomen and representatives of cooperative societies

The problems/constraints faced by fishers, representatives of cooperative societies, and fisherwomen are mentioned in Table 4.3.1, Table 4.3.2, and Table 4.3.3, respectively.

Table 4.3.1 Problems/constraints faced by fishers of cooperative societies (n = 180)

Problem identified	RBQ Score	Rank
Low income through fishing	86.38	1
Financial problems	74.53	2
Poaching & other social problems	60.46	3
No proper implementation of Conservation measures	33.70	4
Destructive fishing practices	32.50	5
No proper functioning of the co-operative society	30.09	6

Low income through fishing: This was the top-ranked problem by most fishers as the fisheries of the Bargi reservoir show a depleting trend. The RBQ score was 86.38.

Financial problems: The financial problem is due to less catch and complete dependency on fishing as the main occupation. The RBQ score of the problem is 74.53. Most of the fishers were only engaged in a fishing activity for generating income.

Poaching and other social problems: The involvement of fishers and non-fishers in the poaching activities and unauthorized fishing was the third major problem reported by fishers with the RBQ score of 60.46.

No proper implementation of Conservation measures: The conservation measures such as fishing ban season and mesh size regulation is not imposed adequately in the reservoir due to lack of an effective monitoring mechanism by the M.P. Fish Federation. The above problem is reported 4th with the RBQ score of 33.70.

Destructive fishing practices: The destructive fishing gears operated in the reservoir disturb the reservoir's ecology and are ranked 5th among the six significant constraints reported with the RBQ score of 32.50.

No proper functioning of co-operative society: The non-functioning of the cooperative society is one of the main problems with the least RBQ score of 30.09. Some societies are defunct as dominated by non-active members.

Table 4.3.2 Constraints faced by the leaders of cooperative societies (n = 180)

Constraints	RBQ	Rank
Default in loan repayment	72.01	1
Inadequate financial support	70.25	2
Group atmosphere & member characteristics	68	3
Lack of professional management	64.91	4
Ignorance of cooperative principles	52	5
Gender biased leadership	43.60	6
Political & other cooperative societies interventions	38.34	7

Table 4.3.2 depicts that seven constraints are faced by the leaders of cooperative societies of which ‘default in loan repayment’ is ranked first, and ‘political & other cooperative societies interventions’ is ranked last.

Default in loan repayment: The repayment of the loan amount extended by members is the major challenge many fisheries cooperatives' leaders faced. Default in role payment affected the overall performance of cooperative societies. If the society members failed to repay the loan amount in the given time, the lending institutions ceased to provide loans for the next time on behalf of cooperative societies. The members sometimes face family problems, the unexpected expenditure of loan amounts on severe diseases, family expenses, or house maintenance, which forced them to utilize the loan amount in other unproductive activities. Rarely but it is also seen that the member could be a wilful defaulter who expected that the loan amount is lapse after the given time or repayment may be made later. So the leaders considered it an effortful task to recover the loan amount from the fishers.

Inadequate financial support was the second major problem: The non-active fishers are frequently faced with inadequate financial support from the lending institutions. Therefore, the members face difficulties in purchasing crafts and gears due to lack of funds as the boat-net subsidy benefit by the M.P. Fish Federation is only provided to active fishers, and non-active fishers are escaped from availing the scheme benefit.

Group atmosphere & member characteristics: It is the third main constraint reported by leaders. A cooperative society is based on achieving common goals by sharing resources. The effective functioning of society requires mutual understanding and shared opinions. The perceived difference in values, needs, and opinion results in the conflicts among members, especially among those fishers who are involved in the operation of destructive gears and poaching and those who are not engaged in any such activities, are the subject of conflict reported. This leads to leaders facing problems in decision making due to the atmosphere of disputes.

Lack of professional management: It is ranked fourth by the leaders. Many leaders believed that if they are provided proper accounting, budgeting, and record-keeping training, they could have performed better than the present. Some of the leaders believed that if all the members are skilled enough to do the necessary accounting, it would have made their task more manageable.

Ignorance of cooperative principles: This is ranked fifth by the leaders. It is observed that many members joined the organization for their economic benefits and accessing the schemes. These members are motivated to achieve their interests and needs at the cost of others viz., the exploitation through zero mesh nets by these members affects other fishers and the fisheries of the entire reservoir. Once they get to avail of financial support, they become entirely ignorant of the cooperative rules, affecting society's functioning. It is suggested by most of the leaders to provide awareness programs on cooperative principles.

Gender biased leadership: This is the sixth problem in order. The leaders agreed that their leadership supports the male members in the majority than the female members. It is also observed that men are preferred more than women as members in a cooperative society because of gender stereotypes.

Political & other cooperative societies' interventions: This is ranked last among all the constraints. Other cooperative societies that are not formed by the reservoir displaced people during its construction are also observed to fish in the reservoir. Three cooperative societies of lower stretch who take the village ponds on the lease are also reported to involve in unauthorized fishing in the reservoir without offering the fish catch to the contractor. These societies have some connections with political persons who support such activities.

Table 4.3.3 Constraints in participation faced by fisherwomen in cooperative societies (n = 180)

Constraints	RBQ	Rank
Household restrictions	81.43	1
Lack of education	76.43	2
Lack of awareness about government schemes	72.5	3
Lack of awareness about cooperative principles	70.8	4
Communication problem	65.36	5
Delay in sanctioning loan	60.07	7
Gender biases in membership	56.36	6
Lack of access to leadership	48.10	8
Inequality in the distribution of loan	38.93	9

Unsuitable repayment schedule	29.64	10
Lack of fishing & netting skills	20.36	11

Around 95% of the cooperative societies' respondents are men, while only 5% are women. The less membership of women in cooperative societies revealed that though women are engaged in fishing activities, their role is undervalued and unrecognized due to their non-participation in cooperative societies. If their memberships are increased in the societies, they may contribute significantly to the fishing income along with their male counterparts.

Household restrictions are the major factor hindering their participation in cooperative societies with an RBQ score of 81.43.

Lack of education is the second most constraint as the majority of the women are illiterate.

Lack of awareness about government schemes is reported as the third most common problem among fisherwomen.

Lack of awareness about cooperative principles is ranked as the fourth constraint faced by fisherwomen.

Communication problem The fifth-ranked problem is hesitation in communication due to the community's existing norms, where women are placed lower than men.

Gender biases in membership is revealed as the common prevailing problem in cooperative societies. Women are observed to be members when her male counterpart is also a member of a cooperative society or widow who has no working family member in the family or for filling the 1% seat of society reserved for ST/SC women.

Delay in sanctioning loans is the seventh major constraint faced by women. Women stated that those fisherwomen who are members of cooperative societies had not received the loan amount till date.

Lack of leadership access is the eighth common problem due to a lack of awareness, education, and empowerment of women. None of the sampled villages have a women leader in the cooperative society.

Inequality in loan distribution, **unsuitable repayment schedule, and lack of netting skills** are other problems ranked ninth, tenth, and eleventh, respectively, as depicted in Table 4.3.3. The findings of the study support the observation of (Meetei *et al.,* 2016).

The economic constraints faced by fishers are

- Lack of financial support through availing schemes
- No provision of emergency credit by M.P. Fish Federation
- Lack of marketing rights to fishers
- The drop in fishing income

The environmental constraints are

- The decline in stocked species and native species of the reservoir (Narmada River)
- Poaching activities by fishers and non-fishers

The social constraints reported are

- The conflict between fishers, non-fishers, contractor, and M.P. Fish Federation
- Fishing close regulations (15 June-15 August), but not adequately followed
- Non-regulation of mesh size, destructive gears
- Illegal sale of fishes by some fishers
- Illiteracy among fishers

4.3.2 Alternative livelihood options

Interaction with key informants and Focus Group Discussion besides direct observations and literature review has suggested three additional livelihood opportunities in the Bargi reservoir region: ecotourism, fish culture on lease in village ponds, and ornamental fish culture that can complement their fishing income.

Ecotourism in Bargi reservoir

Bargi-Maikal resort on the dam site is a top-rated tourist destination in the Jabalpur district that provides a boating facility and a restaurant. The tourism department manages the boating facility, and boating workers are hired from outside. If the fishers, especially those nearby living villages, can provide boat services and work as waiters in restaurants in place of hired workers from outside. Women can also be involved in these activities. It requires inter-departmental collaboration between fisheries and the tourism department so that they can generate additional income. The tourism department can be roped in to provide the required infrastructure and training to fishers.

Aquaculture in village ponds

Fishers can be engaged in the fish culture on lease in village community ponds of the gram panchayat. Few fishers of cooperative societies observed to take village pond on lease along with 4-5 members. If all the cooperative society/fishing village takes fish ponds of their respective gram panchayats on the lease, a supplemental and sustained livelihood can be generated. At present, these ponds are given on lease to non-traditional fishers. Instead, the ponds should be given on lease to the traditional fishers of Bargi reservoir who have expertise in netting skills and can also stock the fish seed purchased from the fish seed farm of the M.P. Fish Federation. The lease amount is also very much affordable, ranging from ₹700- ₹1000 for ten years, depending on the pond's area.

Ornamental Fish Culture

As the fishers are familiar with the fisheries sector, so ornamental fish rearing can be a suitable option for them as an alternative source of livelihood. Besides also they can be trained for the fabrication of aquarium. Common species cultured in the state are Goldfish, Siamese fighting fish, Guppy, and Koi carp. The involvement of the existing fisherwomen SHGs in ornamental activities with financial support from state government and M.P. Fish Federation would be a sustainable option. The reorganization of cooperative society into the Fish Farmer Producer Organization and cooperation among fishers may become an excellent opportunity to increase fishers' income and overall development. It will require planning by M.P. Fish

Federation and training, capacity building, backward-forward linkages to fishers through the M.P. Fish Federation.

Other alternatives

M.P. Fish Federation under Pradhan Mantri Matsya Sampada Yojana should avail various schemes to fishers like

1. Construction of Hatcheries run by fishers
2. Reorganization of cooperatives into Fish Farmer Producer Organization
3. Developing marketing infrastructure
4. Construction of Fish Seed Farm

These schemes are only available to fish farmers/fishers for culture fisheries in ponds/small reservoirs having size <2000 ha (managed by Department of Fisheries). Hence, these schemes should also be made available to fishers of medium and large reservoir fisheries under the M.P. Fish Federation. Operation of Hatcheries and Fish Seed Farm can serve as an additional income generating source to fishers, especially in fish ban season when fishing is stopped in the reservoir.

Thus, the sustainability of the reservoir fishery requires adaptive management approaches through fisher community-based organizations (CBOs) that will regulate and empower local fishing communities, including women, to:

• Prevent overfishing and the use of destructive fishing gears and methods (e.g., nets with too small mesh size or use of poison/explosives)

• Prevent the targeting of vulnerable life stages (breeding/spawning), both within and upstream of the reservoir

• Prevent outsiders from moving in and exploiting the fishery of the reservoir to the detriment of local fishers

• Create opportunities to maximize long-term benefits arising from effective stocking, harvesting, and marketing in an inclusive and equitable way

5. SUMMARY AND CONCLUSION

Reservoirs are mainly established under irrigation projects and are never created primarily for fishery purpose. However, the secondary use of the reservoir for fisheries is becoming an increasingly important activity. The fish production under the reservoir is gradually contributing to the inland fish production of the country. It also provides good quality animal protein and livelihood opportunities to fishers' communities depending on it. However, it is not contributing to the inland fish production to the extent it should. The reservoirs need to be utilized to make significant improvements in the country's inland fish production. Madhya Pradesh is one of the Indian states with an abundance of inland fishery resources and has the maximum number of medium reservoirs in the country. The Bargi reservoir is one of the five largest reservoirs in Madhya Pradesh, and there are around 1875 registered fishers of cooperative societies who depend upon the reservoir fisheries for their primary occupation. The fishery resource of the Bargi reservoir is under the control of the M.P. Fish Federation and is being exploited by the leasing system to a private contractor. Fishers do the fishing in the reservoir, and the contractor does the marketing of catch. For the efficient management of the fishery resources of the reservoir, it is essential to study the socio-economic status, the livelihood of the fishers in the periphery of the reservoir, problems, and difficulties faced by them so that the practically possible solutions can be provided. The study also aimed to understand management by key stakeholders and fisheries governance in the reservoir and poverty status of fishers with the following objectives.

1. To assess the livelihood profile of fishing communities in Bargi reservoir
2. To assess the patterns of the governance system in the Bargi reservoir
3. To identify the problems and suggest possible solutions from fishers' perspective

The six fishing villages, namely Magardha, Durga Nagar, Manadei, Gaghagwari, Narayanganj, and Patha were selected using a multi-stage sampling method. The selection of fishing villages was based on considering all the three stretches of the reservoir, i.e., lower, middle, and upper are covered. The study considered the total number of villages in the two districts, fishers' population details, market distance, landing centers, and fishing sub-caste during the selection of villages for the study.

The respondents were selected from each village using a random sampling method. For the present study, 30 fishers were sampled, such that a total of 180 respondents were selected for the study. Two key informants were selected from each village, and a total of 10 were selected for the study. The pre-tested and well-structured interview schedule was used for primary data collection from fishers. Secondary data were also collected from M.P. Fish Federation, Fishers' Cooperative Societies (FCS).

Bargi reservoir is the fourth largest reservoir in Madhya Pradesh with a total reservoir area of 27696.5 ha, whereas effective water spread area of 16648.5 ha. About 1875 fishers' households depend on the reservoir for their livelihood and belong to 41 fishing villages/ cooperative societies. Out of the total 1875 fishers, around 29.39% are non-active fishers. The fish production from the reservoir is 94.82 tons (2019-20), with a productivity of 5.70 kg/ha. The fish production reached a peak (585.42 tons) in 2017-18 with productivity of 35.16 kg/ha. The higher stocking density till 2018-19 with 580 fingerlings (no.)/ha has lead to increased catch, which declined in 2019-20 to 403 fingerlings (no.)/ha. About 19 fish species were reported from the reservoir, including carps *(Catla catla, Labeo rohita, Labeo bata, Labeo gonius, Cirrhinus mrigla, L. calbasu, Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix, H. nobilis)*, Catfishes *(Mystus seenghala, Wallago attu, Notopterus chitala, Ompok bimaculatus)*, *Tor tor* and *Tor putitora.* From 1990-1994, the reservoir was leased out for fisheries by Madhya Pradesh Fisheries Development Corporation (MPFDC) to a private contractor. Later, for five years (1995-2000), the reservoir is given to the Bargi Dam Displaced & Fish Product Marketing Co-operative Federation (regional federation of dam displaced people) on a royalty basis for fishery purpose. Since 2001, the management regime changes from MPFDC to M.P. Fish Federation who leased out the reservoir to a private contractor. Besides playing the leasing agency role, M.P. Fish Federation is also responsible for seed production in hatcheries near the periphery of the dam site and monitoring of fish seed stocking done by the contractor.

The reservoir management is coordinated between various key stakeholders such as the M.P. Fish Federation, M.P. Power Generating Corporation Limited, M.P. State Tourism Development Corporation, Department of Irrigation, and Department of Water Supply. Concerning the fisheries governance aspects, the reservoirs of the Madhya Pradesh are controlled under different property rights regimes by different

departments of state government. In the state, small and medium reservoirs are owned by the Water Resources Department, and large reservoirs constructed on Narmada or its tributaries are owned by Narmada Valley Development Authority (NVDA) and are controlled by M.P. Fish Federation. Fisheries of water area above 2000 ha and less than 2000 ha are under the Madhya Pradesh Fish Federation and Department of Fisheries, respectively. At present (2017-2024), the lease amount of the reservoir for seven years is ₹7,73,73000. There is no licensing system prevalent in the reservoir. M.P. Fish Federation collects the lease amount. The marketing of fish is done by the private contractor, while fishers of cooperative societies do the fishing on wages. The fishers assemble the catch at the nearby landing centers where it is collected after weighing by the contractor's staff. A small amount of fish is sold directly by fishers to consumers either from home or at the local market. A private contractor pays the wages for netting to the fishers. Presently, fishers are paid at a wage rate of ₹32/kg and ₹19/kg for catching major species, catfishes, and minor species, respectively. Annually there is an increment of ₹2 and ₹1 in the wages of fishers regulated by the M.P. Fish Federation. Contractors sell the fish at distant markets of Howrah (West Bengal). The price of catla is ₹220/kg for size > 10 kg & ₹160/kg for size < 10 kg, rohu is ₹190/kg for size > 10 kg & ₹130/kg for size < 10 kg, chital is ₹550/kg, paden is ₹250/kg, silver carp is ₹60-₹70/kg, katia is ₹400/kg and sambal is ₹500/kg. However, some Mandla district fishers are found selling smoked fishes (minor) at ₹100/kg in Karikun market and fresh IMC’s at ₹120-₹150/kg in the Mandla market. However, fresh IMC’s were sold at ₹100-₹120/kg by some Jabalpur district fishers from their home only.

Regarding conservation aspects, the monsoon fishing ban is implemented from June 15 to August 15. As per the rule, fishers are also not allowed to operate small mesh size nets. However, these measures are only followed to an extent and are limited to official records. Proper monitoring mechanisms were found to be missing. Apart from traditional fishing gears, locally made destructive gears such as *Jhulli Jal, Phasla Jal, Bahav Jal,* and *Bansi* were observed to catch juveniles and brooder fishes. For fishing, the gill net is set in the evening by 3-5 pm and hauled the next day in the early morning 6-9 am. The cast net is mainly operated by non-members and very few fishers when the water level is low in the reservoir.

At present, there are 12 M.P. Fish Federation schemes for fishers of Bargi reservoir that are only availed by registered fishers of cooperative societies/fishing villages in the periphery of the reservoir. Some of the schemes are directly related to fishing activities such as deferred wages scheme, saving cum relief scheme and fishers training scheme, purchase of fishery requisites (80:20 or 50:50 boat-net subsidy scheme for nets and boats). In contrast, the others are more general (such as Group accident insurance scheme, Severe disease treatment grant scheme, Nishadraj Scholarship scheme, Jaldeep scheme, Meenakshi Girl Marriage Scheme).

Most of the fishers (79.44%) stated that they are getting less income from fishing. About 65% revealed that their cost of fishing increased over the years. Most (80.55%) of fishers disagreed that assistance from M.P. Fish Federation contributed to an increase in income. Around 52.22% reported that M.P. Fish Federation schemes benefited only a few people. Subsequently, nearly 55% reported that they might get higher catch and income if fish independent of society.

In the case of fishers' socio-economic profile and livelihood status, the majority (66.66%) belonged to the age group of 30-50 years. 28.33% of the fishers belonged to the age group of above 50 years with the mean age of fishers 45 years. The Kruskal-Wallis test has shown a significant difference in the age of fishers across the sampled villages. Around 47.77% of the respondents were illiterate, and only 1.11% completed higher secondary education. The average year of schooling for fishers is 4.7 years. The sample respondent population was 95% males, and 5% were females. It was found that 32.22% of the respondents had a fishing experience of 20-30 years. Nearly 62.22% of respondents have reported to involved in the fishing activity for two generations indicating their involvement in fishing since the construction of the reservoir as their land was submerged in water. 70.55% of the fishers learned fishing from their fathers.

The majority (90%) of the fishers were from the OBC category, which includes the Patel sub-caste (OBC) constituted 15.55%, and is mainly found to live in Magardha village. 16.66% belonged to the Nanda sub-caste (OBC) and are found to live in Manadei village. Barman sub-caste (OBC) is found in Durga Nagar. Barmaiya fishing community is found distributed mainly in Narayanganj, Gaghagwari, and Patha, while only 10% of respondents of Patha and Ghaghagwari are from the Gond sub-caste

(ST). Hinduism was the only religion among the respondents. All the fishers speak Hindi. All the fishers studied were the registered fishers' of cooperative societies. About 97.77% of fishers have Aadhar and Voter ID card. Nearly 99.44% of fishers have bank passbook.

It was found that 73.88% of respondents live in the nuclear family, and 26.12% live in the joint family. Nearly 53.8% have a family size of fewer than four members, while 32% have 4 to 6 members, and 14% have more than six members in their family. A large number (52.22%) of respondents were found to be living in kaccha houses. All the respondents had their own houses. Concerning household amenities, around 68% have sanitation facilities available in their house while the rest 32% are engaged in open defecation. Many fishers' households of Manadei, Gaghagwari, and Patha villages were engaged in open defecation**.** Low-income level, remote location, vast space, and no benefit from the Gram Panchayat toilet scheme seem to favor open defecation. It was observed that 82.47% of the fishers' had access to water near the premises, and only 17.53% have the availability of drinking water within premises. Around 61.11% of the respondents depend on public tap as the source of drinking water. 96.66% of Bargi reservoir fishers have Electricity in their houses while the remaining 3.34% were dependent on Kerosene for lighting. About 56.93% used firewood for cooking. 45.55% of the respondents have a normal phone for communication. Around 70.88% have extension contact with cooperative societies representatives, and 35.55% contacted the officers from the M.P. Fish Federation. 32% of the respondents participate weekly in cooperative societies. 63.33% of respondents were full-time fishers and were not involved in any secondary activity, while 6.66% were part-time fishers and were also engaged in other occupations such as labor (19.45%), agriculture (13.88%), and remaining 3.33% in construction, vegetable seller, etc. About 60% of household income was contributed by fishing, and the rest earned through involvement in other occupations by the fisher themselves or other household members. Nearly 41.11% have monthly fishing income less than ₹4000. The average annual fishing income of fishers is ₹40,860. The Manadei fishers were having the least average monthly fishing income of ₹2990, and Gaghagwari fishers with a maximum average fishing income of ₹3760. Nearly 76.66% of fishers operate craft *'Nao'* (Plank-built boat) in the middle and lower stretch, and 23.33% have *'Kishti'* (Wooden frame tin sheet boat) in the upper stretch of the reservoir. Only

16.11% of the fishers in all six fishing villages had debt, but the source was not the same for all. 58.88% depend on public transport for transport facilities. Most of them depend on the bank as the credit source. Out of this, 11.66% have a debt to meet family expenses, 3.88% for fishing purposes, and the remaining 1.11% for personal reasons.

The average fishing days/month of fishers' is 23 days in a month. Peak fishing season starts from September and continues till the end of December. The average fish catch of a fisher per day is 3.96 kg, and the average annual catch per fisher is 890 kg in the reservoir.

Livelihood capitals revealed that the financial capital (0.40) was the lowest, while natural capital (0.57) was the highest (0.46) out of the five capitals. For identifying the degree of association between categorical social variables, Spearman rank correlation was done. It is found that age was positively correlated with fisheries experience. Household members are positively correlated with family type. There is also a strong correlation between extension contact and social participation. General Linear Model indicated that fisheries experience influenced the household income as with the shift from >30 years of fishing experience to <10 years of fishing experience, the household income decrease was found to be ₹1107, which is significant at t value .098. The greatest change in household income was found when the fisheries experience changes from >30 years to <10 years. Similarly, the degree of participation in cooperative societies had a positive influence in household income, wherein an increase in participation from no participation to fortnightly participation the household income increases by ₹1383, which is significant at t value .049. The Kruskal-Wallis test revealed that the p-value for the social category, access to schemes, and extension contact is .000, meaning that there is a highly significant difference between social category, access to schemes, and extension contact at 0.001% level of significance among the six sample fishing villages of Bargi reservoir. Also, there is a significant difference in household members, family type, household income, mass media, and social participation of the six villages.

Focus Group Discussion suggested three additional livelihood alternatives for fishers of the Bargi reservoir region to increase their income. The options are eco-tourism, fish culture in village ponds, and ornamental fish culture. Maikal resort on the Bargi

dam site is a top-rated tourist destination in Jabalpur district that offers water sports, a boating facility, a restaurant, and a hotel. M.P. State Tourism Development Corporation manages the boating arrangements, where employees for boating, cooking, cleaning, gatekeeping, waiters, and receptionists are hired from outside. If the fishers, especially those living in nearby villages, will be engaged in delivering boat services and as waiters in restaurants in place of hired workers from outside, it will help in additional income generation. It requires inter-departmental collaboration between fisheries and the tourism department so that they can generate additional income. The tourism department can be tied in to provide the required infrastructure and training to fishers. The second alternative is fish culture on lease in village community ponds under Gram Panchayat. Presently, these ponds are given on lease to non-traditional fishers. Instead, the ponds can be given on lease to the traditional fishers of the Bargi reservoir who have expertise in netting skills. The third one is ornamental fish culture; with a cooperative society and fishers' involvement, it may become a good opportunity to increase fishers' income. It will require planning by M.P. Fish Federation and training, capacity building, backward-forward linkages to fishers through the M.P. Fish Federation. Even involvement of the existing fisherwomen SHGs in ornamental activities with financial support from state government and M.P. Fish Federation would be a sustainable option.

The study revealed that IMCs and Mahseer, the state fish of Madhya Pradesh, and native fish of river Narmada show a declining trend while the population of catfishes is increasing. Thus the Mahseer fish fingerlings need to be stocked along with IMCs to prevent its depletion. There is a lack of coordination between various stakeholders viz., M.P. Fish Federation, M.P. Power Generating Corporation Limited, M.P. State Tourism Development Corporation, Department of Tourism, Department of Electricity. Also, there is a lack of proper functioning of cooperative societies and poor fisheries governance in the reservoir.

Stocking done by a private contractor is 67.13 lakh fingerlings in the year 2019-20, which is significantly less with respect to the effective area of the reservoir. Hence, the stocking density should be increased. Fisherwomen are involved in various fishing activities, but their role is unrecognized and undervalued due to several constraints, so their very little membership is in the cooperative society.

M.P. Fish Federation should avail maximum benefit to fishers through fishers' welfare schemes. Fishing rights are vested with the M.P. Fish Federation based on leasing to a private contractor in Bargi reservoir, and marketing right is with the contractor. In collaboration with the private contractor, M.P. Fish Federation should monitor the operation of unauthorized destructive fishing gears and poaching activities by fishers and non-fishers, which also leads to declining fish catch due to overexploitation in the reservoir. The M.P. Fish Federation must play a prominent role in the management of fisheries and fishers of the reservoir, as most of the time, it is being neglected because of more focus on other aspects of the reservoir such as tourism, electricity generation, irrigation, and water supply. Fishers, private contractors, and the M.P. Fish Federation must collaborate to properly manage the reservoir as conflicts are reported between fishers, contractor, and M.P. Fish Federation staff. The fishing is done by fishers and is paid by the contractor. The fishing wages must be increased, which is also the main reason for many fishers' involvement in poaching activities and destructive fishing gears.

The existing approach in Bargi reservoir fisheries is revenue-oriented, supporting the private contractor, which should be welfare-oriented in favor of fishers by providing marketing rights to fishers. M.P. Fish Federation is giving more focus on small incentives through schemes and subsidies which are short term instead should focus on providing alternative livelihood in the close season and diversified or supplementary livelihood throughout the year to reduce complete dependency on reservoir fisheries, increasing income, and preventing overexploitation of fisheries through destructive fishing practices.

Fishers' welfare schemes are only limited to active fishers who are fishing for more than 100 days. Many active fishers are also found who have not availed any schemes as the schemes are benefitting only a limited number of fishers'. Another problem reported is that many fishes are flushed outside the reservoir by opening irrigation canals and sluice gates during heavy rainfall. Therefore, stocking should be done after sluice gates and irrigation canals are closed. The filter should also be fixed at the canal entrance to prevent fishes from moving out of the reservoir. Cages can be installed and stocked with fingerlings in the irrigation canal and are provided to fishers for generating an additional income source.

Stocking and marketing right should be transferred to cooperative society on a royalty basis in place of contractor system as the wages paid by the contractor is insignificant as compared to the higher price of fish at local and distant markets. It requires fish seed farms, hatcheries, and market infrastructure operated by fishers, developed through Pradhan Mantri Matsya Sampada Yojana. Awareness programs on the cooperative rules, functioning, basic accounting, record keeping & budget-writing need to be imparted by M.P. Fish Federation. Capacity building of fishers through training organized by the M.P. Fish Federation (organized rarely & provided only to some selected members). There is also a need to provide gender awareness programs to all fishers to include fisherwomen in cooperative societies as most household women participate in fishing activities. Stocking should be done in the presence of co-operative leaders to promote transparency in seed stocking. Most of the fishers claimed that stocking density is mentioned in the record only. Mesh size regulations and operation of destructive fishing gears, and poaching activities needs proper monitoring by the M.P. Fish Federation and Contractor. Registration & membership of defunct cooperative societies and non-active fishers should be canceled immediately.

Many fishers registered in cooperative society to avail benefits of subsidies and schemes. Also, there is a need for proper dissemination of practical information on schemes as the majority were uninformed about these schemes' content, eligibility criteria, documents required, and where to avail of them. The current information dissemination strategy seems to provide a very general idea of schemes. Also, most of the information is circulated through the leader of a cooperative society and so getting access to information also depends on the quality of relationships between the fisher and the leader. So information should be directly accessed by individual fisher. Therefore, a mechanism should be developed above the M.P. Fish Federation (Cooperative department) to monitor the number of active fishers eligible for availing schemes and the actual number of fishers to whom schemes and subsidies are granted. There is an immediate need to create a fishers' cooperative unit (FCU) within the M.P. Fish Federation to improve information dissemination to fishers, which may be monitored by the Cooperative Department.

It can be concluded that good fisheries governance through community-based fisheries management requires the transfer of marketing and stocking right to fishers

by royalty system paid to M.P. Fish Federation and developing Fish Farmer Producer Organization through active fishers of functional cooperative societies for improving transparency, increasing income, and developing entrepreneurship among fishers to solve various problems and issues is needed. This organizational transformation requires a shift from profit-oriented, hierarchies based, controlling, and dysfunctional system to purpose/welfare-oriented networks based, empowering, and transparency based system. It can be possible through Union Budget 2020 for fisheries, which emphasizes the formation of 500 Fish FPOs.

As the cooperative societies are not functioning properly, non-profitable, and lost trust due to no selection criteria for membership, it is random, leading to the dominance of community dysfunctionists. With the formation of Fish Farmers Producer Organization (FFPO) from active fishers of cooperative societies, marketing rights should be transferred to fishers' on a royalty basis paying to M.P. Fish Federation. Initially, the FFPO can be engaged in fish culture in village ponds, ornamental fish culture, and fish processing activities. For the above purpose, 100 fisher friends will be selected through the sociometric method, and around 25 of it will be selected as field school trainers who will provide regular lectures and training to the remaining fishers. Around 11 out of these, 25 are selected as entrepreneurs who are provided with hatchery management training. The 5 out of these 11 entrepreneurs are selected as managing director. Best 1 of these 5 are purposively selected as chief executive officer of the FFPO. The FPO is than registered with NABARD. Initially, the NABARD pays to CEO for three years, and FFPO has to make it profitable within these three years. After three years, more active fishers can be registered with an annual membership amount of around ₹1000. In the long run, FFPO can bid the reservoir in place of the contractor after becoming a profitable and trustworthy organization.

Overall, the reservoir fisheries at the Bargi reservoir employ fishers for two generations dependent on it to secure a livelihood. Better governance is very much crucial to improve the livelihood of the fishers. Hence, the development of Bargi reservoir fisheries and livelihood of fishers can be achieved by good governance through the transformation of functional cooperative societies into the Fish Farmer Producer Organization, supported by Budget 2020 of fisheries and transfer of marketing and seed stocking right from contractor to fishers.

The major constraints faced by the fishers are low income through fishing followed by financial problems, poaching & other social problems, no proper implementation of conservation measures, destructive fishing practices, no proper functioning of the co-operative society. However, the constraints faced by fisherwomen are household restrictions, lack of education, lack of awareness about government schemes, lack of awareness about cooperative principles, communication problem, delay in sanctioning loan, gender biases in membership, lack of access to leadership, inequality in the distribution of loan, unsuitable repayment schedule and lack of fishing & netting skills. The problems faced by the representatives of cooperative societies are default in loan repayment followed by inadequate financial support, group atmosphere & member characteristics, lack of professional management, ignorance of cooperative principles, gender-biased leadership, and political & other cooperative societies interventions. The economic constraints faced by fishers are lack of financial support through availing schemes, no provision of emergency credit by M.P. Fish Federation, lack of marketing rights to fishers, and the drop in fishing income. The environmental constraints are a decline in stocked species and native species of the reservoir (Narmada River) and poaching activities by fishers and non-fishers. The social constraints reported conflict between fishers, non-fishers, contractor & M.P. Fish Federation, no proper implementation of close fishing regulations, non-regulation of mesh size, destructive gears, illegal sale of fishes by some fishers, and illiteracy among fishers. The alternative livelihood strategies suggested are ecotourism in the reservoir, aquaculture in village ponds, and ornamental fish culture.

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Plate1: Plank-built boat at the bank of reservoir

Plate 2: Wooden frame tin sheet boat manufactured by fishers

Plate 3: Fish smoking activity by fisherwomen

Plate 4: Catch composition: IMCs and Catfishes

Plate 5: Phasla Jal

Plate 6: Bahav Jal with captured brood fish

Plate 7: Zero-mesh size net (Jhulli Jal)

Plate 8: Interview with M.P. Fish Federation Regional Manager at Jabalpur

Plate 9: Interview with M.P. State Tourism Development Corporation officials at Jabalpur

Plate 14: Smoked dried fish

Plate 15: Fish catch

Plate 16: Fisher illegally selling fish at the Karikun market in Mandla

Plate 17: Fisherwomen selling fish at the Karikun market in Mandla

Plate 10: Focus Group Discussion with fishers of Manadei

Plate 11: Interview with fishers of Narayanganj

Plate 12: Interview of fishers in Durga Nagar

Plate 13: Kuccha house of Durga Nagar fisher

Plate 18: Interview on constraints faced by fisherwomen

Plate 19: Focus Group Discussion on constraints faced by fishers

ICAR-CENTRAL INSTITUTE OF FISHERIES EDUCATION, MUMBAI

"**Fishers' Livelihood and Fisheries Governance in Bargi Reservoir of Madhya Pradesh"**

Interview Schedule for Fishers

A. Social profile

1. Name of respondent: _____
2. Address: Village_____Block_____District _____
3. Contact number:
4. Age:_____years Gender: Male/Female
5. Social category: SC/ ST/ OBC/ Gen
6. Religion: Hindu/ Muslim/ Christians/ Others
7. Education:
8. Marital status: Married/ Unmarried
9. Family type: Joint/ Nuclear
10. Household members**:** Total_____; of which Adults _____
    Children's:_____Male:_____Female:_____
11. Native/migrated (if migrated, original native place):

B. Details of Household: Family Type – Joint/nuclear ii) Family size……

Sr. No.	**Head of HH & Family members**	**Gender**	**Age**	**Educationa**	**Occupation****			**Annual Income (in Rs.)**		
					Primary	**Secondary**	**Livestock**	**Primary**	**Secondary**	**Livestock**
1*										
2										
3										
4										
5										

** Respondent's Name and his/her relationship to Head of Household whether husband / wife*

*If any family members have migrated out, note the place, occupation and whether it's seasonal / permanent

C) Communication Sources & Usage:

S. N	**Items**	**Ownership**	**Usage**	**Frequency**	**Purpose**

				R	O	N	Prs	Pfs	Both
1	Radio								
2	TV (cable)								
3	Newspaper								
4	Internet								
5	Mobile Smart phone								
	Normal phone								
6	Telephone								
7	Others								

***R-Regular, O-Occasional, N-Never (prs-personal, Pfs-Professional)**

D. Socio-economic Aspects

I. Physical Assets

	Response(√)	**Details**
Household assets		
House type	Kucha/Semi pucca/Pucca	
Ownership status of house	Owned /Rented	
Transportation facility	None / Man pooled rickshaw/ Public transport/ Bicycle / Bike / Three Wheeler / Four Wheeler	
Land ownership	Y/N, If any owned land area in acres: _____acres.	
Household amenities		
Sanitation facility in the house?	Yes/No	
If no , type of sanitation practised	Available in house/Public toilet/Open defecation	
Source of drinking water	Tap water treated/ Municipality water/Bore well/ Public tap/lake water/ others	
Location of drinking water	Within premises/Near premises/Away	
Source of lighting	Electricity/ Kerosene lamp/solar light /others	
Fuel used for cooking	LPG/Electricity/Coal/Firewood/others	

Health treatment facility	Govt. Hospital / Dispensary / Private Hospital / Any other	
Fish market facilities	Yes/No	
Road facility	Yes/No	

*(*Pucca 1- roof and wall concrete, floor cement or mosaic tiles, five rooms, attached bathroom and kitchen)*

*(*Pucca 2- roof and wall burned bricks, floor with stone, three rooms, bathroom and kitchen outside)*

*(*Semi Pucca 1- wall and floors are cement, roof asbestos sheet, attached kitchen and bathroom, two rooms)*

*(*Semi Pucca 2- wall and floors are burned brick, roof manmade tiles, bathroom and kitchen outside)*

Do you access basic public service? Yes/ No (if yes give a tick mark)

a) Citizenship photo I.D.: Ration card/Voter card/Aadhar card/BPL card/PAN card/Driving license/Bank passbook/post office passbook/Any other.

II. Human Assets

1. What is your skill in fishing? Fish breeding / Fish disease identification / Netting / Boating / Net making / water quality testing
2. Fisheries experience (in year) –
3. How many training programme you have attended related to fisheries

S. No.	When	Where	By whom	How many days
1.				
2.				
3.				
4.				
5.				

4. Did you receive any grant or exemption for these training? No /Yes, if yes

   then how much
   Rs……..
5. Do you pay for training? No / Yes, if yes then how much

Rs.....

And for which
training.....

6. What you have learned from training: Fish breeding method/Netting (harvesting)/Net breading/product development/ any other

A) Access to different schemes and programs of DOF

Sr. No.	Name of scheme	Beneficiary Y/N	Year	Benefit in (Rs.)
1	Any social-welfare scheme			
2	Craft and gear subsidy			
3	Accident insurance			
4	Saving cum relief scheme			
5	Fishers housing scheme			
6	Other scheme /state packages			

*Do you feel adoption of this/any technology changed your standard of living? (Y/N)

If Yes, then how?

Do you think that fisheries had helped in improving your socio-economic condition? (YES/NO)

How?.....

III. Social Assets

A. Social participation: yes/ no. If yes,

Sr.No.	Statement	Option	Details
1	Membership	Cooperative society/ Gram Panchayat/NGO/SHG/Political party/Any fisheries organisation	
2	Degree of participation	Daily/Weekly/Fortnightly/Monthly/Occasionally/Yearly/Never	
3	Leadership	Yes/No	
4	Benefit from social participation	Economic/Social/Political/No benefits	
5	Satisfaction	Yes/No	

B. Extension system contact

(Do you happen to meet the local officer? (Yes / No), If yes, how often?

Sr. No.	Type of the officer	Yes/ No	Frequency	Purpose
1	Local officer			
2	Secretary cop. Soc.			
3	Panchayat president			
4	V.L.W			
5	Fisheries Extension officer			
6	NGO			
7	Bank officer			
8	Any other			

a. Do women in your household also contribute to fisheries? No / Yes, If yes, than in which work – Netting / Smoking/ Marketing / Net making / Net repairing or any other work

IV. Natural Assets

	Details
1. Area of land/pond or water body	
2. Fish production (per ha.)	
3. Water resources for fisheries activities	

4. Source of fish seeds	
5. Availability of various fish species	
6. Productivity of reservoir(per ha)	

A. Occupational Details

i. Culture based capture fisheries/Only capture fisheries/Any other fishing activity

ii. Engaged in fishing and fisheries related activities (Fully/Partially/Not at all), if partial, mention other activity

iii. No. of years of experience in fishing…….

iv. For how many generations your family is in fishing occupation?

v. Whom did you learn fishing from?

vi. Activity (Employment) during closed season: Unemployment/…….....

vii. Craft and gear- Do you own a boat? Y/N If yes, what is the type of boat: Coracle/Wooden/tubes/other

viii. Do you fish individually or in groups? Individual / Group

ix. Type of fishing nets owned: Gill nets / Cast net / dragnet/ others……. How many no. or kg: _____

x. Fishing days per month? .....

xi. Peak fishing season:

i. Following Closed season Yes/No, If yes details……..

B) Production details.

i. Total catch in Kg/day.....

ii. Where do you sell your fish? Place:_____; Price / kg:_____; Quantity:_____

iii. Species wise composition in catch (in kg)
a) ..... b)..... c)..... d)……

iv. How many kg of fish does your family consume in a week? _____

v. Total production marketed/month in Kg.....

vi. Quantity and price of fish sold

Sr. No.	Particulars	Quantity	Price/kg

1	Catch sold in local market		
2	Catch sold to lessee/contractor/marketing agent		
3	Catch sold to cooperative society		
4	Any other		

vii. Market channel followed to dispose/ sell the catch.....

V. Financial Assets

i. How does you meet the social/cultural/festive expenses: income/saving/loan from bank/loan from money lender/other?

ii. Are you in debt? Yes/ no

iii. Reason for debt? a) Personal b) professional(Fishing) c) Family expenses

Sr. No.	Credit Source	Amount	Interest	Purpose
1	Friends			
2	Relatives			
3	Money Lender			
4	Cooperative Society			
5	Bank			
6	Others			

iv. How do you pay back the loan?
.....

v. If not possible on time what action is taken by lenders?
……
……

vi. Do you save money? Yes/No. if Yes, type of saving a) daily b) monthly c) yearly d) occasional, amount……..
Purpose…….

vii. What is a source of your livelihood?
1. Primary:
2. Secondary:

viii. Saving (Annually): Credit source: Bank / moneylender / self-help group / post office / other.

ix. Fisheries assets: Hatchery / farm / trap / boat / other.

x. Positional assets: Mobile / Fan / Fridge / LPG gas / Other.

xi. Price of fish in market: (Rs/Kg)

A) Expenditure on Health:

i. Are you / your family member suffering from any disease? Yes/No
If yes, what type of disease?

Details……

ii. Where do you go for check-up? PHC / Civic Hospital? Private clinic
iii. Distance travelled from home to health facility: <3km, 4-10k, >10km
iv. How much money have you spent on health of family members during last year? …….
v. Any incidence of premature death / unnatural death / infant mortality in the family? Y/N
vi. Are they satisfied with the present status of healthcare facilities? VS/ S/ NSND/D/VS

B) Food and Other expenditures during the last 30days ended on.....

S. No.	**Particulars**	**Total expenditure**	
		Amount (Rs.)	**% expenditure**
1	**Food-** Egg		
	Meat		
	Fish		
2	Clothing		
3	Housing		
4	Education		
5	Entertainment		
6	Others		

E. Livelihood Resilience of fishers' based on capitals of Sustainable Livelihood Approach Framework (Department of International Development, 1999)

Livelihood Capital	Very low	Low	Medium	High	Very High
Physical Capital					
Possession of boat by the respondent/fisher					
Availability of fishing gears					
Ownership of assets					
Value addition/processing of the catch by the household					
Housing condition					
Marketing of the catch					
Natural Capital					
Distance to nearest water resource Possession of land by the household					
Loss due to natural disaster Sources of drinking water					
Distance to the nearest town					
Social Capital					
Leadership capabilities					
The desire to be a leader					
Participation in social meetings					
Participation in social works					
Social relationships with neighbours					

Social relationships with others fishermen					
Women participation in fisheries work					
Contact with Government and Non- government institutions					
Contribution of women in decision making					
Attitude of working together in community					
Trustworthiness of the people in the community					
Helping behaviour of community leaders					
Human Capital					
Fisheries skill					
Fisheries knowledge					
Fisheries Information					
Awareness about Govt. fisheries Schemes					
Desire to learn new tasks related to fisheries					
Participation in fisheries training programme					
Attitude towards fisheries department					
Availability of Labour for fisheries work					
Availability of time & potential to do extra/supplementary work					
Entrepreneurial behaviour					
Occupational diversity					
Women contribution to household income					
Financial Capital					

Money saving habit/ ability					
Access to credit from various sources					
Repayment capacity of the respondent					
Arrangement of money to deal with different situations					
Supplementary income besides fishing					
Change in catch, over the last 20 years					
Change in revenue generated over the last 20 years					

F. Perception of respondents about impacts of the M.P. Fish Federation /Contractor interventions

Sr. No.	Questions	Agree	Don't Know	Disagree
1	Fish catch from the reservoir is increasing over the years			
2	I am getting less and less Income from fishing			
3	My cost of fishing is increasing over the years			
4	Assistance from DOF has not contributed to increase in fish catch			
5	Assistance from DOF has contributed to increase in my income			
6	My knowledge about fishing and fisheries has increased due to DOF interventions			
7	I feel the cage culture is resulting in increased fish production and income			
8	I may get a higher catch and income if I fish independent of fishers co-operative society			
9	I am sure fish production is going to increase in future?			
10	I feel Compatibility with existing farming system			
11	Fishers co-operative society is truly a democratic organization and all of us feel as equal partners			
12	Do you feel the pen culture will lead to increased fish production and income?			

13	I do not feel stocking of fish seed in reservoir will be of any use			
14	I feel DOF support has benefited but only a few people, not all of us.			

G) List out the Problems / constraints (fisheries related / other than fisheries):

Sr. No.	**Particulars**	**Rank in order**
a.	Low income through fishing	
b.	Fishing related including craft & gear	
c.	Conservation measures (closed season, mesh size, etc.)	
d.	Functioning of co-operative society / SHG including lease money	
e.	Poaching other social problems	
f.	Financial problems	
	Other than fisheries	

H) Involvement of fishers below three livelihood options other than fishing?

Livelihood option	**Yes/No**	**How**
Ecotourism		
Ornamental fish culture		
Fish culture in village ponds		

Reservoir Fisheries

Check List for Collection of Secondary Data and Discussion with Key Informants

Geography & Hydrography of the Reservoir

1. Locational aspects/details of reservoir – locational map, river, dist., no. of villages on the periphery, etc
2. Hydrographic features like FRL, DSL, EWSA, depth / height, length, slope, catchment & command area, year of construction & commissioning, average rainfall
3. Demographic details of reservoir region: no. of villages, general population and fishers population, caste / community composition, major fishing villages, importance of fishing in local economy
4. Historiography of reservoir: local history of dam construction, replacement of people / villages, rehabilitation, etc.

Production Aspects

5. Landing centre and district wise fish production details for as many years as per availability (if not possible then at least for few years)
6. District wise fish production for at least ten years (district in which reservoir is located i.e. from Mandla, Seoni, Jabalpur.
7. What is the average fish production per year? Any fluctuations in last five or ten years?
8. When is the peak fishing period/season? No of fishing days in a year?

Catch composition:

9. What are the species present and caught in Bargi reservoir and their contribution to total catch?
10. What are the species captured in last 5 or 10 years and at present? Any new species found apart from major and minor carps?
11. For which species demand is more? Why?
12. Total species wise catch details of reservoir for at least last five years

S.N.	Species / Group	Total Catch (Kg /year)	External Market Sale (Kg)	Local Market Sale (Kg)	Fish processing unit (kg)

1					
2					
	Total catch				

Fishing effort:

13. What type of gears used by fishers in this reservoir? Details – name of the gear, no and weight of gears, no of fishers using each gear type, approx. cost of gear/kg.
14. What type of crafts used for fishing? Mechanized or non-mechanized (tubes, boat or any other), no of boats and no of fishers using each boat type and approx. cost of boat types
15. Are any destructive gears used in the reservoir? Details – names of the destructive gears
16. How many no of fishers are staying in and around Bargi reservoir? Any migrant fishers staying at this reservoir and from which place each group belongs to?
17. How many no of members from your family involved in fishing? What is the average catch/person?
18. How many times you fish in a week or in a month? What is the average catch/trip? What time generally you go for fishing?
19. Any subsidy on the crafts and gears? From whom? What is the process?
20. Total gear / craft wise catch details of reservoir for at least last five years

S.N.	**Type of Craft**	**Total Catch (in Kg /year or in % terms)**	**Type of gear**	**Total Catch (in Kg /year or in % terms)**
1			1. Gill net	
2			2	
3			3	
4			4	
	Total catch	100%	Total catch	100%

Stocking pattern:

21. Who is stocking the seed? i) DoF ii) M.P. Fish Federation? iii) Contractor iv) Other?
22. What is the source of seed? Purchasing from other state or district, at what price? Specie wise and category wise details, stocking size.
23. Is there any fish seed farm? If yes, details - area, No. of ponds, W.S.A., date of establishment, Production capacity
24. How many stocking done within a year? One or two? Total seed required per year.
25. Stocking details of reservoir during last five or ten years.
26. Any fluctuation in fish caught in last year and this year? What are the reasons for fluctuations?
27. How many landing centers present around the periphery of reservoir? Any demarcation of reservoir made for fishing?
28. Does anybody monitor stocking of seed or does seed stocked in fishers / anyone's presence?

Leasing / licensing policy /regulations, procedures & practices

29. Institutional Framework: Owner Agency: Irrigation Dept. /
30. Which type of management practice is followed? Either it is leasing / licensing / sharing system?
31. Leasing/licensing Agency & authority for fisheries: DOF / M.P. Fish Federation / Any other (Organizational chart)?
32. Since when the reservoir is under lease for fisheries?
33. Did the leasing system change over years? How?
34. Details of lease / license / sharing system

If leased, then

Reservoir -	**Total area (ha)…….**	**Catchment area (ha)……..**	
Given on Lease? -Yes	If 'Y' then to whom? ……, ……..	Lease Period …… …	Lease Amount …… …

-No			

35. If licensed, then, what is the license fee (per person) / gear wise / craft wise

36. Are the fishers fishing in a group or individually?

37. Details of Co-operative Societies:

S.N.	Name of the Co-operative society	No. of villages	Total fisher population	No. of active members	Establishment date
1					
2					
3					

38. How many of the fishers fishing in the reservoir belong to co-operative societies?
39. Why some are members and some are not members?

Roles and responsibilities of M.P. Fish Federation, Co-operatives, fishers and other institutions:

40. What are the detailed terms and conditions governing lease or licensing?
41. What is the role and function of M.P. Fish Federation?
42. What is the role / responsibilities and function of a Co-operative society?
43. What are the rights and responsibilities of individual fisher (member & non-member)?

Fishing Arrangements:

44. Harvesting system (wage system / owner-operator fishing / any other..?)

Fish Species	Major Carp	Local Major	Local Minor	Others (Prawn)
Wages/Kg				

45. Is wage is provided on the basis of large/small size of fish or on total catch?

46. In case of leasing, do the fishers sell their catches directly in the market or through any contractor?
47. Fishers sell their catches illegally in the market without coming to the landing centre?

Marketing arrangement:

48. What is the total amount fish sold in the market?
49. How much of the fish (% of total catch) is locally consumed by fishers?
50. How much of the total catch is sold in the market (local & outside)?
51. How much of the total catch is used in fish processing?
52. List /name of fish market nearby village.
53. List major Marketing channels including % of total catch being sold in that channel.
54. Is there any incidence of poaching in the reservoir? If yes, who are the poachers and why are they poaching?
55. How much of total catch is poached approx?
56. How fishers sell their catch

	Yes/no	**At what price**
Community		
Co-operative society		
Local market		

Benefit sharing arrangement: (by cooperatives)

57. Is there any monetary benefit shared by the cooperatives to the fishers? Yes/No, if yes, then, what % of Profit is shared with the fishers?
58. Is there any non-monetary benefit shared by the cooperatives? Yes/No, If yes, then what are these (Transportation facilities for marketing/Health service/education or all)?

Welfare measures:

59. General availability of schemes and programs of M.P. Fish Federation/Others?
    I. Any welfare scheme (yes/no)
    II. Craft and gear subsidy (yes/no)
    III. Accident insurance (yes/no)

IV. Saving cum relief scheme (yes/no)

V. Fishers housing scheme (yes/no)

VI. Other scheme /state package. (yes/no)

60. Whether the M.P. Fish Federation schemes or programs are being made available to fishers here?
61. What % of fishers are getting benefit from the M.P. Fish Federation schemes/programs?
62. What are the sources of information dissemination on welfare schemes?
63. What are the reasons behind not availing welfare schemes/programs?

Conflict resolution mechanisms:

64. Is there any conflict among the cooperatives? Yes/No, if Yes, then what is it & how it is managed?
65. Is there any conflict among the fishers fishing in different stretches of reservoir or in different sector of reservoir? Yes/No, if yes, then what is the reason?
66. Are there any conflict among fishers and M.P. Fish Federation or Fishers & Contractors/Marketing agents? Or among fishers and farmers downstream i.e. water for fisheries and water for irrigation?
67. Are there any legal / litigations pending / filed in courts of law among stakeholders in the reservoir?
68. How the overall management of the reservoir is carried out by the M.P. Fish Federation?

Monitoring arrangements:

69. Is mess size regulation is followed or not? If Yes, then it is followed for all fishes or for few important fishes?
70. What is the average size of fish to be caught?
71. Is closed season followed or not? Yes/No. If Yes, then
    a) Period of close season ……. (days)
    b) Close season activity ……
    c) Any support during ban period to fishers? Is it providing rice, oil, money etc.?
72. How many nets & how many fishers operate per day in reservoir (Average)?
73. What is the particular time for fishing in a day? What are the reasons in that?

74. Extent of awareness about fishing regulation? Do they comply with regulations?
75. If they do not comply with the regulations, why not?
76. Has community/co-operative society made its own rule and regulations?
77. If yes, what are the important ones related to functioning of co-op, fishing in reservoir, etc?
78. What are the problems faced by fishers in terms of overall management of reservoir, in co-operatives, fishing and fisheries, etc.?

Graduated sanctions (regulation) / DO's & DON'Ts:

79. Is there any other conservation method followed by M.P. Fish Federation/others?

ICAR-CENTRAL INSTITUTE OF FISHERIES EDUCATION, MUMBAI

"**Fishers' Livelihood and Fisheries Governance in Bargi Reservoir of Madhya Pradesh"**

Key Informants' Interview Schedule

A) Basic Information:

a) Key Informant Name: ……..

b) Occupation/Position: …….

c) Village: ……

B) Details of Reservoir:

1) **Hydrographic features of reservoir**:

S.N.	Particulars	
1.	Name of the reservoir	
2.	Name of the river	
3.	Location of reservoir	
4.	Year of impoundment	
5.	Water spread Area	
6.	Irrigation potential / command area	
7.	Area at Full Reservoir Level (F.R.L.)	
8.	Area at Dead Storage Level (DSL)	
9.	Catchment area (sq. km)	
10.	Height of the dam (in meters)	
11.	Maximum length of reservoir	
12.	Max. width of reservoir	
13.	Max. depth of reservoir (from river bed at dam)	
14.	Mean depth	

2) **Demographic features of reservoir**:

S.N.	Particulars	
1.	No. of villages on periphery*	
2.	Total population *	
3.	Total no. of fishers*	
4.	Major Fishing communities and their population* a. b. c. d.	
5.	Literacy rate 2001 or 2011 Census	
6.	Mortality rate	
7.	Major Fishing Villages (list)	
8.	Fish landing points (list)	
9.	Religion	
10.	Major occupations of people on the periphery	

**Use separate sheet if required for collecting village wise population (at least no. of households), % of fishers in each village, % of different communities, etc.*

3) Infrastructure facilities available in the reservoir periphery / region:

a) School (yes / no), College (yes / no), Health care centre (yes / no), Panchayat office, markets, any other facilities

C) Reservoir Management:

1. Fisheries governance:
   a) Owner Agency: Irrigation Dept. / Fisheries Dept./ M.P. Fish Federation?
   b) Management type: leasing / licensing / sharing system
   c) Leasing/licensing Agency & authority for fisheries: DOF / M.P. Fish Federation /Any other (Organizational chart)
   d) Since when the reservoir is under lease for fisheries?
   e) How the system has changed over the years?

2. Details of lease / license /sharing system

If leased, then

Reservoir-	**Total area (ha) ……**		
Given on Lease? -Yes -No	If 'Y' then to whom? ……, ……..	Lease Period ……	Lease Amount ……

If licensed, then

a) License fee (per person) / gear wise /craft wise

1) Angling 2) Group fishers'

4. Detailed terms and conditions governing lease or licensing?
   a) What are the terms governing lease?
   b) Role and function of DOF / M.P. Fish Federation
   c) Role / responsibilities and function of Co-operative society
   d) Rights and responsibilities of individual fisher (member & non-member)

5. Regulatory provision and conservation measurements

6. Co-operative Societies:

S.N.	**Name of the Co-operative society**	**No. of active members**	**Establishment date**
1			
2			
3			

   a) How many of the fishers fishing in the reservoir belong to co-operative societies?
   b) Why some are members and some are not members?
   c) Is there any incidence of poaching in the reservoir? If yes, who are the poachers and why are they poaching? How much of total catch is poached approx?

d) Extent of awareness about fishing regulation?
e) Do they comply with regulations?
f) If they do not comply with the regulations, why not?
g) Has community/co-operative society made its own rule and regulations?
h) If yes, what are the important ones related to functioning of co-op, fishing in reservoir, etc?

D) **Fishery requisites:**

a) Peak fishing period /season
……..
b) No. of fishing days in a year ……

1. Type of gear used by fishers for fishing

Name of gear	No. & weight of gears	No. of fishers using this gear	Approx. cost of gear / kg

2. Type of craft mostly used for fishing

No.	Type of craft	No. of craft & no. of fishers using craft	Approx. cost of craft
1	Non mechanized a) tubes b) boat/coracle c) any other		
2	Mechanized?		

3. Period of close season …….. (days)
4. Close season activity ……
5. Any subsidy from DOF/ M.P. Fish Federation/ Other for gear/boat?
6. How many nets & how many fishers operate per day in reservoir (Average)?

7. Ice procurement (Source and rate)
……
……
……
……
8. Cold Storage Facilities: 1) 2) 3)

E**) Stocking Management:**

1. Source of seed……

2. Is there any fish seed farm: Yes/No (If yes, then,)

S.N.	Particulars	Details
1	Area	
2	No. of ponds	
3	Water spread area	
4	Establishment date	
5.	Production capacity/year	
6.	Actual Production during last year	

3. Rate of seed (Rs.) – Species & size category wise:
4. Stocking size:
5. Rate of stocking (per ha): ……..
6. How many stockings done within a year: One/Two
7. Total seed required per year……
8. Who is stocking the seed in reservoir?
   i) M.P. Fish Federation ii) Contractor iii) Other

9. Provide / collect stocking details of reservoir during last 10 years (collect for previous years if available)

F) **Fish Production, Marketing and utilization pattern**:

1) Total species wise catch details of reservoir for at least last ten years (2006-15)

S.N.	**Species / Group**	**Total Catch (Kg /year)**	**External Market Sale (Kg)**	**Local Market Sale (Kg)**
1				
2				
	Total catch			

Try to collect five yearly or decadal data if yearly data is not available

2) Total gear / craft wise catch details of reservoir for at least last five years (2010-15)

S.N.	**Type of Craft**	**Total Catch (in Kg /year or in % terms)**	**Type of gear**	**Total Catch (in Kg /year or in % terms)**
1			1. Gill net	
2			2	
3			3	
4			4	
	Total catch	100%	Total catch	100%

3) Harvesting system (wage system / owner-operator fishing / any other?)

Fish Species	**Major Carp**	**Local Major**	**Local Minor**	**Others (Prawn)**
Wages/Kg				

4) Disposal pattern:

- How much of the fish (% of total catch) is locally consumed by fishers?
- How much of the total catch is sold in the market (local &outside)?

- List /name of fish market nearby village
- List major Marketing channels including % of total catch being sold in that channel:

5) How fishers sell their catch

	Yes/No	**At what price**
Community		
Co-operative society		
Local market		

Has DoF/M.P. Fish Federation has fixed any price for different species of fish or different size categories? Provide the details.

6) List of species present in reservoir and are caught

Local name	**Scientific name**	**Most abundant from (month)**	**Until (month)**	**Approx. share (%)**

G) Are women engaged in fishing?

i. Total number of fisher women:
ii. Names of the fishing activities in which fisher women are engaged
iii. Are the fisher women engaged in fishing are the registered members of cooperative societies

H) General availability of M.P. Fish Federation scheme and programs?

VII. Any welfare scheme (yes/no)
VIII. Craft and gear subsidy (yes/no)
IX. Accident insurance (yes/no)
X. Saving cum relief scheme (yes/no)
XI. Fishers housing scheme (yes/no)
XII. Other scheme /state package (yes/no)

a) Whether the M.P. Fish Federation programs are being made available to fishers here?
b) What % of fishers is benefiting from the M.P. Fish Federation programs?

I) Are fishers actively participating in the M.P. Fish Federation program?

J) What are the problems faced by fishers in terms of overall management of reservoir, in co-operatives, fishing and fisheries, etc.?