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Assessment of fish stock supplementation for sustainable production from reservoirs of Tamil Nadu state, India

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Abstract – Indian reservoirs offer tremendous scope but fish production remains below potential. The present study evaluates the effectiveness of fish seed stocking on the yield of 62 reservoirs of Tamil Nadu, India during 2011–2020. The results indicate that all large (>50 km^2), 64.1% of the medium (10−50 km^2) and 50.7% of small (<10 km^2) reservoirs are under-stocked with less than <50% of the recommended stocking density. The stocking efficiency was found to be lowest in large (0.05), medium (0.11) and highest in small reservoir (0.26). The regression analysis showed significant positive associations between stocking density and yield in small (R^2=0.05), medium (R^2=0.31) and negative in large (R^2=0.008) reservoirs. The mean annual yield during the studied period was highest in small (137 kg ha^{-1} yr^{-1}), followed by medium (86.64 kg ha^{-1} yr^{-1}) and, large (46.1 kg ha^{-1} yr^{-1}) reservoirs. The study indicated that insufficient availability of fingerlings and inconsistency in the seed quality as the major stumbling blocks in achieving the estimated production potential. It is suggested to improve the hatchery facility, adoption of enclosure culture for rearing fish fingerlings, creating awareness among the stakeholders to optimize the fish production from these resources and also for ensuring improved livelihood of the fishers dependent on this sector. This is the first long-term, state level evaluation of reservoir stocking in Tamil Nadu, complementing past national studies. These findings highlight the importance of optimal stocking density, advanced fingerling use, and cooperative-based management for sustaining fish production and fisher livelihoods in Tamil Nadu.

Keywords: Culture-based fisheries / stock enhancement / impact of stocking / inland fisheries / reservoir / major carps

1 Introduction

Reservoirs in India are the most important inland fisheries resources due to their large size and immense production potential. These resources are gaining attention for future development plans in India to meet nutritional and livelihood security (De Silva, 2016) which can be achieved only through implementation of scientific technologies and suitable governance in place. In developing countries, fisheries enhancement through fish seed stock supplementation is a dominant practice for enhancing fish production in reservoirs (Cowx, 1994; Quiros and Mari, 1999; Khan et al., 2015; Roy, 2019; Sarkar et al., 2020). Fisheries management strategies vary with the size of the reservoir. In India, reservoirs are classified into small, medium, and large categories based on their surface area to enhance management efficiency. In small reservoirs (<10 km^2), culture based fisheries (CBF) is practiced, where fishes are stocked in the water bodies, allowed to grow up to the table size before being harvested (Sugunan, 2000; Sugunan and Katiha, 2004; Chandrasoma et al., 2015). In large (>50 km^2) and medium (10–50 km²) reservoirs, Stock or Species Enhancements (SE) and enclosure culture practices are being practiced, where fishes are stocked, allowed to breed, for enabling the development of breeding population and stock (Sugunan, 1995; Amarasinghe, 1998).

Stocking fish seeds in reservoirs is a part of the management strategy practiced in Indian reservoirs. However, a systematic approach based on research is needed to enhance the fish production in a sustained way. Indian major carps (IMCs – *Labeo catla, L. rohita, Cirrhinus mrigala*), and the exotic carps (*Cyprinus carpio* and *Ctenopharyngodon idella*)

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stocked in the reservoirs contribute to the major landings in inland fish catch as reported by ICAR-CIFRI (2016 and 2020). In 2004, ICAR-CIFRI has also conducted an extensive impact assessment study on the fish seed stocking for 2300 reservoirs in India which revealed a positive impact of stocking on the fish yield (Katiha, 2004). FAO, 2024 report indicates an increased productivity in the recent times through adoption of refined management protocols.

Tamil Nadu, the southern state in India is an important economic and political part of India and has a well established state fisheries department in the country established in 1907 with a vision of safeguarding the traditional fishing rights and well being of the fishers of the state. Other than the Department of Fisheries, Government of Tamil Nadu, the state has other corporate body, the Tamil Nadu Fisheries Development Corporation (TNFDC) that aims to facilitate the infrastructure development for fish production, marketing and management efficiency of freshwater resources. The state being situated behind the mighty Western and Eastern Ghats in the rain shadow area remains semi-arid and dry. However, there are numerous productive reservoirs in the state. The state has a total of 3700 km^2 of water spread area of inland resources suitable for fish culture or enhancement. According to the statistics, there are 54 small, five medium, and three large reservoirs covering an area of 62,015 hectares. The inland fishermen population dependent on these resources for their livelihood is 2.36 lakhs. Among them 88,178 fishers are registered under 415 Fishermen Cooperative Society and actively involved in fishing (DoF, 2024).

Several national-level studies have assessed the impact of fish stocking on reservoir fisheries in India (Sugunan and Katiha, 2004; Sarkar and Mishal, 2017; Sarkar et al., 2018); however, systematic evaluations for Tamil Nadu reservoirs at the state level remain limited. Tamil Nadu has the highest number of reservoirs compared to other states in India (FAO, 2024) and many of these reservoirs are effectively managed by strong cooperative societies. Such cooperative movements play a vital role in the sustainability of the fisheries and the overall welfare of the fishers. Since the state has 62 reservoirs which are stocked with fingerlings, an investigation was conducted to analyze the impact of seed stocking to develop appropriate management guidelines for the state. A wide review of the literature shows that no systematic studies were conducted in recent years in Tamil Nadu reservoirs to evaluate the stocking impact on fish yield in the reservoirs. To develop reservoir fisheries, for enhancing fish production, scientific information on the effect of seed stock supplementation is important. This will help the policy makers and managers in upgrading the decision making processes for sustainably increasing the production using the technological applications. With this objective, the present investigation was undertaken to scientifically evaluate the effect of fish seed stock supplementation on fish yield from the 62 reservoirs for systematically managing the reservoirs in the state of Tamil Nadu, India. We hypothesize that fish seed stocking significantly enhances fish yield and that stocking efficiency will vary according to the size of reservoirs. Specifically, we expect that small reservoirs will show higher stocking efficiency than medium and large reservoirs due to their favorable ecological and management conditions.

2 Method

The reservoirs in Tamil Nadu follow the guidelines of the National Fisheries Development Board (NFDB), which recommend a stocking density of 2,000 fingerlings ha^{-1} yr^{-1} for small reservoirs under culture-based fisheries, 1,000 fingerlings ha^{-1} yr^{-1} for medium reservoirs, and 500 fingerlings ha^{-1} yr^{-1} for large reservoirs under stock enhancement practices, using fish fingerlings of 30−100 mm size. The relationship between fish seed stocking and production from Tamil Nadu reservoirs represents a sustainable resource management approach. To analyze the impact of stocking on fish yield, data on fish catch and number of fish seeds stocked were collected from the Department of Fisheries (DoF), Government of Tamil Nadu. A systematic questionnaire was prepared to collect the basic information on the guidelines followed for management of reservoir fisheries from various stakeholders including the fishermen.

A detailed record on the annual fish catch data for the period, 2011 to 2020 was collected from the DoF to study the yield (kg ha^{-1} yr^{-1}) and per capita fish production (kg $fisher^{-1}$ yr^{-1}). In addition to the official data recorded, structured questionnaires were prepared and provided to reservoir fisher cooperatives (n=30) to gather supplementary information on stocking practices, harvest methods, leasing policies, and governance. This helped in recording any inconsistencies in reporting, and also in modifications of the management practices.

Among 62 reservoirs in Tamil Nadu, 54 reservoirs are under the control of the DoF, Government of Tamil Nadu and eight are under the control of Tamil Nadu Fisheries Development Corporation (TNFDC) for effective management of fisheries and to augment the inland fish production in the state. Majority of the reservoirs managed by the DoF are being leased out. The State Government has 42 fish seed rearing centers supplementing fish fingerling production. A total of 70.8 million quality fish fingerlings of the IMCs have been reared and supplied to various agencies during 2019–2020 to stock the reservoirs. In most of these reservoirs, fishing rights are given to fishermen and record of catch data is managed by the DoF, Tamil Nadu.

Based on Government of India classification, the reservoirs are categorized into small (<1000 ha) medium (1000 to 5000 ha) and large (>5000 ha). The DOF has further categorized the small into small category (SC), SC 1 (>500 ha), SC 2 (100–500 ha) and SC 3 (<100 ha) for the smooth management of fishery resources. The relationship of reservoir area with fish yield, stocking density and efficiency of stocking were derived using linear regression models. Stocking efficiency was calculated as the ratio of annual fish yield (kg/ha/yr) to stocking density (nos./ha/yr), following Sugunan and Katiha (2004). Model effects are presented as rate ratios, which indicate the proportional change in the response variable for a one-unit increase in the predictor. A rate ratio greater than 1 indicates an increase in the response, whereas a value less than 1 indicates a decrease. To test multicollinearity among predictor variables (reservoir area,

Table 1. Range (minimum-maximum) of physico-chemical and nutrient parameters recorded in the reservoirs of Tamil Nadu.

Habitat parameters	Reservoir's Category		
	Large	Medium	Small
Transparency (m)	0.52–1.07	0.2–0.83	0.15–2.2
Water Temperature (°C)	21–29.8	24.1–34.8	25.0–31.5
Sp. conductivity (µS/cm)	119.08–487.35	962–1304	227–1361
pH	6.81–9.60	7.42–11.4	6.2–8.9
Dissolved Oxygen (mg/l)	4.24–13.04	3.29–11.4	4.8–9.6
Alkalinity (mg/l)	97.83–157.5	178–246	16–294
Total hardness (mg/l)	33–132	148–320	12.2–154
NO_3^-(mg/l)	0.004–0.029	0.11–1.7	0.10–1.6
PO_4^{3-} (mg/l)	0.01–0.03	1.2–2.45	0.04–1.8

stocking density, yield), we applied the Variance Inflation Factor (VIF) test using R software. Values were below three indicated acceptable levels of collinearity (VIF range 1.2–2.7). The efficiency of fish seed stocking was calculated based on the proportion of fish yield and stocking density (Sugunan and Katiha, 2004). The correlation between area, stocking density of seed, fish production and efficiency of stocking of different size group of reservoirs were analyzed using correlation analysis (Pearson's).

Habitat parameters were collected for few reservoirs (two large, five medium and 20 small reservoirs) during the study. The water quality samples were taken during pre-monsoon, monsoon and post-monsoon season in the different zones such as littoral and limnetic zone in the early morning hours. The parameters such as temperature, pH, dissolved oxygen and specific conductivity were assessed using a computerized Multiparameter Water Quality Instrument (YSI Professional Plus). A Secchi disc was used to measure transparency at the sampling site. Water samples were also taken laboratory for analyzing alkalinity, hardness, nitrate-nitrogen (nitrate-N), and phosphatephosphorus (phosphate-P). The analyses of water quality parameters followed a standard methodology (APHA, 2012). Fish catch data were validated with the data collected by the DoF through series of discussions with members of various cooperative societies and stakeholder consultations. This multi-source approach ensured both temporal consistency and ecological relevance in evaluating the impact of stocking on fish yield. R.4.5.2 software was used to conduct the statistical analyses (R core Team, 2025).

3 Results

3.1 Habitat characteristics of reservoirs

The water quality parameters for various categories of reservoirs are shown in Table 1. Based on the water quality parameters, the reservoirs in Tamil Nadu were found to be suitable for adopting fisheries enhancement practices. The dissolved oxygen (DO) levels across all reservoir categories ranged from 3.29 to 13.04 mg l^{-1}, indicating generally well-oxygenated conditions suitable for fish growth and survival. Particularly, small and large reservoirs maintained DO mostly above 4 mg l^{-1}, which is considered optimal for fisheries. Medium reservoirs recorded the highest phosphate-phosphorus (PO_4^{3-}) concentration (1.2−2.45 mg l^{-1}), indicating relatively higher nutrient enrichment and eutrophic tendencies. In contrast, water transparency was consistently low across all categories (0.15−2.2 m), with the lowest transparency observed in medium reservoirs (0.2−0.83 m), reflecting high planktonic productivity and suspended solids. These conditions explain the overall suitability of Tamil Nadu reservoirs for fisheries enhancement.

3.2 Fingerling stocking in reservoirs

The study conducted during 2011–2020 showed that the reservoirs in Tamil Nadu are stocked with IMC seeds (ranging from 20−100 mm) during July – September. In Tamil Nadu, 44.62% of reservoirs are stocked with more than 1000 nos./ ha. A total of three large (Mettur, Bhavanisagar and Veeranam), five medium (Poondi, Sathanur, Vaigai, Pechiparai and Krishnagiri) and 54 small reservoirs were studied during the investigation. The study showed that all the large and 64.1% of the medium reservoirs are under-stocked with less than 500 seeds/ha. In small reservoirs, 50.69% are stocked with 1000 nos./ha, as against the required rate of 2000 nos./ha. It was observed that only 6.4% of the small reservoirs are stocked with recommended stocking density. The major fishing craft used in most reservoirs is the coracle, a small traditional Indian fishing craft made of bamboo or Fiber Reinforced Plastic (FRP), commonly used for inland fishing. Gill nets are the widely used fish catching gear, even though other gears like cast net, drag net, hook and line are also in use.

3.3 Fish production

The analyses of data on fish catch from 62 reservoirs revealed that the total fish production of stocked fishes varied from 0.04 to 1719.5 kg ha^{-1} yr^{-1} with a mean value of 97.28 kg ha^{-1} yr^{-1}(Tab. 2). The analysis of stocking efficiency was found to be high in small reservoir (0.26) followed by medium (0.23) and small (0.11) reservoirs. The maximum fish production was obtained during 2015–16 with a yield of 4123.74 tons, and the stocking (26.7 millions) was high during the previous year, 2014–15. The trend of the stocking density and fish yield is presented in Figure 1. The fish yield was maximum near the urban areas of Krishnagiri district (1664.27 kg^{-1} ha^{-1} yr) due to high eutrophication in the

Table 2. The relationship between stocking density, area, fish yield and stocking efficiency of different size group reservoirs.

Category of reservoirs	SD (No. ha^{-1} yr^{-1})	Y(kg ha^{-1} yr^{-1})	SE	r (SD Vs Y)	r (A Vs Y)	r (A Vs SE)
All reservoirs	19.81–8196.7	0.04–1719.51	0.0002–5.31	0.234	−0.691	0.034
Large	22.62–725.28	3.769–98.188	0.025–0.27	−0.091	0.459	0.001
Medium	19.81–1000	5.261–452.516	0.010–0.891	0.512	−0.371	−0.008
Small	27.86–8196.72	0.040–1719.51	0.010–1.928	0.224	−0.092	−0.038
SC-1	27.86–1585.71	0.192–362.82	0.0003–0.695	0.289	−0.255	−0.261
SC-2	82.8–500.8	0.040–1719.51	0.0002–1.685	0.318	0.006	0.033
SC-3	100–8196.7	0.333–680.49	0.0005–1.928	0.260	0.010	0.024

Stocking density- SD, Stocking efficiency- SE, Yield- Y, Area- A, r- correlation coefficient, SC1- small category I, SC2- small category, II; SC3- small category III.

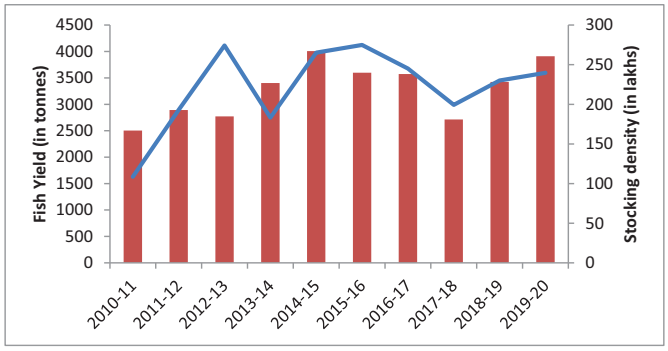

Fig. 1. Trend of total stocking density and total fish yield across 62 Tamil Nadu reservoirs (2011–2020).

reservoirs and minimum in the rural areas of Kanyakumari district (44.21 kg/ha/yr) as the reservoirs are under the oligotrophic category (Fig. 2).

A summary of the linear model statistics relating area, fish yield, stocking and efficiency of stocking are given in Table 3. Based on the area of the reservoir, the relationship between stocking density and fish yield showed a significant positive trend with the exception of large reservoirs (Supplementary Figs. 1–3). There was a significant positive correlation between fish yield and stocking density among the various categories (SC1, SC2 and SC3) of small reservoirs (Supplementary Figs. 4–6). The association between stocking density and yield of the reservoirs in Tamil Nadu showed positive trend with significance (Supplementary Fig. 7). The stocking density and area of reservoir, showed significant ($p<0.05$) relationship but exhibited a negative trend in the scatter plot (Supplementary Fig. 8) whereas fish yield and area were insignificant (Supplementary Fig. 9). The relationship between stocking efficiency with fish yield showed significance ($p<0.05$), while the scatter plot showed slight positive trend (Supplementary Fig. 10). The study showed that the size of reservoir has a direct positive impact on the fish yield and stocking efficiency. R^2 values were generally low (<0.10 for overall area-yield models), indicating that yield variability is also influenced by unmeasured ecological and management drivers.

The correlation coefficient for area and stocking efficiency showed weak positive relationship, whereas the relationship between area and fish yield showed weak negative correlation. Also, the stocking and fish yield showed a weak positive correlation. Based on the size of the reservoirs, the relationships are given in Table 3. The area of the reservoir did not have any impact of stocking on fish yield.

4 Discussion

Reservoir fisheries in India have long relied on stocking as a key management intervention to enhance fish production, and its positive impact has been demonstrated across diverse states and reservoir categories. The national level studies have reported yield improvements from 20 to over 300 kg ha^{-1} yr^{-1} following stocking interventions (Sugunan, 1995; Sarkar et al., 2020, Alam et al., 2021). In small reservoirs, CBF are mainly adopted along with species diversification, species enhancement which commonly followed in medium and large reservoirs for increasing the fish production in Tamil Nadu. The present investigation on 62 reservoirs reveal distinct production trends, with small reservoirs showing comparatively higher stocking efficiency and yields, while medium and large reservoirs remain constrained by under-stocking and ecological limitations with regard to their ecological potential. This reinforces the need for state-specific evaluations that consider both ecological constraints and cooperative-based management practices shaping stocking outcomes.

4.1 Stocking-yield relationship

Stocking has been widely recognized as a driver of reservoir fishery enhancement in India, though realized yields remain below potential. The changes in the proportion of yield determine the success of any stocking program (Sugunan and Kaitha, 2004). Long-term national assessments indicate that stocking interventions increased fish yields in 2,300 reservoirs across 21 states from 20 to 110 kg ha^{-1} yr^{-1} (ICAR-CIFRI, 2017), while the production potential was estimated at 500 kg ha^{-1} yr^{-1}, leaving a gap of 326 kg ha^{-1} yr^{-1} (Sarkar and Mishal, 2017). Similarly, the present study clearly demonstrate that fish stocking has a positive influence on reservoir yield in Tamil Nadu, although the strength of the relationship varies across reservoir categories. Regression analyses revealed significant associations between stocking density and yield, particularly in medium reservoirs (R^2=0.31), but the overall explanatory power remained low (R^2=0.0047 for area-yield models). This suggests that stocking density alone explains

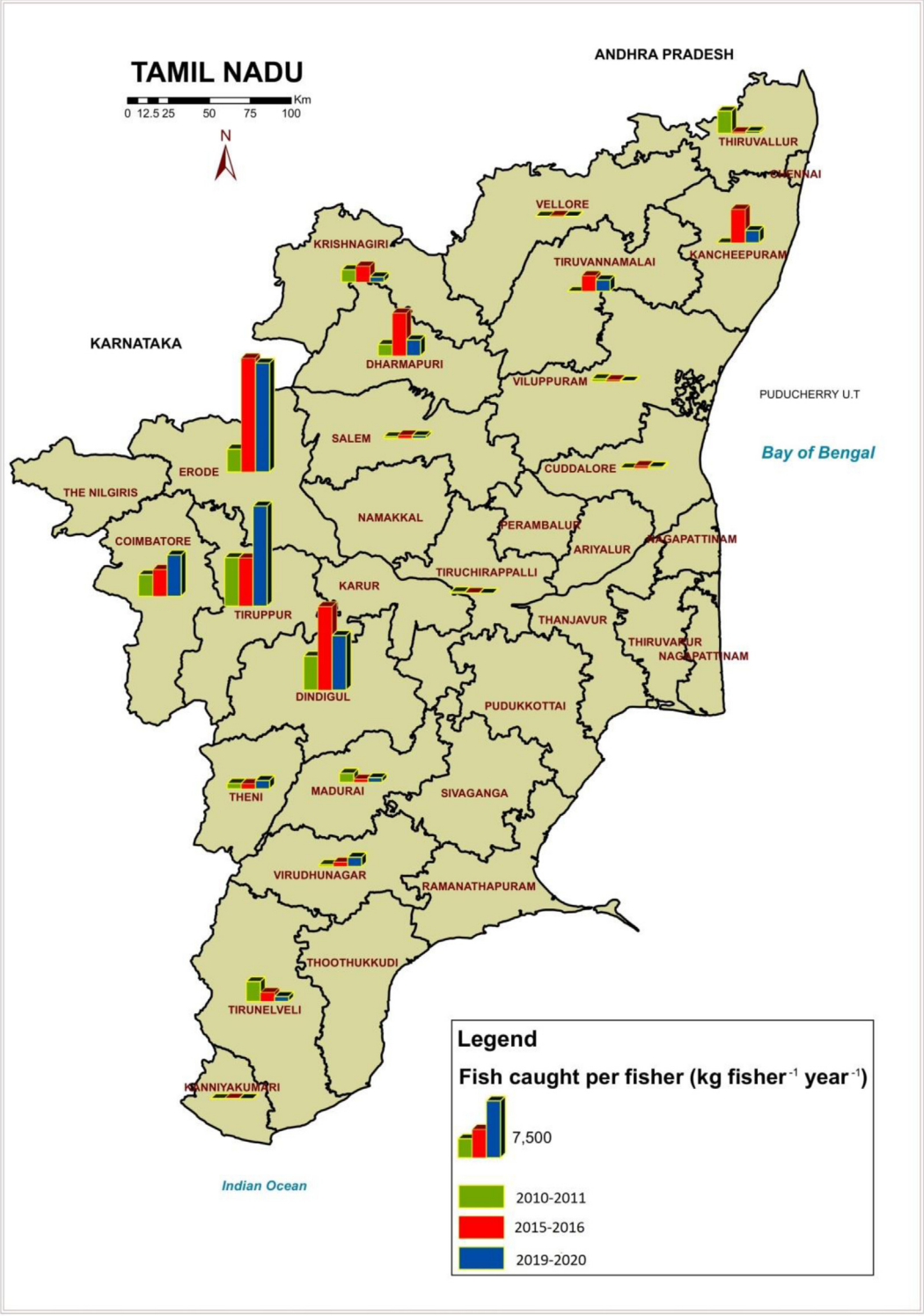

Fig. 2. Fisher per-capita catch (kg/fisher/yr) across districts of Tamil Nadu, based on recorded yield and fisher numbers.

only a small fraction of the variability in yield, with additional ecological drivers such as nutrient status, seed quality, and water-level fluctuations playing important roles (Saha et al., 2021a; Ramya et al., 2021). The limited explanatory power is therefore not a weakness of the dataset but rather a reflection of the multifactorial nature of reservoir fisheries production. While this confirms earlier national-scale observations (Sugunan and Katiha, 2004; Sarkar et al., 2020), the present study contributes novel insights by quantifying category-specific relationships for Tamil Nadu reservoirs and highlighting the differential efficiency of stocking across small reservoirs (SC1, SC2, and SC3). The present study extends

Table 3. Regression parameters describing the effects of reservoir area and stocking density on fish yield and stocking efficiency based on Gamma generalized linear models.

Relationships	Intercept	RateRatio	$R-$squared	$p-$value
AS<-lm (Area~Stocking)	6.8657	0.9999	0.0099	0
AY<-lm (Area~Yield)	4.6242	0.9999	0.0015	0.0835
SY<-lm(Stocking~Yield)	3.6385	1.0009	0.0166	0
AE<-lm (Area~Efficiency)	−1.9287	1.0004	−0.0934	0.0015
L<-lm(StockingL~YieldL)	3.9739	0.9995	0.001	0.4901
M<-lm (StockingM~YieldM)	3.8524	1	0	0.9704
S<-lm(StockingS~YieldS)	3.6473	1.0009	0.0144	0
SC1<-lm(StockingSC1~YieldSC1)	4.0318	1.0006	0.0064	0
SC2<-lm(StockingSC2~YieldSC2)	2.8062	1.0028	0.0087	0.0335
SC3<-lm(StockingSC3~YieldSC3)	1.7112	1.0069	0.0151	0.5248

The relationship of overall Tamil Nadu reservoirs AS- area and stocking; AY- area and yield; SY- stocking and yield; AE- area and efficiency, L- large reservoirs; M- medium reservoirs; S- small reservoirs; SC1- small category I; SC2- small category II; SC3- small category III.

this evidence by showing that across 62 reservoirs, stocking efficiency was highest in small reservoirs (0.26), moderate in medium reservoirs (0.11), and lowest in large reservoirs (0.05). This category-wise analysis provides new insights into the variability of stocking outcomes under different ecological and management contexts. These findings are consistent with Sugunan and Katiha (2004), who reported that stocking in small reservoirs of Andhra Pradesh yielded higher efficiencies than in medium or large ones, largely because smaller systems are more amenable to management and exhibit reduced risks of predation, competition, and under-reporting of catch.

In Tamil Nadu, earlier case studies also documented substantial yield enhancement following stocking, for instance in the Aliyar Reservoir where fish yield increased from 26.7 to 136 kg ha^{-1} yr^{-1} (Selvaraj et al., 1990). Similar positive outcome of stocking on yield were also documented from reservoirs of other Indian states. The fish yield increased from 25.85 to 323 kg ha^{-1} yr^{-1} in Odisha (Sarkar et al., 2020); 310 to 889 kg ha^{-1} yr^{-1} in Jharkhand (Sarkar et al., 2017); Chhattisgarh (48–159 kg ha^{-1} yr^{-1} (ICAR-CIFRI, 2017); 1.5 to 5.3 kg ha^{-1} yr^{-1}) in Arunachal Pradesh (Sharma and Suresh, 2013); 116 to 197 kg ha^{-1} yr^{-1} in Karnataka (Rao et al., 2013), 6–290 kg ha-1 yr-1 in Andhra Pradesh (Sugunan and Katiha, 2004). Positive impact of stocking was reported from some of the south East Asian countries, Srilanka reporting an increase of 263% in 15 perennial reservoirs (Pushpalatha and Chandrasoma, 2010). Stocking in Vietnam's reservoirs has been shown to substantially enhance fish production, with DongMo and SuoiHai reservoirs yielding notable increases that translated into favorable cost-benefit ratios of 5.38 and 7.75, respectively (Nguyen et al., 2005). The average fish yield in small reservoirs (137 kg ha^{-1} yr^{-1}) is approximately 197% higher than that of large reservoirs (46.1 kg ha^{-1} yr^{-1}), highlighting the pronounced productivity contrast and management effectiveness at smaller scales.

4.2 Ecological constraints

The fish yield is not only dependent on the stocking density, but also on other factors like natural productivity, seed quality, water level, diversity of native fishes, recruitment of exotic species and ecological niche (Piska and Rao, 2005; Ramya et al., 2021). While stocking density is a key determinant of yield, ecological conditions strongly modulate the outcome. The water quality from the reservoirs of Tamil Nadu during 2018–2020 highlighted marked trophic variability. Small reservoirs in Tamil Nadu often showed eutrophic tendencies, (Saha et al., 2021b) and such conditions could enhance primary productivity contributing to relatively higher yields compared to the low yield in large reservoirs which are mesotrophic in nature.

Another ecological constraint is the mismatch between stocked species and the prevailing trophic regime as reported by Lorenze, 1995 and Sarkar et al., (2020). IMCs, the most important fish group in stocking programs of the state, feed predominantly on zooplankton in the reservoirs of Peninsular India, however these reservoirs are characterized by high phytoplankton production (Panikkar et al., 2024). Addressing this constraint may require diversification of stocked species to include filter feeders (IMCs) better suited to phytoplankton-rich habitats, or a shift towards advanced fingerling stocking to enhance survival and growth. Further, the low production could also be attributed to the size at stocking as the survival rate of small sized seeds is less compared to the large size, due to the predation effect (Alam et al., 2021).

4.3 Socio-economic implications

Reservoir fisheries in Tamil Nadu are not only ecological systems but also socio-economic lifelines. The state has 0.24 million fishers, of which 88,178 are members of 415 reservoir cooperatives. The present analysis revealed significant disparities in fisher-level yield, ranging from as low as 44.2 kg fisher $^{-1}$ yr^{-1} in oligotrophic reservoirs to over 1600 kg fisher $^{-1}$ yr^{-1} in eutrophic reservoirs of the state. Such variation underscores the uneven distribution of benefits and the critical role of management in ensuring equity.

Stocking programs have historically been implemented through cooperative societies in Tamil Nadu, which manage leasing, stocking, and harvesting. The success can be achieved through efficiently managing the reservoirs fisheries by implementation of optimal fingerling stocking, closed fishing

season, mesh size regulation and restricted harvesting. Socio-economic benefits of reservoir fisheries have been documented in Sri Lanka, where carp stocking led to improved fisher incomes through organized cooperative systems (Wijenayake et al., 2015). Similarly, DoF, Tamil Nadu can improve the livelihood of the fishers through increased fish production by active participation of the cooperative society in participatory mode to manage the resources.

At the same time, limitations in fingerling availability and variability in seed quality constrain production. Understocking was observed in more than 64% of medium and all large reservoirs in this study, directly affecting yields. Expansion of hatchery infrastructure and promotion of enclosure culture for fingerling rearing could bridge this gap, while training fisher cooperatives in seed handling and release strategies would further enhance outcomes.

4.4 Policy relevance

The findings of this study have direct implications for reservoir fisheries policy in Tamil Nadu and beyond. The identification of under-stocking as the primary constraint, coupled with the documentation of ecological and socioeconomic factors shaping efficiency, provides a robust evidence base for tailored management. Policy interventions should prioritize scaling up fingerling production and promoting the use of advanced fingerlings (>120 mm) to improve survival rates. Stocking strategies should also be diversified to include filter-feeding and phytoplanktivorous species such as *L. catla, L. rohita*, and *C. mrigala*, which are better suited to phytoplanktondominated systems, thereby addressing the existing species mismatch problem. Stocking strategies should also be diversified to include species better suited to phytoplankton-dominated systems, thereby addressing the species mismatch problem. Strengthening fisher cooperatives through capacity building, participatory monitoring, and transparent governance will be essential to ensure equitable benefit sharing. In doing so, it contributes new knowledge that can guide Tamil Nadu fisheries policy toward bridging the existing yield gap and enhancing the livelihoods of reservoir-dependent communities.

5 Conclusion

The key role of seed stock supplementation for management of reservoir fisheries has been adopted in the reservoirs in India. The results demonstrate that while stocking positively influences fish yields, its explanatory power is limited, reflecting the role of additional ecological and management factors. Stocking efficiency was highest in small reservoirs (0.26), moderate in medium reservoirs (0.11), and lowest in large reservoirs (0.05), underscoring the importance of reservoir category in determining outcomes. This study highlights that the major constraint in deriving the potential from reservoir fisheries is under stocking which could be due to the insufficient production of fish seeds. This shortage can be mitigated through breeding of endemic fish species for stocking purpose and rearing of fish seeds in net enclosures for stocking reservoirs. The management recommendations proposed in this study are therefore strongly supported by the demonstrated under-stocking levels, ecological limitations, and the markedly higher stocking efficiency observed in small reservoirs compared to larger systems. A set of management suggestions can be formulated in light of the current study, field observations, and discussions with multiple stake-holders to realize the optimal fish production potential from the reservoirs. First, stocking strategies should emphasize high-density stocking using advanced fingerlings (>120 mm), supported by enclosure culture and nearby nursery-rearing facilities to ensure quality seed supply. Second, regulatory measures should include a closed fishing season during the breeding period and protection of identified spawning grounds. Third, cooperative-based management should be strengthened through capacity-building programs and active participation of local fishing communities in reservoir fisheries management.

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Conflicts of interest

The authors have no relevant financial or non-financial interests to disclose. All authors of this manuscript have no conflicts of interest about the submitted manuscript.

Data availability statement

Data will be made available on genuine request

Ethics approval

The submitted manuscript is not submitted in any other journal.

This research does not involve directly with any fish sample or tissue, rather is solely based on the stocking and catch data. Fish catch data were directly obtained from the commercial catch by fishermen for their livelihood.

Supplementary material

Supplementary Fig. S1 (A–G). Relationships between stocking density and fish yield across different reservoir size categories in Tamil Nadu: (A) Large, (B) Medium, (C) Small (overall), (D) SC-1, (E) SC-2, (F) SC-3 and (G) overall reservoir.

Supplementary Fig. S2 (A–C). Relationships between reservoir area with (A) fish yield, (B) stocking density, and (C) stocking efficiency in Tamil Nadu reservoirs.

The Supplementary Material is available at https://www.alr-journal.org/10.1051/alr/2025025/olm.

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