



Governability Assessment Framework as a tool for Fisheries Management in Small and Medium Reservoirs in India

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Abstract

Reservoirs are important impounded water bodies that serve multiple primary objectives like irrigation and power generation besides supporting other economic activities like fisheries and tourism. This communication discusses a governability assessment framework that can be used to assess and understand the various competing systems in a reservoir to achieve better management strategies for sustained fisheries. Fisheries is often an ancillary benefit activity in reservoirs and the agencies controlling fisheries are often dependent on other actors for its regulation. Decisions by the owner Departments have an impact on fishing activities and management of fishery is thus complex, and synergy between the agencies is primary factor for better management that supports livelihoods, which can be complimented with technical solutions to fishery related issues. The two steps in a four step assessment framework adapted is being discussed where the fisheries governance problems in reservoirs and the system properties- system to be governed; governing system and governing interactions, are presented.

Keywords: Reservoir, small, medium, governability, assessment framework, fisheries, India

Introduction

Reservoirs in India are impoundments due to construction of dams 'on a river, stream or any water course' mainly for hydro-electric or irrigation

projects and are classified as small (<1000 ha), medium (1000 to 5000 ha) and large (> 5000 ha) (Sugunan, 1995). Further small reservoirs are also classified as Category A (40-200 ha) and Category B (201-1000 ha) (NFDB). India has 19134 small reservoirs with a total water surface area of 1485557 ha, 180 medium reservoirs with total water spread of 5, 27,541 and 56 big reservoirs with total water spread of 11, 40,268 ha. Fisheries happen to be one of the several incidental benefits that accrue from reservoirs, the other being flood control, navigation, and water supply, fisheries, salinity and pollution control etc.

While the main purpose of reservoirs was not fisheries, it is an important activity which, however, depends on geo-climatic as well as topographic and physiographic factors of the reservoir. Productivity of reservoirs has seen wide variation with species being introduced ones like crabs or small quantities of native species. The fish productivity in reservoirs has increased from 50 kg ha^{-1} for small, 12 kg ha^{-1} for medium and 11.4 kg ha^{-1} for big reservoirs (Sugunan, 1995) to 190 kg ha^{-1} for small, 98 kg ha^{-1} for medium and 34 kg ha^{-1} for big (CIFRI, 2021). The potential average annual productivity has been estimated at 500 kg ha^{-1} for small reservoirs; 200 kg ha^{-1} for medium reservoirs and 100-150 kg ha^{-1} from the large reservoirs.

In this paper we look at the reservoirs using a governance assessment framework and look at how fisheries are situated in this context. We have selected one small and one medium reservoir in two southern states of the country. The small reservoir, Aliyar, from Tamil Nadu state, which has the largest number of reservoirs in the country and the medium reservoir, Malampuzha, from Kerala state which a leading fish producing state is.

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Materials and Methods

Governance is dynamic and involves several dimensions like authority, decision-making and accountability, and the system is supposed to ensure overall effectiveness of the entity and is subtle and may not be easily observable. Management is a part of governance which also has to consider other dimensions. We have based this study on the governability assessment framework by Chuenpagdee & Jentoft (2013), which was developed for fisheries and coastal systems. They have postulated a four step process in the framework, where step 1 looks at the fisheries governance problem; step 2 examines the system properties, step 3 and 4 looks at the features of and measures the governance systems and governing interactions.

The first two steps of the framework have been used in this communication to understand the fisheries governance in reservoirs in India. In step 1, we try to identify the fisheries governance problems, and in step 2, the system properties that are important factors in the 'governance problem' are discussed, which includes the system to be governed (both natural and socio-economic), the governing system and the governing interactions.

Step 1 analyses the 'fisheries governance problems'. Fisheries activities in reservoirs are managed by the State Department of Fisheries and all interventions are by this line department, and issues maybe technical or managerial. In step 2, we examine the system properties. This includes the 'system to be governed' which has a natural and a socio-economic dimension. The natural system includes the fishery *per se* and the socio-economic system includes the human dimension of the fishery as fishing rights in several reservoirs are leased out to groups or individuals. The next aspect looked at is the 'governing system' as fisheries has been an important spin off of the construction of dams which have major uses like irrigation and power generation and minor ones like tourism and fisheries. 'Governing interactions' is the last system property being examined as dams were constructed over rivers to serve multiple development goals and technically dams and reservoirs have multiple agencies as governing stakeholders.

Two reservoirs have been selected for the study, a medium reservoir, Malampuzha in Palakkad district of Kerala state in the South West of India and a small reservoir, Aliyar, in Coimbatore district in Tamil

Nadu state in the South East of the country. Malampuzha reservoir, situated in Palakkad district of Kerala, impounds the Malampuzha river, which is a tributary of the Bharathappuzha. The dam is a multi-purpose one for irrigating agricultural lands, power generation for industrial and household use, providing drinking water etc. and is the largest irrigation dam in the state of Kerala (IDRB, 2019). The Aliyar situated in Coimbatore district is a two stage structure, with an Upper Aliyar (Aliyar power house) and a lower Aliyar (Aliyar mini power house), the Upper being primarily for power production and the Lower used for irrigation, besides power generation (<https://www.tangedco.gov.in/hydrokadam.html#aliyar>). Both the reservoirs support fishing activities.

Results and Discussion

The 'fisheries governance problems' have some degree of similarity in reservoirs across the country. The fisheries activities are controlled and managed by Department of Fisheries of the respective states. The line department carries out periodic stocking, issues fishing licenses and controls the procurement and marketing which is carried out under its aegis. The fishers (individuals or groups) have no involvement in any of the above processes. Licenses are most likely linked to stocking and fishing is not open access. There is seldom any other technical intervention by the Department. Fishing in the reservoirs in both cases are still carried out using primitive techniques, for which technical solutions are available but have been sporadically implemented without any follow up schemes or programmes. Women are excluded from fishing or marketing activities in Malampuzha though in Aliyar the fishing activity is carried out by husband-wife teams. Despite stocking, production continues to be sub-optimal in reservoirs in the country. The lack of studies on the bottom and column topography that can assist fisheries management may be a reason for this, though such assessments have been carried out for sedimentation (CWC, 2019). Loss of fingerlings to natural predators is also commonly noticed. Cage culture as an option has been recently introduced and is being piloted in both the states. This could help in increasing productivity of fisheries in the reservoirs as there is better control on the stocked fish. Technological options are now available with different material and types of cages (Das et al., 2009). Fishing *per se* is drudgery filled mainly due to fishing methods being used, air-filled

tyre tubes for floatation in Malampuzha and bamboo coracles in Aliyar.

An assessment of the '**natural system**' shows that the fishery in reservoirs is based primarily on stocking with the species being fast growing carps. There are also some native species which are grouped under 'others' in the catch statistics. In Malampuzha, fingerlings are purchased on tender basis from authorized agents and introduced post monsoon. A seed farm of the Fisheries Department supplements fingerling stock and the gap also is filled by sourcing from hatcheries in states like Andhra Pradesh. Carps, tilapia, giant freshwater prawns, pearl spot, cat fish are the major species contributing to the production. The peak season for fishing is January – February and June – September, the catch from Malampuzha varied from 2.03 to 24.29 kg unit⁻¹ day⁻¹. However over the last few years the total production has been falling from 47000 kg in 2014-15 to 37000 kg in 2016-17. Constraints faced in fishing include high wind speeds making fishing challenging. There is also a difficulty in fishing also when water is released through sluice gates, as part of regulating water levels.

In Aliyar, as in Malampuzha, the fishery is mainly constituted of carps. Stocking is done by releasing fingerlings of 7 to 8 cm into the reservoir to be harvested upon reaching the marketable size of 1 kg (in about 6 months after stocking). The fries were earlier procured for stocking from another reservoir in the state, Bhavanisagar and reared in nursery tanks. At present, a fish seed farm is located at the dam site which is operated by the TNFDC (Tamil Nadu Fisheries Development Corporation) which meets the stocking requirements now (<https://www.fisheries.tn.gov.in/TNFDC>).

The '**socio-economic system**' is related to the fishers and their livelihood. In Malampuzha, fishermen are organized under SHGs and fishing is done by 8 groups (a total of 114 fishermen, 80 of whom are active). Only men go fishing, which is carried out without any craft. They tie an inflated rubber tube around their waists which allow them to remain afloat while paddling through the reservoir (Pravin et al., 2014), where they set gillnets ranging from 32 mm to 300 mm mesh sizes (about 14 different meshes are used depending on the size of the fishes to be harvested). Fish that are caught are deposited in plastic bags that are carried along. This severely

restricts the volume of fish that can be brought ashore. Two types of nets are used; one which is operated in upper water column and the gear is usually fabricated with nylon multifilament with thermocol pieces as floats and having no sinkers, which the fishermen refer to as 'net'. The other is operated in the lower water column and is called '*uduvala*' locally and is made of nylon monofilament and has plastic floats and lead sinkers. Costs of gear vary from INR 5000-6000. The fishermen usually set their gear at about 3 pm in the afternoon working for about 2 to 3 h and haul the gear between 5 and 6.30 am the next day. Most fishermen stay within 1 to 3 kms from the dam site and access the reservoir on foot. Small indigenous varieties are caught in gear with mesh sizes of 32 and 36 mm. A perennial issue with fishing in reservoirs is the occurrence of tree stumps which tend to damage gear. The smaller mesh sized gears are usually operated in the upper water columns and so have less chances of getting damaged. Fishermen 'sell' their catch to the sale counter which is managed by the Department of Fisheries. The fish caught is procured by the Department of Fisheries at fixed prices. For example rohu is priced at Rs. 120, mrigal and catla at Rs. 100, tilapia at Rs. 150. The indigenous pearl spot fetches Rs. 350. Small native species fetch an average 80-100 per kg. To reach the sales counter fishermen either walk or use a bike. Sometimes a group of fishermen get together and hire a mini-van. About 25% of the sales revenue goes to the Department of Fisheries, which uses the funds to source fingerlings for stocking the reservoir and to run the sales counter. Consumers, who include local traders, buy the fish directly from the counter. Local traders then sell this in peripheral areas and the marketing chain may extend anywhere from 7 kms (Palakkad town) to 32 km (Alathur) away.

There are ten fishing units operating in Aliyar reservoir. Each unit is a husband and wife team and they fish using coracles and multi-filament gill nets of size ranging from 120 to 210 mm mesh size for harvesting IMCs and other species like tilapia and barbs in the reservoir. All the fishers are migrants from villages in Salem (about 220 kms away) and Erode districts (about 150 kms away). They have been fishing in the reservoir for the past 30-35 years and are all from the fishermen community. Living in make shift dwellings around the reservoir a majority of the fishermen are above 50 years of age with minimum levels of education. These fishers enjoy exclusive fishing rights at Aliyar and operate

under the control of TNFDC (Tamil Nadu Fisheries Development Corporation). Fishing crafts are bamboo and, of late, FRP coracles and gear are nylon monofilament gillnets of various mesh sizes ranging from 110 to 300 mm. Mesh size of 300 mm is used when the water level is full during September-October months and smaller mesh sizes like 55-60 mm are also used occasionally to catch native fishes during the rains. Fish catch varies between 10 kg to 20 kg per fishing unit and the family income varied from Rs.800 to Rs.1600 per day (Gowsalya et al., 2020). The gear is set by about 6 pm in the evening (starting 4 pm) and retrieved the next day at about 6-8 am. For the past decades the fish productivity in this reservoir has been about 100 kg / ha/ year, and to increase unit productivity floating cages have been piloted. The oars of the coracles are deposited at the TNFDC office and collected daily when fishing commences. This is one way for the TNFDC to keep track of the fishing activity, along with maintaining a record of the daily catches. The sales counter at TNFDC is open to the customers from 10-11 am every morning and the fishers help in cleaning the fish that has been sold. The price of the fish and share of fishermen are fixed by the TNFDC based on grading of fishes. The total revenue is shared by the Fishermen and TNFDC in a 6:4 ratio. The local consumer demand of fresh reservoir fish is met through TNFDC sales outlet and the unsold catch is sent to the places like Pollachi, Tirupur and Coimbatore outlets of the TNFDC. The Corporation also provides credit for the purchase of gear and for their repair and maintenance and for maintenance of coracle. This is generally adjusted against their daily catch revenues. The socio-economic conditions of the fishers however continue to be poor (Chandrasekar et al., 2020).

Though the contribution of reservoirs to the fisheries production of the country is still not very significant, there is still a lot of potential. An assessment of the '**governing systems**' of the reservoirs for fisheries is important to evolve policies for bringing in further improvement in fish production and also positively impact the livelihoods of reservoir dependent fisher families. Several fishery management systems have been observed in reservoirs (Sugunan & Sinha, 2000) from private ownership to completely state managed, basically with reference to the leasing policies – either to private individuals or to groups or cooperatives. The reservoir fisheries activities examined in this study, are managed by the respective State Fisheries

Departments. This is done either directly by the Department as in the case of Malampuzha or through another body under the Department as was seen in Aliyar (the TNFDC). The state governance structure generally is top-down and all decisions regarding management are taken at the top levels, which included sourcing of seed/ fingerlings, stocking the reservoir, issuing licenses to fish, and controlling marketing activities. The actual fishers are decision-takers with no control either over the resource they harvest or the catch they sell. Though the stated fundamental objective of the Department of Fisheries is to see that fish production from reservoirs is increased, the only strategy so far has been the annual stocking. That the dependent fishers have not really benefited much is also evident from the fact that there has been no much change in their socio-economic status over the years. In Malampuzha the system to allocate the fishing rights to the local cooperative society has been practiced from almost the very beginning and all fishers are members of the local SC/ST Fishermen Cooperative Society. In Aliyar, till about 2014, the fishing was done directly by the licensed fishing units under the control of TNFDC, after which for a few years annual fishing rights were leased to a private party (through tender) who had to do the management including stocking. This was later repealed and the management is back with the TNFDC.

'**Governing interactions** are also complex in reservoirs. The dam structure is generally under the Public Work's Departments (PWD) of the states. They are responsible for overseeing construction and look after maintenance of the dams and are the main focal point with which other departments work in tandem. The irrigation related activities are taken care of by the Irrigation Departments and the energy related activities like power generation and supply, by the Electricity Department (or Boards). There is also a central agency Central Water Commission under the Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti of the Government of India that carries out reservoir monitoring and updates on its website information on the storage status of the reservoirs.

The dam owner in Malampuzha is the Irrigation Department, Government of Kerala, and 'is responsible for all dam operation and maintenance', including preparedness and emergencies and has a plan including land, recreation, fish and wildlife

(O & M Manual for Malampuzha Dam, 2019). In the case of Aliyar, the dam (and reservoir) is with the Tamil Nadu Public Works Department, Water Resources Organisation, Government of Tamil Nadu, which owns 85 dams and reservoirs in the state. There are 38 other dams which are under the Tamil Nadu Electricity Board, the waters of which also flows into the reservoirs managed by the irrigations department (like the Aliyar system which has two dams). Based on the river basins, four regions were formed and the Aliyar reservoir is under the control of the Chief Engineer, WRO, PWD, Pollachi Region, Coimbatore. Besides this there are five functional units to undertake special activities like plan formulation, data, design research and construction support, operation and maintenance etc. Fisheries in Malampuzha is *per se* dependent on the decisions of the power and irrigation sectors as far as when fishing is allowed, though fisheries is mentioned as one of the purposes of the reservoir but are managed by the Department of Fisheries. In Aliyar the management of fisheries rests with the TNFDC.

Fisheries are one of the several ancillary economic and livelihood activities in a reservoir which has multiple stakeholders and multiple control points. While the owners of the dams control all operation and management, fisheries itself is controlled by the fisheries departments (either directly as in the case of Malampuzha or through the TNFDC as in Aliyar). Since the main purpose of both the reservoirs studied is irrigation, it is the agricultural calendar that decides the regulation of water in the reservoirs. In cases where there is a potential risk, like when there is heavy rainfall warranting opening of the sluice gates, fisheries activities may cede altogether. In effect fisheries activities should in no way impede the other activities in the reservoir. Especially since the fisheries in reservoir depends heavily on stocked species, sudden action by the PWD to open the dam gates in case of flood threat, leads to escapement of stocked carps which affects the catch severely.

Though immense potential exists for increasing fish production this has not been possible mainly because of these factors. In addition, waters impounded in reservoirs are often in areas which have been forest lands or areas which have been residential like villages. Stumps and remnants of the structures below often pose impediments on the use of fishing gear like gill nets, which have been introduced, in reservoirs. This can reduce the productivity of reservoirs even though stocking is

done. Stocking is undertaken by the department of fisheries of the respective states. Though some control on fishing happens through licensing/permissions, poaching is a perennial problem along with loss due to natural predators. The policy on fishing implements is in variance too in different reservoirs as observed, where in Malampuzha fishing boats are not allowed to be operated and in Aliyar they are still operating traditional coracles. The socio-economic conditions of the fishers in these reservoirs have also been low even though they have been fishing for decades. That the governance system is complex is clear and so will require a fine balancing act to get the point across. The limits of governability can be a pointer in the adjustment to make (Chuenpagdee & Jentoft, 2009) and so once we realize that fisheries development is restricted by the issues in governance ways may be found on how that the department needs to be proactive in leveraging with the other stakeholders in pressing for the cause of fisheries development and increased fish production in reservoirs in the country. Several studies on how the yield from reservoirs can be increased have been carried out, however as we have seen the major factor seems to be governance and not requirement of technical solutions, and a more holistic approach is required for reservoir fisheries to be really effective and contribute to enhanced fish production as well as improve livelihoods of people dependent on it.

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