



The status and prospectus of fisheries and aquaculture in Maharashtra, India

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Fisheries and aquaculture sector has witnessed rapid development across the states of India and has paved way for income generation and livelihood for associated rural and urban communities. Maharashtra state ranks 7th with around 5 % share in country's fish production, is yet to explore its untapped potential completely. Marine fisheries had always a major share (currently 82 %) compared to inland fisheries (currently 18 %) for Maharashtra. The cyclic vulnerability of marine catch and growing demand of ever increasing human population provides scope for increasing share of inland fisheries in food basket. The systematic structuring of policies and rigid implementation of the regulations for sustainable utilization of the available fisheries resources needs attention for further growth in fisheries sector of the state.

[**Keywords:** Aquaculture, Maharashtra, Production, Resources, Status of Fisheries]

Introduction

FAO has already alarmed about one of the greatest global challenges as, how climate change, economic and financial uncertainty and overexploitation of many natural resources impacted the burden to feed more than 9 billion people by 2050. To overcome this situation fisheries sector can play an important role in nutrition and food security by proper utilization of the available water resources. Fisheries and aquaculture sector continue to stand as prime source of nutrition, food, earning and livelihood of millions of people around the globe¹.

India is habitat to more than 10 per cent of the global fish diversity and stands second to China in fish production with 12.32 million metric ton (MMT) production during 2017-18. The inland fish production was 8.76 MMT while that of marine fish landing was 3.56 MMT during 2017-18^(Ref. 2). The country also accommodates a rich diversity in fish species that are edible for human consumption satisfying the local and international market. India is one of the mega biodiversity hotspot in the world and ranks ninth in position in freshwater mega biodiversity³.

The Maharashtra State holds a prominent position among Indian states with second largest geographical area (10 %) occupying the western and central part of the country. It is bestowed with long coastline stretching nearly 720 km along the Arabian Sea. The rivers system including tributaries of Maharashtra

cross through different types of agro-climatic, topographical and hydro-dynamical conditions within the state boundaries, exhibiting diverseness in their biotic and abiotic features throughout their 19,456 km stretch⁴⁻⁷. India is witnessing the growth of fisheries and aquaculture in past two decades due to blue revolution; however the potential contribution of Maharashtra is yet to emerge. In contrast to the national scenario, the state always had a major share of marine fisheries (currently 82 %) compared to inland fisheries (currently 18 %). This paper attempts to analyse the state and prospects of fisheries and aquaculture development in Maharashtra.

Materials and Methods

Research methodology

The present review is based on the primary and secondary fisheries data of Maharashtra, collected from different stakeholders and key informants. A pre-tested interview schedule was planned to collect data from the members of the primary Fisheries Cooperative Societies and other key stakeholders *viz.* progressive farmers, seed producers and others⁷. Data was collected from several agencies in the state covering all types of aquatic resources like marine water, brackish water, farm ponds, village ponds, irrigation tank and reservoir and its users. Secondary information was also collected from the annual reports, scientific communications and

other literature published by the state Department of Fisheries (DoF), water resources, line Departments and Department of Animal Husbandry, Dairying and Fisheries (DAHDF), Govt. of India.

Results and Discussion

Major prospective resources

Maharashtra state is gifted with vast aquatic resources comprising of marine and inland water resources viz. rivers, lakes, reservoirs, tanks, canals, farm ponds, backwater and estuaries along coastline stretching 720 km. These resources contribute to the state’s ecological and natural resource of aquatic wealth. About 3.83 lakh hectare inland water areas are available for fish culture which is 5.24 % of the total inland water area of the country. Besides, the state has the major riverine systems and canals forming a network of 19456 km (Table 1). The area under wetland is estimated to be about 3.30 % of the total geographical area of the state occupying 10.14 lakh ha⁴. The public participation through 3,484 primary fisheries co-operative societies, 37 fisheries co-operative unions and two federations working for fisheries communities in the State is exemplary. Tables 1, 2 & 3 give an overview of the status of fisheries resource in Maharashtra.

Sl No.	Resource	Value
1	Total inland water bodies (lakh ha)	3.83
2	Rivers (Km)	19456
3	Reservoirs (lakh ha)	2.99
4	Tanks & ponds (lakh ha)	0.72
5	Brackish water (lakh ha)	0.12
6	Fish seed center-Government (Nos.)	43
7	Chinese Circular Hatcheries -Government (Nos.)	28
8	Rearing Units -Government (Nos.)	15
9	Freshwater prawn hatchery (Nos.)	01
10	Primary Fisheries Cooperative Society (Nos.)	2603

Govt. of Maharashtra & DAHDF, Govt. of India, 2017

Sl no.	Resource	Value
1	Length of coast-line (Km)	720
2	Continental Shelf ('000 sq km)	112
3	Coastal district (Nos.)	06
4	Number of Fish Landing Centers (Nos.)	184
5	Major Fish Harbours (Nos.)	03
6	Fishing villages (Nos.)	456
7	Fishermen families (Nos.)	81,492
8	Fisher-folk population (lakh)	4.50
9	Brackish water (lakh ha)	0.12
10	Ice plant & cold storage units (Nos.)	170
11	Traditional fishing crafts (Nos.)	7073
12	Motorized fishing crafts (Nos.)	3382
13	Mechanized fishing crafts (Nos.)	13,053
14	Primary Fisheries Cooperative Society (Nos.)	370

CMFRI, 2019, Govt. of Maharashtra & DAHDF, Govt. of India, 2018

Inland fisheries resources

Freshwater resources include rivers, streams, wetlands, lakes, ponds, farm ponds, reservoirs, barrages and tanks. Area estimates of freshwater wetland of Maharashtra include: 20219 numbers of wetlands with area of about 886148 ha⁴. Reservoirs/barrages account 36.29 %, tanks/ponds 20.57 %, rivers/streams contributes 29.54 % to the total wetland area available in Maharashtra (Table 3 & Fig. 1). Major and Minor Rivers originating in Maharashtra are illustrated in Table 4.

Reservoir fisheries resources

Maharashtra has 1845 numbers of large and medium reservoirs covering an area of 2.99 lakh ha¹¹. There is wide gap between potential and actual yield in reservoir fisheries which can be bridged with

Table 3 — Area estimates of wetlands in Maharashtra

Sl No.	Wetland category	Number of wetlands	Total wetland area (a) (Ha)	% of wetland area
Inland Wetlands – Natural				
1	Lakes/Ponds	39	9003	0.89
2	Ox-bow lakes/ Cut-off meanders	2	15	0.00
3	Riverine wetlands	1	2	0.00
4	Waterlogged	35	284	0.03
5	River/Stream	3501	299730	29.54
Inland Wetlands -Man-made				
6	Reservoirs/Barrages	759	368135	36.29
7	Tanks/Ponds	15845	208669	20.57
8	Waterlogged	37	310	0.03
Total – Inland		20219	886148	87.35
Coastal Wetlands – Natural				
9	Creeks	162	41636	4.10
10	Sand/Beach	400	4873	0.48
11	Intertidal mud flats	752	22249	2.19
12	Salt Marshes	32	614	0.06
13	Mangroves	1270	30238	2.98
Coastal Wetlands - Man-made				
14	Salt pans	205	7025	0.69
15	Aquaculture ponds	6	71	0.01
Total – Coastal		2827	106706	10.52
Sub-Total		23046	992854	97.86
Wetlands (< 2.25 ha), mainly Tanks		21668	21668	2.14
Total		44714	1014522	100.00

National Wetland Atlas: Maharashtra, Space Applications Centre (ISRO), 2010

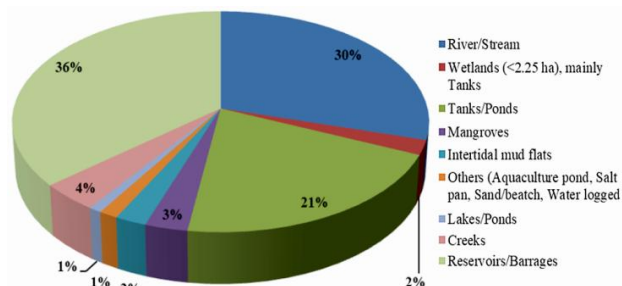


Fig. 1 — Type-wise wetlands distribution in Maharashtra

Table 4 — Major and minor rivers flowing in Maharashtra

Sl No.	Major rivers	Origin	Total length (km)	Catchment area in MH (km ²)
1	Godavari	Trimbakeshwar (Nashik)	1465	152199 (49%)
2	Krishna	Mahabaleshwar	1401	69425 (27%)
3	Tapi	Multai in the Betul district of Madhya Pradesh	724	51504 (79%)
Minor rivers				
1	Vaitarna	Nashik	171	3637
2	Dammanganga	Nashik	143	2357
3	Ulhas	Raigad	145	3864
4	Savitri	Pune	99	2899
5	Sastri	Ratnagiri	64	2174
6	Washishthi	Ratnagiri	48	2239
7	Purna	Saputara hills of the Western Ghats (Chinchi)	180	2431
8	Amba	Borghat Hills (Sahyadri ranges)	76	420
9	Ambika	Saputara Hill ranges near village Kotambi (Nashik)	136	2715
10	Narmada	Amarkantak (Madhya Pradesh)	1312	1658 (1.56%)
11	Wardha	Baitul district in Madhya Pradesh	538	
12	Wainganga	Shivni district in Madhya Pradesh	635	
13	Pranhitha	After confluence of Wardha and Wainganga	112	
14	Manjara	Balaghat Range	737	
15	Girna	Western Ghats	330	

National Wetland Atlas: Maharashtra, 2010

scientific fisheries management practices⁸⁻¹⁰. The untapped reservoir fisheries resource can be utilized using modern technologies like cage culture along with existing practices of pen culture, species enhancement and by stocking fast growing fish species. By promoting technologies like cage culture, the productivity of the reservoirs can be enhanced many fold (Table 5). Due to high initial investments, this technology is yet to be adopted on a larger scale in Maharashtra (Table 6).

Riverine fisheries resources

River fisheries are a mirror of riverine health. The Godavari, Tapi and Krishna are the major rivers of the state. Other main rivers are Koyana, Bhima, Vaitarna, Dammanganga, Ulhas, Savitri, Satri, Washishthi, Vainganga etc. The state is crisscrossed by several rivers, rivulets, streams and streamlets that run 19456 km in length (Table 4).

Fish seed production resources

Quality fish seed production is an essential input for successful implementation of aquaculture.

Table 5 — Major Reservoirs in Maharashtra

Sl No	Name	Location	River	Area (ha)
1	Ujjani	Indapur	Bhima	18145
2	Gosikhurd	Nagpur	Wainganga	16301
3	Majalgaon	Beed	Sindphana	6794
4	Isapur	Kalamnuri (Yawatmal)	Penganga	6660
5	Yeldari	Jinture (Parabhani)	Purna	6272
6	Upper Wardha	Morshi (Amravati)	Wardha	5500
7	Bembada	Yavatmal	Bembla	5272
8	Hatnue	Bhusaval	Tapi	5100
9	Itiadh	Gondia (A.Morgaon)	Gadvi	4862
10	Upper Dudhana	Jalna	Dudhana	4559
11	Lower Wardha	Wardha	Wardha	4078
12	Mula (Dnyaneshwar sagar)	Rahuri (Ahmadnagar)	Mula	3511
13	Girna	Malegaon (Nashik)	Girna river	3290
14	Manjara	Beed	Manjara	3206

Department of Fisheries, Govt. of Maharashtra, 2018

Aquaculture in Maharashtra has been solely dependent on West Bengal for the supply of fish seed. Despite the annual demand of fish seed of 60 crore standard fry a huge local supply gap exists with only 10 crore fry produced in the state. The state has 28 government carp hatcheries as of date, however these need upgradation to completely meet the local demand of fish seed. The traditional bundh breeding of Indian major carps is being practiced only in the Eastern Vidharbha region of the state, however Vidharbha region contributed largely to carp fish seed production to the tune of 46 % during 2015-16. In this region, smaller earthen or cement made bunds traditionally called as *Mogra bandh* (Fig. 2a) act as natural hatcheries in which the natural breeding is supplemented with the modern trend of induced breeding technology. However, in another traditional system of seed production of 'Wet bundh' (Fig. 2b) water is allowed to rush from the elevated catchment over an extensive shallow area of about 0.5 to 4 acres which provides naturally suitable conditions for brood carps to spawn.

Setting up of brood banks and hatcheries across the state is, therefore a priority area need to focus. Diversification of fish species in fish seed production system is essential to meet out the local demand. The model path of establishment of large scale hatcheries in Andhra Pradesh during 1900's towards increasing seed and fish production of the state¹² can be adopted in a similar way for Maharashtra. Thus the large scale establishment of hatcheries in public and private

Table 6 — Cage culture practices in Maharashtra

Sl No	Name of the reservoir	Location
1	Mula dam	Ahmednagar
2	Majalgaon dam	Beed
3	Manjara dam	Beed
4	Devalgaon Raja	Buldhana
5	Karawand dam/Arunapuri dam	Dhule
6	Itiadoh dam	Gondia
7	Pujaritola dam	Gondia
8	Waghur Dam	Jalgaon
9	Radhanagari	Kolhapur
10	Manoli	Kolhapur
11	Kudnur dam	Kolhapur
12	Tulshi dam	Kolhapur
13	Andur talav	Kolhapur
14	Kanherwadi talav	Kolhapur
15	Khaire reservoir	Mahad
16	Pench dam	Nagpur
17	Vaitarna	Nashik
18	Bhavali Dam	Nashik
19	Dhamini dam	Palghar
20	Panshet	Pune
21	Varasgaon	Pune
22	Pawna	Pune
23	Dimbhe	Pune
24	Kasarsai Dam	Pune
25	Aamby Valley (3 sites)	Pune
26	Hadshi Dam	Pune
27	Saltar dam	Pune
28	Hetvane dam	Raigad
29	Morbe dam	Raigad
30	Karav/Pashane dam	Raigarh
31	Whel reservoir	Ratnagiri
32	Kamat	Sangali
33	Kanher dam	Satara
34	Tarali Dam	Satara
35	Urmodi dam	Satara
36	Ekhrukh dam	Solapur
37	Ujani dam	Solapur
38	Baravi dam	Thane
39	Manivali Tarf Khedul dam	Thane
40	Upavan lake	Thane
41	Bor dharan	Wardha

Bhendarkar *et al.*, 2018

sector in Maharashtra will likely lead to increased fish production.

Fish diversity

Maharashtra has rich freshwater fish genetic resources and constitutes 31.01 % to the freshwater fish diversity of India¹³. Maharashtra water harbour about 289 species of freshwater fishes with 194 species of primary freshwater fishes and 95 species of diadromous fishes. Out of 289 fishes, 96 species are recorded as cultivable freshwater fishes, which constitute 44.4 % to the total freshwater fish diversity of Maharashtra¹⁴. 73 freshwater fish species are endemic to Maharashtra⁵. There is a need of attention



Fig. 2 — a) Mogra bandh; and b) Wet bundh breeding practices in Gondia District

for collection of fishes from wild to develop the brood stock for captive breeding, seed production, experimental aquaculture and commercial culture of larger and fast growing endemic fishes and colourful fishes for food and aquarium purposes, which could prove to be a potential source of income in the rural areas of Maharashtra.

Brackish water resources

Brackish water regions in estuaries are another group of water bodies which undergo diurnal fluctuation in salinity due to tidal movement. This resource has huge potential for supporting finfish and shellfish which have ability to withstand higher salinities. High value fish like sea bass, pearl spot and shrimp could be cultured in large quantities. Maharashtra has 0.12 lakh ha of brackish water area which can be utilized for commercial production of shrimps, oysters, mussels, crabs, lobsters, sea bass, groupers, mullets, milk fish, cobia, silver pompano, pearl spot, ornamental fishes and sea weed culture.

Apart from this, Maharashtra also has vast inland salt affected water logged area of 177093 ha¹⁵. Mono-cropping of sugarcane coupled with over irrigation and excessive fertilizer use over decades in the Sangli, Kolhapur, Satara and few other districts of Maharashtra resulted in salinization of large agricultural lands and ground water resource

rendering them unfit for crop cultivation. The most remunerative and suitable alternative for such areas could be the culture of salt-tolerant species *viz.* *Lettopeneous vannemei*, mud crab, Asian Seabass, grey mullet, etc.

Strategic programme

The Maharashtra state initiated constructing farm ponds on private land under "Magel Tyala Shet Tale-Farm Pond on Demand" scheme during February 2016. It was primarily aimed at ensuring irrigation for crop with a target of excavating 111111 no. of farm ponds during 2016-17. These water bodies store water for agriculture use during the drought period and can be simultaneously used for aquaculture by stocking fish species such as *Catla catla*, *Labeo rohita*, and *Cirrihinus mrigala*, *Oreochromis niloticus*, *Pangasianodon hypophthalmus*. This additional water area will support Mission Fingerling programme to achieve Blue revolution.

Underlining the need to reduce burden on agriculture sector and make farmers adopt allied income sources, fisheries offers an opportunity to increase income. Maharashtra State, therefore initiated "Talav Tethe Masoli/Where there is pond, there is a fish" in Vidarbha region of Maharashtra which is accelerating blue revolution. Derelict 7000 irrigation *Malagujari/mama* tanks of Eastern Vidarbha of Maharashtra can be utilized for fish culture and offer huge potential for fish farming in this region that already contributes significantly to the total fish production of the state. This would give better returns and allied income to farmer. A recent "Action plan on Development of Fisheries and Aquaculture in Vidarbha"¹⁶ recommended creating an intuitional mechanism for building a fisheries database on resources, production and regional strategies to enhance freshwater fish production. As a part of the Blue Revolution schemes, several new strategies appear to have struck a chord with the Maharashtra state's fishing communities.

Marine fisheries resources

Marine fisheries play a predominant strategic role in the economic activity and food security of our country by its contribution to national income, foreign exchange, food and employment. It consists of multi species, multi gear and multi seasonal fisheries exploited through an open access regime. Among the four regions of the Indian peninsular coast line, Maharashtra along with Gujarat and Daman & Diu

fall under the north-west coast which contributed highest share (32.8 %) in the total fish landing in India during 2018-19. However the estimated marine fish landings of Maharashtra during 2018-2019 marginally declined by 1.68 % to 4.67 lakh tonnes from previous landing of 4.75 lakh tonnes^{6,17}, likely due to negative impact of El-Nino phenomenon that affects the reproduction of Indian mackerel and other pelagic fishes. Over last two decades the sector has registered slow growth in production from about 4.02 lakh tonnes in 2000-01 to 4.67 lakh tonnes in 2018-19, contributing 12.13 % of the total marine fish production in India (Fig. 3). Also the cyclic dip in the marine fish landing occurring at an average span of around every 3 years confirms the vulnerability of the state marine catch to the El-Nino phenomenon (Fig. 4).

About 4.50 lakh fisherfolk operate using diverse types of craft-gear combinations with regional and seasonal variations all along the Indian coastline. Also the secondary and tertiary sector provides employment to many more people who directly or indirectly depend on marine fishing industry.

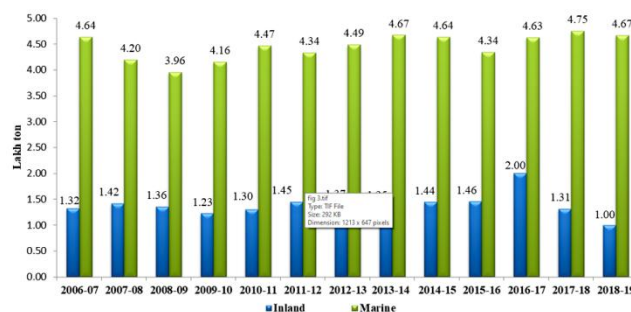


Fig. 3 — Inland and marine fish production in Maharashtra (Sources: Dept. of Fisheries, Govt. of Maharashtra, 2019)

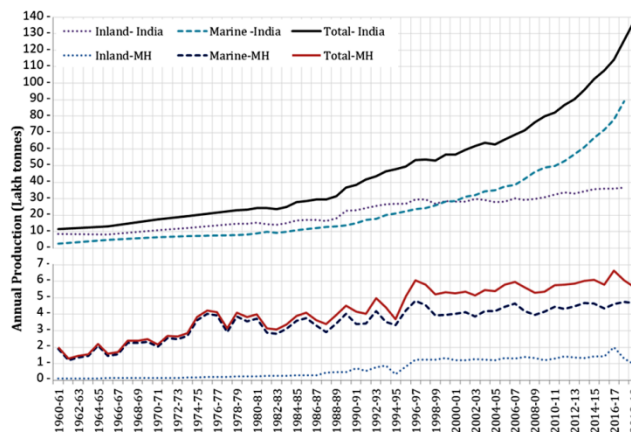


Fig. 4 — Trend of fish production in India and Maharashtra during 1960-2019

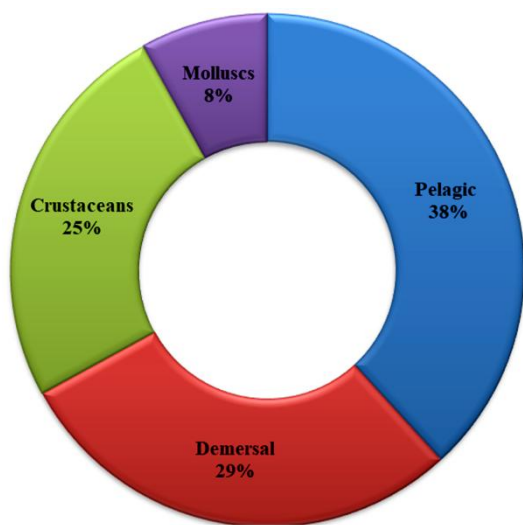


Fig. 5 —Resource wise contribution of landing in Maharashtra

Maharashtra ranks 5th in total marine fish landing in India¹⁸. The major share is contributed by Pelagic resources (38 %), followed by demersal (28.7 %), crustaceans (24.8 %) and molluscs (9 %) (Fig. 5). Other Prominent contributing species/groups to marine fisheries resources were non-penaeid prawns (12.6 %), penaeid prawns (11.4 %), croakers (10.2 %), threadfin breams (8.4 %) Indian mackerel (7.1.5 %), Bombay-duck (5.6 %) and ribbonfish (5 %). The brood stock development of silver pomfret (*Pampus argenteus*, Euphrasen, 1788) and rabbit fish (*Siganus vermiculatus*, Valenciennes, 1835) started at Marine Biological Station, Ratnagiri¹⁸.

Fisheries growth of Maharashtra

Maharashtra state is the 7th largest producer of fish and contributes 5.38 % of country's fish production. Total fish production increased from 1.48 lakh tonnes in 1962-63 to 5.67 lakh tonnes in 2018-19 (Fig. 4). The fisheries production in terms of value tremendously accelerated from ₹ 5.27 crore in 1962-63 to ₹ 7735.10 crore in 2017-18^(ref. 6).

The Indian fisheries transformed from inland dominated fisheries sector to rapidly increasing contribution from marine fisheries in total production of the country, since 2000. However, on the contrary it is interesting to note that in Maharashtra, marine fisheries production has continued to be major share in total production of the state since past six decades (Fig. 4). The growth of inland fisheries has remained slow and stagnated despite having water bodies available for fisheries and aquaculture spread out in total of 3.84 lakh hectare area (Table 7). On the

Table 7 — Fish production trend in Maharashtra state

Year	Inland (lakh tonnes)	Marine (lakh tonnes)	Total production (lakh tonnes)
2006-07	1.32	4.64	5.96
2007-08	1.42	4.20	5.62
2008-09	1.36	3.96	5.31
2009-10	1.23	4.16	5.38
2010-11	1.30	4.47	5.77
2011-12	1.45	4.34	5.79
2012-13	1.37	4.49	5.86
2013-14	1.35	4.67	6.03
2014-15	1.44	4.64	6.08
2015-16	1.46	4.34	5.80
2016-17	2.00	4.62	6.62
2017-18	1.31	4.75	6.06
2018-19	1.00	4.67	5.67

Dept. of Fisheries, Govt. of Maharashtra, 2019

contrary despite having less area under water bodies in Chhattisgarh (2.33 lakh ha)⁷ as compared to Maharashtra (3.84 lakh ha), production from inland fisheries in Chhattisgarh state has seen an unprecedented growth of 1050 % during past two decades². The very systematic structured policy along with proper utilization of its limited water bodies, has been instrumental in achieving this exemplary growth. Maharashtra state for its own good, should look into the model example set by growth of fisheries in Chhattisgarh and other progressing states. Also the cyclic vulnerability of marine catch and growing demand of ever increasing human population provides scope for increasing share of inland fisheries in food basket. However, the inland fisheries too may remain prone to the extreme weather events as evident by the drastic reduction in the inland fisheries production of Maharashtra by 50 % (Fig. 4) during 2017-19, which can be attributed to the heavy rainfall received in major producing region of Vidharbha during these years.

Species cultured

Indian major carps are predominantly cultured, however minor carps, barbs and catfish categories of fishes also find a place. Major species cultured are catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*). Maharashtra also attempts to develop the culture of fish like Pangasius, and Tilapia have been undertaken in recent years.

In India, cage culture is an upcoming promising technology through which fishes are reared in captivity. The state has also adopted the cage culture technology with its first trial done at Bor reservoir in

Wardha district in 2011-12 under National Mission for Protein Supplements Scheme. At present, Maharashtra is increasing numbers of cage culture practices at different reservoirs as given in Table 6 including the government, private, fishermen co-operatives and NGO-promoted projects¹⁹.

The vast underutilized resources offer livelihood opportunities to the unemployed youth and unexplored potential of boosting fish production by emerging entrepreneurship, however the upcoming modern technologies in fisheries and aquaculture are yet to receive due attention by the policy makers.

Governance and institutional frameworks of the fisheries and aquaculture sector in Maharashtra

Fisheries in India are managed with a broad range of institutional structures. The institutional bodies involved directly in aquaculture and fisheries in Maharashtra (Fig. 6) are as follows:

1) *Department of Fisheries (Govt. of Maharashtra)*: is the sole administrative controlling authority working under the Agriculture, Animal Husbandry, Dairy Development and Fisheries Department in Maharashtra state. It has two main sub-departments viz., inland and marine managed by the Commissioner Fisheries. The DoF is responsible for planning, development, promotion, extension and training for improving fishery sector by adopting modern sustainable techniques in various fields of fisheries.

2) *Maharashtra Fisheries Development Corporation Ltd (MFDC)*: is the commercial wing of DoF in Maharashtra and serves as the nodal agency for cage culture technology.

3) *Primary Fisheries Cooperative Society (PFCS)*: At present, total 2973 PFCS are active in Maharashtra. Members of the PFCS are the direct stakeholder of the development of fisheries.

4) *ICAR- Central Institute of Fisheries Education (ICAR-CIFE), Mumbai*: is the Deemed-to-be-University for higher education in fisheries.

5) *Mumbai Research Centre (ICAR- Central Marine Fisheries Research Institute)*: is working with a multidisciplinary approach for research in marine capture and culture fisheries in Maharashtra.

6) *Fisheries Survey of India (FSI), Mumbai*: is the apex fishery Institute in India with the primary responsibility of survey and assessment of fishery resources in the Indian Exclusive Economic Zone (EEZ) and adjoining seas for promoting sustainable exploitation and management of the marine fishery resources.

7) *Mumbai Research Centre (ICAR-Central Institute of Fisheries Technology)*: undertakes post-harvest research in fisheries.

8) *Maharashtra Animal and Fisheries Science University (MAFSU), Nagpur*: The University has two fisheries college at Nagpur & Udgir which offer B.F.Sc, degree programs in Fisheries Sciences.

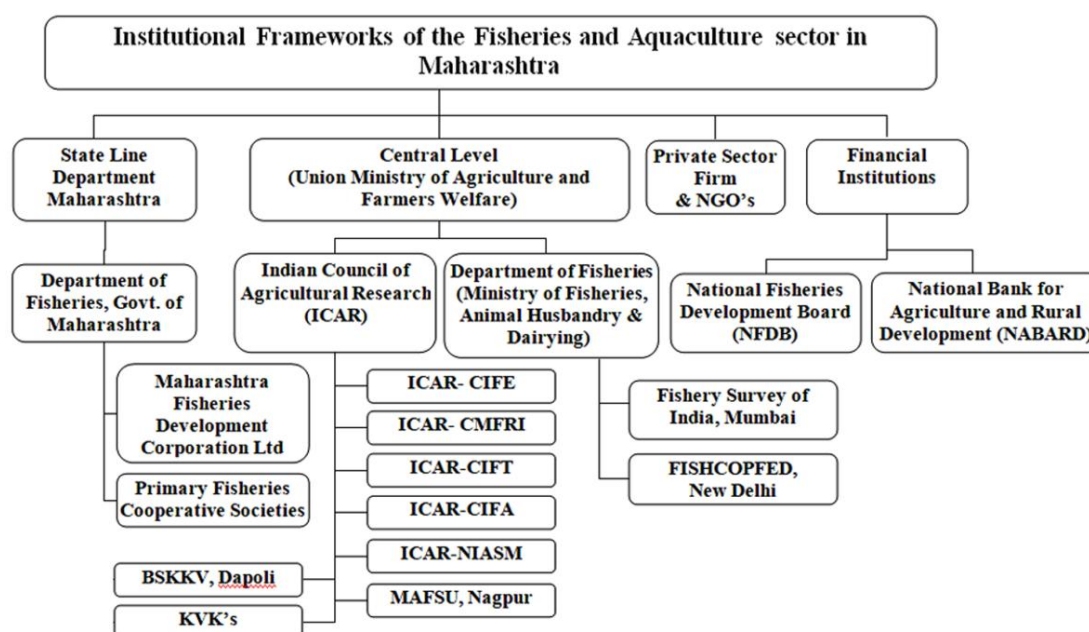


Fig. 6 — Institutional framework of the fisheries and aquaculture sector in Maharashtra

- 9) *Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli*: The College of Fisheries, Ratnagiri offers B.F.Sc, M.F.Sc and Ph.D. programmes in Fisheries Sciences.
- 10) *ICAR-National Institute of Abiotic Stress Management (ICAR-NIASM), Baramati*: work on the management of abiotic stresses affecting fisheries and agriculture.
- 11) *Krishi Vigyan Kendra's (KVKs)*: are extension agencies providing critical input support for the farmers and fishermen.

Factors responsible for the stagnant growth

The fisheries sector especially inland sector of Maharashtra faces several challenges responsible for stagnant growth (Fig. 7) which need to be addressed for boosting growth. The major thrust areas to be

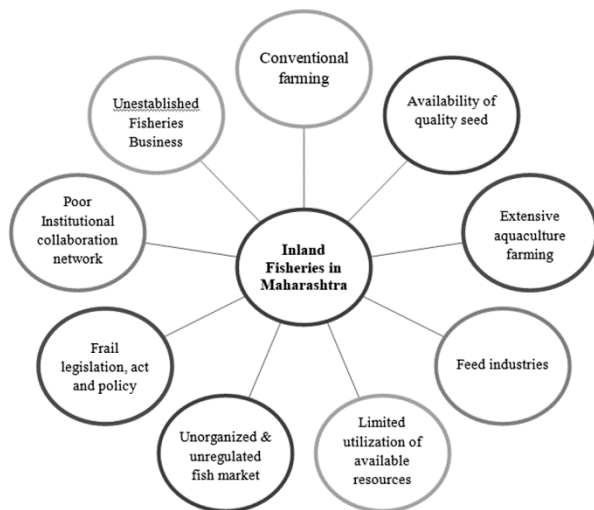


Fig. 7 — Factor responsible for stagnant growth of inland fisheries

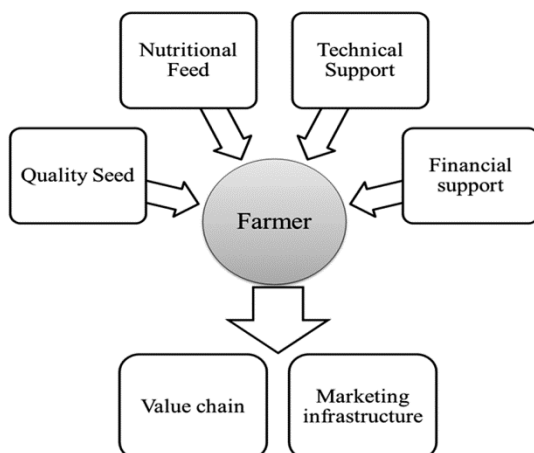


Fig. 8 — Backward and Forward linkages in Aquaculture Business Model

focused for the growth of inland fisheries in the form of backward and forward linkages are listed below and is depicted in Figure 8.

Strategies and recommendations

- Integrated approach for inland fisheries development.
- Promotion and implementation of culture based fisheries in small and stocking cum capture based fisheries in medium and large reservoirs.
- Mobilizing and facilitating riverine fishing communities for establishing potential enterprises through their organizations.
- Empowerment of women: Encouraging women's participation at all levels in fisheries sector
- Promoting intensification of pond based aquaculture.
- *Matsya Palak/ Matsya Mitras* (Friend of Fish) need to be encouraged to organize fishers/fish farmers for proper distribution of inputs and procurement of the produce.
- Enhancement of potential of poorly productive reservoirs in the state through stocking them with proper seed.
- Collection and maintenance of fish catch effort data on regular basis.
- Strengthening the capacity of the fishers and DoF personnel on reservoir fisheries management.
- Establishment of a live gene bank in Maharashtra, for the Indian Major Carp, viz. Catla, Rohu & Mrigal with government support to enhance supply of its pure strains.
- Establishment of State level Brood bank.
- Establishment of the Disease Monitoring System in each division.
- To establish outlets for aquaculture products.
- Establishment of small and medium commercial feed manufacturing unit.
- Initiation of participatory research with progressive farmers and hatchery operators on breeding (induced and selective), hybridization, management of nursery, transportation, marketing etc.
- Large-scale or small-scale catfish hatchery may be constructed to encourage fish culturists to take up catfish culture on commercial scale.
- Strengthening of state level training and HRD infrastructure.
- Need of Policy level interventions.

Conclusion

Maharashtra has the largest number of manmade water bodies in the country and is geared up to expand its fisheries and aquaculture. The systematic structuring of policies and rigid implementation of the regulations for sustainable utilization of the available water resources for fisheries/aquaculture development should be given more attention to achieve the exemplary growth similar to Chhattisgarh State. From a broader perspective, this expansion should necessarily be carried out with holistic integrated development of reservoirs to impart self-resilience to the unit for sustainability. This necessitates hiring of trained manpower along with upgrading technical skills of existing manpower of hatcheries, farms, fishing units, processing plants, feed plants and other associated units in the State Government Departments, Universities, and other related organisations in the public sector and private sector. The knowledge-based fisheries management is estimated to require double the trained manpower with skills from diversified areas of science, technology, innovation and policy, than the present availability. The recent progressions shown in expansion of the area under aquaculture in the state still needs support in seed production, adoption of best practices and are the key factors for the development of fisheries and aquaculture in the state. The diversification of fish production in other areas like integrated fish farming, capture fisheries, riverine fisheries, saline water fisheries and brackish water fisheries is needed to enhance the production and cater the growing demand. The current measures therefore are more focused on Intensive Aquaculture in ponds and tanks through integrated fish farming, carp polyculture, running water fish culture, freshwater prawn culture and the expansion of riverine fisheries. Overall, there is huge gap between State's potential and actual fish production which necessitates systematic policy efforts to support and facilitate the stakeholders to bridge the gap.

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