

ACTION PLAN

**DEVELOPMENT OF FISHERIES AND
AQUACULTURE IN VIDARBHA**



FUNDED BY

Vidarbha Development Board, Nagpur



Submitted By

COLLEGE OF FISHERY SCIENCE, NAGPUR
MAHARASHTRA ANIMAL AND FISHERY SCIENCES UNIVERSITY



Action Plan

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Aquaculture in Vidarbha**

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Submitted by
College of Fishery Science, Nagpur
(Maharashtra Animal and Fishery Sciences University)



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Message

Government of Maharashtra has adopted the Blue Revolution policy of GOI. The Key objective of Blue revolution is to achieve an additional production of 5 million tonnes of fish production by the end of 2020, by enhancing the fish production from the fresh waters. This will call for major technological interventions, innovation and out of box thinking. On the other hand, objective of doubling the income of farmers and people living in rural areas, upto 2022 has also been committed by central and state government which requires intensification of efforts of developing agriculture allied sectors including fresh water aquaculture and pond fisheries.

Vidarbha, though a land locked region, has got a huge potential of freshwater fisheries with abundant water bodies, assured rainfall and presence of large population of traditional fishermen. Utilizing the untapped potential of any region is an important step towards achieving economic and human development. It has been a consistent effort of the Vidarbha Development Board to strive for identification of such untapped potential in the region and to come up with an action plan for its proper utilization and in the process create employment and livelihood opportunities within the region.

The Action Plan for Development of Fisheries and Aquaculture in Vidarbha, 2017 is a welcome step not only as an evaluation study of the status of fisheries in the region but also as a clearly drawn actionable and pragmatic ready reckoner for the department of fisheries and other implementing agencies to work for the betterment of fishermen and farmers by providing them productive livelihood opportunity.

I congratulate the College of Fishery Science, Maharashtra Animal & Fishery Sciences University, Nagpur for the sincere efforts that they have put in to bring out this Action Plan. Another outcome of this timely completed report is to demonstrate that the desired results can be achieved with proper convergence and symphony of multiple departments of the Government. I trust that this report will serve as a guiding light in the process of development of inland fisheries not only in the region of Vidarbha but the entire state.

Anoop Kumar

(Anoop Kumar, IAS)

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Message

Vidarbha Development Board, Nagpur plays a major role in conducting studies of various development issues of Vidarbha region. One of the prime and most valuable objectives and functions of the Board is to assess the social and economic capacity of the region on the basis of available natural resources, infrastructure along with needs and opportunities prevailing in the region.

It has been observed that even though, the region accounts for a very high quantum of natural water bodies in general and Ex Malguzari Lakes in particular, yet the development of fisheries has not occurred to its full potential. In view of the present status of fisheries in the region, the Board approved the proposal for “Action Plan for Development of Fisheries and Aquaculture in Vidarbha” submitted by MAFSU, Nagpur.

It is my immense pleasure to submit the Action Plan which will work as guiding map for the Department of Fisheries. All efforts are made to make the report comprehensive and implementable. Meetings and discussions with various agencies, stakeholders including cooperative societies and fish market agents were held for having the realistic solutions to overcome the problems.

During the course of study, MAFSU team visited various lakes, tanks, fish seed production and rearing centers throughout the region on sample basis and officials of fisheries co-operative societies, fishermen and traders etc. This study proved beneficial to identify backward and forward linkages which in turn would be helpful for planning and Development of Fisheries and Aquaculture in Vidarbha Region. The study has revealed the prospect of development of freshwater aquaculture and increasing the level of fish production in Vidarbha using scientific and economically viable technologies in the available water resource. It has also mentioned the potential business models to be espoused for bringing livelihood security, entrepreneurship development and providing alternate source of income for the marginal fish farmers.

To conclude, I express my gratitude to Hon’ble Chairman, Vidarbha Development Board, Nagpur and Divisional Commissioner, Nagpur, Dr. Kapil Chandrayan, Expert Member-VDB for their valuable inputs and suggestions. Finally, I take this opportunity to thank the Vice Chancellor, MAFSU, Nagpur and the whole team for making the report worthy.

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Message

It gives a great sense of satisfaction and pleasure to read the Action Plan for Development of Fisheries and Aquaculture in Vidarbha. Inland fisheries development in Vidarbha region has a huge potential in terms of provision of productive employment and livelihood opportunities as well as in bringing about a positive change in the economic scenario of the region. The sector warrants a planned and systematic intervention from the state since long and I am sure that this report will play a pivotal role in designing and execution of such an intervention.

As a coordinator my major role was to ensure coordination between the Vidarbha Development Board's objective behind having such a study and the study team of College of Fishery Science, MAFSU's efforts in completing the report in time. As a result there were multiple interactions held with the research team and many more rounds of revision of methodologies and draft reports. I must put on record that the process of preparation of this action plan was as satisfying as the quality of this report. The process of preparation was inclusive and led to increased understanding of the varied dimensions of the various issues pertaining to the topic. It is also important to note that it is for the first time that we have tried to evaluate the performance of the fishing co-operative societies in the most scientific manner.

I am sure that the various departments and offices concerned with the development of fisheries will take due cognizance of this report and work in synchronization to achieve the desired development of the sector in the Vidarbha region.

The report is a result of the vision of Hon'ble Shri. Anoop Kumar, IAS, Chairman Vidarbha Development Board, Nagpur who has been the driving force behind the sustained efforts towards development of inland fisheries in Vidarbha. The constant support of Dr. Nirupama Dange, Member Secretary, VDB provides an enabling environment for researchers to focus on the research activities. I must acknowledge the sincere efforts of Principal Investigator Shri. Sachin Belsare, Dr. Prashant Telvekar, Dr. Satyajit Belsare, Shri. Shamkant Shelke, Dr. J. G. K. Pathan, Shri. Rajiv Rathod, Shri. Sagar Joshi, Shri. Shailendra Relekar, Shri. Umesh Suryawanshi and Shri. Swapnil Ghatge. This work would not have been completed in time without their untiring efforts.

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Foreword

India is the second largest producer of fish in the world contributing to 5.68% of global fish production. India is also a major producer of fish through aquaculture and ranks second in the world after China. During the financial Year 2015-16, India has exported ₹30420.83crore of fish and fish products which is about 0.9% of the National Gross Domestic Products (GDP) and 5.17% to the agriculture GDP (2015-16).

The Maharashtra State has a coastline of 720 km with 173 fish landing centres and the area suitable for marine fishing is 1.12 lakh sq km. In addition to this, the area suitable for inland and brackish water fishing in the State is 4.19 lakh ha and 0.10 lakh ha, respectively. The estimated inland fish production of Maharashtra for the year 2016-17 is 1.46 lakh MT with a gross value of ₹1,455 crores.

Vidarbha is the eastern region of the Indian state of Maharashtra, comprising Nagpur Division and Amravati Division. It occupies 31.6% of the total area and holds 21.3% of the total population of Maharashtra. Vidarbha's economy is primarily agricultural and also the region is rich in forest and mineral wealth. The Vidarbha region also has vast expanse of inland water bodies such as farm ponds, village tanks, Malguzari talav, lakes & ponds and reservoirs etc. These water bodies can contribute enormously to the fish production; but producing it on sustainable basis without depleting productive natural resources and without damaging the precious aquatic environment is a real challenge. Development of fisheries in the region can ensure food security as well as tackle unemployment in the region which is predominately inhabited by rural populace. Though, the inland fisheries and aquaculture hold immense fisheries potential, it is also essential to make it more efficient and cost-effective. Systematic and technological interventions backed by adequate policy support are vital for making the fisheries and aquaculture operations sustainable and economical.

The scientists at MAFSU have conducted an in depth study and came out with the present status, potential, strategies, approaches and the way forward for achieving the targeted fish production through fish farming in Vidarbha region. I am sure that the insights gained here can contribute significantly towards improved reservoir fisheries and aquaculture management practices for growth and development of inland fisheries sector in Vidarbha region.

A. S. Bannalekar



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Preface

Fisheries and aquaculture has emerged as an important commercial activity due to its role in providing food security and employment to landless, small and marginal farmers, and contribution to foreign exchange of the country. India occupies second position globally in terms of fish production. The overall fish production has crossed 10 million metric tonnes (MMT), of which 67% of the production comes from inland fisheries.

The share of fisheries sector in the State GDP and Agriculture GDP of Maharashtra is 0.39% and 3.45% respectively. The share of Inland sector in the State GDP is 0.083% and in the agriculture GDP of the State is 0.85%.

Looking to the potential the focus of the Blue Revolution shall be on the activities to increase production from aquaculture and fisheries resources from “Inland areas” of Maharashtra. Vidarbha is endowed with abundant water resource (1,87,249 ha) in the form of farm ponds, village tanks, Malguzari talav, lakes & ponds and reservoirs etc. It accounts for 46% (68,330 tonnes) of the total inland fish production of Maharashtra State during 2015-16.

The vast fishery resources in the Vidarbha region offer immense opportunities to enhance fish production through intensification of aquaculture practices in ponds and tanks, species diversification, adoption of scientific reservoir fisheries management etc. A focused approach of this nature would ensure sustained acceleration and escalation of fish production in Vidarbha region.

The researchers in the College of Fishery Science, Nagpur were tasked with responsibility to find out shortcomings in realizing fisheries potential of the Vidarbha. The research team has succeeded in the given task and also suggested measures to vitalize inland fisheries in Vidarbha. I would like to compliment the efforts of the project team of College of Fishery Science, MAFSU, Nagpur to bring out this document, covering the available fisheries resources, institutional framework, projects levels of fish production and actionable recommendations for development of fisheries sector in Vidarbha. I hope that the diverse stakeholders will find the contents useful.

P. T. Jadhao

Acknowledgement

This report is the result of the initiative, constant encouragement and valuable guidance of Shri. Anoop Kumar (IAS), Hon'ble Divisional Commissioner, Nagpur; Chairman, Vidarbha Development Board, Nagpur & Hon'ble Vice-Chancellor, Maharashtra Animal & Fishery Sciences University, Nagpur. Shri. Govind Bodke (IAS), Commissioner, Department of Fisheries, GoM provided desired support for the conduct of the study. Prof. A. K. Misra, Ex- Vice-Chancellor, Maharashtra Animal & Fishery Sciences University, Nagpur is acknowledged for his kind support. Financial assistance extended by Vidarbha Development Board, Nagpur for the conduct of the study is thankfully acknowledged.

Mrs. Nirupama Dange (IAS), Additional Commissioner & Member Secretary, Vidarbha Development Board, Nagpur provided excellent administrative support throughout the course of the study. Respectful gratitude is expressed to Dr. Kapil Chandrayan, Co-ordinator & Expert Advisor, Vidarbha Development Board, Nagpur for his unparalleled guidance, valuable insights in the subject, constant encouragement & untiring help in all aspects of the study.

Sincere thanks and deep sense of gratitude is expressed towards Dr. A. S. Bannalekar, Director of Research, Maharashtra Animal & Fishery Sciences University, Nagpur for his advice and peerless motivation. Valuable support of Dr. P. T. Jadhao, Dean, Faculty of Fisheries, Maharashtra Animal & Fishery Sciences University & Associate Dean, College of Fishery Science, Nagpur from the beginning of the work is deeply acknowledged.

Technical help and constant guidance provided by Dr. Subrato N. Das, Director, Maharashtra Remote Sensing Application Centre & Dr. Mrs. Tutu Sengupta, Associate Scientist & Guardian Scientist, Water Resources for providing the maps and GIS data of water resources is acknowledged.

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Thanks are due to Regional Deputy Commissioner of Fisheries, Nagpur & Amravati Division for being supportive and providing necessary information during the course of study. Sincere efforts & support of all Assistant Commissioner of Fisheries, Fisheries Development Officer, Assistant Fisheries Development Officer & Field workers of Department of Fisheries of both Nagpur & Amravati Division is deeply acknowledged. Similarly support rendered by Maharashtra Fisheries Development Corporation Ltd., Mumbai & its Nagpur regional office is acknowledged.

Support endued by all the members of Fisheries Co-operative Societies & District Fisheries Federation of entire 11 districts of Nagpur and Amravati region along with Vidarbha Vibhagiya Macchimar Sahakari Sangh for their sincere co-operation during the entire period of study is acknowledged. Management of leased out fish seed production and rearing centres, fish farmers and fish marketeers of both the region is highly appreciated.

Finally, needful support of the entire staff, students of College of Fishery Science and whosoever were directly or indirectly involved in this study is gratefully acknowledged.

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1. Executive Summary

1. Executive summary

1.1 Background:

- Out of the total inland fish production (1.49 lakh tonnes) of the Maharashtra State, the Vidarbha region accounted for 46% (68,330 tonnes) of fish production during 2015-16. The traditional fisheries in numerous water bodies like village tanks, Malguzari talav, lakes and reservoirs etc. of Vidarbha is the mainstay of most of the fish production. The available water spread area for fisheries in Vidarbha region including Amravati and Nagpur division is 1,87,249 ha.
- The rate of growth in terms of fisheries potential is not yet achieved in Vidarbha. This can be attributed to less focus on sustainable development of inland capture fisheries particularly pertaining to reservoirs in the past; increasing pressure on the resources, including habitat degradation; and multiple-use of inland water-bodies with least priority to fisheries requirements.
- Vidarbha has huge aquaculture potential for development through both expansion and intensification. The average fish production from aquaculture practices is very meager as compared to the national average of 2.9 tonnes/ha/year. This production can be increased to the tune of 4-5 tonnes/ha/year by adopting improved farming practices.
- There is scope to increase annual fish production from reservoirs up to 210kg/ha/year, 120 kg/ha/year and 90 kg/ha/year from small, medium and large reservoirs respectively.

1.2 Inland water resources of Vidarbha:

- Till date there was no reliable database of the water resources from Vidarbha which was a main hurdle in planning, development, sustainable utilization and conservation of available resources. For this purpose, Geographical Information System (GIS) and Remote Sensing (RS) tool was used by Maharashtra Remote Sensing Application Centre (MRSAC), Nagpur for thematic identification of different types of water bodies scattered over the Vidarbha.
- The IRS-P6 & LISS-III post monsoon and pre-monsoon satellite data of MRSAC, Nagpur for the year 2015-16 was used for the present study wherein MRSAC had mapped and categories different water bodies (abandoned quarry with water, cooling pond/cooling reservoir, aquaculture pond, farm pond, lakes/ponds, reservoir, tanks) and developed GIS of these water bodies.

- Utilizing the 2015-16 satellite data total 30,650 number of waterbodies with 1,87,249 ha water spread area are mapped by MRSAC of which 28,625 are seasonal (1,01,410 ha) and 2,025 are perennial (85,839 ha) water bodies.
- Maximum numbers of waterbodies are documented in Chandrapur district, followed by Gondia, Gadchiroli, Buldhana and Akola districts, whereas the maximum water spread area was found to be under Nagpur district followed by Yavatmal, Chandrapur, Gondia and Amravati districts. The large water bodies with area more than 5000 ha & above are restricted to four districts namely i.e. Nagpur, Amravati, Gondia and Yavatmal.
- According to the category wise distribution of waterbodies in Vidarbha region it is observed that 99% are smaller water bodies under the category of 0.02-1 ha, 1-5 ha, 5-20 ha & 20-50 ha having water spread area of 32%. On the contrary 1% of waterbodies comes under the category of 50-200 ha, 200-500 ha, 500-1000 ha, 1000-5000 ha and 5000 ha & above but have water spread area of 68%.
- According to the waterbody type wise distribution in Vidarbha region it is found that the maximum number of abandoned quarries with water are observed in Nagpur district (58%); cooling pond/cooling reservoirs (64%), aquaculture ponds (29%) and farm ponds (20%) in Chandrapur district; lakes/ponds (25%) in Gondia district; reservoirs (18%) and tanks (24%) in Nagpur district.
- The qualitative assessment of available water resources from Vidarbha region and their suitability for fisheries and aquaculture revealed that the fish production potential to the tune of 1.41 lakh tones from the available water spread area of 1,87,249 ha could be achieved by adoption of modern fisheries management techniques and scientific technologies.
- Further, it is stated that since 2015-16 onwards to till date, the additional water spread area has been developed in Vidarbha under various programmes initiated by the State Government of Maharashtra viz., “Magel Tyala Shet Tale”, “Jal Yukt Shivar Abhiyan”, “Amrut Kund Shet Tale” etc. However, to assess the suitability of these water bodies for fisheries and aquaculture a detailed assessment in near future needs to be planned.

1.3 Institutional frame work of fisheries in Vidarbha:

State Fisheries Department:

- In Vidarbha, Department of Fisheries (DoF) is the main agency for the management and development of fisheries resources and promotion of aquaculture. The Major activities of DoF includes leasing of water bodies, formation of fisheries cooperative society, seed production and seed rearing of cultivable fish species and seed rearing, implementation of Centrally sponsored and State sponsored schemes, extension services to the farmers, promotion of innovative scheme such as “Blue Revolution”, “Mission Fingerling” and “Talav Tithe Masoli” etc.
- In Vidarbha, for effective administration the DoF is divided into Nagpur and Amravati division. The Nagpur division includes district offices at Nagpur, Bhandara, Chandrapur, Gondia, Gadchiroli and Wardha. The districts offices under Amravati division are at Amravati, Akola, Washim, Buldhana and Yavatmal.
- However, the state of affairs in the DoF in Vidarbha is miserable wherein the Fisheries Development Officer (FDO's) are assigned duties of Assistant Commissioner of Fisheries (ACF's) and ACF's are given additional charge of Regional Deputy Commissioners (RDC's). In most of the district headquarters, the permanent positions of ACFs, FDOs and Assistant Fisheries Development Officers (AFDO) are not filled in. It is observed that total 53 % of sanctioned technical posts in DoF for development of fisheries in Vidarbha region are lying vacant since long. This is one of the major reasons hampering the growth rate of fisheries development in Vidarbha.
- At present, there are 14 fish seed production centres under the DoF in Vidarbha. Among these 05 are functional, 01 non-functional and 02 centres are yet to be operational. Out of the remaining 06 centres, 02 centres are operated by Maharashtra Fisheries Development Corporation Ltd. (MFDC) and 04 centres are leased out to private parties by DoF, Maharashtra State. Similarly, the DoF has 12 established fish seed rearing centres in Vidarbha. Out of these, the 05 rearing centres are operated by DoF, 03 are leased out to private parties and 04 centres are non-functional.

The DoF is supposed to be the nodal agency for fisheries governance and development however, bears a fatigued look. The DoF is inherently understaffed therefore; collection of revenue by leasing out state owned water bodies, litigation and disbursement of subsidies provided under various schemes has become the sole activities of the DoF. The stagnation in the job, lack of career advancement and capacity building opportunities for the

DoF personnel are some of the reasons attributed towards less motivation for developmental work. The DoF personnel are not being treated at par with their counterparts in agriculture, animal husbandry, dairy and other allied sectors of agriculture. The cumulative effect of all these have resulted in growing sense of frustration and loss of professional pride among the DoF personnel which is further weakening the institutional network of the fisheries sector in Vidarbha.

Maharashtra Fisheries Development Corporation Ltd. (MFDC):

- The MFDC is chosen as a commercial wing of State Department of Fisheries in Maharashtra to demonstrate and to standardize location specific improved fisheries and aquaculture technologies in the State. In Vidarbha, the major activities entrusted upon MFDC in collaboration with State Fisheries Department, includes demonstration and dissemination of culture based capture fisheries in reservoirs, fish seed production of commercial important fish species, standardization and promotion of modern fish culture technology such as cage culture, establishment of hygienic fish markets, promotion of fish and fishery product etc.
- The study revealed that the very purpose of handing over the reservoirs and Fish Seed Production Centres to MFDC is defeated in Vidarbha due to low fish seed production, unkempt fish seed production centres and rearing ponds, pathetic record keeping and low maintenance of proper data on fish production from reservoirs etc. by MFDC. Further, the cautious analysis of cage culture data revealed that the success of cage culture units installed by MFDC in Isapur reservoir (Yavatmal District), Bor reservoir (Wardha District) and Pench reservoir (Nagpur district) is not encouraging.

The main reasons for under performance of MFDC in Vidarbha are lack of manpower and technical staff, weariness toward development of fisheries and overall ineffectiveness of the regional level administration.

Fisheries cooperative sector:

- The major role of inland fisheries cooperative societies is to increase the maximum output from the fishery resources and thereby, increase the livelihood, income & wellbeing of their members and management of fishery resources.
- The Vidarbha has 1,356 registered primary cooperative societies with total membership of 95,265 numbers. Additionally, there are 11 district fisheries federations. The maximum numbers of cooperative societies are registered in Yavatmal district while, the minimum number of societies are registered in Akola

district. The district of Chandrapur has maximum membership to cooperative societies whereas, Akola district has minimum registered members. The highest numbers of active societies is recorded in Buldhana district while the Yavatmal district has most inactive societies.

- In the present study, total 240 societies (i.e. 21% of all societies) representing 11 districts of Vidarbha were surveyed. The data from “Performance Assessment Ranking” (PAR) revealed that, none of the society was under excellent category of performance ranking, 44 societies were found to be under good performance ranking, 173 societies were recorded as average performance ranking and 23 societies were performing below average.
- The major challenges faced by cooperative sectors are summarized viz., inland fisheries is not treated at par with Agriculture in the context of taxes, electricity tariff etc.; scientific and rational criteria are not followed while fixing lease period and lease amount; existing water usage policy does not recognize minimal water levels essential for fisheries in water bodies; non-availability of quality seed and other inputs; lack of capital & insufficient credit facilities; loan interest rates for fisheries not at par with agriculture; non-coverage of reservoir fishery under insurance; poor extension services; least involvement of fishing communities in planning and decision making process and entry of some influential people in the business.
- On the other hand, inland fisheries co-operative sector is poorly managed and inefficient in providing various services such as fish marketing, storage, value addition, channelizing welfare measures etc. to its members. The functioning of the societies and federations is hindered by political factions among members. The societies are after short gains and reluctant to accept progressive policy changes. Agitations against policy changes are common and mostly politically driven. Sub leasing of water bodies by societies is common practice which motivates wealthy and influential persons to enter into the sector. This leads to loss of livelihood of the poor members and loss of expected revenue to the government. Post leasing litigations are quite common. No reliable up-to-date precise data of production is reported or shared by cooperative society which brings uncertainty into the planning process. Overall the weakness in institutional management and governance of cooperative sector in Vidarbha is hindering technology based development interventions and equitable distribution of benefits to the local communities / members.

Supporting departments (District Administration, Water Resources Department, Zilla Parishad and other Local self Government bodies):

- The State Government policy for transfer of fishing rights of all tanks constructed by Irrigation Department to the DoF has come into effect since 1966. This policy is put into practice to generate employment through development of pisciculture in the irrigation tanks and reservoirs by the local fisheries co-operative societies.
- The water bodies under Zilla Parishad (ZP) in Vidarbha include small village tanks, lake & ponds and Malguzari talav which are leased out to highest bidders mostly from fishermen community by respective local Self Government body. In case of tanks with Gram Panchayats, the respective Gram Panchayat has exclusive right to allocate water bodies for fish rearing to any one from the village.
- The District Administration led by the district collector allocates grants for planned schemes of Fisheries Department through the District Planning and Development Committee (DPDC). Under this excavation of the new fish ponds, renovation of existing or dilapidated structures and ponds, subsidies on fish seed, feed, net, fertilizers and small boats in inland areas are covered.
- The District Administration also encourages Fisheries Department to take up innovative schemes in the district as per the resource availability and scope. The major programme initiated by the Office of Divisional Commissioner, Nagpur in recent years is “Talav tethe masoli”, which has been taken up on missions scale by all the six District Administration Offices of Nagpur division. The programme is in consonance with idea of “Mission Fingerling” put forth under blue revolution scheme of National Fisheries Development Board (NFDB), Hyderabad and is heralded as exemplary by the State Government of Maharashtra. This scheme has been adopted by State Government for whole of Maharashtra as “Matsya Yukta Talav”.
- Overall, the departments like Irrigation, Revenue, Environment and Forest, Water Resources, Urban Development and State Pollution Control Board etc, are directly or indirectly involved with the management and development of fisheries resources in Vidarbha.
- Reducing competition by integrating and optimizing use of resources and harnessing the potential of complementary benefits would be in the greater interest of the state. Thus, the first step in this direction would be to mainstream this perception across these sectors and build a coordination mechanism at the highest level to strengthen cooperation and facilitate actions.

Maharashtra Animal and Fisheries Sciences University, Nagpur:

- The fisheries sector has great potential to generate self-employment, especially for rural landless labours and marginal farmers of Vidarbha. Keeping this in view, the Government of Maharashtra has established the College of Fishery Science at Nagpur and Udgir under the Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur during 2006 & 2007 respectively.
- The College of Fishery Science, Nagpur aims not only to produce fisheries professionals but entrepreneurs who would take up fisheries and aquaculture related business independently to generate employment and wealth through hands on training, experiential learning programmes and industrial exposure etc. The areas identified are the fish seed production and culture of important cultivable fish species such as carps, air breathing catfishes like magur, breeding and rearing of ornamental fish varieties; farm made feed formulation and manufacturing; and value added fish product and by-product development from low cost indigenous fish varieties.
- The major research focus of the institute relates to diversification in aquaculture, developing technologies in which unproductive lands can be transformed into productive aqua farms, management of aquatic resources and biodiversity, post-harvest and value addition, ecosystem management and extension services. Five research and extension projects have been so far completed by the college, through which scientific fish culture technologies are disseminated in the various districts of Vidarbha.
- In all MAFSU, is providing positive learning environment for the students and farmers through teaching, research and extension.

Human resource development:

- The specific scope for human resource development in Vidarbha includes restructuring of staffing pattern of DoF and filling up of the vacant technical positions on priority basis; modernization & strengthening of Fisheries College; establishment of fisheries information and training centre; conducting comprehensive Training Need Assessment (TNA); establishing dedicated, professional and efficient network of extension personnel for reaching taluka and panchayat levels and encompassing all aquaculture and fisheries resources; conducting participatory planning exercise at local resource level/reservoir level/river segment level on management of resource by ensuring environmental and livelihood security; conducting mass awareness and village level awareness programme on the importance of fish biodiversity and

ecosystem health; conduct demonstration of improved aquaculture technologies with due importance to technological, social, environmental and institutional aspects; Strengthening of existing fisheries cooperatives through training of their members on resource management and cooperative management aspects etc.

1.4 Contemporary management and technologies of fisheries in Vidarbha:

Seed production and rearing:

- The success of the inland fisheries and aquaculture development largely depends on the availability of quality seed in sufficient quantities. Currently there are 15 established seed production centres in Vidarbha which produce about 265 million spawn annually (33% of total capacity). Similarly, there are 12 fish seed rearing centres which produce 06 million fish fingerling which is about 11% of the total capacity.
- The requirement of seed is estimated based on the water body area suggested by MRSAC, Nagpur and stocking density is estimated as per recommendation of State Fisheries Department, Government of Maharashtra (GoM). There is a requirement of 30,006 million fish spawn and 165 million fish fingerlings in the Vidarbha. Overall the deficit of 29,735 million fish spawn and 159 million fingerlings is observed in the Vidarbha.
- The strengthening of existing fish seed production and rearing centres and developing dysfunctional and under-performing fish production centres operational to their fullest capacity should be the major initiative to bridge the gap in potential fish seed production and the deficit.
- 05 new hatchery centres with 100% assistance from NFDB need to be established in the Government sector with an additional installed capacity of 100 million spawn/hatchery with rearing space.
- Encouraging installation of portable carp hatcheries in each district at cluster level with technical support from College of Fishery Science (COFS), Nagpur & Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar and funding support from NFDB.
- In the private sector, over a period of 5 years i.e., by 2022-23, it is proposed to encourage setting up of 8 new seed production centres with rearing space for 50 million spawns to cope up with the rising demand of fingerlings.

- There is an urgent need to take up brood stock management and upgradation programme to avoid inbreeding and poor seed quality through use of advance technology like cryopreservation of sperm. In addition, “Fish Seed Industry Policy” should be framed for Maharashtra for bringing the aspects of fish breeding, seed production and marketing under Certification and Licensing System. The facilities in this regard shall be developed by DoF at Fish Seed Production Centres.

Reservoir fisheries:

- The current average fish yield is 21 kg/ha/year, 12 kg/ha/year and 9 kg/ha/year for small, medium and large reservoir respectively which is very meager when compared to the potential. The average untapped potential for the Vidarbha reservoirs is worked out to be 280 kg/ha, which is more than twenty times the current fish yield.
- The proposed intervention plan for the reservoirs are aimed at supplementary stocking with quality fingerlings of Indian Major Carps until a critical mass of breeding population is established in the large reservoirs; creation of adequate rearing space for production of quality fingerlings for stocking; culture based capture fisheries indigenous fish and prawn species in the medium reservoirs and aquaculture practices in small reservoirs; introduction of Co-management regime for the management of reservoir fisheries by involving fishers as active partner in planning; bringing all the reservoirs under scientific fisheries management practices; leasing of reservoirs on long-term; and Human Resource Development (HRD) programmes for fisheries managers and fishers.

Riverine fisheries:

- The Vidarbha region is geographically located in Godavari and Tapi River basins. The majority of Vidarbha region is drained by tributaries of Godavari river (Wainganga, Wardha, Pranhita, Penganga) and partly by tributaries of river Tapi (Khapra, Sipna, Gadga and Dolar along with Purna) at North border of the region. The total length of rivers in Vidarbha is approximately around 6,474 km.
- Formation of riverine fisheries cooperative societies, allocation of fishing rights to traditional riverine fishermen, mainstreaming sustainability, environment and biodiversity concerns by creating awareness and promotion of fisheries co-management regime with fishing communities as partner are some of the initiatives suggested in this study.

- Participatory planning and implementation of conservation/protection and habitat restoration measures including demarcation and declaration of protected areas and issuing biometric identity cards to all inland fishermen (riverine and reservoir fishermen separately) through the State Fisheries Department shall also be contemplated in the Vidarbha.

Pond culture:

- Aquaculture has huge potential for development through both expansion and intensification. As per the estimates derived from the MRSAC data the areas under different water bodies suitable for aquaculture is worked to be 69,321 ha. In this, grow-out fish culture is possible in 187 ha of abandoned quarries, 93 ha of aquaculture ponds, 1629 ha of farm ponds, 59383 ha of lakes, 7925 ha of small tanks & 104 ha of reservoirs below 20 ha. Thus by expanding the aquaculture activity from the present 93 ha to 69,321 ha and promotion of technology backed intensification the total fish production from culture sources can be increase to 1.26 lakh tonnes by the end of the ten year long development programme.
- Carp culture is the backbone of Indian freshwater aquaculture, comprising around 85% of the total freshwater production in Vidarbha. But recently, there is diversification in culture of species such as air breathing catfishes like *Clarius magur* (Magur), pangasius, monosex tilapia and freshwater prawns because of higher consumer preference, high market price etc. In Vidarbha, very few farmers have already under taken up this activity and shifting their way from conventional carp culture to such high yielding varieties.
- Promotion of diversified aquaculture species is important to make this industry ever-growing. Similarly, diversification of aquaculture with the introduction of only legally cleared new species is also encouraged.
- To augment fish productivity levels the quality feed would be a major input. Developing strategies for rigorous training of on-farm feed preparation covering selection of feed ingredients, mixing and formulation needs priority. Setting of 20 units of customized feed mill designs with production capacity of about 100 kg feed in a day (about eight hours) at District headquarters on a pilot basis with subsidy support from NFDB and establishment of commercial small and medium scale feed manufacturing units with daily production capacity of 50-100 tonnes under PPP model with financial support from NFDB is proposed.

1.5 Fish markets and marketing in Vidarbha:

- The fish trading market in Vidarbha is still highly unorganized and unregulated. The Mayo fish market of Nagpur; Bengali camp fish market, Chandrapur; Athawadi bazaar fish market, Yavatmal and Itwara bazaar fish market of Amravati can be easily identified as the core markets of Vidarbha in respect to the fish marketing system.
- Assessment of markets, market channels, margin and market potential reveals that, there is large scale demand for fresh water fishes within Vidarbha and from nearby states.
- Lack of systematic harvesting, poor handling of fishes, fluctuating supply, limited icing and other preservation facilities, delay in supply of fish due to remotely and sporadically located production sites, limited practice of grading leads to low realization of income and critical gap in the value chain. Basic infrastructure like for ice storage, water supply, common weighing facility and facility for storage of fish is not available in most of the fish markets.
- However, in recent years numbers of new markets have been setup by State Government under NFDB scheme in districts namely Nagpur, Bhandara, Gondia, Chandrapur, Amravati and Yavatmal. However, the response from fish marketers is not forthcoming for these newly established markets due to limited space allotted to the marketers, overall invisibility to the consumers and rental charges. At retail level, retailers continue to struggle to get enough space in markets for selling fish. There is need for advocacy effort so that local authorities designate space as per requirement of seller.
- Minimizing involvement of marketing intermediaries by evolving a cooperative fish marketing system with proper price monitoring system is a measure suggested.
- Fish is notified a commodity under the Model Act circulated by union government “The State/Union Territory (UT) Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017”. The Agricultural Produce Market Committee (APMC) Act of the state should follow the same and promote marketing of fish on the lines of APMC. It is also proposed to have Minimum Support Price (MSP) for fish and fishery products.
- The statistics shows that there is a huge demand for pangasius, scampi and tilapia in domestic markets within India and export markets abroad. In view of ensuing growth of fisheries in Vidarbha, it is proposed to establish small scale processing plants through PPP model and NFDB assistance for such species.

- Capacity building of fish producers through technical training on scientific harvesting, handling of fish, icing, smoking, food safety and quality standards should be given due attention. The technical support in this regard can be given by Central Institute of Fisheries Technology (CIFT), Cochin; Central Inland Fisheries Research Institute (CIFRI), Barrackpore; Central Institute of Fisheries Education (CIFE), Mumbai; COFS, Nagpur and College of Fisheries (COF), Ratnagiri.
- Development of a range of value added fish products from freshwater fishes produced in the region and their promotion for Geographical Indications must be undertaken.

1.6 Fisheries business models:

- In Vidarbha, inland fisheries and related businesses have opportunities in each element of the value chain - be it the product, inputs (like seed, feed, credit or crop insurance), farming practices, warehousing, logistics, food processing, or food retail to be developed as business models. This would result in spiraling expansion of fish production and also sustainable livelihood to farmers, cooperative sector, Self Help Groups (SHG), unemployed youth, entrepreneurs etc.
- The fisheries business models suitable for Vidarbha are viz., carp seed production in Fibre Reinforced Plastic (FRP) portable hatcheries, fingerling production model, monosex tilapia culture in farm ponds/aquaculture ponds, grow-out culture of Indigenous catfish (Indian magur), culture of pangasius, polyculture of giant fresh water prawn-Scampi (*Macrobrachium rosenbergii*) and Indian major carps, inland saline aquaculture, fish pickle production unit, fish drying unit, fish retail outlet/co-operative store etc.

1.7 Legislation, Act & Policy:

- Fisheries cannot be considered as a simple economic activity, it is an important means of providing livelihood and food security indirectly to many others dependent on this sector. The expansion of inland fisheries through the reservoir leasing, culture in agriculture farm ponds, introduction cage culture and high yielding fish species has high potential for development in Vidarbha.
- The legislation in Maharashtra Fisheries Act, 1960 and many of the other provisions do not focus on inland fisheries and riverine sector including biodiversity and conservation. Major aspects like restriction on types of fishing gear and mesh size, restriction on size and sex of the fish/shellfish to be caught, closed season, introduction and regulation of invasive and exotic species, declaration of sanctuaries

or protected waters, prohibition on indiscriminate fishing etc. are important for sustainable development of fisheries in inland areas of Vidarbha. However, these aspects are not clearly defined and specified in the earlier legislations.

- The associated responsibility of judicious use and protection of natural resources have made it extremely necessary to enact legislation for regulation of fishing methods, reservoir fisheries management, responsible fisheries in inland water resources etc. Vidarbha region being an inland region the Acts, Rules and Regulations should be focused on the inland fisheries, inland aquaculture, biodiversity, exotics species introduction, safeguarding the traditional fisher's rights, etc.
- Therefore, it is proposed to have a separate "Maharashtra Inland Fisheries and Aquaculture Act" for the Maharashtra State having background of the Indian Fisheries Act, 1897 and the Maharashtra Fisheries Act, 1960.

2. Introduction

2. Introduction

2.1 Present status of fisheries; India, Maharashtra & Vidarbha:

The fisheries sector is an important player in the overall socio-economic development of India. Presently India is the second largest fish producing and second largest aquaculture nation in the world. India is also a major producer of fish through aquaculture and ranks second in the world after China. The total fish production during 2015-16 (provisional) is at 10.79 Million Metric Tonne (MMT) with a contribution of 7.21 MMT from inland sector and 3.58 MMT from marine sector. Fisheries is a sunrise sector with varied resources and potential, engaging over 14.50 million people at the primary level and many more along the value chain. Transformation of the fisheries sector from traditional to commercial scale has led to an increase in fish production from 7.5 lakh tonne in 1950-51 to 107.95 lakh tonne (Provisional) during 2015-16 while the export earnings from the sector registered at Rs. 30,420.83 crore in 2015-16 (US \$ 4.69 billion). The sector contributed about 0.9% to the National Gross Value Added (GVA) and 5.17% to the agricultural Gross Value Product (GVP) (2015-16). Historical scenario of Indian fisheries reveals a paradigm shift from marine dominated fisheries to a scenario where inland fisheries have emerged as a major contributor to the overall fish production in the country. Inland fisheries presently has a share of 66.81% in total fish production of the country. Within inland fisheries there is a shift from capture fisheries to aquaculture during the last two and a half decade. Freshwater aquaculture with a share of 34 percent in inland fisheries in mid-1980s has increased to about 80 percent in recent years. The fisheries sector is the source of livelihood for a large section of economically backward population of the country. Approximately, 14.50 million people in the country are directly or indirectly engaged in fisheries activities for their livelihood (Source: Department of Animal Husbandry, Dairying & Fisheries (DAHD), Annual Report, 2016-17)

In Maharashtra, total 4.50 Lakh people are associated with the fisheries trade, out of which 54,901 are active fishermen engaged mostly in marine sector. (<https://fisheries.maharashtra.gov.in/1113/Fisheries-Resources>). The fishermen population of Vidarbha is 5,72,799 of which approximately 95,265 are members of primary fishermen co-operative societies.

Maharashtra State offers an excellent opportunity particularly in inland fisheries sector because of the vast inland water resources at its disposal. The inland fisheries resources of Maharashtra include 16,000 km rivers and canals, 2,99,000 ha reservoirs &

72,000 ha tanks ponds. During 2015-16, the total fish production of the State was 6.20 lakh tonnes of which 4.71 lakh tonnes was from the marine sector and 1.49 lakh tonnes from the inland sector. (Source: Agriculture Statistics at a glance, 2016). The gross value of marine production and inland fish production was Rs 44,470 crores and 1,455 crores respectively. The export earnings from the fisheries sector in Maharashtra registered at Rs 3,673 crores. (Source: Department of Fisheries, Maharashtra)

Out of the total inland fish production of the Maharashtra State, the Vidarbha accounted for 46% (68,330 tonnes) of fish production during 2015-16. The high magnitude of inland fish production from Vidarbha is because of the numerous water bodies like village tanks, Malguzari talav, lakes & ponds and reservoirs etc. (1,67,679 ha) in Nagpur and Amaravati divisions. (Source: Information collected through questionnaires from District Fisheries Offices in Vidarbha-Annexure D).

The traditional reservoir fishery adopted by fishermen is so far the major source of inland fish production in Vidarbha. However, the rate of growth in terms of potential is not yet achieved. This can be attributed to less focus on sustainable development of inland capture fisheries particularly pertaining to reservoirs in the past; increasing pressure on the resources, including habitat degradation; and multiple-use of inland water-bodies with least priority to fisheries requirements. Keeping in view the vast potential of underutilized resources, immediate measures to intensify the fisheries activities in Vidarbha must be taken up seriously.

2.2 Strength, Weakness, Opportunity and Threats (SWOT) analysis of fisheries sector of Vidarbha:

Area	Strength	Weakness	Opportunities	Threats	Actionable recommendations
1	2	3	4	5	6
Resources	Large resource base in the form of farm ponds, malguzari talav, lake, tanks & ponds and reservoirs	<ul style="list-style-type: none"> • Under-utilization/Un-utilization of freshwater resources for inland fisheries and aquaculture. 	<ul style="list-style-type: none"> • Utilization of the resources by adoption of scientific improved fisheries and aquaculture technologies. 	<ul style="list-style-type: none"> • Poor technical skills of fish culturists. • Multi-ownership of water bodies. • Inadequate technical manpower in the fisheries department. 	<ul style="list-style-type: none"> • Formulation and implementation of training and demonstration programmes for fish culturist. • Involvement of DoF in development of all types of waterbodies. • Utilization of skills of professional fisheries graduates.
Fisheries cooperative society	Good linkage of Fisheries Cooperative Societies in the region	<ul style="list-style-type: none"> • Poorly managed cooperative societies. • Inland fisheries is not treated at par with Agriculture in the context of taxes, electricity tariff etc. • Scientific and rational criteria are not followed for fixing lease period and lease amount of the waterbodies. 	<ul style="list-style-type: none"> • Scope of fisheries development through involvement of fisheries cooperatives in planning, decision making and implementation of programmes. • Inland fisheries should be given status at par with agriculture sector. • Revision of leasing rights policy. 	<ul style="list-style-type: none"> • Conflicts among the members. • Less adoption of newer technologies. • Poor technical skills and financial management. • Increasing dominance of political factions in cooperative societies. • Concurrence of fishermen cooperative societies on leasing rights policy guidelines. 	<ul style="list-style-type: none"> • Programmes to promote inclusiveness in cooperative society management. • Awareness and demonstrations on modern technologies. • Capacity building programmes for members of the society. • Social, economical and sectoral problems of the cooperatives need to be addressed on urgent basis. • Revision in existing leasing policy.

Area	Strength	Weakness	Opportunities	Threats	Actionable recommendations
1	2	3	4	5	6
Production potential	Excellent fisheries production potential from available resources	<ul style="list-style-type: none"> • Aquaculture technology is not adopted by farmers leading to meager production levels. • Low production from small, medium and large reservoir viz., 21 kg/ha/year, 12 kg/ha/year and 9 kg/ha/year respectively. 	<ul style="list-style-type: none"> • Intensification in aquaculture sector and to raise production level upto 4 to 5 tonnes/ha. • Potential to increase production moderately up to 210 kg/ha/year, 120 kg/ha/year and 90 kg/ha/year for small, medium and large reservoirs respectively. 	<ul style="list-style-type: none"> • Dependency for quality seed, feed and other inputs on State agencies. • Less adoption of scientific technologies and management. • Under stocking of desirable fish species and stocking of undesirable species. • Irrational use of resources. 	<ul style="list-style-type: none"> • Upgradation of existing seed production facilities & promotion of private entrepreneurs and industry. • Formulation and implementation of need based skill development programmes for intensification of aquaculture and sustainable development of reservoir fisheries. • Creation of adequate rearing spaces in the vicinity of reservoir for raising seed upto fingerling size.
Institutional network	Strong institutional framework of fisheries and related departments	<ul style="list-style-type: none"> • Department of Fisheries is inherently understaffed. • More administrative work and less technical work entrusted to DoF personnel. • Lack of capacity development programme for DoF personnel. • Weak extension network • Weak coordination of line department and other department viz., Water Resource, Revenue, Forest etc. 	<ul style="list-style-type: none"> • Restructuring and filling of vacant posts. • Separation of administrative and technical wing in DoF. • Presence of capacity building institutes such as CIFE, Mumbai; MAFSU, Nagpur; RAMETI, Nagpur; VANAMATI, Nagpur; YASHADA, Pune etc. • Creation of fisheries extension wing in the department. 	<ul style="list-style-type: none"> • Financial burden on State • Delayed recruitment of technical staff in DoF. • Ineffective programmes implementation at field level. • Inability of administration to depute DoF personnel to training. • Lack of professionalism • Less motivation towards extension. 	<ul style="list-style-type: none"> • Filling up of all sanctioned technical posts of DoF in Vidarbha on priority basis. • The restructuring of the staff positions in DoF at par with agriculture and allied sectors. • Creation and filling up of posts of fisheries extension officers in DoF. • Formation of Regional Co-ordination Committee (RCC) for vigorous fisheries development of Vidarbha.

Area	Strength	Weakness	Opportunities	Threats	Actionable recommendations
1	2	3	4	5	6
Legislation, Act and Policy	Existence of basic legislations viz. Indian Fisheries Act, 1897 and Maharashtra Fisheries Act, 1960 and GoM Government Resolution (GR) on Fishing Rights of Irrigation Tanks And Reservoirs	<ul style="list-style-type: none"> Existing legislation in Maharashtra focused on Marine sector. Less inclusiveness in policy guidelines. 	<ul style="list-style-type: none"> Review of existing legislations taking into consideration present needs of Inland fisheries and aquaculture in Vidarbha. Framing up of robust, holistic and inclusive Inland fisheries legislation. 	<ul style="list-style-type: none"> Conformity among policy makers, administrators and stakeholders in enacting a new legislation focusing more on Inland fisheries sector. 	<ul style="list-style-type: none"> Formulation of Maharashtra Inland Fisheries and Aquaculture Act on priority.

2.3 Potential of fisheries in Vidarbha:

The Vidarbha has vast and varied inland fisheries and aquaculture resources which are mostly underutilized. The major fisheries resources are in the form of network of rivers & rivulets, reservoirs, village ponds & tanks, malguzari talav and farm ponds. At present, both reservoirs and freshwater aquaculture in ponds and tanks are the two main pillars for future growth of inland fish production of Vidarbha as well as Maharashtra state.

Vidarbha has huge aquaculture potential for development through both expansion and intensification. The fish culture in ponds is being practiced in majority of community tanks, village ponds, government tanks, or privately owned farms. The average fish production from these culture practices is very meager as compared to the national average of 2.9 tonnes/ha/year. This production can be increased to the tune of 4-5 tonnes/ha/year by adopting improved farming practices. In order to achieve these production levels, proper inputs in terms of quality seed, feed, health management and marketing support are necessary. The diversification of species under culture is also very important to make culture fishery vibrant and ever-growing. The candidate species having high production and market potential such as pangasius species, native catfishes (Magur and Singhi), monosex tilapia and giant freshwater prawn (*Macrobrachium sp.*) needs to be promoted as per government guidelines.

In Vidarbha reservoirs, offers huge resources and untapped production potential for incremental growth in fish production and overall development in Inland fisheries sector. The fish production statistics from reservoirs of Vidarbha is inaccurate. Nevertheless, it has been established that fish yield from reservoir fisheries in Maharashtra is poor, varying from 21kg/ha/year, 12 kg/ha/year and 9 kg/ha/year for small, medium and large reservoir. The similar trend of fish yield is observed in Vidarbha too. The production potential of small, medium and large reservoir is 500, 250 and 100 kg/ha/year respectively (Handbook of Fisheries and Aquaculture, Indian Council of Agriculture Research (ICAR), New Delhi). There is huge gap between actual production and potential from reservoirs of Vidarbha. Thus, with scientific reservoirs management (stocking with quality fingerlings of Indian Major Carps (IMC), creation of adequate rearing space for production of quality fingerlings for stocking and continuous programme for Human Resources Development (HRD) of reservoir fisheries managers and fishers) this production gap can be reduced. With these measures there is potential to increase annual fish production moderately up to 210 kg/ha/year, 120 kg/ha/year and 90 kg/ha/year for small, medium and large reservoirs respectively.

Overall, various programmes aimed at production and distribution of quality seed and feed for fish culture in ponds and tanks and also for reservoir fisheries, are essential to optimize production and productivity from inland fisheries and aquaculture in the Vidarbha. Today, these vast underutilized resources offer enormous potential to boost the fish production and opportunities of livelihood to the unemployed youth and emerging entrepreneurs of the Vidarbha.

2.4 Objective of action plan:

- Quantitative and qualitative appraisal of district wise fish & fishery resources of Vidarbha.
- To document the institutional framework, the linkages and identify the undermining factors of fisheries development in the region
- To document contemporary management technologies as well as marketing infrastructure and forward linkages of fisheries.
- To suggest business models, legislation act and policies for conservation, management and development of fisheries.
- To identify the intervention by State Government.

2.5 Methodology for preparation of action plan:

The present study was carried out in two divisions namely Nagpur and Amravati covering 11 district of Vidarbha. The specific methodology included consultations meets with all the concerned agencies, formulation of questionnaires, survey of seed production & rearing centres, fisheries cooperative societies and fish markets through field visits, collection of data like primary and secondary baseline data of available resources from government agencies viz. District Administration, State Fisheries Department, Irrigation Department, Zilla Parishad, seed stocking data, fish production data and mapping of seasonal and perennial water bodies resources in consultation with Maharashtra Remote Sensing and Application Center (MRSAC).

The detailed methodology employed to assess data on water resources, institutional framework (survey of seed production & rearing centres, fisheries cooperative societies), markets and marketing system in Vidarbha is mentioned separately in respective chapters.

The list of stakeholders interviewed and/or accessed for information is provided separately in Annexure II. The secondary data sources referred in preparation of action plan are mentioned separately in the reference section.

3. Mapping of inland water bodies of Vidarbha

3. Mapping of inland water bodies of Vidarbha

3.1 Introduction:

Vidarbha is located right at the heart of the Indian Union occupying 45,868 Sq. Km. area between 19°05' to 21°47' North latitude and 75°59' to 79°11' East Longitude. The Vidarbha region is surrounded by Madhya Pradesh in the North, Chattisgarh in the East, remaining part of Maharashtra in the West and Karnataka in the South. Vidarbha is endowed with rich natural resources in the form of forests, minerals, rivers and dotted by manmade reservoirs and malguzari talav. Till date there was no reliable database of the water resources from Vidarbha which was a main hurdle in planning, development, sustainable utilization and conservation of available resources. Therefore, need was felt to thematically identify the different types of water bodies scattered over the region using Geographic Information System (GIS) and Remote Sensing (RS) tools for developing the database of waterbodies for development of fisheries sector in the region. The technical support in this regard was received from Maharashtra Remote Sensing and Application Center (MRSAC), Nagpur.

3.2 Materials and Methods:

The IRS-P6 & LISS-III post monsoon and pre-monsoon satellite data of MRSAC, Nagpur for the year 2015-16 was used for the present study. The MRSAC mapped and categorized different water bodies in the Vidarbha and also developed GIS of these water bodies. The methodology adopted is given in Figure 1.

The total water spread area and the related numbers of all the different types of water bodies (abandoned quarries with water, cooling pond/cooling reservoir, aquaculture pond, farm pond, lakes/ponds, reservoir, tanks) were mapped using post monsoon satellite imagery. The perennial water bodies including water spread area and the related number were mapped using pre monsoon satellite imagery. The seasonal water bodies including water spread area and the related number were deduced by subtracting the perennial water spread area and the related numbers of water bodies from the total water spread area and number of water bodies.

Hence, in the report all the tables showing the total water body in all cases depicts the total water spread area cover in the post monsoon season. Whereas, the seasonal water body area cover depicts the area cover of post monsoon season excluding the area cover of perennial water bodies in the premonsoon season. This was necessary for quantitative and qualitative analysis of water resource from Vidarbha.

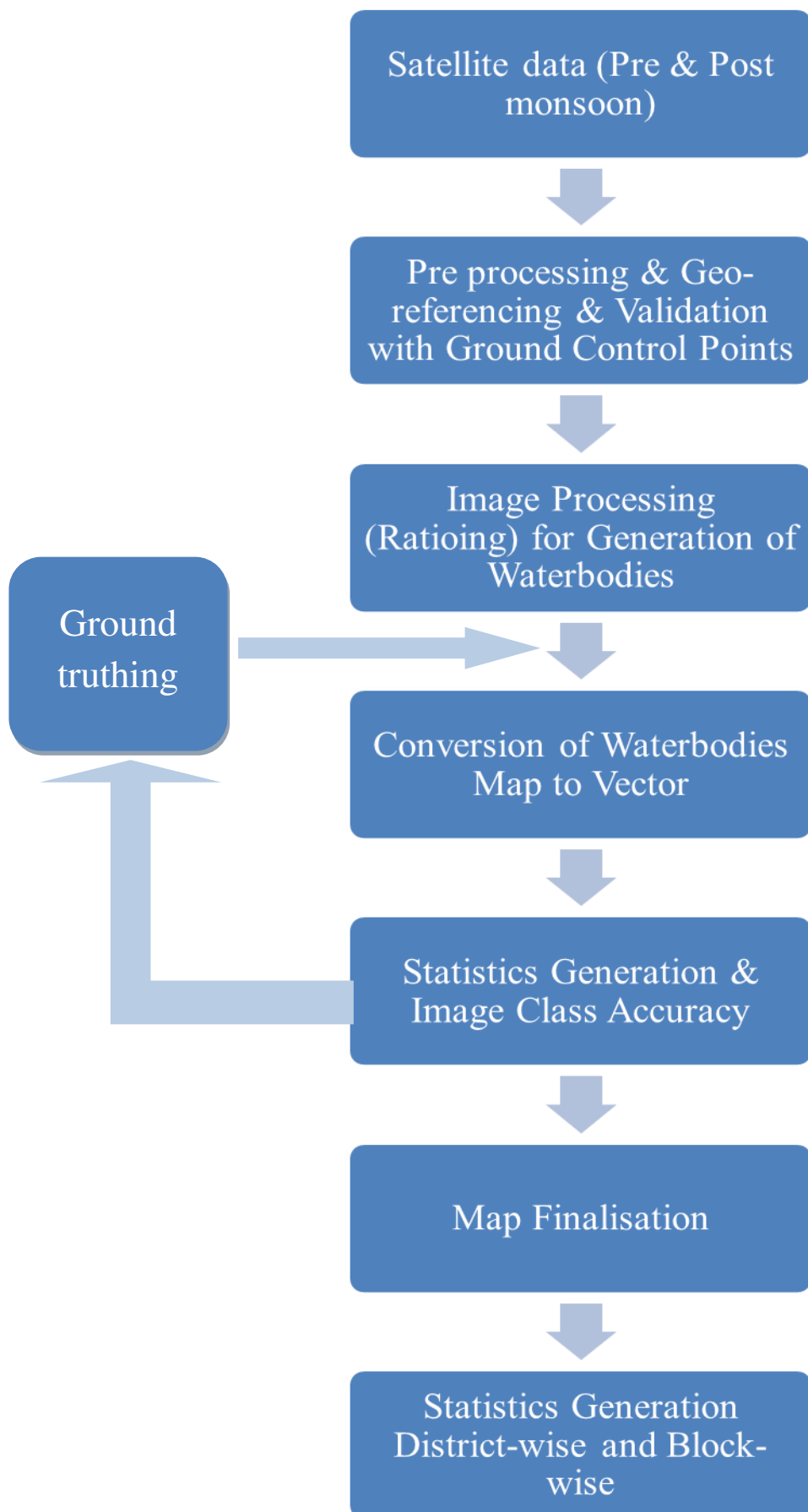


Fig. 1. Schematic diagram for mapping and development of GIS

The waterbodies were mapped with different categories of area (0.02-1 ha, 1-5 ha, 5-20 ha, 20-50 ha, 50-200 ha, 200-500 ha, 500-1000 ha, 1000-5000 ha and 5000 ha & above) during pre and post monsoon season and assigned the seasonal and perennial status.

It was observed that the categorization of water bodies based on water spread area changes during post monsoon and pre monsoon seasons. The water bodies fill to their brim during post monsoon season and are allotted in the higher water spread area category. While during the premonsoon season the same water body shrinks and falls in the category of waterbodies with lower water spread area.

For example, water body under the category 5000 ha & above, which is actually a perennial water body but listed in the seasonal waterbody category because of its shrinkage. The water spread area of this water body has shrunk in the summer below the range of its previously allotted category (i.e. 5000 ha & above) to a newer category of 1000-5000 ha. Refer Table no. 1 and Fig no. 2 example of shrinkage and enumeration of waterbodies.

Table 1. Example of shrinkage and enumeration of waterbodies (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
1000-5000	2	2,500	2	2,500	1	4,500
5000-Above	1	6,000	1	6,000	0	0

Source: MRSAC and Focused Group Discussion (FGD) among researcher

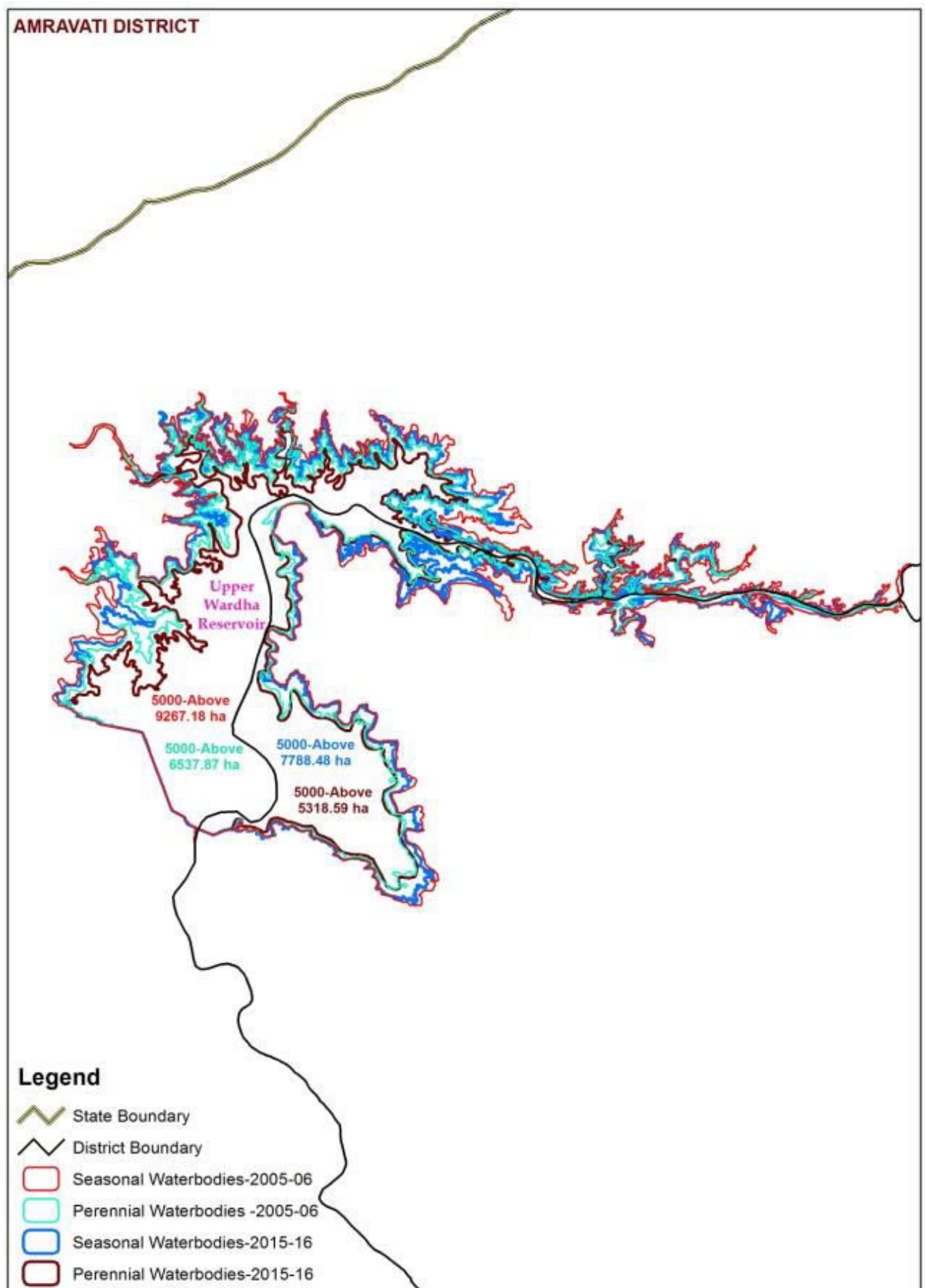


Fig. 2. Example of shrinkage and enumeration of waterbodies

The water bodies were classified type wise into following categories abandoned quarries, cooling pond, aquaculture ponds, farm ponds, lakes/ponds, reservoir and tanks. (Source: National Wetland Atlas: Maharashtra, Government of India, May 2010). The definitions of type of waterbodies classified according to shape and other criteria used in the study are given below:

- **Abandoned Quarries** Industrial ponds/mining pools mainly comprising an open or surface working or excavation for the extraction of stone, ore, coal, gravel or minerals. Texture is rough and tonal appearance light.
- **Cooling pond:** An artificial lake used for the natural cooling of condenser-cooling water serving a conventional power station. These ponds can be of any shape and size. Texture is rough and tonal appearance blue shade.
- **Aquaculture ponds:** Ponds which are geometrical in shape usually square or rectangular. Tone is blue.
- **Farm ponds:** Ponds which are geometrical in shape usually square or rectangular but smaller in size as compared to aquaculture ponds and are built in the agriculture/horticulture farms. Tone is blue.
- **Lakes/Ponds:** Larger bodies of standing water occupying distinct basins. These wetlands occur in natural depressions and normally fed by streams/rivers. On satellite images lakes appear in different hues of blue interspersed with pink (aquatic vegetation), islands (white if unvegetated, red in case of terrestrial vegetation). Vegetation if scattered make texture rough. **Ponds:** Generally, suggest a small, quiet body of standing water, usually shallow enough to permit the growth of rooted plants from one shore to another.
- **Reservoir:** A lake built for the storage of water, usually by the construction of a dam across a river. On RS images, reservoirs have irregular boundary behind a prominent dyke. Wetland boundary in case of reservoir incorporates water, aquatic vegetation and footprint of water as well. Tone is dark blue in deep reservoirs while it is ink blue in case of shallow reservoirs or reservoirs with high silt load.
- **Tanks:** A term used for an artificial pond, pool or lake formed by building a mud wall across the valley of a small stream to retain the monsoon. Tanks appear in light blue colour showing bottom reflectance.

The fisheries and aquaculture management of waterbodies depends on the type of water body and its water spread area. Therefore, in the present study, the data on waterbodies and their types was used for the qualitative assessment of fisheries resources of Vidarbha.

3.3 Water bodies in Vidarbha:

Utilizing the 2015-16 satellite data, total 30,650 number of waterbodies with 1,87,249 ha water spread area were mapped by MRSAC of which 28,625 were seasonal (1,01,410 ha) and 2,025 were perennial (85,839 ha) water bodies. The maximum numbers of waterbodies were documented in Chandrapur district, followed by Gondia, Gadchiroli, Buldhana and Akola districts; whereas, the maximum water spread area was found to be under Nagpur district followed by Yavatmal, Chandrapur, Gondia and Amravati districts. The large water bodies with area more than 5000 ha & above, are found in four districts namely Nagpur, Amravati, Gondia and Yavatmal. The details of district wise seasonal and perennial water bodies mapped in the Vidarbha region are given in Table 2.

Table 2. District wise distribution of seasonal and perennial water bodies in Vidarbha region (2015-16)

District name	No. of waterbodies	Total area (Ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Nagpur	2,673	35,958	2,472	16,743	201	19,216
Bhandara	2,068	9,232	1,880	6,698	188	2,534
Gondia	4,052	22,825	3,722	14,284	330	8,542
Gadchiroli	3,738	7,292	3,554	5,996	184	1,296
Chandrapur	5,547	25,429	5,213	15,578	334	9,852
Wardha	1,134	10,571	1,049	5,096	85	5,475
Total	19,212	1,11,308	17,890	64,394	1,322	46,914
Amravati	2,409	16,010	2,316	8,332	93	7,678
Akola	2,829	5,836	2,791	4,198	38	1,638
Washim	1,596	8,026	1,453	5,149	143	2,877
Buldhana	2,859	14,015	2,601	8,317	258	5,698
Yavatmal	1,745	32,054	1,574	11,020	171	21,034
Total	11,438	75,941	10,735	37,015	703	38,926
Grand total	30,650	1,87,249	28,625	1,01,410	2,025	85,839

Source: MRSAC

According to the category wise distribution of waterbodies in Vidarbha region, it is observed that 99% are smaller water bodies under the category of 0.02-1 ha, 1-5 ha, 5-20 ha & 20-50 ha; which are 32% of total water spread area. On the contrary, 1% of waterbodies are under the categories of 50-200 ha, 200-500 ha, 500-1000 ha, 1000-5000 ha and 5000 ha; account for 68% of the total water spread area in Vidarbha. The category wise distribution of seasonal and perennial water bodies in Vidarbha region is given in Table 3.

Table 3. Category wise distribution of seasonal and perennial water bodies in Vidarbha region (2015-16)

Category (Ha)	No. of waterbodies	Total area (Ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	21,816	5,337	21,799	5,323	17	14
1-5	5,522	12,917	4,757	10,601	765	2,317
5-20	2,324	22,222	1,458	13,440	866	8,783
20-50	634	19,947	398	12,743	236	7,204
50-200	265	23,535	172	14,738	93	8,797
200-500	50	16,006	23	7,655	27	8,351
500-1000	17	12,857	10	8,547	7	4,310
1000-5000	17	37,556	7	13,624	10	23,932
5000 & above	5	36,871	1	14,738	4	22,133
Total	30,650	1,87,249	28,625	1,01,410	2,025	85,839

Source: MRSAC.

According to the type wise distribution of the waterbodies, it is found that the maximum number of abandoned quarries with water is observed in Nagpur district (58%); cooling pond/cooling reservoirs (64%), aquaculture ponds (29%) and farm ponds (20%) in Chandrapur district; lakes/ponds (25%) in Gondia district; reservoirs (18%) and tanks (24%) in Nagpur district. The type wise distribution of seasonal and perennial water bodies in Vidarbha is given in Table 4.

Table 4. Type wise distribution of seasonal and perennial water bodies in Vidarbha (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	462	622	462	622	-	-
Aquaculture pond	343	89	343	89	-	-
Cooling pond/Cooling reservoir	290	93	290	93	-	-
Farm Pond	14,166	1,810	14,166	1,810	-	-
Lakes/Pond	11,849	60,418	10,313	44,575	1,536	15,844
Reservoir	200	1,16,292	14	47,896	186	68,396
Tank	3,350	7,925	3,047	6,326	303	1,599
Total	30,660*	1,87,249	28,635	1,01,410	2,025	85,839

Source: MRSAC.

Note: As suggested by MRSAC *10 seasonal waterbodies (area 0.13 ha) are added to 30650 in district wise and category wise distribution of waterbodies in Vidarbha

As mentioned earlier, the qualitative assessment of fisheries sector in Vidarbha is done based on data on type wise water bodies provided by MRSAC, Nagpur. The block wise data provided by MRSAC (2015-16) will help in planning of fisheries and aquaculture activities for each block in 11 districts of Vidarbha. Similarly, the quantitative analysis of the data on block wise and type wise distribution of seasonal and perennial water bodies in different districts of Vidarbha region was also carried out.

Further, it is stated that since 2015-16 onwards to till date, the additional water spread area has been developed in Vidarbha under various programmes initiated by the State Government of Maharashtra viz., “Magel Tyala Shet Tale”, “Jal Yukt Shivar Abhiyan”, “Amrut Kund Shet Tale” etc. However, to assess the suitability of these water bodies for fisheries and aquaculture a detailed assessment in near future needs to be planned.

3.4 Block, category and type wise distribution of water bodies in Vidarbha:

A. Nagpur Division:

District: Nagpur

Nagpur district, the second capital of Maharashtra is located in the eastern part of the State of Maharashtra and lies between 20° 30' and 21° 45' North latitude and 78° 15' and 79° 40' East longitude covering an area of about 9,864 km². It is bounded on the north by Chindwada district of Madhya Pradesh, on the east by Bhandara, on the South by Chandrapur and on the west by Wardha and Amravati district of Maharashtra. The district has been divided into 14 Administrative Sub-units (tahsils). They are Nagpur, Nagpur (Rural), Kamptee, Hingna, Katol, Narkhed, Saoner, Kalmeshwar, Ramtek, Parseoni, Mauda, Umrer, Kuhi and Bhiwapur. There are 1,869 villages and 29 towns in the district. According to the 2011 census, the population of Nagpur district is 46,53,570.

Total 2,673 number of waterbodies with 35,958 ha water spread area are mapped; of which 2,472 are seasonal (16,742 ha) and 201 are perennial (19,216 ha) water bodies. Waterbodies map of Nagpur district is given in Fig 3. The district is having 24% of tanks, 57% of abandoned quarries, 21% of cooling ponds and 18% of reservoirs in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Nagpur district are given in Table 5. Further, the category wise details of the seasonal and perennial waterbodies in Nagpur district are given in Table 6 and the type wise distribution of seasonal and perennial water bodies in Vidarbha region is given in Table 7.

Table 5. Block wise distribution of seasonal and perennial water bodies mapped in Nagpur district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Bhiwapur	247	1,362	233	1,066	14	296
2	Hingna	170	891	157	576	13	315
3	Kalameshwar	166	1,139	156	583	10	557
4	Kamptee	32	947	30	886	2	61
5	Katol	144	1,393	110	768	34	625
6	Kuhi	386	5,099	373	1,430	13	3,669
7	Mauda	83	236	78	170	5	65
8	Nagpur (Rural)	226	3,990	214	2,200	12	1,790
9	Nagpur (Urban)	27	401	24	158	3	243
10	Narkhed	123	512	111	263	12	249

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
11	Parseoni	154	2,706	149	1,024	5	1,681
12	Ramtek	594	11,943	548	3,926	46	8,017
13	Savner	133	1,101	122	466	11	635
14	Umred	188	4,238	167	3,225	21	1,012
Total		2,673	35,958	2,472	16,742	201	19,216

Table 6. Category wise details of the seasonal and perennial waterbodies in Nagpur district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	1,876	505	1,875	504	1	1
1-5	458	1,082	374	824	84	258
5-20	234	2,206	165	1,518	69	688
20-50	51	1,617	29	859	22	758
50-200	36	3,755	22	2,378	14	1,377
200-500	9	2,953	3	955	6	1,997
500-1000	3	1,783	3	1,783	0	0
1000-5000	5	14,501	1	5,510	4	8,992
5000-Above	1	7,556	0	2,412	1	5,145
Total	2,673	35,958	2,472	16,743	201	19,216

Table 7. Type wise distribution of seasonal and perennial water bodies in Nagpur district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	267	227	267	227	0	0
Aquaculture pond	6	8	6	8	0	0
Cooling pond/Cooling reservoir	50	24	50	24	0	0

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Farm Pond	1,155	225	1,155	225	0	0
Lakes/Pond	341	4,739	251	3698	90	1,042
Reservoir	36	28,814	0	10,931	36	17,883
Tank	818	1,921	743	1,630	75	291
Total	2,673	35,958	2,472	16,742	201	19,216

District: Bhandara

The district of Bhandara in the North-Eastern extreme of the Nagpur division of Maharashtra State lies between 20° 39' to 21° 38' north latitudes and 79° 27' to 80° 42' east longitudes covering an area of about 3,890 km². The district is bounded by the Balaghat district of Madhya Pradesh in the north, the Gondia district in the east, Chandrapur district in the south and Nagpur district in the west. The river Wainganga and its tributaries Bagh and Bavantari rivers, form the northern boundary of the district. The district has a population of 12,00,334 in 7 blocks (Census 2011). Bhandara district is situated to the north east of Maharashtra and is considered as rice bowl of the state. It, along with adjoining Gondia district (which has been carved out of Bhandara), have innumerable water tanks known as 'malguzari' talav for paddy cultivation.

Total 2,068 number of waterbodies with 9,232 ha water spread area are mapped; of which 1,880 are seasonal (6,698 ha) and 188 are perennial (2,534 ha) water bodies. Waterbodies map of Bhandara district is given in Fig 4. The district is having 10 % of lakes/ponds in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Bhandara district are given in Table 8. Further the category wise details of the seasonal and perennial waterbodies in Bhandara district are given in Table 9 and the type wise distribution of seasonal and perennial water bodies in Bhandara district is given in Table 10.

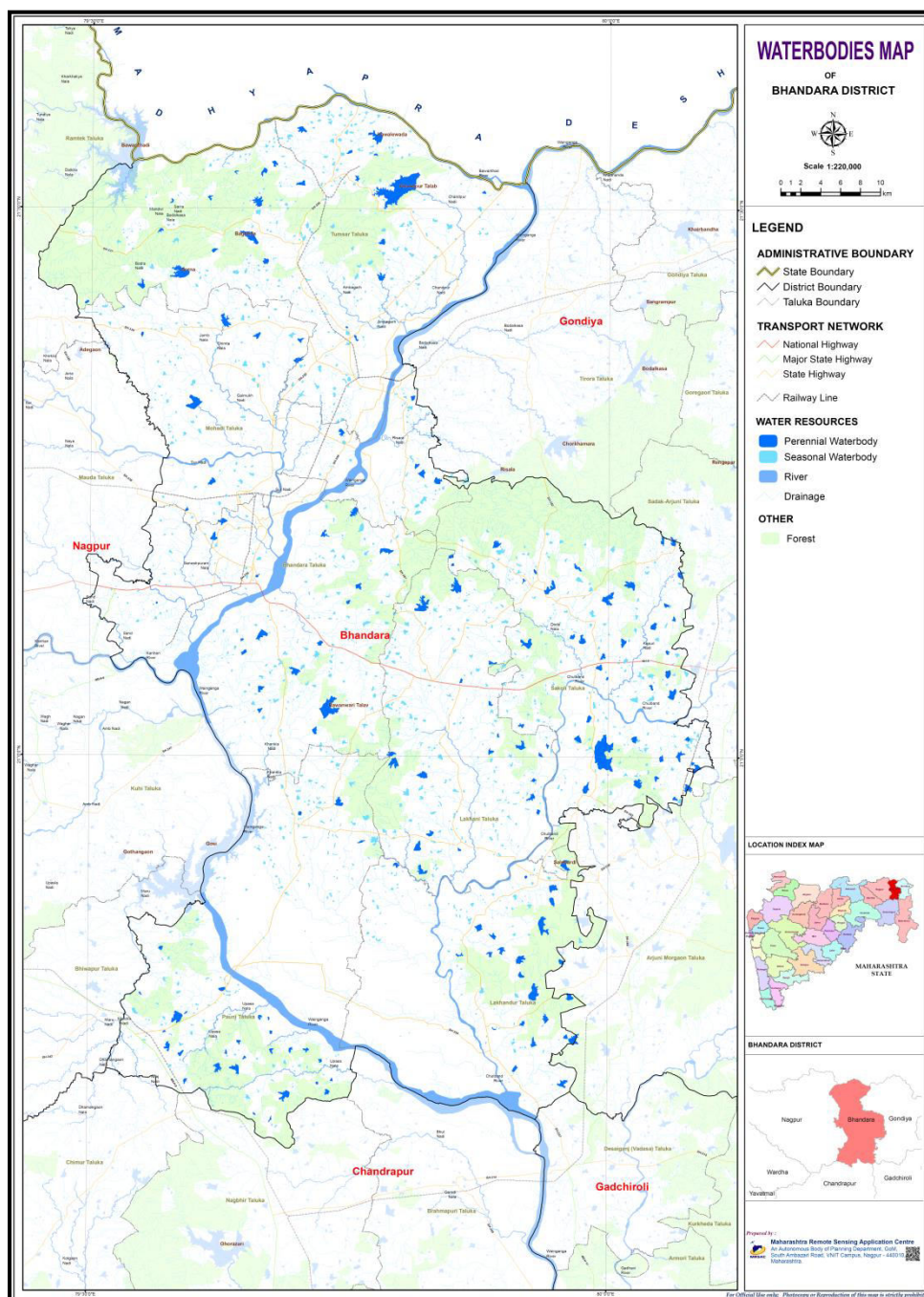


Fig. 4. Waterbody map of Bhandara district

Table 8. Block wise distribution of seasonal and perennial water bodies mapped in Bhandara district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Bhandara	250	1,115	231	824	19	291
2	Lakhandur	147	904	132	712	15	192
3	Lakhani	270	1,185	242	873	28	312

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
4	Mohadi	276	836	254	643	22	193
5	Pauni	287	962	262	733	25	228
6	Sakoli	329	2,090	288	1,488	41	602
7	Tumsar	509	2,139	471	1,424	38	716
Total		2,068	9,232	1,880	6,698	188	2,534

Table 9. Category wise details of the seasonal and perennial waterbodies in Bhandara district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	979	350	979	350	0	0
1-5	725	1,736	663	1,535	62	200
5-20	276	2,564	177	1,589	99	975
20-50	65	1,985	42	1,298	23	687
50-200	21	1,604	18	1,244	3	360
200-500	1	408	0	97	1	311
500-1000	1	585	1	585	0	0
Total	2,068	9,232	1,880	6,698	188	2,534

Table 10. Type wise distribution of seasonal and perennial water bodies in Bhandara district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	3	6	3	6	0	0
Aquaculture pond	34	13	34	13	0	0
Cooling pond/Cooling reservoir	1	0.4	1	0.4	0	0
Farm Pond	391	49	391	49	0	0
Lakes/Pond	1,402	6,945	1,235	5,302	167	1,644
Reservoir	9	1,771	0	935	9	835
Tank	228	448	216	393	12	55
Total	2,068	9,232	1,880	6,698	188	2,534

District: Gondia

The district of Gondia in the North-Eastern extreme of the Nagpur division of Maharashtra State lies between 20° 39' 22'' to 21° 38' 35'' north latitudes and 79° 47' 32'' to 80° 41' 12'' east longitudes covering an area of about 5,431 km². The district is bounded by the Balaghat district of Madhya Pradesh in the north, the Rajnandgaon district of Chhatisgarh in the east, Chandrapur district in the south and Bhandara district in the west. The river Wainganga and its tributaries Bagh, Pangoli and Bavantari rivers, form the northern boundary of the district. The district has 8 tahsils. The population in Gondia district is 13,22,507 (2011 Census).

Total 4,052 number of waterbodies with 22,825 ha water spread area are mapped; of which 3,722 are seasonal (14,284 ha) and 330 are perennial (8,542 ha) water bodies. Waterbodies map of Gondia district is given in Fig 5. The district is having 25 % of lakes/ponds, 11% of aquaculture ponds and 10% of reservoirs in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Gondia district are given in Table 11. Further the category wise details of the seasonal and perennial waterbodies in Gondia district are given in Table 12 and the type wise distribution of seasonal and perennial water bodies in Gondia district is given in Table 13.

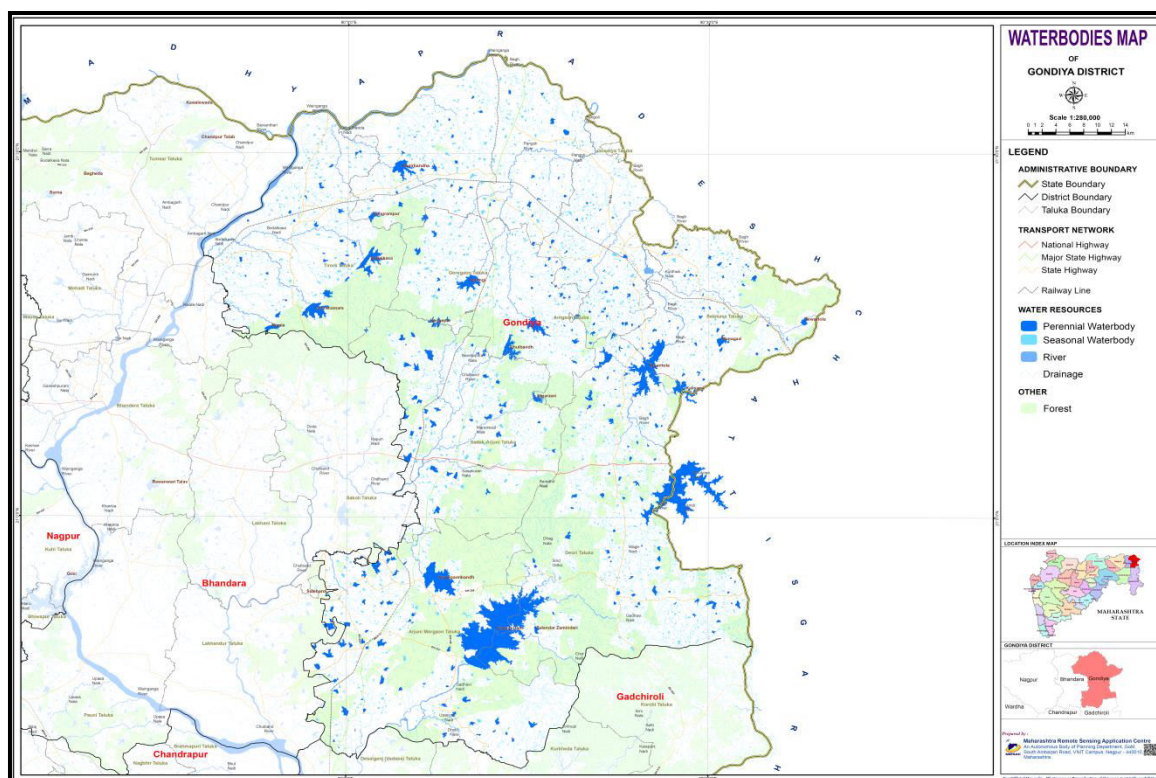


Fig. 5. Waterbody map of Gondia district

Table 11. Block wise distribution of seasonal and perennial water bodies mapped in Gondia district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Amgaon	446	775	417	633	29	142
2	Arjuni Morgaon	487	9,344	428	3,695	59	5,648
3	Deori	810	3,876	754	2,999	56	876
4	Gondia	507	1,831	457	1,553	50	278
5	Goregaon	427	2,048	394	1,431	33	617
6	Sadak-Arjuni	450	1,824	397	1,348	53	476
7	Salekasa	497	1,179	475	992	22	187
8	Tirora	428	1,948	400	1,631	28	317
Total		4,052	22,825	3,722	14,284	330	8,542

Table 12. Category wise details of the seasonal and perennial waterbodies in Gondia district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	2,379	946	2,374	942	5	4
1-5	1,214	2,734	1,017	2,147	197	587
5-20	359	3,370	261	2,444	98	926
20-50	69	2,114	52	1,624	17	490
50-200	20	1,795	11	973	9	821
200-500	7	2,537	5	2,026	2	510
500-1000	1	731	0	78	1	653
1000-5000	2	2,471	1	2,078	1	4,549
5000-Above	1	6,127	1	6,127	0	0
Total	4,052	22,825	3,722	14,284	330	8,542

Table 13. Type wise distribution of seasonal and perennial water bodies in Gondia district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	1	0.1	1	0.1	0	1
Aquaculture pond	66	11	66	11	0	66
Cooling pond/Cooling reservoir	0	0	0	0	0	0
Farm Pond	740	108	740	108	0	740
Lakes/Pond	2,919	9,390	2,623	7,624	296	2,919
Reservoir	20	12,896	1	6,181	19	20
Tank	306	420	291	359	15	306
Total	4,052	22,825	3,722	14,284	330	4,052

District: Gadchiroli

Gadchiroli is located in the Southeastern part of the State of Maharashtra and lies between $18^{\circ} 18'$ to $20^{\circ} 20'$ North latitude and $79^{\circ} 45'$ to $80^{\circ} 54'$ East longitude covering an area of about $14,412 \text{ km}^2$. The district was formed Chandrapur district. It is bounded on the north by Bhandara district on the east by Rajnandgaon and Bastar districts of Chhatisgarh, on the South by Karimnagar and Adilabad districts of Andhra Pradesh and on the West by Chandrapur district. Wainganga and Pranhita rivers form the entire western boundary of the district separately it from the Chandrapur district. The district has been divided into 12 Administrative Sub-units (tahsils) namely Gadchiroli, Chamorshi, Dhanora, Kurkheda, Armori, Sironcha, Aheri, Desaignanj, Korchi, Mulchera, Bhamragad and Etappli. There are 2 towns and 1,679 villages in the district. Total population of the district according to 2011 census was 10,72,942.

Total 3,741 number of waterbodies with 7,292 ha water spread area are mapped; of which 3,557 are seasonal (5,996 ha) and 184 are perennial (1,296 ha) water bodies. Waterbodies map of Gadchiroli district is given in Fig 6. The district is having 24 % of lakes/ponds in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in the Gadchiroli district are given in Table 14. Further the

category wise details of the seasonal and perennial waterbodies in Gadchiroli district are given in Table 15 and the type wise distribution of seasonal and perennial water bodies in Gadchiroli district is given in Table 16.

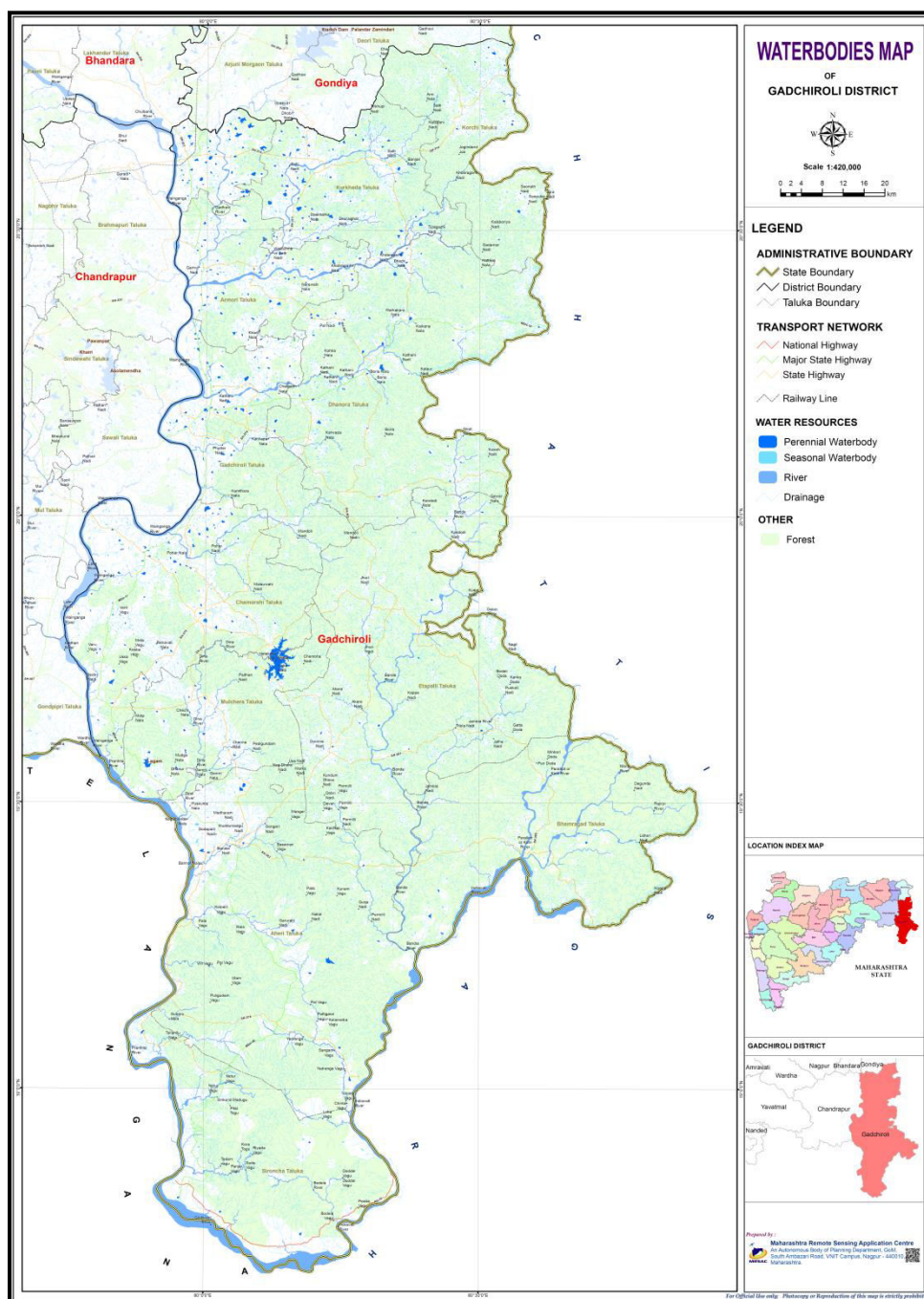


Fig. 6. Waterbody map of Gadchiroli district

Table 14. Block wise distribution of seasonal and perennial water bodies mapped in Gadchiroli district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Aheri	79	324	71	277	8	47
2	Armori	339	707	313	550	26	157
3	Bhamragad	112	150	110	135	2	15
4	Chamorshi	511	742	487	584	24	158
5	Desaiganj (Vadasa)	147	653	121	427	26	225
6	Dhanora	615	739	595	632	20	107
7	Etapalli	621	450	617	442	4	8
8	Gadchiroli	230	629	207	492	23	137
9	Korchi	313	275	306	255	7	20
10	Kurkheda	580	978	546	811	34	168
11	Mulchera	146	1,543	137	1,295	9	248
12	Sironcha	48	101	47	97	1	4
Total		3,741	7,292	3,557	5,996	184	1,296

Table 15. Category wise details of the seasonal and perennial waterbodies in Gadchiroli district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	2,524	973	2,520	970	4	3
1-5	986	2,062	880	1,759	106	303
5-20	188	1,685	121	1,051	67	634
20-50	36	1,086	30	894	6	191
50-200	3	219	2	55	1	165
1000-5000	1	1,267	1	1,267	0	0
Total	3,738	7,292	3,554	5,996	184	1,296

Table 16. Type wise distribution of seasonal and perennial water bodies in Gadchiroli District (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	1	1	1	1	0	0
Aquaculture pond	11	2	11	2	0	0
Cooling pond/Cooling reservoir	0	0	0	0	0	0
Farm Pond	630	77	630	77	0	0
Lakes/Pond	2,868	5,683	2,689	4,607	179	1,076
Reservoir	2	1,356	0	1,146	2	210
Tank	229	173	226	162	3	10
Total	3,741	7,292	3,557	5,996	184	1,296

District: Chandrapur

Chandrapur district is located in the eastern part of the Maharashtra State and lies between 78° 48' to 79° 59' East latitudes and 19° 27' to 20° 43' North longitudes, covering an area of about 11,443 km². The district is bounded by Nagpur, Bhandara and Wardha districts on the north, Gadchiroli district on the east, Yavatmal district on the west and Adilabad district of Andhra Pradesh on the south. The eastern boundary is demarcated by the Wainganga river, the western boundary by the Wardha river and the southern boundary by Wainganga river and Manikgarh hills. This district is divided into 4 Sub Divisions, having 15 Talukas. There are 14 towns and 1,791 villages. According to the 2011 census, the demographic features observed in Chandrapur district are 22,04,307.

Total 5,547 number of waterbodies with 25,429 ha water spread area are mapped; of which 5,213 are seasonal (15,578 ha) and 334 are perennial (9,852 ha) water bodies. Waterbodies map of Chandrapur district is given in fig 7. The district is having 64% of cooling ponds, 29% of aquaculture ponds, 23% of tanks and 20% of farm ponds in the Vidarbha region. Tanks are also more in numbers followed by Nagpur district. The details of block wise distribution of seasonal and perennial water bodies mapped in the Chandrapur district are given in Table 17. Further the category wise details of the seasonal and perennial

waterbodies in Chandrapur district are given in Table 18 and the type wise distribution of seasonal and perennial water bodies in Chandrapur district is given in Table19.

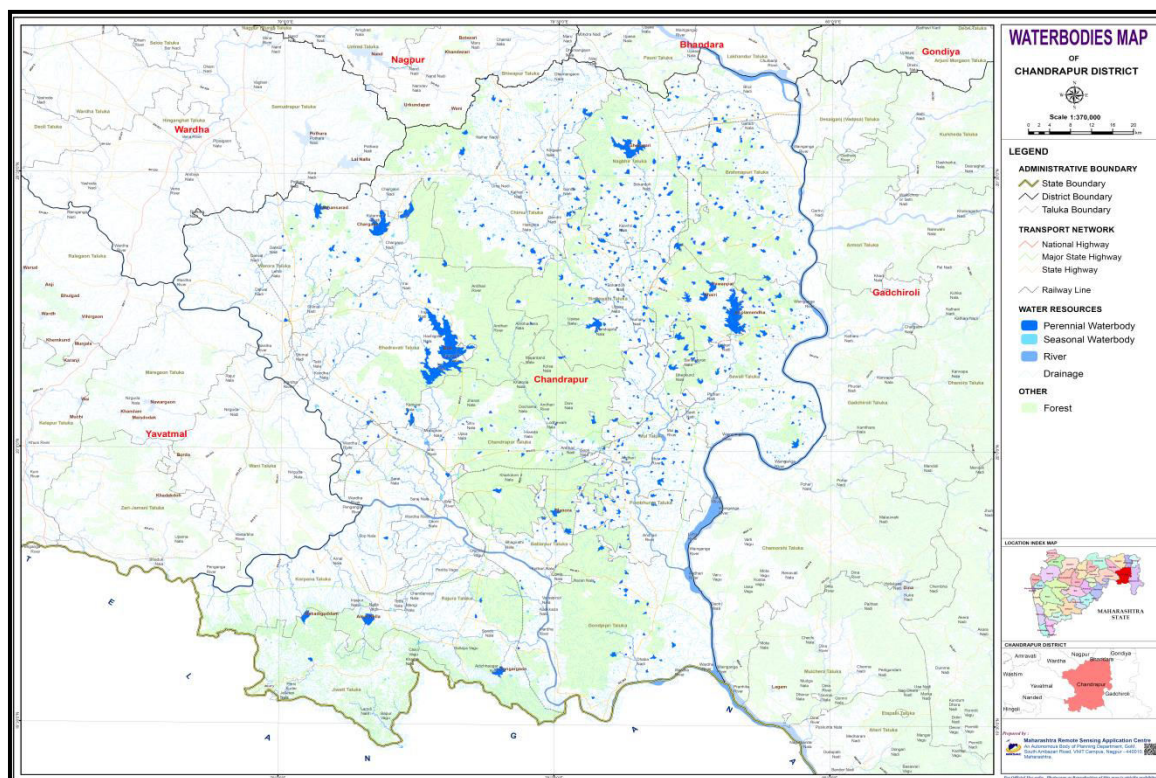


Fig. 7. Waterbody map of Chandrapur district

Table 17. Block wise distribution of seasonal and perennial water bodies mapped in Chandrapur district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Ballarpur	119	189	114	128	5	60
2	Bhadravati	431	5,075	419	1,909	12	3,166
3	Brahmapuri	265	1,393	224	1,078	41	315
4	Chandrapur	390	1,296	370	795	20	501
5	Chimur	1,490	1,981	1,444	1,370	46	612
6	Gondpipri	248	556	234	366	14	190
7	Jiwati	37	291	36	213	1	78
8	Korpana	89	100	88	85	1	15
9	Mul	374	1,495	344	1,143	30	353
10	Nagbhir	340	2,868	269	1,738	71	1,130
11	Pombhurna	240	597	227	435	13	162
12	Rajura	362	975	356	689	6	286
13	Sawali	331	1,498	304	1,140	27	359
14	Sindewahi	354	4,888	314	3,050	40	1,838
15	Warora	477	2,227	470	1,440	7	787
Total		5,547	25,429	5,213	15,578	334	9,852

Table 18. Category wise details of the seasonal and perennial waterbodies in Chandrapur district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	4,026	791	4,026	791	0	0
1-5	871	2,099	800	1,864	71	234
5-20	457	4,545	265	2,563	192	1,982
20-50	137	4,193	88	2,701	49	1,492
50-200	45	3,772	28	2,571	17	1,202
200-500	7	2,163	6	1,933	1	231
500-1000	2	1,908	1	123	3	1,785
1000-5000	2	5,958	1	3,032	1	2,925
Total	5,547	25,429	5,213	15,578	334	9,852

Table 19. Type wise distribution of Seasonal and Perennial water bodies in Chandrapur district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	64	154	64	154	0	0
Aquaculture pond	173	36	173	36	0	0
Cooling pond/Cooling reservoir	18	26	18	26	0	0
Farm Pond	2,876	296	2,876	296	0	0
Lakes/Pond	1,608	10,923	1,376	7,499	232	3,424
Reservoir	25	11,731	4	5,940	21	5,791
Tank	783	2,264	702	1,628	81	636
Total	5,547	25,429	5,213	15,578	334	9,852

District: Wardha

Wardha district lies between $20^{\circ} 18'$ to $21^{\circ} 21'$ North latitude and $78^{\circ} 30'$ to $79^{\circ} 15'$ East longitude covering an area of about $6,309 \text{ km}^2$. This district is bounded on the south and southwest by Yavatmal district, on the southeast by Chandrapur district, on the north and northeast by Nagpur and on the west by Amravati district. It is divided into eight

administrative sub-units i.e., tahsils namely, Wardha, Deoli, Selu, Arvi, Ashti, Karanja, Hinganghat and Samudrapur. There are 1,382 villages and 7 towns in the district. According to the 2011 census; the total population of Wardha is 13,00,774.

Total 1134 number of waterbodies with 10,571 ha water spread area are mapped; of which 1,049 are seasonal (5,096 ha) and 85 are perennial (5,475 ha) water bodies. Waterbodies map of Wardha district is given in Fig 8. The district is having 6% of farm ponds, 6 % of reservoirs, and 4% of tanks in the Vidarbha region. The district is having least number of waterbodies as compared to the other districts of Vidarbha. The details of block wise distribution of seasonal and perennial water bodies mapped in the Wardha district are given in Table 20. Further the category wise details of the seasonal and perennial waterbodies in Wardha district are given in Table 21 and the type wise distribution of seasonal and perennial water bodies in Wardha district is given in Table 22.

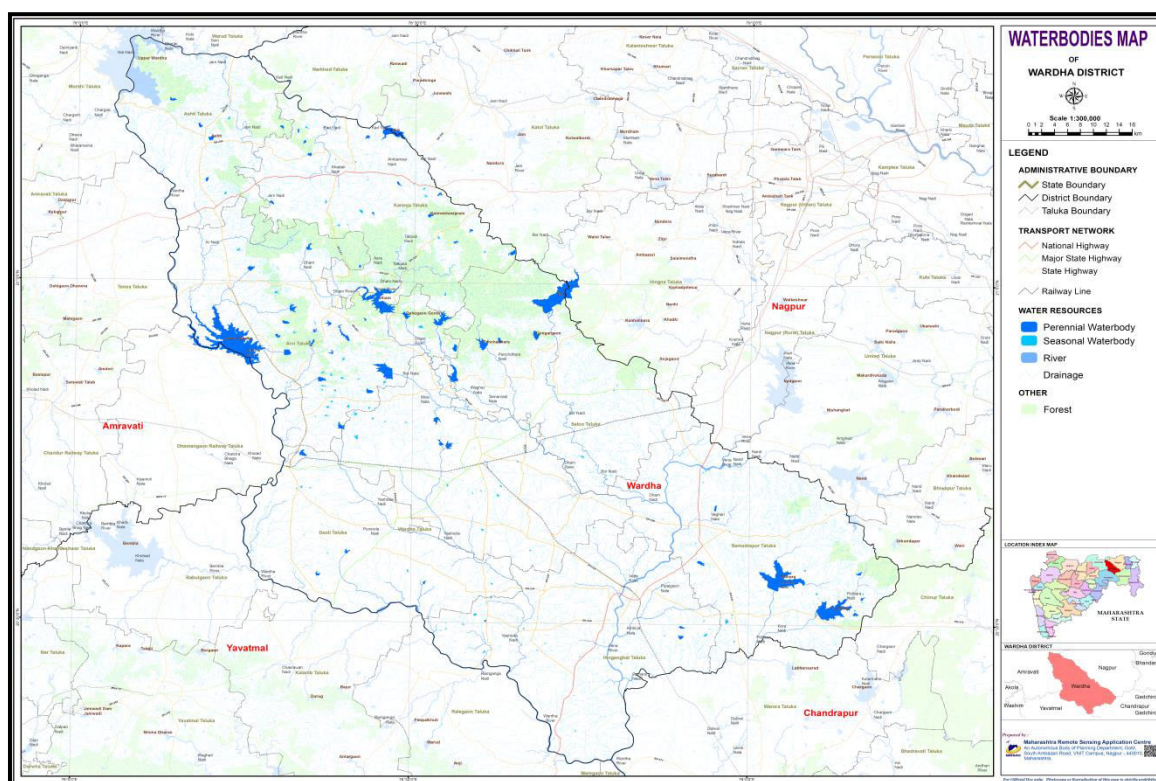


Fig. 8. Waterbody map of Wardha district

Table 20. Block wise distribution of seasonal and perennial water bodies mapped in Wardha district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Arvi	106	5,176	75	1,800	31	3,376
2	Ashti	26	152	17	88	9	64
3	Deoli	241	170	238	113	3	56
4	Hinganghat	278	160	274	130	4	30
5	Karanja	42	641	25	336	17	305
6	Samudrapur	126	2,202	118	1,586	8	615
7	Seloo	235	1,804	228	841	7	963
8	Wardha	80	267	74	202	6	65
Total		1,134	10,571	1,049	5,096	85	5,475

Table 21. Category wise details of the seasonal and perennial waterbodies in Wardha district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	951	141	951	141	0	0
1-5	73	183	46	87	27	96
5-20	66	711	24	281	42	430
20-50	24	714	18	510	6	203
50-200	12	926	9	702	3	224
200-500	3	891	2	548	5	1,439
500-1000	2	1,668	1	883	1	785
1000-5000	3	5,337	2	3,040	1	2,297
Total	1,134	10,571	1,049	5,096	85	5,475

Table 22. Type wise distribution of seasonal and perennial water bodies in Wardha district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	0	0	0	0	0	0
Aquaculture pond	0	0	0	0	0	0
Cooling pond/Cooling reservoir	1	8	1	8	0	0
Farm Pond	867	104	867	104	0	0
Lakes/Pond	118	1,649	60	1,075	58	574
Reservoir	11	8,249	1	3,504	10	4,745
Tank	137	561	120	406	17	155
Total	1,134	10,571	1,049	5,096	85	5,475

B. Amravati Division:

District: Amravati

Amravati district is located in the Northern parts of Maharashtra State and lies between $20^{\circ} 32'$ to $21^{\circ} 46'$ North latitudes and $76^{\circ} 37'$ to $78^{\circ} 27'$ East longitudes covering an area of about $12,235 \text{ km}^2$. It is bounded on the north Betul district in Madhya Pradesh, on the east by Nagpur and Wardha districts, on the south by Yavatmal and on the south-west and west by Akola and Buldhana districts of Maharashtra respectively. The district is sub-divided into 14 administrative sub-units (i.e. tahsils) viz., Amravati, Bhatkuli, Nandgaon-Khandeshwar, Achalpur, Chandur Bazar, Morshi, Warud, Chandur railway, Dhamangaon Railway, Tiwsa, Daryapur, Anjangaon, Dharni and Chikhaldara. The district comprises of one municipal corporation, ten municipal cities and 842 Panchayats working for rural development of the district. The total number of villages is 2,157. The total population of Amravati is 28,88,445.

Total 2,410 number of waterbodies with 16,010 ha water spread area are mapped; of which 2,317 are seasonal (8,332 ha) and 93 are perennial (7,678 ha) water bodies. Waterbodies map of Amravati district is given in Fig 9. The district is having 16% of aquaculture ponds, 12% abandoned queries and 10% farm ponds in the Vidarbha region. The

details of block wise distribution of seasonal and perennial water bodies mapped in Amravati district are given in Table 23. Further the category wise details of the seasonal and perennial waterbodies in Amravati district are given in Table 24 and the type wise distribution of seasonal and perennial water bodies in Amravati district is given in Table 25.

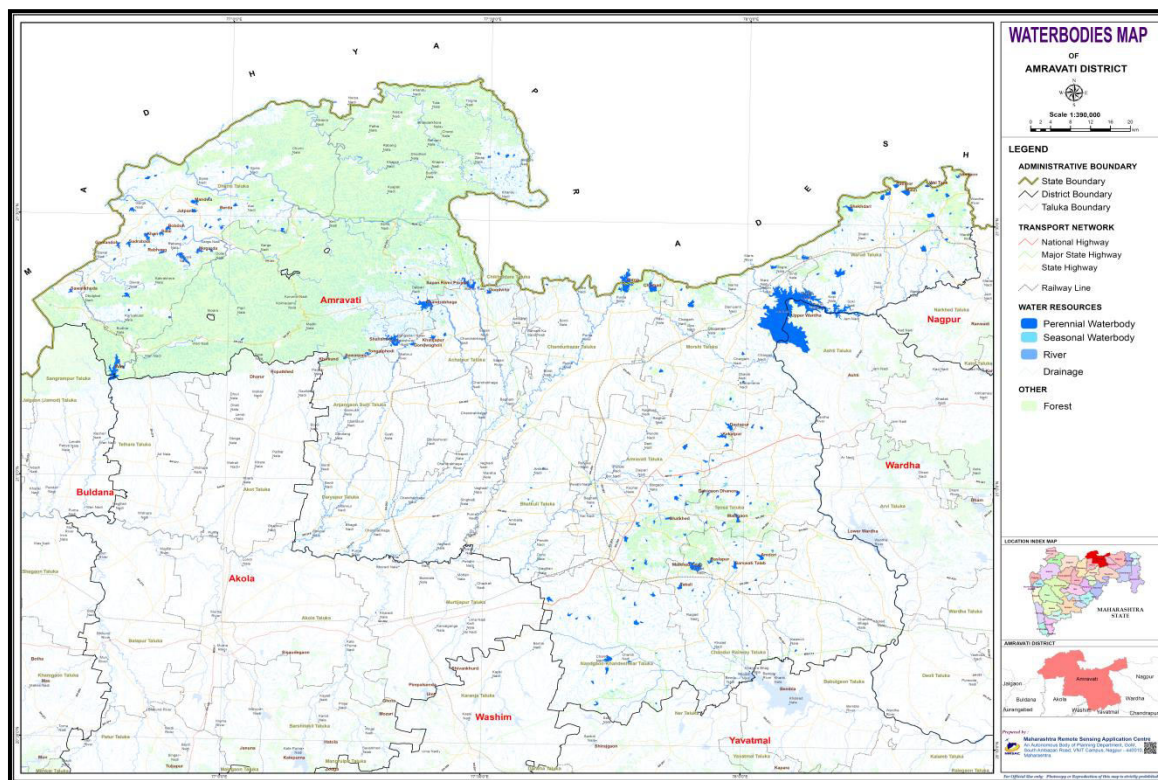


Fig. 9. Waterbody map of Amravati district

Table 23. Block wise distribution of seasonal and perennial water bodies mapped in Amravati district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Achalpur	130	259	126	195	4	63
2	Amravati	173	757	165	620	8	137
3	Anjangaon Surji	111	21	111	21	0	0
4	Bhatkuli	242	117	242	117	0	0
5	Chandur Railway	121	670	116	447	5	222
6	Chandurbazar	126	573	121	237	5	336
7	Chikhaldara	219	1,327	207	803	12	524
8	Daryapur	400	71	400	71	0	0
9	Dhamangaon	120	73	119	62	1	10
10	Dharni	144	1,750	120	1,197	24	553

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
11	Morshi	229	8,221	223	2,864	6	5,357
12	Nandgaon Khandeshwar	144	595	138	513	6	81
13	Teosa	83	395	73	283	10	111
14	Warud	168	1,181	156	899	12	282
Total		2,410	16,010	2,317	8,332	93	7,678

Table 24. Category wise details of the seasonal and perennial waterbodies in Amravati district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	1,854	355	1,854	355	0	0
1-5	325	744	298	662	27	82
5-20	149	1,476	110	1,104	39	372
20-50	48	1,524	31	998	17	526
50-200	25	2,099	17	1,013	8	1,086
200-500	7	2,024	6	1,730	1	293
5000-Above	1	7,788	0	2,470	1	5,319
Total	2,409	16,010	2,316	8,332	93	7,678

Table 25. Type wise distribution of seasonal and perennial water bodies in Amravati District (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	55	79	55	79	0	0
Aquaculture pond	99	19	99	19	0	0
Cooling pond/Cooling reservoir	0	0	0	0	0	0
Farm Pond	1,422	170	1,422	170	0	0
Lakes/Pond	664	4,562	594	3,737	70	825
Reservoir	18	10,868	3	4,042	15	6,826
Tank	152	312	144	285	8	27
Total	2,410	16,010	2,317	8,332	93	7,678

District: Akola

Akola district is located in central eastern part of the district and lies between $20^{\circ}16'$ to $21^{\circ}16'$ North latitudes and $76^{\circ}41'$ to $77^{\circ}37'$ East longitudes covering an area of about $5,429 \text{ km}^2$. The district is bounded by Amravati district on the north and east, Washim district on the south and Buldhana district on the west. The district has been subdivided into 7 administrative sub-units (i.e. tahsils) viz., Akola, Telhara, Murtijapur, Balapur, Patur, Barsitakli and Akot. According to the 2011 census; the total population of Akola is 18,13,906.

Total 2,829 number of waterbodies with 5,836 ha water spread area are mapped; of which 2,791 are seasonal (4,198 ha) and 38 are perennial (1,638 ha) water bodies. Waterbodies map of Akola district is given in Fig 10. The district is having 17 % of farm ponds, 7 % abandoned queries and 7% farm ponds in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Akola district are given in Table 26. Further the category wise details of the seasonal and perennial waterbodies in Akola district are given in Table 27 and the type wise distribution of seasonal and perennial water bodies in Akola district is given in Table 28.

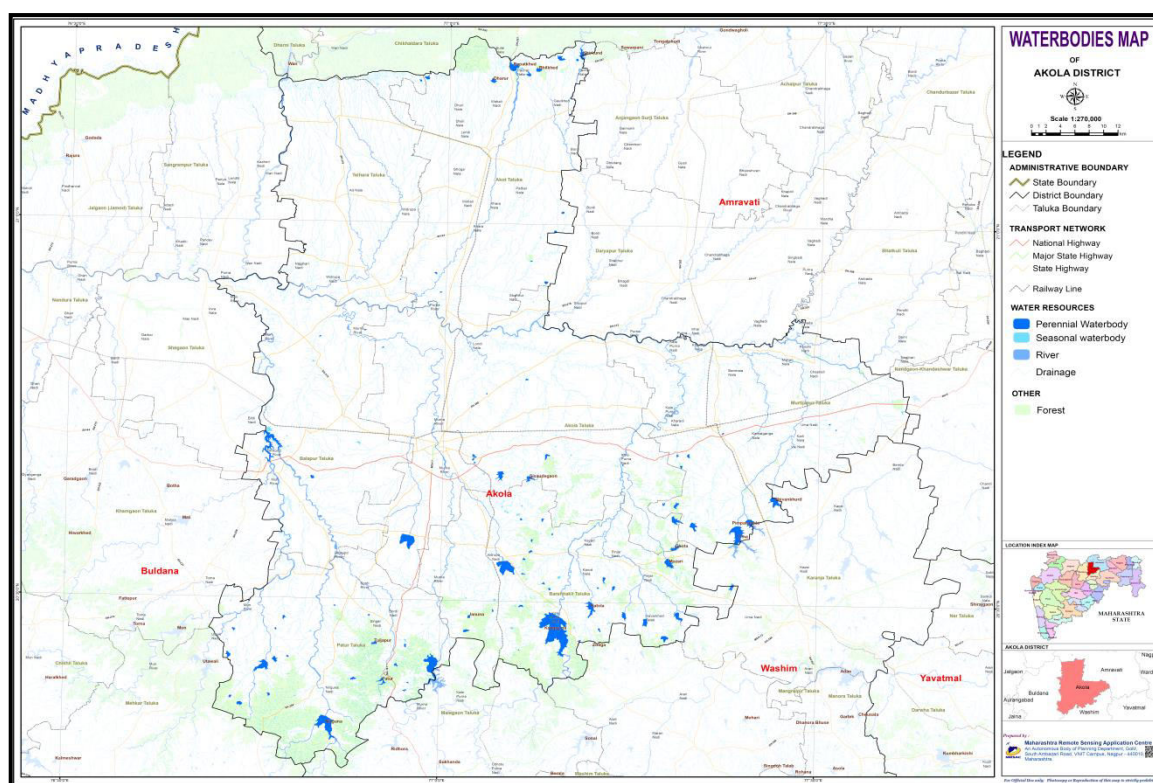


Fig. 10. Waterbody map of Akola district

Table 26. Block wise distribution of seasonal and perennial water bodies mapped in Akola district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Akola	714	629	709	514	5	115
2	Akot	454	432	446	269	8	162
3	Balapur	374	363	372	145	2	219
4	Barshitakli	185	2,180	172	1,504	13	677
5	Murtijapur	663	887	658	697	5	191
6	Patur	65	1,270	60	996	5	275
7	Telhara	374	74	374	74	0	0
Total		2,829	5,836	2,791	4,198	38	1,638

Table 27. Category wise details of the seasonal and perennial waterbodies in Akola district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	2,622	424	2,622	424	0	0
1-5	121	265	117	252	4	13
5-20	51	479	32	238	19	241
20-50	17	537	10	324	7	212
50-200	11	976	4	260	7	716
200-500	5	1,497	4	1,042	1	455
500-1000	1	511	1	511	0	0
1000-5000	1	1,147	1	1,147	0	0
Total	2,829	5,836	2,791	4,198	38	1,638

Table 28. Type wise distribution of seasonal and perennial water bodies in Akola district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	34	54	34	54	0	0
Aquaculture pond	0	0	0	0	0	0
Cooling pond/Cooling reservoir	0	0	0	0	0	0
Farm Pond	2,444	345	2,444	345	0	0
Lakes/Pond	226	1,498	201	1,130	25	368
Reservoir	13	3,816	1	2,556	12	1,260
Tank	112	123	111	114	1	10
Total	2,829	5,836	2,791	4,198	38	1,638

District: Washim

Washim district is located in central eastern part of the State and lies between $19^{\circ} 51'$ to $20^{\circ} 45'$ North latitudes and $76^{\circ} 36'$ to $77^{\circ} 41'$ East longitudes covering an area of about $5,155 \text{ km}^2$. The district is bounded by Akola district on the north and Amravati on the north-east, Yavatmal district on the east and south-east, Parbhani district on the south and Buldhana district on the west. The district has been subdivided into 6 administrative sub-units (i.e. tahsils) viz., Karanja, Mangrulpir, Manora, Washim, Malegaon, and Risod. There are 789 villages and 4 towns in the district. According to the 2011 census, the total population of in Washim district is 11,97,160.

Total 1,596 number of waterbodies with 8,026 ha water spread area are mapped; of which 1,453 are seasonal (5,149 ha) and 143 are perennial (2,877 ha) water bodies. Waterbodies map of Washim district is given in Fig 11. The district is having 7 % of reservoirs, 6 % farm ponds, 5 % lake/ponds and 4 % tanks in the Vidarbha region. The district is having least area cover by water bodies in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Washim district are given in Table 29. Further, the category wise details of the seasonal and perennial waterbodies in

Washim district are given in Table 30 and the type wise distribution of seasonal and perennial water bodies in Washim district is given in Table 31.

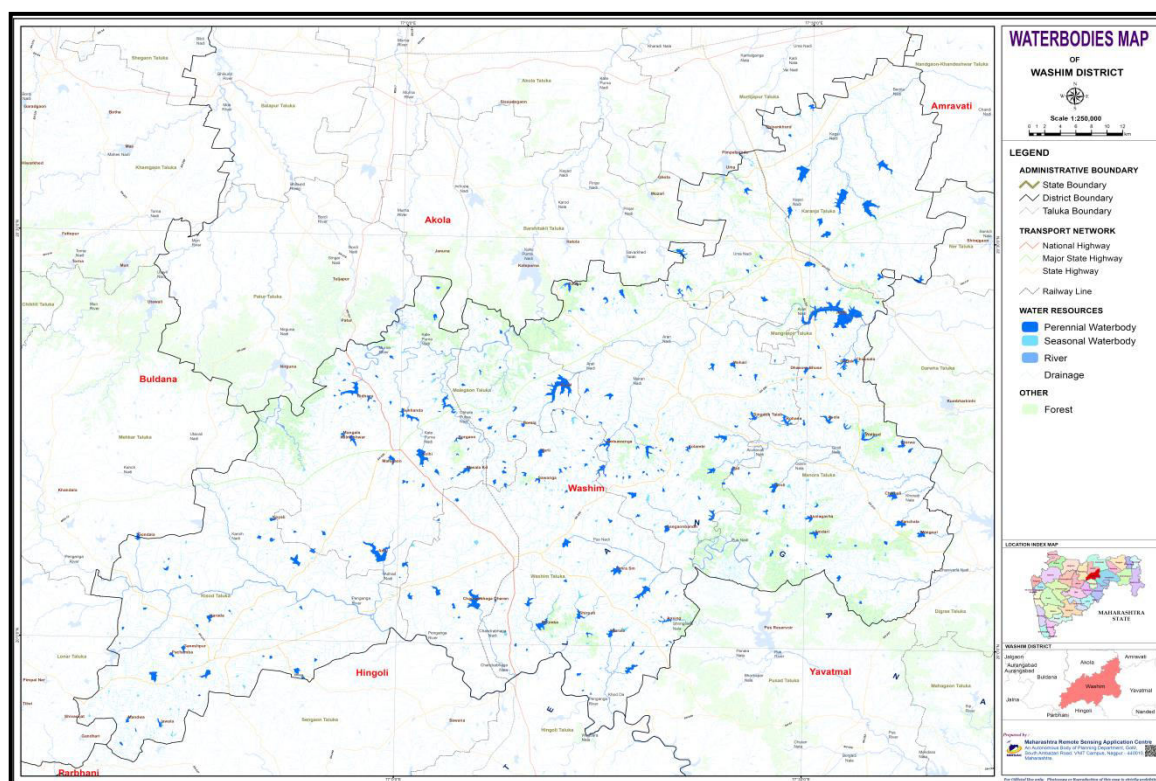


Fig. 11. Waterbody map of Washim district

Table 29. Block wise distribution of seasonal and perennial water bodies mapped in Washim district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Karanja	426	1,220	406	831	20	389
2	Malegaon	179	1,693	150	943	29	750
3	Mangrulpir	317	1,140	291	842	26	298
4	Manora	277	1,827	254	1,096	23	731
5	Risod	138	710	120	489	18	221
6	Washim	259	1,436	232	949	27	487
Total		1,596	8,026	1,453	5,149	143	2,877

Table 30. Category wise details of the seasonal and perennial waterbodies in Washim district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	1,153	206	1,153	206	0	0
1-5	217	568	180	440	37	128
5-20	143	1,524	71	747	72	777
20-50	51	1,716	23	933	28	783
50-200	29	2,543	25	2,097	4	446
200-500	2	609	0	134	2	743
500-1000	1	860	1	860	0	0
Total	1,596	8,026	1,453	5,149	143	2,877

Table 31. Type wise distribution of seasonal and perennial water bodies in Washim district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	12	20	12	20	0	0
Aquaculture pond	0	0	0	0	0	0
Cooling pond/Cooling reservoir	0	0	0	0	0	0
Farm Pond	893	90	893	90	0	0
Lakes/Pond	547	4,664	430	3,242	117	1,422
Reservoir	13	2,849	2	1,489	11	1,360
Tank	131	402	116	308	15	94
Total	1,596	8,026	1,453	5,149	143	2,877

District: Buldhana

This district is located in the north-central parts of the State and lies between $19^{\circ} 51'$ to $21^{\circ} 17'$ North latitudes and $75^{\circ} 57'$ to $76^{\circ} 59'$ East longitudes covering an area of about $9,661 \text{ km}^2$. The district is bounded on the north by Madhya Pradesh, on the east by Amravati and Akola districts, on the south by Jalna district and on the west by Jalna and Jalgaon districts. The district has been divided into 13 administrative sub-units (viz., tahsils) namely, Buldhana, Chikhali, Deolgaon raja, Malkapur, Nandura, Motala, Jalgaon, Jamod, Sangrampur, Khamgaon, Shegaon, Mehekar and Lonar. There are in all 1,433 villages and 11 towns in the district. According to the 2011 census, the total population of Buldhana district is 25,86,258.

Total 2,861 number of waterbodies with 14,015 ha water spread area are mapped; of which 2,603 are seasonal (8,317 ha) and 258 are perennial (5,698 ha) water bodies. Waterbodies map of Buldhana district is given in Fig 12. The district is having 13 % of reservoirs, 13 % farm ponds and 12 % tanks in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Buldhana district are given in Table 32. Further the category wise details of the seasonal and perennial waterbodies in Buldhana district are given in Table 33 and the type wise distribution of seasonal and perennial water bodies in Buldhana district is given in Table 34.

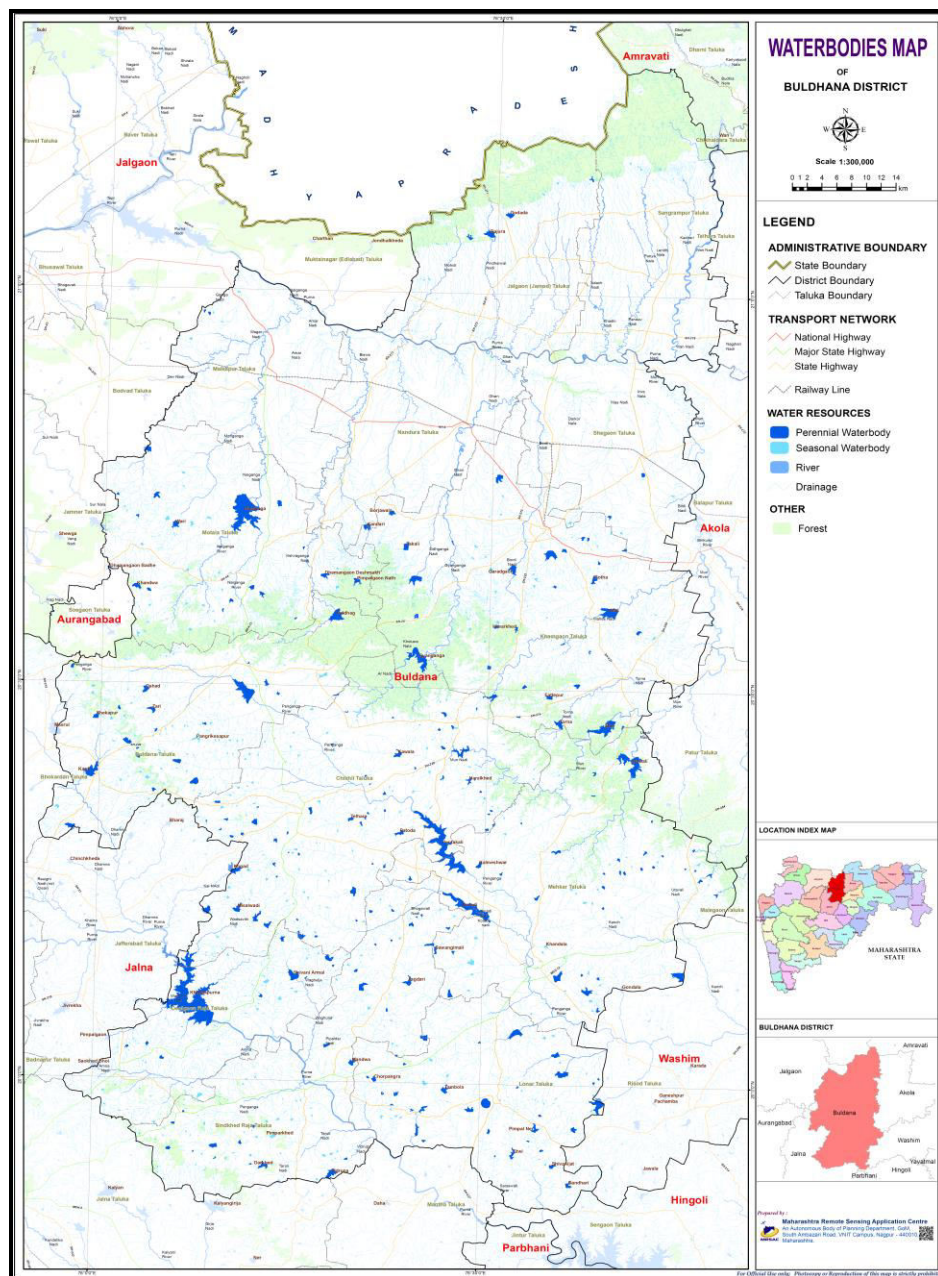


Fig. 12. Waterbody map of Buldhana district

Table 32. Block wise distribution of seasonal and perennial water bodies mapped in Buldhana district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Buldhana	218	1,455	188	1,019	30	436
2	Chikhli	440	2,275	388	1,591	52	684
3	Deolgaon Raja	280	2,622	264	557	16	2,064
4	Jalgaon (Jamod)	125	208	123	160	2	47
5	Khamgaon	213	1,887	184	1,231	29	656
6	Lonar	131	1,152	97	701	34	450
7	Malkapur	90	47	89	45	1	1
8	Mehkar	211	1,672	179	921	32	752
9	Motala	172	1,635	148	1,301	24	334
10	Nandura	86	20	86	20	0	0
11	Sangrampur	179	43	179	43	0	0
12	Shegaon	405	106	404	90	1	15
13	Sindkhed Raja	311	895	274	636	37	259
Total		2,861	14,015	2,603	8,317	258	5,698

Table 33. Category wise details of the seasonal and perennial waterbodies in Buldhana district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	2,243	399	2,236	393	7	6
1-5	319	855	192	511	127	344
5-20	191	1,744	102	885	89	859
20-50	62	2,037	42	1,403	20	634
50-200	35	2,872	24	1,859	11	1,012
200-500	6	1,967	3	1,114	3	853
500-1000	2	1,956	2	1,956	0	0
1000-5000	1	2,185	0	195	1	1,990
Total	2,859	14,015	2,601	8,317	258	5,698

Table 34. Type wise distribution of seasonal and perennial water bodies in Buldhana district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	4	2	4	2	0	0
Aquaculture pond	28	5	28	5	0	0
Cooling pond/Cooling reservoir	0	0	0	0	0	0
Farm Pond	1,899	237	1,899	237	0	0
Lakes/Pond	508	4,816	345	3,373	163	1,443
Reservoir	26	7,813	1	3,789	25	4,024
Tank	396	1,141	326	910	70	231
Total	2,861	14,015	2,603	8,317	258	5,698

District: Yavatmal

Yavatmal district is located in eastern part of the State and lies between $19^{\circ} 26'$ to $20^{\circ} 42'$ North latitude and $77^{\circ} 18'$ to $79^{\circ} 98'$ East longitude covering an area of about $13,582 \text{ km}^2$. It is bounded on the north and northeast by Amravati and Wardha districts, on the east by Chandrapur, on the south by Nanded district and Adilabad district of Andhra Pradesh and on the west and south-west by Akola and Parbhani districts. The Wardha and the Penganga rivers have demarcated the district boundaries on the eastern and southern sides respectively. The district has been subdivided into 16 sub-units (tahsils) viz., Darwha, Pusad, Yavatmal, Kelapur, Digra, Vani, Ner, Babhulgaon, Mahagaon, Umarkhed, Ralegaon, Ghatanji, Maregaon, Kalamb, Zari Zamni and Arni. There are 2,130 villages and 13 towns in the district. According to the 2011 census, the total population of Yavatmal district is 27,72,348.

Total 1,749 number of waterbodies with 32,054 ha water spread area are mapped; of which 1,578 are seasonal (11,020 ha) and 171 are perennial (21,034 ha) water bodies. Waterbodies map of Yavatmal district is given in Fig 13. The district is having 24 % of aquaculture ponds and 14 % reservoirs in the Vidarbha region. The details of block wise distribution of seasonal and perennial water bodies mapped in Yavatmal district are given in Table 35. Further the category wise details of the seasonal and perennial waterbodies in

Yavatmal district are given in Table 36 and the type wise distribution of seasonal and perennial water bodies in Yavatmal district is given in Table 37.

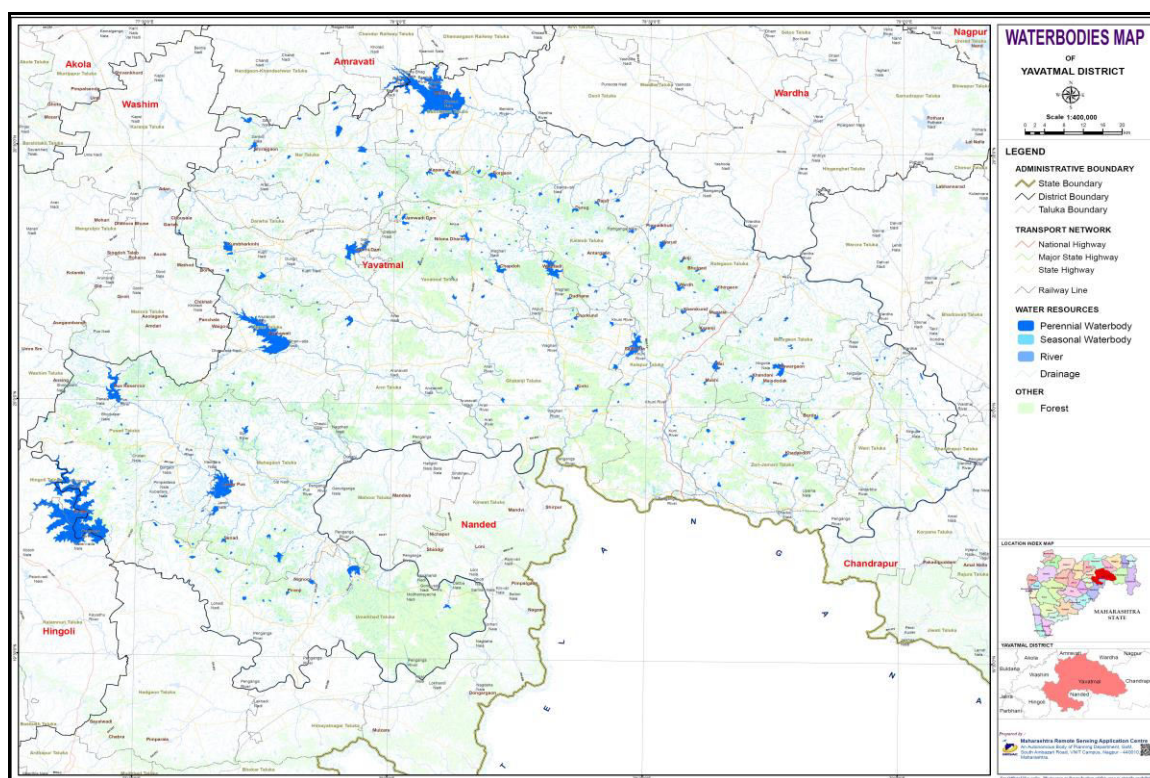


Fig. 13. Waterbody map of Yavatmal district

Table 35. Block wise distribution of seasonal and perennial water bodies mapped in Yavatmal district (2015-16)

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
1	Arni	171	267	166	118	5	149
2	Babulgaon	43	6,293	40	214	3	6,079
3	Darwha	69	1,447	62	695	7	752
4	Digras	91	3,265	87	1,045	4	2,220
5	Ghatanji	78	330	71	184	7	146
6	Kalamb	119	587	106	345	13	242
7	Kelapur	78	1,255	65	588	13	667
8	Mahagaon	75	2,313	57	983	18	1,330
9	Maregaon	78	709	64	207	14	502
10	Ner	75	1,091	60	558	15	533
11	Pusad	279	10,581	263	4,333	16	6,249
12	Ralegaon	65	627	51	277	14	350

Sr. No.	Block name (Census 2011)	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
		No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)	No. of waterbodies	Area (ha.)
1	2	3		4		5	
13	Umarkhed	77	818	63	357	14	462
14	Wani	270	362	263	298	7	64
15	Yavatmal	119	1,783	104	625	15	1,158
16	Zari-Jamani	62	325	56	193	6	132
Total		1,749	32,054	1,578	11,020	171	21,034

Table 36. Category wise details of the seasonal and perennial waterbodies in Yavatmal district (2015-16)

Category (ha)	No. of waterbodies	Total area (ha)	Seasonal waterbodies		Perennial waterbodies	
			No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
0.02-1	1,209	247	1,209	247	0	0
1-5	213	590	190	520	23	70
5-20	210	1,919	130	1,020	80	899
20-50	74	2,424	33	1,199	41	1,225
50-200	28	2,973	12	1,585	16	1,388
200-500	3	958	2	560	5	1,518
500-1000	4	2,853	2	1,766	2	1,087
1000-5000	2	4,690	0	1,512	2	3,178
5000-Above	2	15,400	0	3,730	2	11,670
Total	1,745	32,054	1,574	11,020	171	21,034

Table 37. Type wise distribution of seasonal and perennial water bodies in Yavatmal district (2015-16)

Type of waterbodies	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)	No. of waterbodies	Total area (ha)
1	2	3	4		5	
Abandoned quarry with water	21	78	21	78	0	0
Aquaculture pond	144	29	144	29	0	0
Cooling pond/Cooling reservoir	2	1	2	1	0	0
Farm Pond	849	110	849	110	0	0
Lakes/Pond	648	5,549	509	3,290	139	2,259
Reservoir	27	26,128	1	7,382	26	18,746
Tank	58	159	52	130	6	29
Total	1,749	32,054	1,578	11,020	171	21,034

3.5 Quantitative and qualitative assessment of the fish and fishery resources of Vidarbha:

The quantitative assessment of data on the block wise distribution of total, seasonal and perennial waterbodies and their types (abandoned quarry with water, cooling pond/cooling reservoir, aquaculture pond, farm pond, lakes/ponds, reservoir, tanks) in terms of number and area in 11 districts of Vidarbha is provided in the Annexure III. This quantitative data will be useful for block-wise micro planning for sustainable utilization of waterbodies for fisheries and aquaculture in respective district of Vidarbha.

The qualitative assessment of fish and fisheries resources of Vidarbha was done based on type of water body, utilization of resources based on type of waterbody and technology to be adopted. Analysis was done on area, production, input, output and profit. It is surmised that the total area of the available resources is 1,87,249 ha of which 1,87,161 ha can be utilized for scientific technology based aquaculture practices. This is further classified as waterbodies suitable for development in line with aquaculture (0-60 ha water spread area), waterbodies with 60-1000 ha water spread area suitable for culture based capture fisheries of indigenous fish and prawn species and waterbodies with 1000 ha & above water spread area suitable for development of stock enhancement based fisheries of indigenous fish and prawns.

The total area of 1,87,249 ha from Vidarbha region has an estimated production potential of 1.41 lakh tonnes. The total amount required as an input cost for developing the total available area for fisheries is estimated to be Rs. 664.32 crore which will result in revenue of Rs. 1203.33 crore. Thus, the net profit from fisheries venture is estimated approximately to Rs. 538.01 crore. The details of qualitative assessment of the fish and fishery resources of Vidarbha are presented in Table 38.

Table 38. Qualitative assessment of the fish and fishery resources of Vidarbha region

Waterbody type	Utilisation based on waterbody type	Technology to be adopted	Total area (ha)	% of area to be considered for adopted technology	Total area adopted for technology (ha)	Production		Estimated required Input in Rs. crore	Estimated output In Rs. crore	Estimated profit in Rs. crore
						Quantity	Unit			
1	2	3	4	5	6	7		8	9	10
Abandoned quarry with water	Fish seed rearing & growout culture	Spawn to fingerling production	622	70	435	418 [#]	Million fingerling	4.00	25.00	21.00
		Growout culture of carps		30	187	1,272	Tonnes	6.56	11.44	4.88
Subtotal			622	100	622	1,272	Tonnes	10.56	36.44	25.88
Aquaculture pond	Growout culture	Carp culture	93	96	89	605.20	Tonnes	3.12	5.44	2.32
		Monosex tilapia culture (2 cycles/year)		1	1	17.00	Tonnes	0.10	0.11	0.01
		Indigenous catfish		1	1	3.90	Tonnes	0.07	0.14	0.07
		Culture of pangasius		1	1	18.00	Tonnes	0.09	0.14	0.05
		Poly culture of prawn and carps		1	1	3.19	Tonnes	0.03	0.08	0.05
Subtotal			93	100	93	647.29	Tonnes	3.41	5.91	2.50
Cooling pond/Cooling reservoir	Not suitable for fisheries and aquaculture		89	Not suitable for fisheries and aquaculture						

Waterbody type	Utilisation based on waterbody type	Technology to be adopted	Total area (ha)	% of area to be considered for adopted technology	Total area adopted for technology (ha)	Production		Estimated required Input in Rs. crore	Estimated output In Rs. crore	Estimated profit in Rs. crore
						Quantity	Unit			
1	2	3	4	5	6	7		8	9	10
Farm Pond	Fish seed rearing	Spawn to fingerling	1,810	10	181	174 [#]	Million fingerling	1.66	10.39	8.73
	Growout culture	Carp culture		35	633.5	4308	Tonnes	22.21	38.72	16.51
		Monosex tilapia culture (2 cycles/year)		20	362	6154	Tonnes	0.36	0.40	0.04
		Indigenous catfish		5	90.5	353	Tonnes	0.06	0.13	0.06
		Culture of pangasius		10	181	3258	Tonnes	0.16	0.25	0.09
		Poly culture of prawn and carps		20	362	1155	Tonnes	0.11	0.29	0.18
	Subtotal		1810	100	1810	15228	Tonnes	24.57	50.18	25.61
Lakes	0 to 20 – Growout culture	*Growout culture of indigenous fish and prawn species	51,670	100	51,670	87,838	Tonnes	452.83	789.56	336.72
	20 to 60 – Growout culture	*Growout culture of indigenous fish and prawn species	7,714	100	7,714	7,868	Tonnes	40.56	70.72	30.16
	60 to 200 - Culture based capture fisheries	**Culture based capture fisheries of indigenous fish and prawn species	1,035	100	1,035	241	Tonnes	1.00	2.00	1.00
Subtotal			60418	-	60418	95947	Tonnes	494.40	862.28	367.88

Waterbody type	Utilisation based on waterbody type	Technology to be adopted	Total area (ha)	% of area to be considered for adopted technology	Total area adopted for technology (ha)	Production		Estimated required Input in Rs. crore	Estimated output In Rs. crore	Estimated profit in Rs. crore
						Quantity	Unit			
1	2	3	4	5	6	7		8	9	10
Reservoirs	20 to 60 – Growout culture	*Growout culture of indigenous fish and prawn species	104	100	104	106	Tonnes	0.55	0.95	0.41
	60 to 200 - Culture based Capture fisheries	**Culture based capture fisheries of indigenous fish and prawn species	8,466	100	8,466	1,973	Tonnes	8.18	16.36	8.18
	200 to 1000 - Culture based Capture fisheries	**Culture based capture fisheries of indigenous fish and prawn species	42,575	100	42,575	6,740	Tonnes	28.00	58.00	29.00
	1000 to 2000 - Stock enhancement	**Stock enhancement based fisheries of indigenous fish and prawn species	11,163	100	11,163	1,253	Tonnes	7.00	15.00	8.00
	>2000 - Stock enhancement	**Stock enhancement based fisheries of indigenous fish and prawn species	53,984	100	53,984	4,127	Tonnes	18.20	37.10	18.90
Subtotal			1,16,292	-	1,16,292	14,199	Tonnes	61.92	127.41	64.48
Tank	0 to 20 – Grow out culture	*Growout culture of indigenous fish and prawn species	7,925	100	7,925	13,473	Tonnes	69.46	121.11	51.65
Subtotal			7,925	-	7,925	13,473	Tonnes	69.46	121.11	51.65
Grand total			1,87,249	-	1,87,161	1,40,766	Tonnes	664.32	1,203.33	538.01

Note:

1. Culture in abandoned quarry with water is subjected to suitability of water quality parameters.
2. All estimated production is based on year round availability of water with minimum water depth as per the technology to be adopted.
3. The production for the aquaculture pond and farm pond is calculated considering the technology developed by fisheries institutes under ICAR, New Delhi.
4. The area of waterbody types/categories is considered based on data provided by MRSAC, Nagpur (2015-16).
5. The area of lakes/reservoirs/tanks under the categories 0 to 20 ha, 20 to 60 ha, 60 to 200 ha, 200 to 1000 ha, 1000 to 2000 ha, and > 2000 ha is calculated on basis of the taluka wise distribution of seasonal water body type data provided by MRSAC, Nagpur.
6. # Quantity expressed in million fingerlings; hence, not considered in production calculation.
7. * The production is calculated considering 25% of aquaculture growout production from 0 to 20 ha lakes/reservoirs/tanks and 15% of aquaculture growout production from 20 to 60 ha lakes/reservoirs/tanks considering the inputs costs, viz., seed, fertilizers, feed & feed supplements and other operational costs.
8. ** The production for the lakes/reservoirs/tanks under the category 60 to 200 ha, 200 to 1000 ha, 1000 to 2000 ha, and > 2000 ha is estimated based on the guidelines provided by GoM, GR dated 30th June 2017; NFDB, Hyderabad; Handbook of fisheries and aquacultures; researcher experience and FGD during the course of study.

Based on different technology practices, if the input cost is shared between the public sector and private partners (farmers, cooperative societies, entrepreneurs and enterprises etc.), promotion of fisheries venture will be more viable. The developmental schemes (Source: Central scheme: Blue revolution, 2016, DAHD) for input and other costs are suggested as follows:

- **Aquaculture:** The central assistance for fish culture from NFDB at 50% of project/unit cost with a ceiling of Rs. 0.75 lakh/ha and for freshwater prawn culture at 50% of the unit cost with a ceiling of Rs. 1.25 lakh/ha for all beneficiaries is available through blue revolution scheme.
- **Culture based capture fisheries:** Under the Inland Capture Fisheries (village ponds, tanks etc.) sector the NFDB provides following assistance.
 - Fish Seed Rearing Units schemes to the tune of 50% of the unit cost with a ceiling of Rs.3.0 lakh per ha.
 - Input cost support (fish seed, feed, manure, disease prevention measures, transportation charges etc.) with central assistance for fish culture is restricted to 50% of project/unit cost with a ceiling of Rs. 0.75 lakh/ha for all beneficiaries and for prawn culture input cost is restricted to 50% of the unit cost with a ceiling of Rs. 1.25 lakh/ha for all beneficiaries.
 - Craft and gear (boats of appropriate sizes including fishing nets, fish & ice holding boxes etc.) at 50% of the unit cost with a ceiling of Rs.0.50 lakh per unit.
 - Construction of landing centers (landing & berthing platforms, auctioning platform/hall, net mending shed etc.) at 50% of the unit cost with a ceiling of Rs. 2 lakh per landing center.
- **Stock enhancement based fisheries of indigenous fish and prawn species:** In stock enhancement based fisheries programme seed is the only input cost. As per NFDB norms, the reservoirs having total water spread area of more than 1000 ha are entitled to receive the financial assistance for stocking of fingerlings for three consecutive years @ 50% of the first year sanction of stocking.

In addition to above NFDB provides assistance for Integrated Development of Reservoirs activities (pre-culture preparation, strengthening of bunds, desilting, dewatering etc, hatcheries, fish rearing units, fish stocking, cage culture, feed mills, boats & nets, landing centres, cold storages, ice plants, fish transport facilities etc) at 50% of the unit cost with a ceiling of Rs. 1 crore per project.

4. Institutional frame work of fisheries in Vidarbha

4. Institutional frame work of fisheries in Vidarbha

4.1 State Fisheries Department:

The Department of Fisheries (DoF) is the main agency for the management and development of fisheries resources and promotion of aquaculture in the state. The department is presently functioning as a service department under the Animal Husbandry, Dairy and Fisheries Secretariat. In terms of manpower, budget, spread of offices as well as public contacts, it is one of the smaller sized departments. There are two major wings in the department i.e. Marine and Inland division. At the state-level, a Commissioner is the head, while four Deputy Commissioner support him. At the regional level, six Regional Deputy Commissioners are assisted by District Fisheries Development Officers. However, in costal districts, the post of Assistant Directors (Fisheries) is also present. The Registrar (Cooperatives) and Statistical Officers are deputed from concerned Departments to the Fisheries Department.

Aims and objectives:

- Optimize fish production.
- Sustainable fisheries development with ecological balance.
- Provide clean nutritious food.
- Increase foreign exchange.
- Encourage co-operative movement.
- Employment generation.
- Uplift socio-economic conditions of fishermen.
- Facilitate technical and financial assistance to the fishermen.
- Development of infrastructure facilities.
- Encourage fish culture by providing incentives to fishermen.
- Collection of statistical information, fish catch and revenue.
- Modernization by electronic gadget.
- Creation of awareness among the common people.
- Ensuring protection of environment and conservation of bio diversity.

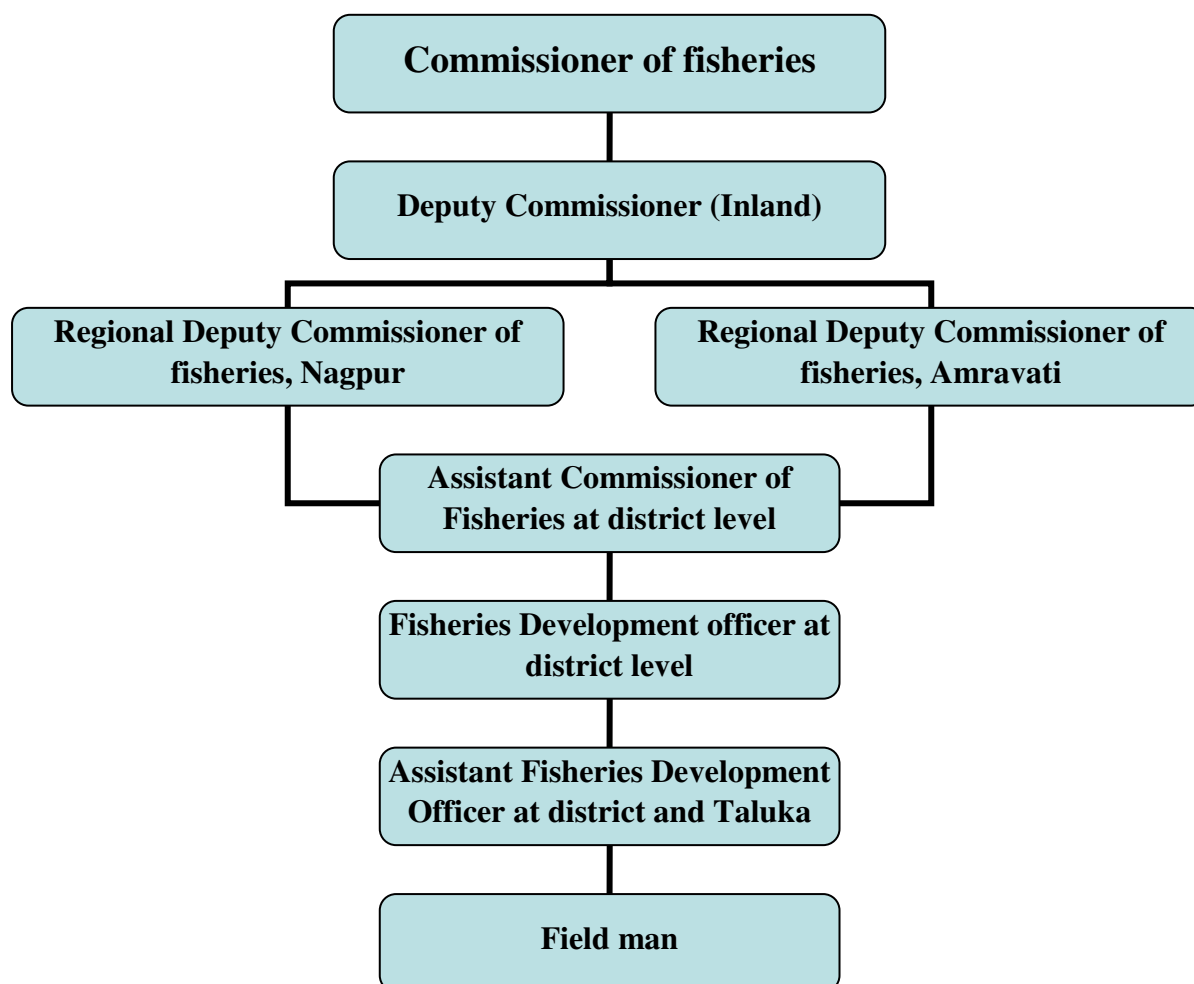
Strategy for inland fisheries:

- Optimization of fish seed production of existing farms.
- Reservoirs fisheries development.
- Training and extension.

- Strengthening of marketing infrastructure.
- Strengthening of Inland Fisheries Statistics & with information networking.

Structure of Department of Fisheries in Vidarbha:

In Vidarbha for effective administration DoF is divided into Nagpur and Amravati division. The Nagpur division includes district of Nagpur, Bhandara, Chandrapur, Gondia, Gadchiroli and Wardha. The districts under Amravati division are viz., Amravati, Akola, Washim, Buldhana, Yavatmal. The district offices are headed by Assistant Commissioner of Fisheries who work under the supervision of Regional Deputy Commissioners at Nagpur and Amravati. The Assistant Fisheries Development Officers are deputed to look after fisheries activities in two or more than two blocks. The fieldsmen are stationed at seed production centres and rearing centres. The organizational structure of Department of Fisheries in Vidarbha is as follows:



Staffing pattern of Department of Fisheries in Vidarbha:

The staff position of Department of Fisheries calls for one Assistant Commissioner of Fisheries and one Fisheries Development Officer at district level who will work in tandem

with Regional Deputy Commissioner at district level. However, state of affairs in the Department of Fisheries in Vidarbha are miserable wherein the Fisheries Development Officer (FDO's) are assigned duties of Assistant Commissioner of Fisheries (ACF's) and ACF's are given additional charge of Regional Deputy Commissioner (RDC's). In most of the district headquarters the permanent positions of Assistant Commissioner of fisheries are not filled in and Assistant Fisheries Development Officer (AFDO) is given charge of Fisheries Development Officers (FDO's).

The two posts of RDC's sanctioned at Nagpur and Amravati Regional Offices are vacant. The 11 posts of Assistant Commissioner of Fisheries are sanctioned for each district offices but only 4 posts are filled. Out of 16 sanctioned posts of Fisheries Development Officers, only 14 posts are filled. The sanctioned posts under cadre of Assistant Fisheries Development Officers are 53 of which only 18 posts are filled in and remaining are vacant. Out of 75 sanctioned posts of Fieldman only 38 posts filled in. It is observed that out of 157 technical and field level posts sanctioned for development of fisheries in Vidarbha only 74 posts are filled in and 83 posts are still vacant. (Table 39)

Table 39: Staffing pattern of department of fisheries in Vidarbha

Region	District	Sanction post					Filled post					Vacant post				
		RDC	ACF	FDO	AFDO	FM	RDC	ACF	FDO	AFDO	FM	RDC	ACF	FDO	AFDO	FM
1	2	3					4					5				
Nagpur	Regional office	1	0	1	3	0	0	0	1	3	0	1	0	0	0	0
	Nagpur		1	1	7	10		1	1	2	5		0	0	5	5
	Bhandara		1	1	6	9		0	1	2	7		1	0	4	2
	Chandrapur		1	1	4	10		1	1	2	3		0	0	2	7
	Bramhapuri		0	1	3	2		0	1	1	2		0	0	2	0
	Gondia		1	1	4	7		0	1	1	5		1	0	3	2
	Gadchiroli		1	1	3	2		0	1	0	1		1	0	3	1
	Wardha		1	1	3	5		0	1	0	0		1	0	3	5
Nagpur division total		1	6	8	33	45	0	2	8	11	23	1	4	0	22	22
Amravati	Regional office	1	0	1	3	0	0	0	1	1	0	1	0	0	2	0
	Amravati		1	1	3	5		1	1	2	3		0	0	1	2
	Morshi, Dist. Amravati		0	1	2	4		0	0	0	0		0	1	2	4
	Akola		1	1	2	4		1	1	1	3		0	0	1	1
	Washim		1	1	2	0		0	1	1	0		1	0	1	0
	Buldhana		1	1	3	5		0	1	1	5		1	0	2	0
	Yavatmal		1	1	3	4		0	1	1	4		1	0	2	0
	Isapur Dist. Yavatmal		0	1	2	8		0	0	0	0		0	1	2	8
Amravati division total		1	5	8	20	30	0	2	6	7	15	1	3	2	13	15
Grand total		2	11	16	53	75	0	4	14	18	38	2	7	2	35	37
Note:		RDC: Regional Deputy Commissioner of Fisheries; ACF: Assistant Commissioner of Fisheries; FDO: Fisheries Development Officer; AFDO: Assistant Fisheries Development Officer; FM: Field man														

Source: Office of Regional Deputy Commissioner of Fisheries, Nagpur and Amravati Division

Major activities:

- Leasing of water bodies like major and minor irrigation tanks.
- Formation of fisheries cooperative society.
- Seed production and seed rearing of cultivable fish species.
- Implementation of Centrally sponsored and State sponsored schemes.
- Promotion of improved aquaculture practices and extension services to fish farmers.
- Promotion of innovative schemes such as “Blue Revolution”, “Mission Fingerling” and “Talav Tethe Masoli” etc.

Survey of functional and non-functional seed production & rearing centres:

The inland water bodies of Vidarbha are rich in freshwater fish species and fresh water prawn species. The species mostly cultured in freshwaters of the region and the seed of which is being produced are catla, rohu, mrigal, silver carp and grass carp etc. The availability of fish seed is an essential prerequisite for fish culture. The main sources of fish seeds in Vidarbha are spawns produced by induced breeding method in State Fisheries Department hatcheries, natural bundh breeding of cooperative societies particularly of Bhandara and Gondia Districts and import from other states like West Bengal, Chhattisgarh and Andhra Pradesh etc.

The paucity of quality and quantity of fish seed is the most important constraint in the region. The transportation of fish seed from the far distance escalates seed price and also cause mortality of spawn which directly affects the economics of fish culture. In lieu of this, the State Government of Maharashtra had built hatcheries and rearing spaces in the state to increase fish seed production.

a. Methodology:

In the present survey all the 11 districts of Vidarbha were selected to study functional and non-functional seed production & rearing centres by purposive sampling method. The survey was carried out with help of questionnaires (Annexure IV & V), case studies, systematic observations based on field visits and long discussions with the staff of Department of Fisheries.

b. Present status of seed production and rearing centres:

I. Details of Fish Seed Production Centres:

At present, there are 15 established seed production centres in Vidarbha. The 14 fish seed production centres are under the DoF in Vidarbha. Among these 05 are functional, 01 non-functional and 02 centres are yet to be operational. Out of the remaining 06 centres, 02 centres are operated by Maharashtra Fisheries Development Corporation (MFDC) and 04 centres are leased out to private parties by DoF, Maharashtra State. The College of Fishery Science (COFS), Nagpur has one circular fish seed hatchery which is operational since 2008-09. (Table 40)

Table 40. Fish seed production centres of Vidarbha

Division	District	Name
1	2	3
Nagpur	Nagpur	Vena [#]
		Pench
		COFS
	Bhandara	Shivnibandh
	Chandrapur	Amalnala
		Chargaon*
	Gondia	Itiadoh
	Wardha	Bor*
		Kelzar**
	Total	9
Amravati	Amravati	Morshi**
	Akola	Katepurna
	Buldhana	Koradi
	Yavatmal	Isapur**
		Arunavati
		Bembala
	Total	6
Grand Total		15
Note :		[#] Non-functional * Leased out to MFDC ** Leased out to Private sector

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

The seed production centres are located mostly near to the reservoirs. In many cases, the average distance of fish seed production centres from the district headquarters is 30-70 km whereas Chargaon fish seed production centre in Chandrapur district, Isapur fish seed

production centre in Yavatmal district is located 135 km and 125 km respectively from their district headquarters.

Water quality parameters play an important role in successful seed production. The functional centres analyze p^H , hardness, dissolves oxygen and temperature of water during operation. The seed production centre at College of Fishery Science, Nagpur and Koradi seed production centre in Washim district have their separate laboratories for water quality analysis. However, the same facility is not available at other seed production centres. The soil type at majority of the centres is clayey-loamy.

Components of fish seed production centres:

The fish seed production centres in Vidarbha is having following important components.

Spawning pool: The spawning pool is used to hold injected breeders for natural spawning and fertilization. All the fish seed production centres surveyed have one spawning pool which is sufficient to carry required broodstock. The broodstock holding capacity of spawning pool varies with the production capacity at different centres.

Incubation pool: In the incubation pool hatching of fertilized fish eggs takes place. The four tanks are necessary to produce spawns by incubating eggs. It was observed that out of 13 operational seed production centres, 10 seed production centres have prescribed number of incubation pools but in case of 03 seed production centres only 50% of incubation pools were in functional condition.

Brood stock pond: Brood stock pond is one of the most important components of seed production centre. The quantity and quality of egg depends upon the quality and quantity of brooders which in turn affects the overall spawn production capacity.

Spawn rearing ponds: A seed production centre is generally considered as a facility for producing fry and fingerlings suitable for stocking in grow-out ponds. Spawn rearing area is major factor in rearing spawn for better growth and nourishment.

Fry rearing ponds: Nursery rearing of fry and fingerlings is generally carried out in three stages i.e. early fry rearing (spawn-early fry), fry rearing (early fry-fry), and fingerling rearing (fry-fingerling). The duration of the nursery cycle varies depending on the stage of rearing.

The details of components of fish seed production centres in Vidarbha are presented in Table 41.

Table 41: Details of components at fish seed production centre in Vidarbha

Component	Total	Maximum			Minimum		
		Name of centre	Unit	No	Name of centre	Unit	No
1	2	3			4		
Water spread area (ha)	59.97	National fish seed production centre, Morshi, Dist- Amravati	13.62 ha	-	College of Fishery seed production centre, Dist- Nagpur	0.82 ha	-
Capacity of overhead tanks (liters)	760000	National fish seed production centre, Morshi, Dist- Amravati	150000 liters	1	Amalnala fish seed centre, Dist- Chandrapur	25000 liters	1
Broodstock holding capacity (kg) and Number of Spawning Pool (No.)	3880 & 16	Chargaon fish seed production centre, Dist- Chandrapur	1800 kg	4	Katepurna fish seed production centre, Dist- Akola	40 kg	1
Egg holding capacity (lakh) and number of incubation pool (No.)	1015 & 49	Pench fish seed production centre, Dist- Nagpur	200 lakh	4	Amalnala fish seed centre, Dist- Chandrapur	25 lakh	2
Water spread area & number of brood stock pond	19.85 & 74	National fish seed production centre, Morshi, Dist- Amravati	4.81 ha	13	Bor fish seed production centre, Dist- Wardha	0.4 ha	1
Availability quantity of brood stock (Kg)	19450	Pench fish seed production centre, Dist- Nagpur	5200 kg	-	Bor fish seed production centre, Dist- Wardha	160 kg	-
Water spread area & number of spawn rearing ponds	25.78 & 375	National fish seed production centre, Morshi, Dist- Amravati	8 ha	100	Kelzar fish seed production centre, Dist- Wardha	0.08 ha	19
Water spread area & number of fry rearing ponds	16.2 & 227	Pench fish seed production centre, Dist- Nagpur	5.44 ha	68	Vena fish seed production centre, Dist- Nagpur	0.12 ha	3

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

Present status of seed production:

The annual spawn production capacity of all the established hatcheries in Vidarbha is 7,922 lakh. The actual annual average production for 2013-14 to 2017-18 is 2,651.27 lakh spawns. The average revenue for 2013-14 to 2017-18 is Rs 43.39 lakh annually (Table 42). Despite of this, the region has not attained self-sufficiency in carp seed production. The

region is rich in fishery resources but deficit in fish production for many reasons of which one of the major reasons is the shortage of quantity and quality of fish seeds.

Table 42: Fish seed production centres in Vidarbha and their capacity

Division	District	Name	Capacity (spawn/fry /fingerling in lakh)	Average actual production of last five years (lakh)	Average revenue of last five years	% of actual production with respect to capacity
1	2	3	4	5	7	8
Nagpur	Nagpur	Vena	440	-	-	0
		Pench**	1,200	608.2	-	51
		COFS	400	61	0.95	41
	Bhandara	Shivnibandh	450	483.94	9.29	108
	Chandrapur	Amalnala	416	39.28	6.48	9
		Chargaon*	416	37.23	0.67	9
	Gondia	Itiadoh	200	111.26	1.77	56
	Wardha	Bor*	200	29.89	1.38	15
		Kelzar**	200	66.37	0.84	33
	Total	9	3,922	1,437.17	21.38	39
Amravati	Amravati	Morshi**	500	97.35	0.77	19
	Akola	Katepurna	1,000	455.99	8.81	46
	Buldhana	Koradi	500	354.62	5.93	71
	Yavatmal	Isapur**	2,000	306.14	6.5	15
		Arunavati	Newly constructed Centres operations yet to start			
		Bembala				
	Total	6	4,000	1,214.1	22.01	30
Grand total		15	7,922	2,651.27	43.39	35
Note :		* Leased out to MFDC ** Leased out to private sector				

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

The average actual seed production of last five years from established seed production centres in Vidarbha is only 33 % of the total production capacity. It is due to under production at many centres. The exception to this is observed at Shivnibandh centre of Bhandara district where the seed production was above the capacity (108%). The Koradi fish seed centre of Buldhana district is one which is working efficiently and has produced near to the capacity (71%). The minimum seed production in Nagpur division is carried out by centres namely Amalnala and Chargaon centres in Chandrapur district (9%) and Bor centre in Wardha district. The fish seed production centres under the control of MFDC are under performing. Similarly, the minimum seed production in Amravati division was observed at Morshi centre (19%) and Isapur centre (15%). It is evident that the leased out fish seed

production centres at PENCH, Kelzar, Morshi and Isapur are producing only 51%, 33%, 19% and 15% respectively. Among these four leased out centres, except PENCH the situation elsewhere is not encouraging. Although, the centres established by State Fisheries Department have proximity to reservoirs and have sufficient rearing spaces the fish seed production is below capacity. The centre established under College of Fishery Science, Nagpur is producing 41% of capacity due to shortage of water and rearing space.

It is expected that annually the seed production centre should produce at least 70% spawn of its total production capacity. Considering this, in year 2016-17, the 13 functioning hatcheries could have produced 5,370 lakh spawn. However, the actual seed production is 3,427 lakh which is only 45% of the total capacity.

The share of minor carp and exotic species (grass carp, silver carp, cyprinus, pangasius etc.) seed in total seed production was very meager while majority seed production was of major carps. It can be concluded that the centres preferably produce major carp seed than the minor carp and exotic species.

II. Details of seed rearing centres:

At present, the Department of Fisheries has 12 established seed rearing centres in Vidarbha. Out of these, the 05 rearing centres are operated by DoF, 03 are leased out to private parties and 04 centres are non-functional. (Table 43)

Table 43: Fish seed rearing centres of Vidarbha

Division	District	Name
1	2	3
Nagpur	Nagpur	Khindshi
	Bhandara	Nagthana**
	Chandrapur	Maregaon**
		Kini**
		Adyal**
		Asolamendha
	Gadchiroli	Murkheda
Gondia	Ambora*	
Amravati	Amravati	Mandva
		Baslapur*
	Yavatmal	Saikheda
		Pus*
Total		12
Note :		* Leased out to Private sector ** Non-functional

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

The average distance of fish seed rearing centres from district headquarters is 10-70 km whereas, Mandva in Amravati district and Pus fish seed rearing centres in Yavatmal

districts are located at furthest distance from the district headquarters i.e. 160 km and 125 km respectively. The centres at Asolamendha and Adyal in Chandrapur district are also relatively far-away from the headquarters and remotely located (100 km and 102 km).

In successful seed rearing, water quality parameters play an important role. The facility to analyze pH, hardness, temperature etc. during fish seed rearing is present at 05 functional centres. The sandy soil is not suitable for pond construction whereas clayey-loam is very suitable for pond construction. The majority of centres have clayey-loam and clayey type soil. However, the soil quality of Nagthana in Bhandara district & Maregaon in Chandrapur district is sandy where water retention seems to be an acute problem. Within seed rearing centres, reservoir ponds are used for water storage which play important role during post monsoon season. In the present survey, it was noticed that the facility of reservoir pond with water spread area of around 0.40 ha and 0.38 ha is available only at the Baslapur in Amravati district and Ambhora in Gondia district respectively.

Components of fish seed rearing centres:

The fish seed rearing centres in Vidarbha commonly have following important components:

Spawn rearing ponds: The fish seed rearing centres are established to rear seed up to fry and fingerling size. The spawn is procured from the seed production centres of the Fisheries Department and stocked in rearing ponds in high density where it is reared up to fry size after proper nourishment.

Fry rearing ponds: The nursery rearing of fry and fingerling is generally carried out in three stages: early fry rearing (spawn-early fry), fry rearing (early fry-fry), and fingerling rearing (fry-fingerling). The duration of the nursery cycle varies depending on the stage of rearing. Generally, this practice is not followed in Vidarbha region due to lack of skilled human resource at the disposal of fisheries department.

Grow-out pond: It is also called as stocking pond where fish is grown up to the table size (Marketable size). These ponds are comparatively larger than the spawn and fry rearing ponds. This facility is not available at all the seed rearing centres in Vidarbha.

Table 44: Components of fish seed rearing centre in Vidarbha

Component	Total	Maximum			Minimum		
		Name of centre	Unit area (ha)	No	Name of centre	Unit area (ha)	No
1	2	3			4		
Total area (ha) and number	45.6 & 12	Saikheda fish seed rearing centre, Dist-Bhandara	7.6	-	Kinhi fish seed rearing centre, Dist-Chandrapur	0.08	-
Total water spread area (ha) and number	15.02 and 187	Mandva fish seed rearing centre, Dist-Amravati	2.28	23	Kinhi fish seed rearing centre, Dist-Chandrapur	0.08	3
Total water spread area (ha) & number of nursery ponds	3.36 & 91	Saikheda fish seed rearing centre, Dist-Bhandara	0.96	8	Kinhi fish seed rearing centre, Dist-Chandrapur	0.08	3
Total water spread area (ha) & number of nursery ponds	7.34 & 74	Mandva fish seed rearing centre, dist-Amravati	1.68	20	Asolamendha fish seed rearing centre, Dist-Chandrapur	0.09	3
Total water spread area (ha) & number of nursery ponds	4.32 & 22	Asolamendha fish seed rearing centre, Dist-Chandrapur	1.05	3	Ambhora fish seed rearing centre, Dist-Gondia	0.12	1

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

Present status of seed rearing:

The total average annual seed rearing capacity (fry/semi-fingerling/fingerling) of all seed rearing centres in Vidarbha is 534 lakh whereas the actual average annual production from 2013-14 to 2017-18 is 62.21 lakh. The average revenue is 2013-14 to 2017-18 is Rs 17.23 lakh. (Table 45). The fingerling sized fish seed is considered as ideal stocking material for grow-out culture. However, only 04 centres in Vidarbha produce fingerlings and remaining are producing seed up to fry and semi-fingerling.

Table 45: Fish seed rearing centres in Vidarbha and their capacity

Division	District	Name	Capacity of stocking (spawn in lakh)	Actual stocking	Capacity of production (fry/semi-fingerling/fingerling in lakh)	Average actual production of last five years (In lakh)	Average revenue of last five years (lakh)	Percentage of actual production with respect to capacity
1	2	3	4	5	6	7	8	9
Nagpur	Nagpur	Khindshi	-	-	80	1.35	0.68	1.69
	Bhandara	Nagthana**	-	-	152	-	-	0.00
	Chandrapur	Maregaon**	45	-	19	-	-	0.00
		Kini**	10	-	8	-	-	0.00
		Adyal**	32	-	4	-	-	0.00
		Asola-mendha	139	49.26	31	7.48	1.35	24.13
	Gadchiroli	Murkheda	-	28.75	81	1.99	0.28	2.46
	Gondia	Ambora*	35	39.77	18	0.83	0.26	4.61
	Total	8	261	117.78	393	11.65	2.57	2.96
Amravati	Amravati	Mandva	64.25	72.8	30	8.29	2.47	27.63
		Baslapur*	-	2.44	30	23.3	6.94	77.67
	Yavatmal	Saikheda	150	81.50	60	11	3.67	18.33
		Pus*	50	48.94	21	7.97	1.58	37.95
	Total	4	264.25	205.68	141	50.56	14.66	35.86
Grand total		12	525.25	323.46	534	62.21	17.23	11.65
Note :		* Leased out to private sector ** Non-functional - Data not available						

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

The average actual seed rearing (fry/semi-fingerling/fingerling) of last five years from above seed rearing centres in Vidarbha is only 12% of the total capacity. One of the major reasons for production much below the actual capacity is due to under stocking (only 61.58% of the total capacity) by the fish seed rearing centres. The maximum fish seed production was observed at Baslapur centre in Amravati district which is near to the capacity (78%). It was followed by Pus fish seed rearing centres in Yavatmal district (38%). The minimum seed production was carried out at Khindsi in Nagpur district (1.69%) fish seed rearing centre of State Fisheries Department. The overall performance of fish seed rearing centres operated by State Fisheries Department is not satisfactory owing to lack of manpower. Among the leased out seed production centres, Ambora centre in Gondia produces minimum (5%) while, Baslapur and Pus seed rearing centres are producing 78% and 38% of capacity respectively. The sorry state of fish seed rearing in Vidarbha is due to insufficient rearing facilities, scarcity of water, lack of manpower and overall neglect & apathy.

It is expected that the seed rearing centres in Vidarbha should produce at least 70% seed of the total production capacity. Considering this, during the year 2016-17, the 12 rearing centres could have produced 374 lakh seed but have actually produced 128 lakh (i.e. 24% of the total capacity).

Challenges:

- In Vidarbha, seed production centres and rearing centres of the State Fisheries Department do not have adequate capacity (in terms of infrastructure, equipment and personnel) to perform the function. It is the fact that the seed production centres & seed rearing centres are not running efficiently and produce very less seed.
- The centres get insufficient water during dry season hampering the seed rearing. Hurdles are faced by the Fisheries Department for water agreement with Water Resource Department.
- Irrigation water tariff is high and electricity rates are charged as per industrial rates.
- Siltation and seepage in ponds is common at many centres.
- Majority centres have derelict and dilapidated hatchery structures and internal water supply system. Heavy leakages in main water supply line from reservoir.
- Unreliable power supply is a major problem at all the seed production Centres.
- Leased out seed production centres don't have proper broodstock and the facility of broodstock rearing. Moreover, these centres hardly possess technical capacity of producing quality fish seed.
- In leased out centres, broodfish are bred multiple times over very short intervals, i.e. within two to three weeks resulting in poor quality of the seed.
- The brood fishes are reared and bred over the years repeatedly which has been the major cause behind inbreeding problems in hatcheries.
- No technical support is provided by State Fisheries Department to leased out seed production and rearing centres.
- Lack of onsite infrastructure facilities for training of fish farmer.
- No capacity development program for DoF personnel on recent technological advances, cross sectorial integration, Information Communication and Technology (ICT) skills, sustainability concerns, fisheries co-management, etc.

4.2 Maharashtra Fisheries Development Corporation Ltd. (MFDC):

Aims and objectives of MFDC:

- To promote, develop & scientifically exploit the marine as well as inland fishery resources and procure fish and other products.
- To acquire, maintain and operate fishing vessels, nets, hooks and other gear to raise overall production of fish within the State of Maharashtra and also from the seas far and near.
- To sell and export fish, fresh, frozen processed or dry and other aquatic products either produced by the company or acquired or purchased from other agencies on wholesale or retail or agency or by any other methods, either in this state or any other state in India.

Structure:



Table 46. Staffing pattern of MFDC in Vidarbha

Region	Location	Sanction post					Filled post					Vacant post				
		DM	SSS	FI	AFDO	FM	DM	SSS	FI	AFDO	FM	DM	SSS	FI	AFDO	FM
1	2	3					4					5				
Nagpur	Nagpur	1	2	1	1	0	0	1	1	0	0	1	1	0	1	0
	Chargaon FSPC	0	0	1	1	4	0	0	1	1	1	0	0	0	0	3
	Bor FSPC	0	0	1	1	4	0	0	1	1	1	0	0	0	0	3
	Pench Cage culture	0	0	1	1	4	0	0	1	0	1	0	0	0	1	3
	Irai dam	0	0	1	0	4	0	0	0	0	1	0	0	1	0	3
Amravati	Isapur cage culture	0	0	1	1	1	0	0	1	0	0	0	0	0	1	1
Total		1	2	6	5	17	0	1	5	2	4	1	1	1	3	13
Note:		DM :Divisional Manager, SSS : Senior Sale Supervisor, FI: Fish Inspector, AFDO: Assistant Fisheries Development Officer, FM: Field Man														

Source: FGD of researchers with MFDC, Regional Office, Nagpur.

Major activities in Vidarbha:

The MFDC is chosen as a commercial wing of State Department of Fisheries in Maharashtra to demonstrate and to standardize location specific improved developed aquaculture technologies in the State. In Vidarbha, the major activities entrusted upon MFDC in collaboration with State Fisheries Department, Maharashtra are:

- **Demonstration and dissemination of culture based capture fisheries in reservoirs:** The reservoirs need to be managed on scientific lines for increasing the fish production and overall productivity of the reservoir. The traditional reservoir fishery adopted by fishermen is the major source of inland fish production in Vidarbha which yields very meager fish production. In this regard, the MFDC is entrusted with employing demonstration and dissemination of culture based capture fisheries in selected reservoirs in Vidarbha. At present, Bor dam in Wardha district, Erai dam in Chandrapur district and Isapur dam in Yavatmal district etc. are under control of MFDC. However, it was noticed that the MFDC is subleasing these water bodies to private parties and has modest approach towards actual demonstration and dissemination of technology. The MFDC does not have proper data on annual fish production and per hectare yield increment, revenue generated, livelihood upliftment of the fisherman population, and popularization of scientific fisheries management regimes in reservoirs etc. It reveals that the purpose of handing over the reservoirs having good fisheries potential to MFDC seems defeated in Vidarbha.
- **Fish seed production of commercial important fish species:** The MFDC is handed over with Chargaon fish seed production centre in Chandrapur district and Bor in Wardha district. During the survey it was observed that both these centres are operational at sub optimal production level. The hatcheries are in bad state, record keeping is pathetic, rearing ponds were heavily infested with weed & grasses and devoid of water even during peak breeding season. The regional level administration seems to be not prompt to prevent deteriorating situation of seed production centres.
- **Pilot scale demonstration, standardization and promotion of modern fish culture technology such as cage culture:** In Vidarbha, the MFDC has initiated the reservoir cage culture in the year 2010 under National Mission for Protein Supplement, Rashtriya Krishi Vikas Yojana (RKVY) scheme of Central Government at 03 localities namely Isapur reservoir (Yavatmal District), Bor reservoir (Wardha District) and Pench reservoir (Nagpur district). The financial assistance was of Rs. 10.02 Cr.

The total cages of 6m x 4m x 4m size dimensions with 10 mm mesh size for rearing and 30 mm mesh size for grow out culture of fishes were installed by MFDC at these selected sites. The batteries of 32 cages were installed at each selected site. Thus, the total cages installed were 96 comprising 24 rearing and 72 grow out cages. The material for cages was High Density Poly Ethylene (HDPE) supplied by M/s Nilkamal Pvt. Ltd. Total cost for installation of cages is 300 lakhs. The species selected for cage culture were monosex tilapia (*Oreochromis niloticus*), pangasius (*Hypophthalmus sutchi*) and common carp (*Cyprinus*) which was stocked @ 148no/m³, 98 no/m³ and 16 no/m³ respectively. The feed brand used was ABIS (IB group, Rajnandgaon, Chhattisgarh). In this regard, the details of fish culture in cage such as species wise stocking, average size at harvest, production, average sale price & total quantity of feed used in various units were collected from MFDC, Mumbai (Annexure VI). The analysis of the data revealed that the results of cage culture units installed by MFDC at Bor, Pench, and Isapur were not encouraging and shortfalls in survival rate, feed consumption, production levels were observed. Recently these cage units have been leased out to private parties.

- **Establishment of hygienic fish markets:** The domestic fish markets in Vidarbha are generally located either on road or in the unauthorized areas. The condition of these markets is mostly unhygienic with poor infrastructure facilities in terms of water supply, icing and preservation, display platforms etc. In order to attract consumers to fish market and to get better price for produce, the MFDC in collaboration with State Fisheries Department, Maharashtra and financial support from National Fisheries Development Board (NFDB), Hyderabad have initiated and established hygienic fish markets at various places in Vidarbha. These markets are established at authorized places of Local Self Government bodies. However, the response from fish marketers is not forthcoming for these newly established markets. The major reasons could be location of the markets, invisibility to consumer, less involvement of stakeholders, insufficient space for fish cutting and sale.
- **Promotion of fish and fishery product:** The MFDC had come up with few good initiatives to promote fish and fishery products in Vidarbha in collaboration with State Fisheries Department and NFDB. Through this, the MFDC distributed few units of fish on wheels; fish kiosks serving fresh fish, bicycles with chilled storage units, etc. on subsidize rates to selected cooperative societies and fishermen in some districts of Vidarbha. At the beginning, this seemed to be a good initiative from MFDC which

received good response from the people at large. However, during the survey it was observed and shared by members of cooperative societies that the units such as fish on wheels and fish kiosks serving fish are in sick state. The main reasons being lack of promotion, guidance and follow up by MFDC and State Fisheries Department.

4.3 Fisheries cooperative sector:

Introduction:

The fishery co-operative movement in India began in 1913 when the first fishermen's society was organised under the name of 'Karla Machhimar Co-operative Society' in Maharashtra. The structure continued to grow into multi-functional units at the primary level, federations at district/regional, state and national levels. In India, this role of institutional support and social connectedness among fisheries communities is played by conventional fishermen groups, fishermen cooperative societies, federations, etc. There are 21 State federations, 156 Central societies, 14,731 Primary societies of fisher folks having a membership of 21,81,296 in the country (Source: Hand Book on Fisheries Statistics 2014).

Most of the Fisheries cooperative societies have been established to coordinate production and marketing of fish harvests and to avail benefits of government schemes. Major part of the fisheries cooperative movement in the country has been a state promoted initiative. There are, however, exceptions to this, for example, fisheries cooperative societies organized and supported by some Non-Governmental Organisations (NGOs) in southern states such as in Tamil Nadu and Kerala by South Indian Federation of Fish Workers Societies (SIFFS); societies organized at Tawa reservoir and Bergi reservoir in Madhya Pradesh by the Kisan Adivasi Sangthana and Bergi Bandh Visthapit Sangh respectively.

In most of the cases, the fishermen's cooperatives have been found successful and were able to retain the loyalty of their members. However, these organizations by their very nature and reason for existence have focused on increasing the maximum output from the fishery resources and thereby, increasing the livelihood, income and wellbeing of their members. There have been instances where these fisher folk organizations have played an important role in resource enhancement and management of fishery resources.

Role /Importance of fisheries cooperative societies in the sector:

Fishing communities is one of the weaker sections of society. The major responsible factors for their slow growth are illiteracy, poverty, lack of knowledge of latest's fisheries technology and lack of proper price to their produce. Fishermen are exploited by middlemen

who act as money lenders and contractors. This vicious circle is further strengthened by the lack of institutional support both in infrastructure and finances.

- **To provide finance to the member fishermen:** The fishermen are poor, illiterate and low ability to take loan from organized financial Institutions, the co-operative fisheries societies mobilize financial resources from members in the form of share capital and deposit from the members and non-members. It also mobilizes resources from District Central Co-operative Banks, State Cooperative Bank, National Bank for Agriculture and Rural Development (NABARD), National Federation of Fisheries Cooperatives Ltd. (FISHCOPFED), National Co-operative Development Corporation [NCDC], State and Central Governments. These agencies provide loans, subsidies, aids to the members of fisheries co-operatives.
- **To motivate fishermen to organize fisheries co-operatives:** The Co-operative sector is a very effective tool for the development of weaker sections of the society. For the economic development of fishermen and for solving the common problems there is a need of establishment of fisheries co-operatives. These societies help to rescue fishermen from moneylenders, middlemen, traders, capitalist, etc. It means fisheries co-operatives can increase the collective power of fishermen community. Fishermen can keep pressure on the government for providing facilities like landing centres, fish processing centres, export of fish and fish products, etc. The fisheries co-operative societies can work as mediator between fishermen and all government and semi government agencies.
- **To provide fish seeds, nets and boating materials, inputs and equipments:** Recently the fishing business has been changed tremendously. Now fishing is carried out by modern technology. The new technique also being adopted in the processing and selling of fish. Similarly, modern mechanized boats, gill nets, deep freezing facilities, storage facilities, transporting and canning facilities have been developed.
- **Procure fish from members and provide complete infrastructure for sale of fish:** Co-operatives purchase the fish from fishermen who are the members of the society at a remunerative price. Fisheries co-operatives also provide some infrastructural facilities like storage, transport, canning, processing before the sale of fish.
- To arrange technical guidance for members.
- To provide health care facilities and family welfare services to the members of fisheries co-operatives.
- Setting up of demonstration units for member fishermen.

- Research and consultancy programmes for fishery cooperatives.

Methodology:

The primary focus of fisheries cooperative societies is on raising production, developing marketing and financial management. The members in the fisheries cooperative societies can be grouped into communities as indigenous groups, who depend completely on fish and other aquatic resources for their subsistence; opportunistic group, who depend partly on fish and emerging groups, who have recently started fishing. In Vidarbha, indigenous group members belong to Dhiwar, Bhoi and Gond caste of fishermen.

Fisheries cooperative societies as a social organization have not been studied in Vidarbha lately. The present study was undertaken to assess the internal functioning of the fisheries cooperative societies established and promoted under different scenarios. The basic approach in the present survey is to adopt a combination between primary and secondary data and information pertaining to the spatially dispersed fisheries cooperative societies of Vidarbha. The sample survey was carried out with the help of questionnaires, case studies, systematic observations based on visits and long discussions with the chairman / secretary / members of fisheries cooperative societies of Vidarbha (Annexure VII). The primary cooperative societies meet was carried out at respective district offices of Department of Fisheries. In addition to this, a stakeholders meeting involving executives of 11 district fisheries federations of Vidarbha was also organized to discuss pertinent issues of cooperative sector.

In order to study the functioning and performance of cooperative societies in effectively managing their resources and contributing to growth in the sector, the performance indices were identified based on the collected data (Table 47). The major five performance indices i.e. working status (active/inactive), percentage ratio of active members to total members, category of audit report, percentage of net profit/loss to revenue and percentage gap in fish production were selected for assessment of performance of the society.

Table 47. Performance indicators and justifications

Performance Indicators	Justification
1	2
Working status (active/inactive)	The status of society helps to identify its working or deferred nature.
Percentage ratio of active members to total members	The ratio indicates the overall involvement of members in activities & decision making process and inclusiveness of the society.

Performance Indicators	Justification
1	2
Category of audit report	An audit report is an appraisal of cooperative societies for financial wellbeing. Category of audit report reflects assets, liabilities, and society's financial position and its future progress.
Percentage of net profit/loss to revenue	Ratio analysis is the process of determining and interpreting numerical relationship among the variables. The percentage ratio of net profit/loss to revenue indicates overall performance and earning capacity of business. It reveals effectiveness of business transaction in terms of profit and overall efficiency of cooperative societies.
Percentage gap in fish production	The difference between actual fish production and estimated production is calculated as the percentage deviation from estimated production. The fish production gap is a major indicator for production potential and efforts taken by cooperative societies thereof.

Source: FGD among the researchers

The data collected from surveyed cooperative societies (240 numbers and 21 % of total societies) was compiled and assessed for selected performance indices. Based on this, the framework for performance assessment and subsequent scoring of cooperative society is finalized. The selected performance indicators and scoring pattern is given as follows:

Table 48: Performance indicators and scoring pattern of cooperative societies

Performance indicator	Categorization	Percentage weightage to categorization	Scoring	
			Weightage	Maximum score
1	2	3	4	5
Status	Active	100%	20	20
	Inactive	0%	0	
Percentage ratio of active to total members	80-100%	100%	20	20
	60-80%	75%	15	
	40-60%	50%	10	
	20-40%	25%	5	
	0-20%	0%	0	
Category of audit report	A	100%	20	20
	B	75%	15	
	C	50%	10	

Performance indicator	Categorization	Percentage weightage to categorization	Scoring	
			Weightage	Maximum score
1	2	3	4	5
Percentage of net profit/loss to revenue	50-100%	100%	20	20
	40-50%	75%	15	
	30-40%	50%	10	
	20-30%	25%	5	
	0-20%	10%	2	
	Below 0%	0%	0	
Percentage production gap	80-100%	0%	0	20
	60-80%	25%	5	
	40-60%	50%	10	
	20-40%	75%	15	
	10-20%	85%	17	
	Below 10%	100%	20	

Source: FGD among the researchers

In addition, the members of the societies were surveyed for the training needs necessary to upgrade technological skills and add more productively to the society's benefit. Accordingly, training needs assessment in Vidarbha is analyzed.

Results and discussion:

Present status of fisheries cooperative societies in Vidarbha:

The region is having 1,356 registered primary cooperative societies with total membership of 95,265 numbers. Out of these, 1,149 are active cooperative societies. In the present study, total 240 (i.e. 21%) societies representing all 11 districts of Vidarbha were surveyed. (Table 49)

The maximum number of cooperative societies is registered in Yavatmal district. While, the minimum societies are registered is in Akola district. The district of Chandrapur has maximum members of cooperative societies whereas Akola district has minimum members. The highest numbers of active societies are recorded in Buldhana district while the Yavatmal district has most number of inactive societies.

In general observation, it was noticed that though Nagpur region has more potential in fisheries sector, the number of societies registered are comparatively less. Thus, there is scope to increase registration of societies.

Table 49. Present status of fisheries cooperative societies in Vidarbha (2015-16)

Region	District	Total number of societies	Members	Active societies	In-active societies
1	2	3	4	5	6
Nagpur	Nagpur	126	10,981	126	0
	Bhandara	127	10,099	127	0
	Chandrapur	167	23,497	130	37
	Gadchiroli	96	11,381	60	36
	Gondia	133	11,077	126	7
	Wardha	47	2,510	34	13
Amravati	Amravati	93	4,800	70	23
	Akola	38	2,215	35	3
	Buldhana	178	6,810	166	12
	Washim	139	4,923	125	14
	Yavatmal	212	6,972	150	62
Total		1,356	95,265	1,149	207

Source: Data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division

Performance of fisheries cooperative societies in Vidarbha:

The overall performance of fisheries cooperative societies in Vidarbha is assessed based on selected performance indices viz., working status (active/inactive), percentage ratio of active members to total members, category of audit report, percentage of net profit/loss to revenue and percentage gap in fish production as mentioned in methodology. The Performance Assessment Ranking (PAR) based on scoring of fisheries cooperative societies is presented in Table 50.

Table 50. PAR of fisheries co-operative societies based on scoring

Region	District	No. of Cooperative societies surveyed	Percentage of Cooperative societies surveyed	Performance Assessment Ranking			
				80-100%	60-80%	40-60%	Below 40%
				Excellent	Good	Average	Below average
1	2	3	4	5	6	7	8
Nagpur	Nagpur	20	16	0	1	16	3
	Bhandara	15	12	0	3	11	1
	Chandrapur	40	30	0	8	31	1
	Gadchiroli	14	15	0	1	12	1
	Gondia	28	60	0	8	18	2
	Wardha	13	8	0	1	10	2

Region	District	No. of Cooperative societies surveyed	Percentage of Cooperative societies surveyed	Performance Assessment Ranking			
				80-100%	60-80%	40-60%	Below 40%
				Excellent	Good	Average	Below average
1	2	3	4	5	6	7	8
Amravati	Amravati	6	6	0	4	2	0
	Akola	14	37	0	1	9	4
	Buldhana	31	22	0	5	19	7
	Washim	35	20	0	6	27	2
	Yavatmal	24	11	0	6	18	0
Total		240	21	0	44	173	23

Source: Estimated from data collected through questionnaires during field visits from cooperative societies and FGD among the researchers

From the data it reveals that, out of the 240 cooperative societies surveyed none was under excellent category of PAR, 44 societies were found to be under good performance ranking, 173 societies were recorded as average and 23 societies were performing below average.

The number of societies under good category is only 18% of the total societies surveyed. The good, average and below average scoring, ranking and performing societies based on performance indicators are presented in Table 51.

The maximum number of societies was found under average category (72%) but their performance was not up to the mark based on selected performance indicator. The below average societies are 10% of the total societies surveyed. The major reasons for low performance assessment ranks are namely poor scoring on account of category of audit report, percentage of net loss to revenue and gap in actual and potential fish production. This implies that these societies are not managed efficiently by the members. It also reveals that insufficient efforts were put in by the societies towards raising operational resources and fish production.

Table 51. Scoring, ranking and performing of societies based on performance indicator

Sr. no.	Name of society	Performance indicator					Categorization of performance indicator					Scoring based on performance indicator						
		Status active/ inactive	% Ratio of active to total members	Category of audit report	% of net profit/ loss to revenue	% produ-ction gap	Status active /inactive	% Ratio of active to total members	Category of audit report	% of net profit/ loss to revenue	% of produ-ction gap	Status active /inactive	% Ratio of active to total members	Category of audit report	% of net profit/ loss to revenue	% of produ-ction gap	Total score	
1	2	3					4					5						
Good- score, rank and performance of societies based on performance indicators (Score 60-80%)																		
1	Jay Gangejhari F.C.S. Ta. Arjuni-Mor Dist. Gondia	Active	100	B	61	75	100%	100%	75%	100%	25%	20	20	15	20	5	80	
2	De. Kanhadevi Tekadi F.C.S.Tah. Par, Dist. Nagpur.	Active	100	B	32	41	100%	100%	75%	50%	50%	20	20	15	10	10	75	
3	Naldamyanti F.C.S. Ta.Morshi Dist.Amravati	Active	71	A	8	15	100%	75%	100%	10%	85%	20	15	20	2	17	74	
Average - score, rank and performance of societies based on performance indicators (Score 40-60%)																		
4	Aadarsha F.C.S. Ta. Sakoli Dist. Bhandara	Active	100	B	22	97	100%	100%	75%	25%	0%	20	20	15	5	0	60	
5	Nirantar F.C.S. Ta. Aarmari Dist Gadchiroli	Active	52	B	43	96	100%	50%	75%	75%	0%	20	10	15	15	0	60	
6	Kiran F.C. Ta.Karanja Dist.Washim	Active	71	B	29	87	100%	75%	75%	25%	0%	20	15	15	5	0	55	
Below average - score, rank and performance of societies based on performance indicators (Score 0-40%)																		
7	Magasvargiy F.C.S. Pachoda, Zila Wardha	Active	28	C	-102	70	100%	25%	50%	0%	25%	20	5	10	0	5	40	
8	Jagdamba F.C.S. Ta. Barshitakli Dist. Akola	Active	39	C	5	96	100%	25%	50%	10%	0%	20	5	10	2	0	37	
9	Shyamkimata F.C.S. Ta. Barsi Takdi Dist Akola	Active	35	C	12	97	100%	25%	50%	10%	0%	20	5	10	2	0	37	

Source: Estimated from data collected through questionnaires during field visits from cooperative societies and FGD among the researchers

During the survey the members of the primary societies and executives of district fisheries federation were inquired about their training needs. From their discussion and questionnaires, the following trend of percentage of training need assessment is revealed. (Table 52)

It was observed that, the most of the members need skill development training mainly on “Improved fish culture practice, fingerling production, value addition and improved fish harvesting methods”. Similarly, the members also express to go through skill development programs involving farm made feed preparation, fish culture in seasonal water bodies, fish seed production and hatchery management as well as cage culture etc.

Table 52. Percentage of training needs assessment in Vidarbha

Type of training as requested by cooperative society members	Percentage
1	2
Improved fish culture practices	13
Fingerling production	11
Value addition	11
Improved fish harvesting methods	10
Farm made feed preparation	9
Fish culture in seasonal water bodies	8
Seed production	7
Cage culture	5
Fish handling and marketing	5
Prawn farming	5
Good management practices	4
Fish preservation	4
Boat building	3
Co-operative management training	1
Net fabrication	1
Fish drying	1
Species diversification	1
Pearl culture & ornamental fish rearing	1

Source: Estimated from data collected through questionnaires during field visits from cooperative societies

Challenges:

- Inland fisheries is not treated at par with Agriculture in the context of taxes, electricity tariff etc.
- Scientific and rational criteria are not followed for fixing lease period and lease amount for different water resources by leasing authority.
- Existing water usage policy does not recognize the minimal water level for fisheries in water bodies.
- The duration of leasing of water body under Panchayats (Extension to Scheduled Areas) Act (PESA) act does not suit for fisheries development in some part of Vidarbha.
- Poor availability of quality fish seed in required quantities for stocking water bodies at right time.
- Production is decreasing from water bodies due to aquatic vegetation, siltation, underwater obstacle and pollution in most of the Malguzari talav, village ponds, lake, etc.
- Insufficient fish market facility at block and village level.
- Transportation of fish through government transportation mode is not allowed.
- Less access to markets and involvement of large number of intermediaries.
- There is no provision of minimum support price to produce.
- Lack of adequate incentives for promotion of export oriented inland fishery enterprises.
- Lack of capital and insufficient credit facilities/bank finance to cooperative sector.
- Loan interest rates for fisheries are not at par with agriculture.
- Non-coverage of reservoir fishery under insurance.
- No clear policy for relief to fishers for natural calamity.
- Existing welfare measures provided by Government (Centre/State) to inland fishers are not adequate / satisfactory.
- Poor extension services for the fisher communities with regards to promotion of fish seed production, on-site feed production, fish farming and other fish based enterprises.
- Less or no provision in case of distress during natural calamities like drought and flood etc. as the same is considered under agriculture sector.

- No involvement of fishing communities in planning and decision making process at local Self Government institute and State Level Government Administration.

In Vidarbha, inland fisheries co-operative sector are poorly managed and inefficient in providing various services (fish marketing, storage, value addition, channelizing welfare measures) to its members due to some inherent flaws:

- Conflicts among the members and lack of management skills among executives of cooperative society leading to poor performance and losses.
- The functioning of the societies and federations is hindered by political factions among members.
- Fisheries cooperative societies are managed by some local strongmen and executive body is manipulated by them.
- The societies are after short gains and reluctant to accept progressive policy changes.
- Agitations against policy changes are common and mostly politically driven.
- The societies cry foul on leasing rates but do not take much effort to increase fish production.
- Sub leasing of water bodies by societies is common practice. This motivates wealthy and influential persons to enter into the sector. This is a major concern regarding loss of livelihood of the poor members and loss of expected revenue to the government.
- Lack of scientific fisheries management leading to less productivity of the water bodies.
- Indiscriminate stocking leads to proliferation of undesired species and thus creating loss to indigenous biodiversity.
- Illegal fishing by use of explosives or poisonous substance to some extent.
- The societies hardly follow any conservatory measures such as restriction on types of gear and mesh size used for fishing, restriction on size of the fish caught, closed season and no fishing during migration.
- No reliable up-to-date precise database of production reported or shared by cooperative society which brings uncertainty into the planning process.

Conclusion:

The Vidarbha region has good potential for increasing fish production through network of established fisheries cooperatives. However, the technical and financial management of cooperatives need to be strengthened through training and skill development

programs focusing not only on technical aspects but also on operation, accounting and managerial skills.

The fisheries cooperative sector in Vidarbha is facing serious problems regarding existing leasing policy, water usage policy, availability of seed and other inputs, low productivity due to aquatic vegetation and siltation, lack of capital & insufficient credit facilities, life insurance and entry of some influential people in the business. The lack of coordination between financial institutions and cooperative organizations is observed.

The fisheries business is considered to be a lucrative business. However, due to poor management skills and poor financial support, the illegal practice of subleasing of water bodies to influential and wealthy stakeholders is practiced widely in Vidarbha. In such subleasing practice, the fishermen would only get royalty on fish catch and most of the profit goes in the hands of the proprietor. This not only deprives fishermen of their rightful share in the profit but inadvertently leads to low inputs towards raising productivity of water body. This is one of the major reasons plaguing the growth and wellbeing of the fisheries cooperative sector in Vidarbha.

In view of this, it is required to take necessary steps to improve the functioning and business performance of fishermen cooperative sector. It has become necessary to organize techno-financially feasible and professionally managed fisheries cooperative sector. Further, the policy guidelines regarding leasing, conservation and management of fisheries resources in inland fisheries sectors need to be formulated in coordination with fisher communities and government agencies.

4.4 Role of supporting department (District administration, Water Resource Department, Zilla Parishad and other Local Self Government bodies):

Though the major role of inland fisheries development in Vidarbha is assigned to State Fisheries Department, the other important government agencies like Collector Office, Water Resources Department, Cooperative Department, Zilla Parishad and other Local Self Government bodies play equally important role in planning and fund allocation, transfer of water bodies to Department of Fisheries, registration of fisheries cooperative societies and leasing of village ponds, tanks and lakes etc. respectively.

Fishing rights in the rivers are not leased out in the districts. Government tanks belong to Revenue, Irrigation and Forest Departments whereas some tanks are owned by local bodies

like Municipalities, Gram Panchayats, etc. The State Government policy for transfer of fishing rights of all tanks constructed by Water Resources Department to the Fisheries Department has come into effect since 1966. This policy has put into practice to generate employment through development of pisciculture in the Irrigation Tanks and Reservoirs by the local Fisheries Co-operative Societies. Generally, the tank is auctioned in favour of the highest bidder, preference being given to the fisheries co-operative societies or fishermen. The 50% revenue from this activity goes to Water Resources Department and the remaining 50% is shared by Fisheries Department.

Pisciculture is also undertaken by local bodies, Gram Panchayats and individual pisciculturist. The water bodies under Zilla Parishads (ZP) in Vidarbha are small village tanks, lake & ponds and Malguzari talav which are leased out to highest bidders mostly from fishermen community by respective local Self Government body. The fish cultivation in these water bodies is purview exclusively of the leasee and the Fisheries Department has only a supervisory job. In case of tanks with Gram Panchayats, the respective Gram Panchayat has exclusive right to allocate water bodies for fish rearing to any one from the village. However, in case of tanks, ponds, lakes and other smaller water bodies in areas where PESA act is in place, allocation of all such water bodies to beneficiaries is exclusive right of the respective Gram Sabha.

The District Administration led by the district collector allocates grants for planned schemes of Fisheries Department through the District Planning and Development Committee. Under this excavation of the new fish ponds, renovation of existing or dilapidated structures and ponds, subsidies on fish seed, feed, net, fertilizers and small boats in inland areas. The District Administration also encourages Fisheries Department to take up innovative schemes in the district as per the resource availability and scope. The major programme initiated by the Office of Divisional Commissioner, Nagpur in recent years is “Talav tethe masoli”, which has been taken up on missions scale by all the six District Administration Offices of Nagpur division. The programme is in consonance with idea of “Mission Fingerling” put forth under blue revolution scheme of NFDB, Hyderabad and is heralded as exemplary by the State Government of Maharashtra. This scheme has been adopted by State Government for whole of Maharashtra as “Matsyayukta Talav”. (Reference: GoM GR: Fisheries 2017/Case No. 121/ADF 13 dated 29th July, 2017).

The Department of Cooperation monitors the working of fisheries cooperative societies, their organization and registration etc. It also monitors and controls the work of society employees. The inspection and audits of these cooperative societies is with the

Department of Cooperation. If the society members are found to be involved in fraudulent practices, the department reserves right to withdraw the registration of that cooperative society. In doing so, this Department maintains check and balances over operations and working of the fisheries cooperative societies. During the survey, it was observed that few district level fisheries cooperative federations in Vidarbha namely at Chandrapur and Bhandara were under serious scrutiny of the Department of Cooperation lately. The Chandrapur district fisheries federation was working under the guidance of Administrator deputed by the Government.

As with other natural resource based sectors fisheries sector also complement and compete with other sectors for resources. Reducing competition by integrating and optimizing use of resources and harnessing the potential of complementary benefits would be in the greater interest of the state. Thus the first step in this direction would be to mainstream this perception across these sectors and build a coordination mechanism at the highest level to strengthen cooperation and facilitate actions. Departments like Department of Irrigation, Department of Revenue, Department of Environment and Forest, Department of Water Resources, Department of Urban Development, State Pollution Control Board, etc, are directly or indirectly involved with the management and development of fisheries resources and programme. Department of Irrigation, Department of Revenue and Department of Environment and Forest hold and own water and use for various purposes including irrigation, flood control, power generation and other purposes. Department of Forest and Environment on the other hand use water for conservation of biodiversity. Similarly, the DoF attempts to make best use of available water holds for conservation and development of fisheries and aquaculture and maintaining the health of aquatic ecosystems and its contained aquatic biodiversity.

In the existing arrangement of water is between the Department of Irrigation and DoF, the right to manage fishery is vested with the DoF and in turn fishing right is extended to fisheries cooperatives or individuals on lease basis. In doing so, the Department of Irrigation is doing a great service to the poor and disadvantaged group of fishers by providing them livelihood opportunity and production of high quality protein food for the public in general. But somewhere the very emphasis on fisheries is lost which goes in favor of revenue which is generated by way of lease money. In the process the interest of fisheries becomes secondary resulting in critical situation for the very survival of fisheries at some occasion. On the other hand, the leasing process is so cumbersome and complex that the DoF officials have to spend major time to facilitate leasing process, collection of lease amount and settling conflicts and

legal issues. This issue deserves priority attention for a better and acceptable solution to enable the DoF to provide better governance and facilitate sustainable development of reservoir fisheries.

Under the proposed programme there is a provision for developing seed rearing ponds in the vicinity of reservoirs which would require allocation of suitable land for the purpose by the Water Resource Department. Similarly canal water is provided by the Water Resource Department for irrigation of crops on land and not for farming in ponds through aquaculture. Both, agriculture on land and aquaculture in pond are basically food farming and hence, this discrimination to aquaculture needs to be removed. The state has good and extensive network of irrigation canals which also retains water flows for several months. The flowing water with high level of dissolved oxygen offers opportunity for culture of fish in cages and also in small fenced segments - pens. A formalized agreement between the DoF and the Water Resource Department is pre-requisite for initiating this innovative development intervention. There are a number of cross-sectoral issues which essentially require highest level of coordination support and complementation.

4.5 Maharashtra Animal and Fisheries Sciences University, Nagpur:

The fisheries sector has great potential to generate self-employment, especially for rural landless labours and marginal farmers of Vidarbha. Keeping this in view, the Government of Maharashtra has established the College of Fishery Science at Nagpur and Udgir under the Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur during 2006 & 2007 respectively. Although, the Colleges are in infant stage, they have been actively involved in intensifying aquaculture activities through dissemination of advanced fish farming technologies amongst the rural farmers and unemployed youth of this region. The fisheries college in Vidarbha region of Maharashtra is instrumental in creating technical manpower in terms of professional fisheries graduates.

The Maharashtra Animal and Fishery Sciences University, Nagpur has emerged as a premier organization for fisheries research education in Maharashtra. The university has been playing a pivotal role in the development of qualified and trained human resources incorporating various new dimensions into its academic curricula to suit the needs of the stakeholders. In recent years, new course curriculum has been initiated with emphasis on specializations in basic and emerging areas of fisheries science. The major research focus of the institute relates to diversification in aquaculture, developing technologies in which unproductive lands can be transformed into productive aqua farms, management of aquatic

resources and biodiversity, post-harvest and value addition, ecosystem management and extension services.

The College of Fishery Science, Nagpur aims not only to produce fisheries professionals but entrepreneurs who would take up fisheries and aquaculture related business independently to generate employment and wealth through hands on training, experiential learning programmes and industrial exposure etc. The areas identified are the fish seed production and culture of important cultivable fish species such as carps, air breathing catfishes like magur, breeding and rearing of ornamental fish varieties; farm made feed formulation and manufacturing; and value added fish product and by-product development from low cost indigenous fish varieties.

Several noteworthy work like enhanced production efficiencies through incorporation of scientific fish seed stocking management, feed management, diversification of aquaculture practices with reference to species and systems, conservation & biodiversity, post-harvest and value addition etc. has been undertaken by the fisheries faculty under MAFSU, Nagpur. The college has successfully completed 05 externally funded projects of over Rs. 1 crore and 03 projects are ongoing. Various important technologies have been standardized and disseminated in the field viz. hatchery seed production of Indian major carps, common carps & magur; fish stock enhancement in small reservoirs; fish culture in polythene lined farm ponds and diversified fish culture involving commercially important varieties like tilapia and *Pangasius spp.* etc. The college has documented an inventory of endemic fish varieties of Vidarbha. The college regularly participated in Kisan rallies, exhibition, radio talks and other extension activities. The college regularly conducts training programmes on “Improved Aquaculture Technology” for the farmers and till date more than 500 farmers have participated in such training programmes. The college has developed important vernacular publication in the form of manual, booklet, broucher, leaflet etc. In all MAFSU, is providing positive learning environment for the students and farmers through teaching, research and extension.

4.6 Need and scope for Human Resource Development (HRD):

The development of any sector largely depends on its trained and skilled human resource and capacity building programmes undertaken by professionals are often successful. Therefore, HRD is an integral part of development and cannot be overlooked. So far, HRD activities in fisheries sector in Vidarbha have been inadequate and do not meet the requirements of the sector, especially in the wake of growing challenges such as emerging

technologies, new approaches to fisheries management, changes in the national and international development, social mobilization of the community and their empowerment, getting access to information and services, developing technical and managerial skills etc. which lead to adoption of good management practices, hygiene and safety, sustainable farming practices, adapting to climate change, etc.

Capacity development in fisheries is increasingly recognized as a high priority area. A special focus on capacity development is particularly important. Capacity development takes place not just within individuals, but also between them and the institutions and the network they create. Importantly, capacity development efforts for more sustainable fisheries management require more than fisheries specific skills (e.g. fisheries science, fisheries management, fisheries law, fisheries technology etc.) but also wider non-fisheries skills such as conflict management, general management, good governance, community mobilization, information and communication skills, etc. Thus, the specific scope for human resource development in Vidarbha includes:

- Restructuring the staffing pattern of DoF and filling up of the vacant technical positions on priority basis.
- Modernization & strengthening of Fisheries College in the region.
- Establishment of fisheries information and training centre.
- Conducting comprehensive Training Need Assessment (TNA) and organizing quality training for all category of DoF staff.
- Establishing dedicated, professional and efficient extension services system with network reaching at taluka and panchayat levels and encompassing all aquaculture and fisheries resources, whether public, private, community and multi-owned under its fold for providing extension services support.
- Facilitating local level organizations of fish farmers and fishers.
- Conducting participatory planning exercise at local resource level / reservoir level / river segment level on management of resource by ensuring environmental and livelihood security.
- Conducting mass awareness and village level awareness programme on the importance of fish biodiversity and ecosystem health.
- Conduct demonstration of improved aquaculture technologies with due importance to technological, social, environmental and institutional aspects.
- Strengthening of existing fisheries cooperatives through training of their members on resource management and cooperative management aspects

In the wake of globalization, liberalization of trade and privatization and greater participation of private sector hand in hand with the public sector, flow of technologies has been increased. These technologies are generated within the country or flowing in from outside. Fisheries and allied sectors are also transforming to industries at a faster pace. Therefore, there is now greater demand for knowledgeable and skilled human resources for the development of standard products and services in the sector.

***5. Contemporary management
and technologies of fisheries
in Vidarbha***

5. Contemporary management and technologies of fisheries in Vidarbha

Introduction:

The fisheries resources of Vidarbha are vast and varied with large untapped potential which can contribute considerably to improve production, nutritional security, livelihood and employment. During the past, the inland fisheries in Vidarbha, is mostly concentrated in reservoirs as capture fisheries but with the introduction culture based capture fishery concept the sector registered slow growth and changes. But recently, it is realized that aquaculture has potential, versatility as a viable and cost effective alternative to capture fisheries. The present chapter provides an insight into aspects of contemporary management and technology of fisheries in Vidarbha.

5.1 Seed production and rearing:

Seed is the critical input for fish culture activities in reservoirs, ponds & tanks, village ponds, Malguzari talav and aquaculture ponds etc. The major cultivable fish group in Vidarbha includes major carps, minor carps and exotic carp. The Indian Major Carps breed spontaneously in natural waters, viz., rivers and bundh type tanks during monsoon. Fish seed in the form of spawn, fry and fingerlings can be collected from the natural resources. Bundh breeding along with induced breeding are the two major technologies adopted for seed production in Vidarbha.

a. Bundh breeding:

The concept of bundh breeding of major carps is regular practice for seed production in Vidarbha. Dry bundh breeding method is more popular and largely practiced in eastern Vidarbha and had played an important role in seed supply at local level at some places.

Dry bundh is a seasonal shallow pond ranging from 0.5 to 4 acres area bounded by embankments on three sides and gets filled during the monsoon but remain completely dry for a considerable period during the remaining part of the year. The smaller units of the dry bundh made of cement brick is traditionally called as 'Mogra bundhs'.

The brooders are collected in May and stocked in storage tanks where they are kept sex wise till the first monsoon showers. As soon as water accumulates in the bundhs, a selected number of these breeders are introduced into these bundhs. The dry bundh breeding is completely dependent on weather conditions. No scientific management like stocking

density of the brooders, male female ratio and maturity status is followed. The selected brooders are released into dry bundh after injecting with synthetic hormone along with several other non-injected pairs as a sympathetic breeding method. Generally 10% of the brood stock is injected with a single dose of hormone, after which mass spawning of carps occurs. Fish in bundhs generally commence to breed during the early hours of the morning and continue to breed throughout the day. Catla prefer deeper waters, when compared to rohu or mrigal, which breed in shallow waters varying in depth from 0.5-1 metre. As soon as breeding commences, arrangements for collection and hatching of eggs are made. The eggs are collected by pieces of nylon net or mosquito netting, cloth or gamcha after lowering the water level and hatched in the double walled hatching hapas, ordinarily fixed in the bundhs. The hatchlings are lifted from hapas by muslin cloth pieces after 12 hours of hatching and are transferred to nurseries. The survival rate is as low as 15%.

Disadvantages:

- Hatching rate of eggs and survival of hatchlings upto the spawn stage is very poor.
- The brood fish are mainly collected by gillnets or cast nets thereby causing injury to the brood fish.
- In the late monsoon with accumulation of more waters, some dry bundhs start overflowing, thus increasing the risk of loss of seed from the bundh.
- The early stages of seed are voracious in their feeding habits and inadequate natural food makes them cannibalistic.
- Due to lack of management there are chances of heavy damage to the developing eggs and subsequently to the juvenile fishes.

b. Induced breeding of carps:

Induced breeding technique is responsible for augmenting the carp seed production in India. Induced breeding system not only produces large quantity of seed but also meets the species-wise requirement. Most of the seed production units have eco hatcheries where GnRH-based induced breeding methods are adopted for seed production in Vidarbha.

The fish seed production capacity, requirement and deficit in Vidarbha region can be seen in the Table 53. The requirement of seed is estimated based on the water body area suggested by MRSAC, Nagpur and stocking density estimated as per recommendation of State Fisheries Department, GoM. (Source: GoM GR: Fisheries 2016/Case No. 171/ADF 13 dated 30th June, 2017)

Table 53. Capacity, production, requirement and deficit of carp seed in Vidarbha

Capacity (million)			Production (million)			Requirement (million)			Deficit (million)		
*1			#2			*#3			Ψ4		
Spawn	Finger-ling	Total	Spawn	Finger-ling	Total	Spawn	Finger-ling	Total	Spawn	Finger-ling	Total
792	53	845	265	6	271	29,841	165	30,006	29,576	159	29,735

Note: * Capacity & # Production – As per data collected through questionnaires during field visits from DoF, Nagpur and Amravati Division.

*# Requirement – Estimated as per on the basis of water body area of MRSAC (2015-16); stocking density estimated as per GoM ADF GR and FGD among researcher.

Ψ Deficit – Calculated by subtracting production from requirement (3-2).

Today, most of the seed is procured from neighbouring states like Chhattisgarh, Andhra Pradesh and West Bengal to meet the deficit. Maximum seed produced in Vidarbha is through use of eco hatcheries and minor component from bundh breeding. The government is also proposing portable carp hatcheries commercialized by CIFA.

c. Eco-hatchery:

The circular hatchery is commonly known as the eco-hatchery in India. At present, there are 15 established seed production centres in Vidarbha. The 14 centres are under the Department of Fisheries, Maharashtra State. In this, 05 are functional, 01 non functional and at 02 centres the operation is yet to be started. Out of the remaining 06 centres, 02 centres are operated by Maharashtra Fisheries Development Corporation (MFDC) and 04 are leased out to private parties by Department of Fisheries, Maharashtra State. The College of Fishery Science (COFS), Nagpur has one more circular fish seed hatchery which has been operational since 2008-09. General structure and operational managerial aspects of eco hatchery comprising of spawning pool, incubation pool spawnery and overhead tank is described below.

The spawning pool of the eco-hatchery system consists of a circular open tank of 6-12m diameter having depth of 1.2 m. The tank is made up of brick or RCC or FRP. The base of the pool is sloped towards centre where the central outlet is located. From the central outlet spawned eggs are carried to the egg collection chamber. The single water inlet point at 60° to the tangent at the junction of the wall and floor of the spawning pool is preferred in Vidarbha fish seed production centres. The spawning pool may also be connected directly to the

incubation pool. In this case, individual egg delivery pipe from individual central outlet increases the egg recovery rate.

Managerial operational aspects of spawning pool:

- Water temperature range of 28-30°C.
- Dissolved oxygen in range of 5-6 ppm can hold 3-5 kg brood/m³.
- Water depth in range of 0.6-1.0 m as per brood stock density.
- Brood is kept in the pool under shower before and after hormone administration.
- Water current is allowed in the breeding pool before one hour of calculated spawning time which initiates extrulization (excitement of spawners) and spawning.
- Water inflow both in the central outlet (egg delivery pipe) and single inlet must be adjusted in such a manner that it creates a speed 3-5 m/second maintaining the requisite water depth.
- Since the effective spawning comes to an end within 1.0-2.5 hours from initiation of the spawning, the breeding pool should be operated at best up to 2 hours.
- Water current is stopped and brood fish are removed back to the pond as soon as breeding operation ceases.
- Spawning and hatching units are cleaned and disinfected with 5 ppm potassium permanganate (KMnO₄) solution before and after each operation. Again after 5-6 continuous operations, it is preferred to disinfect with strong formaldehyde solution.

Incubation of eggs:

Next to the induced spawning, the important task is the incubation of the fertilized eggs till the production of larvae or spawn. Out of these, hatching hapa and incubation pool of eco hatchery is popular among the carp seed producers of Vidarbha.

Incubation in Hatching Hapa:

The hapa incubator is a double-chambered cloth wall enclosure where outer hapa is made of bolting cloth (0.5 mm mesh) and the inner hapa is made of mosquito net cloth (2.0-2.5 mm mesh). The hapa incubator is fixed in the pond by means of four bamboo poles. The water hardened eggs which are obtained by induced breeding are kept in this inner hapa. The hatchlings are sieved to outer hapa through the mesh leaving the egg shell in the outer hapa. The inner hapa with the egg shell is taken out leaving the hatchlings in the outer hapa for three more days till yolk sac absorption.

Incubation in Eco-hatchery Pool:

The hatching pool or incubation pool is circular in shape and made up of cement concrete, brick masonry or FRP material. There are two chambers, *i.e.*, inner and outer. The outer chamber is of 3-6 m diameter whereas the inner chamber is of 1.0-1.5 m. The depth of the pool is 1.0-1.5 m. The circular wall which separates the outer and inner chambers is made of wire mesh. This structure is wrapped with nylon cloth (mesh size 1/80 inch) which allows the water to flow from outer chamber to the inner chamber. Finally, water comes out from the incubation pool through a centrally placed vertical outlet. The water inlet pipes are the duck mouth taps fixed in a circular row, placed equidistantly from each other at the floor of the outer chamber. The egg delivery pipe connects the spawning pool with the incubation pool and delivers eggs for incubation instantly soon after spawning. After incubation hatchlings/spawn are delivered through the outlet pipe which is fixed at the junction of the floor and side wall of the outer chamber to the spawn collection chamber.

Managerial operational aspects of incubation pool:

- Eggs are received on a water cushion of the incubation pool.
- Direction of the duck mouth and speed of water is maintained in such that developing eggs are away from both screen and water preventing them from mechanical injury.
- The water speed of the pool is maintained at 4-5 m/second 1st 1-2 hours, 1-2 m/second for next 6 hours and 3-4 m/second for rest of operation to avoid premature hatching of the developing eggs.
- The hatching time is temperature-dependent and varies from 16-20 hours.
- Eggs are loaded @ 7,50,000-10,00,000 eggs/m³ of water.
- The eggs are extremely sensitive to the harmful effects of various micro-organisms. Such situation is generally come across during pre-monsoon breeding. To control this problem it is preferred to sprinkle KMnO₄ solution intermittently at (2 hrs intervals in the incubation pool.
- For better recovery and survival of spawn, it is necessary to clean the chamber during the incubation of eggs. The following practices are adopted in Vidarbha for cleaning of the incubation pool.
 - **Surface cleaner:** A wooden or bamboo stick of 2 cm diameter is kept on the water surface across the outer chamber in between two walls. It accumulates the foam, floating debris and insects efficiently which are removed manually afterwards.

- **Sub-surface cleaner:** A perforated wooden plank of 4-5 cm width is fixed to the surface water half immersed. It cleans the subsurface water of the chamber.
- **Column cleaner:** A stick of 4-5 cm diameter is kept across the outer chamber in between two walls. On the stick coir rope with soft bristles of 1.0-1.5 m length is tied at 10-15 cm distance. The dead eggs and spawn get stick to the bristles of the coir rope. These ropes are cleaned manually from time to time during incubation operation.

Common carp is an important species cultured in ponds and tanks in Vidarbha. Common carp generally spawns throughout the year in tropical climate with two peak breeding periods - one from mid-November to mid-February and other during July-August. Common carp can be bred naturally through stripped spawning, spontaneous spawning as well as through use of eco hatchery.

d. Stripped spawning:

In this type of artificial propagation, the female brood are induced by synthetic hormone, and kept along with the male brood. The male brood is also injected with synthetic hormone. When females become ripe for stripping, both male and female are stripped into a basin. The milt (spermatozoa) obtained from male fertilize the eggs. Since common carp eggs are sticky in nature, the fertilized eggs get chance to clump together. It is essential to remove the stickiness of the egg at once to make the egg free-floating for incubation. Several degumming methods are available for the purpose. The cream milk method is regularly used in Vidarbha for removing of stickiness of common carp eggs.

Cream-milk method of degumming:

In this method, degumming of common stripped eggs is done at site in field condition. 20 g of full cream milk powder (fat content 26-28%) is dissolved in one litre of water which is equivalent to one part cow milk and nine parts of water for degumming purpose. The egg-milt mixture is treated either with the milk preparation for 45 minutes and stirred to get individual eggs free from each other.

e. Spontaneous spawning:

Common carp can be bred in hapa or in cement cistern or in earthen pond spontaneously. However, some substratum is required which act as egg collector. Common aquatic weeds, viz., *Hydrilla* is good egg collector. About 2 kg of egg collector is required for 1 kg of female brood. Sometimes root fibres of water hyacinth are also effectively used in

village ponds. Collections of eggs by above egg collectors of plant origin have several disadvantages. Recently, a technique has devised in which common carp can be bred in bulk utilizing the spawning and incubation pools of eco-carp hatchery. This practice is adopted by most of the hatchery operators in our region and synthetic fibre of gunny bag are used for collection of eggs in this activity. The incubation pool is utilized to incubate the eggs which are stucked to the synthetic fibre.

f. Spawn rearing:

The newly hatched spawn have the reserve yolk which nourish spawn till it is unable to feed naturally on exogenous food. It is observed that in most of the seed production centres spawn are sold to fisheries cooperative societies and fish culturist as per the demand. In few cases the spawn are reared further upto fry and fingerling stage. These fry and fingerling rearing systems are in the form of earthen pond in our region. Before stocking rearing systems are fertilized with minimum inputs and without ascertaining the plankton production the spawns are stocked in nurseries of 200-1000 m² with a water depth of 1.0-1.5 m. Under heavy densities of stocking, the plankton production in the pond cannot be maintained which results in low survival and less realization of fry. In some cases supplementary feeding with finely powered groundnut and rice bran is practiced. After rearing of spawn for 12 to 15 days the obtained fry is either sold or reared upto fingerling stage. The Proper management and rearing of the spawns can give an average survival of 40-60% of fry and 60-80% of fingerlings. On the contrary due to unscientific practices adopted by seed centres in Vidarbha meager survival rate of 10 to 20% is achieved.

5.2 Reservoir fisheries:

Vidarbha region offers an excellent opportunity in the inland fisheries sector because of the vast inland water resources at its disposal. In Vidarbha, the fishing rights in the reservoirs are leased out to fisheries cooperative societies. Generally, the tank is auctioned in favour of the highest bidder, preference being given to the fisheries co-operative societies or fishermen. In addition to lease amount, the seed is the only purchased input for reservoir fisheries invested by these cooperative societies. The paucity of quality and quantity of fish seed is the most important constraint faced by the society in the region. The main source of fish seed in Vidarbha, is spawns produced by induced breeding method in State Fisheries Department hatcheries, natural bundh breeding of cooperative societies and import from other states like West Bengal, Chhattisgarh and Andhra Pradesh etc. The import from unscrupulous

sources and transportation of seed from the far distance escalates seed price, high mortality, impurity and low growth rate and have led to spread of unwanted species.

The recommended stocking density in reservoirs, ponds and tanks suggested by Department of Fisheries, Maharashtra state is given in Table 54.

Table 54. Recommended stocking density (2016-17)

Sr. No.	Average water spread area of reservoirs, ponds and tanks (ha)	Recommended stocking density of fingerlings
1	2	3
1	0 – 20	5000 nos/ha.
2	20.01 – 60	10,000 number for 20 ha and 2,000 numbers/ha for every additional hectare
3	60.01 – 200	1,80,000 number for 60 ha and 1,000 numbers/ha for every additional hectare
4	200.01 - 1000	3,20,000 number for 200 ha and 500 numbers/ha for every additional hectare
5	1000.01 – 2000	7,20,000 number for 1000 ha and 500 numbers/ha for every additional hectare
6	2000 & above	12,00,000 number for 2000 ha and 500 numbers/ha for every additional hectare

Source: GoM GR: Fisheries 2016/Case No. 171/ADF 13 dated 30th June, 2017.

The species composition should be decided on the specific need of the reservoir with due consideration to the observation and experience of the reservoir user communities. It is recommended that, the small reservoirs should be stocked with advanced fingerlings and managed on the basis of culture based capture fisheries whereas in medium and large reservoirs repeated stocking and subsequent harvesting at marketable size.

In Vidarbha, most of the cooperative societies indiscriminately stock the spawn stage directly into the reservoir. But few cooperative societies stock spawn in small natural water bodies adjacent to reservoir until seeds attain advanced fry stage without any management such as fertilization, manuring and feeding.

The fishing is carried with indigenous modified craft locally called as “Donghi”, inflated rubber tubes and specially designed Thermacoal raft. The most commonly used gears are gill net, cast net, angling, traps etc.

The major practices of reservoir fisheries in Vidarbha are as follows:

- The input cost required for reservoir fisheries is contributed by members of cooperative societies. Internally, the fishing rights are given to the members. The harvesting is carried out either in groups or by individual member of society. The harvested material is sold in the market by society and profit is shared among members. In this practice, members are more benefited as they get price for their produce at par with actual market rates.
- The key members of cooperative society contribute required input cost. The harvesting rights are given to the members or the local fisherman and per kilogram charges of harvesting is paid to them. The harvested fish is collected and marketed by these key members. The cooperative society gets profit from the sale of fish but the actual fishermen/members get only royalty charges which varies according to fish species and size between 15-20% of actual price paid to the society.
- The reservoir rights are acquired by the cooperative societies & the stocking and harvesting control is allotted to contractor. In such practices, the society gets advance from the contractor. The stocking, minimum management, fishing and marketing is carried out by contractor whereas the cooperative society gets the royalty from the sale of fish. In this system, the contractor and dominant members of societies are benefited whereas actual fishermen/members lose their right of fishing as well as earning opportunities.
- The subleasing of reservoirs to the private parties is practiced illegally in some reservoirs of Vidarbha. In this practice, the society gets lease rights at Government rate as per policy. Subsequently, the societies sublease the reservoir to private parties at higher rates. Here, the actual fishermen/members lose their right of fishing, earning opportunity, livelihood while, the private party exploits the waterbody irrationally to fetch more profit. In addition, the Government also loses the expected revenue and the concept of community welfare through sustainable development of reservoir fisheries is hampered.

The contract system and illegal subleasing practice is directly affecting the revenue of the Government of Maharashtra.

The average yield is 21 kg/ha/year, 12 kg/ha/year and 9 kg/ha/year for small, medium and large reservoir respectively which is very meager when compared to the potential. The indiscriminate stocking, under stocking, high mortality rates, impure seed, lack of management are the major factors for low production in reservoirs of Vidarbha. Additionally,

the co-operative societies are knowingly or unknowingly stocking seed of exotic species like tilapia, common carp, African catfish and pangasius which breed in the natural water bodies and pose serious threats to the native fish fauna in near future. It is observed that some of the reservoirs are heavily infested with these exotic species and the native species stocks are declining to severe extent.

5.3 Riverine fisheries:

The Vidarbha region is geographically located in Godavari and Tapi River basins. The majority of Vidarbha region is drained by tributaries of Godavari river (Wainganga, Wardha, Pranhita, Penganga) and partly by tributaries of river Tapi (Khapra, Sipna, Gadga and Dolar along with Purna) at North border of the region. The total length of rivers in Vidarbha is approximately around 6,474 km. The major rivers and tributaries in Akola and Washim districts are Purna and Penganga rivers, likewise Amravati district by Purna and Wardha rivers along with tributaries of Tapi, Gondia and Bhandara districts by Wainganga river and its tributaries, Buldhana district by Penganga and Purna, Gadchiroli and Chandrapur districts by Godavari, Penganga, Wardha, Wunna, Wainganga and Pranhita rivers, Nagpur district by Wardha and Kanhan rivers, Wardha district by Wardha and Wunna rivers, Yavatmal district by Wardha and Penganga rivers (Source: District Gazetteers). The rivers Godavari & Tapi (tributaries) which flow from the Vidarbha region are among the 30 river basins in world which are prioritized for the protection of aquatic biodiversity (Source: Groombridge and Jenkins, 1998).

Of the 216 freshwater fishes reported from Maharashtra State 120 (more than 50% approx.) are found in Vidarbha region only magur (*Clarias batrachus*) is utilized for culture purpose and breeding technology for hardly 10 fish species and hatcheries technology for few species are in existence. The fish fauna is dominated by indigenous carps (*Labeo calbasu*, *Labeo fimbriatus*, *Labeo gonius*, *Labeo bogut*, etc), indigenous catfishes (*Bagarius yarelli*, *Clarias batrachus*, *Ompak bimaculatus*, *Rita kuturnee*, *Mystus cavasius*), murrels (*Channa marulias*, *Channa straitus*), mahseer (*Tor tor*), feather back (*Notopterus notopterus*), leaf fish (*Nandus nandus*) fullbeak (*Xenentodon cancilla*), spiny eels (*Mastacembelus armatus*, *Macrognathus aral*) etc. The riverine fish fauna is suitable for promotion of regional aquaculture and species diversification in aquaculture, ornamental purpose and development of sport fisheries. The hook and lines, gillnets, seine nets, indigenous fishing methods (gaarot, leaf fishing etc.) and indigenous traps are used for capture of the riverine fish fauna. Majority of the riverine catches are sold in the village markets and the large size fishes fetch good

prices. The Small Indigenous Species (SIS) which grow below size range of 20cm constitute bulk of seasonal catches. These SIS are marketed in small heaps (locally called *vata*) of around 50-100 gms and play a vital role in providing nutritional security to people in the villages. When the SIS are available in bulk they are smoked in order to increase the shelf life and sold by heaps. In comparison to the cultured fishes the riverine fish fauna fetches more price and supports the nutritional security of rural population. There is need to document the fish fauna of individual rivers and indigenous traditional knowledge.

The estimation of catch and catch composition in riverine fisheries poses considerable problems due to the geographical coverage and remoteness of the fishing activity with no specific landing centres and markets in comparison to marine fisheries sector. Also the most basic information about inland fisheries is generally lacking, such as basic life history of important food fishes, total harvest and production, total contribution to employment and livelihoods, and contribution of inland fish to nutrition and human well being is not only a national but a global issue.

The review of literature reveals that the five interacting freshwater biodiversity threat categories, viz., over exploitation; water pollution; flow modification; destruction or degradation of habitat; and invasion by exotic species (Dudgeon *et. al.*, 2005), with more or less varying severity are observed in the freshwaters systems of the Maharashtra state (Molur *et al.* 2011) and in the Vidarbha region also. Rivers of the Vidarbha are overfished and fishery is rapidly declining. As the rivers are habitat of the native fish germplasm it needs to be conserved. Protecting of traditional river pools and temple ponds acting as the natural sanctuaries for the riverine biodiversity is also important. Entry of exotics and indiscriminate fishing are major reasons for the decline of valuable catch in addition to pollution and other anthropogenic activities. Regulatory regime has also lost its relevance due to loss of priority, means, support, capacity and institutional arrangements.

The term inland fishery in strict sense means capture of fishes from the riverine waters which is usually confused/misunderstood with inland culture fish production. Riverine fisheries support a large number of traditional rural fisher folk living in the vicinity of rivers providing food security, cultural and religious identity, recreation and source of livelihood. The traditional riverine fishermen are deprived of the fishing rights in the rivers and not considered as stakeholders of rivers during dam construction which change the whole ecology of the rivers. Dams and barrages and related changes in hydrology (dry rivers, stagnant reservoirs, increasing sedimentation in rivers, etc.) have adversely impacted the

traditional riverine fisheries, fishing patterns and livelihood of traditional riverine fishermen and dependent population e.g. Gosekhurd dam. The department of fisheries only controls leasing out fishing rights in lakes and dams. Therefore, the aspects related to conservation and protection of riverine diversity remains untouched. At present, there is no effective legal instrument for protecting riverine fisheries. Much of the legislation is related to Maharashtra Fisheries Act, 1960 and many of the provisions are no longer relevant and do not focus on inland fisheries and riverine sector including biodiversity conservation.

5.4 Pond culture:

In Vidarbha, pond aquaculture is almost synonymous to carp culture, since carp alone contributes a major share of the total aquaculture production of the region. The carp culture involves mainly two groups, *i.e.*, Indian major carps such as catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) and the chinese carps such as silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*). Seed rearing and grow-out culture are the two main components of carp culture technology in this region.

However, the technologies of seed rearing, comprising of rearing of spawn to fry in nursery and further fry to fingerlings in rearing ponds, which have been accepted as economically viable activities by the farmers is limited and neglected by the farmers, which emphasize mainly on grow-out culture of carps.

Fry rearing & fingerling rearing:

The fry rearing refers to the rearing of the three to four days old spawn (5-6 mm) in nursery ponds for a period of 15 to 20 days till they grow to fry stage. Similarly fingerling rearing refers to rearing of fry of carps measuring 20-25 mm in size for two to three months to fingerling stage in rearing ponds.

Generally, smaller seasonal earthen ponds of 0.02-0.1 ha size with average water depth of 1.0-1.5 m are preferred for fry rearing by the fish farmers while relatively larger ponds of 0.05-0.2 ha area with 1.2 to 1.5 m water depth are utilized for fingerling rearing. Smaller enclosures like cage and pens are also sparingly used as alternatives for the fry rearing & fingerling rearing in large water bodies.

The majority of ponds dries during summer months which helps in eradication of predatory and weed fishes and organic mineralization. There is general lack of awareness regarding series of pre-stocking management measures in nursery and rearing ponds.

Generally mono-species rearing of the spawn is practiced in carp nursery and recommended stocking density normally ranges between 3-5 million per hectare. While the usual stocking density followed in carp rearing is 0.2-0.3 million fry/ha. in Vidarbha region.

The combination of Groundnut Oil Cake (GOC) and rice bran at 1:1 ratio has been the most commonly used supplementary feed for seed rearing of all the major carps. These ingredients are grinded to powder form and are broadcasted over the water surface for easy availability to the seeds. Availability of formulated commercial feed for carp fry is still a constraint for which farmers resort to use of this traditional feed mixture.

On an average good survival of 40-60% of fry and 60-80% of fingerlings can be achieved in nursery and rearing ponds respectively after adoption of scientific management practices. But due to in adherence of proper management practices, a low survival ranging to 20-30% of fry and 30-40% of fingerlings is normally achieved in nursery and rearing ponds respectively.

Grow-out culture:

The recommended practice of grow-out culture involves fertilization (10-20 tonnes/ha/yr cattle dung in combination with urea @ 100 kg/ha/yr and super phosphate @ 50kg/ha/yr) prior to stocking. The recommended stocking density for perennial ponds is 5,000-10,000 fingerlings/ha and 2,000-3,000 fingerlings/ha for seasonal ponds. The fish are fed with a mixture of groundnut and rice bran/deoiled rice bran at 1:1 ratio or commercially available fish feeds. The average production is in the range of 2.5 to 5 tonnes/ha/yr for perennial ponds and 1-1.5 tonnes/ha/yr for seasonal ponds.

Presently in Vidarbha region, the growout culture is in budding stage and mostly practiced in ponds of varying size of 0.04-1.0 ha in area with 1-1.5 m in water depth. Cattle dung and lime are the most commonly used fertilizers but recommended doses are not followed or fertilization is not done. The seed is stocked at average rate of 4,000-6,000 fingerlings/ha irrespective of type of pond. The supplementary feeding in the form of rice bran and GOC mixture is practiced only in final stage of culture without calculating ration need. Generally, fishes are harvested after a grow-out period of one year during which it reaches to marketable size of 0.6-0.8 kg. However, the fishes even marketed in smaller sizes of over 300 g due to scarcity of water in ponds after monsoon in case of seasonal ponds. The average production 600 – 800 kg/ha which is very low as per recommendation.

Though importance of fish culture as an economically promising enterprise is gradually realized by farmers, non-availability of quality fish seed and lack of scientific culture know-how is a major constraint for the development of pond culture activity.

5.5 Diversification of culture species:

Carps culture is the backbone of Indian freshwater aquaculture, comprising around 85% of the total freshwater production. Among Indian major carp production, the contribution of Rohu alone is about 85%. Since the inception of pisciculture and with the advent of induced breeding technology, scientific culture practices of catla, rohu & mrigal and exotic carps such as common carp, silver carp and grass are practiced in very small scale in Vidarbha. But recently, there is diversification in culture of species such as air breathing catfishes like *Clarius batrachus* (Magur), pangasius, monosex tilapia and freshwater prawns because of higher consumer preference, high market price etc. In Vidarbha, very few farmers have already undertaken this activity and shifting their way from conventional carp culture to variety of high yielding culture.

Pangasius culture:

Pangasius (*Pangasianodon hypophthalmus*) was introduced into India possibly during 1997 clandestinely via Bangladesh and adopted for culture in the state of West Bengal. Culture of pangasius is largely restricted to pond aquaculture systems. It is also being adopted for cage aquaculture because it responds well to supplied diets. It is tolerant to high stocking densities. However, growth and yield characteristics of the fish in cages still remain unexplored.

In Vidarbha during the survey the grow-out farmers revealed that the fish is cultivated both under monoculture as well as polyculture with Indian major carps and Chinese carps. However, monoculture was found to be more profitable to the farmers. Therefore, most of the farmers prefer monoculture practice. Farmer have started pangasius culture in farm ponds, agriculture pond and aquaculture ponds with average area of about 0.1 ha – 0.5 ha. The seed is procured from West Bengal, Chattisgarh and Andhra Pradesh. The seed is stocked at the rate of 10 – 15 number/m². Most of the farmers use supplementary feed in the form of cooked de-oiled rice bran (DOB) and broken rice at the rate of 5% of the body weight. The locally available agricultural waste product is also used along with DOB for feeding. The average quantity harvested is around 2-3 tonnes/ha with minimum management practices in around 8-10 months.

Tilapia:

Tilapia fish species also holds vast promise to become an important species for aquaculture in India. The uncontrolled breeding of tilapia in ponds, which has led to excessive recruitment, stunting and a low percentage of marketable-sized fish, dampened the initial enthusiasm for tilapia as a food fish. The species has spread all across the country within a few years due to its prolific breeding and adaptability to wide range of environmental condition. Overpopulation of the species affected the fisheries of several reservoirs and lakes. Hence, the Fisheries Research Committee of India had imposed ban on tilapia propagation in 1959.

However, tilapia holds vast promise to become an important species for aquaculture in India, considering the demand for more fish. There is high potential of export of tilapia to US, Europe and Japan. Hence, monosex culture of tilapia is promoted in India because of faster growth and larger and more uniform size of males. Hence only few fish farmer groups, M/s Aresen Bio Tech, Vijaywada, Andhra Pradesh; M/s Ananda Aqua Exports (P) Ltd., Bhimavaram, Andhra Pradesh; M/s Indepesca Pvt. Ltd., Mumbai, Maharashtra; M/s CP Aqua (India) Pvt. Ltd., Chennai, Tamilnadu; M/s Rajiv Gandhi Centre for Aquaculture (RGCA) and the Rural and Development (R & D) arm of the Marine Products Export Development Authority (MPEDA) are already permitted by Government of India for the seed production and farming of tilapia (monosex and mono culture of Nile/Genetically Improved Farm Tilapia (GIFT)/golden tilapia) in accordance with the guidelines for the hatchery operation and farming of tilapia, developed by the Sub-Committee under the National Committee on Introduction of Exotic Aquatic Species into Indian Waters.

In Vidarbha the cage culture of monosex tilapia was carried out by MFDC and recently the farmer has started culture in farm ponds, agriculture pond and aquaculture ponds with average area of about 0.1 ha – 0.5 ha. The seed procured from West Bengal, Chattisgarh and Andhra Pradesh was stocked at the rate of 15– 20 number/m². Most of the farmers used supplementary feed (cooked de-oiled rice bran (DOB) and broken rice at the rate of 5% of the body weight) in the initial stages of cultures. The formulated commercial feed is used at the end of culture period. The average quantity harvested is around 4-6 tonnes/ha with minimum management practices in around 6 months.

The production of pangasius and tilapia is being carried out in ponds without considering the ecological and biological consequence of the fishes on the diversity of native fishes. Many issues on quality and the nature of farming system are arising. The locations of

culture sites are found close to open waters and hence there exist every chance of escape. The pangasius and tilapia has potential to mature and breed naturally in wild and hence escaped fish may colonize and form feral population in different agro-climatic conditions impacting the ecosystem and in turn affecting the biodiversity. Because of its breeding ability and threat to local biodiversity, the Government of India through NFDB, Hyderabad has issued guidelines to carried growout culture in ponds. But these guidelines are hardly followed by farmers of Vidarbha.

6. Fish markets and marketing in Vidarbha

6. Fish markets and marketing in Vidarbha:

Fish marketing differs from that of marketing of agricultural products. Fish marketing is confronted with certain peculiar problems: greater uncertainty in fish production, highly perishable nature of fish, assembling of fish from numerous landing centers, too many species and as many demand pattern, violent and frequent fluctuations in prices, difficulties in adjusting supply to variations in demand and need for transportations of fish in specialized means of transport.

World per capita apparent fish consumption increased from an average of 9.9 kg in the 1960s to 14.4 kg in the 1990s and 19.7 kg in 2013, with preliminary estimates for 2015 indicating further growth, exceeding 20 kg. (Source: SOFIA, 2016). The annual per capita consumption of fish for the entire population in India is estimated at 5-6 kg whereas for the fish eating population it is found to be 8-9 kilogram, which is a poor 50 per cent of the global rates. (Source: <http://eprints.cmfri.org.in>)

Overall, there is a steady domestic demand for fresh water fish. This is mainly due to increase in purchasing power of consumers and their preference of fish being a low cost animal protein. About 70% of the fish catch is marketed fresh and the remaining is utilized in the form of processed, dried, smoked, reduced to fishmeal, etc. However, the harvested fish is not evenly distributed to interior areas due to lack of transportation and non-availability of proper storage facilities. Therefore, there is a need for balanced system of distribution to make fish available in the interior areas at reasonable rates.

The fish produced in the country both from marine and inland sectors, is marketed domestically through a network of wholesale, major, minor retail, roadside markets, etc. The majority of domestic markets are unhygienic and the fish storing and handling facilities are poor. There is also a lack of proper transportation system including roads, refrigerated vehicles, etc. Availability of potable water, good quality ice, electricity, waste disposal system etc. is inadequate. There is considerable time lag during the transportation of fish from the landing centre to the interior markets which results in poor quality of material leading to food borne diseases, nutritional and post-harvest loss. The similar situation prevails in all the districts of Vidarbha.

6.1 Survey of fish markets:

One of the major objectives of fisheries development in the Vidarbha was to ensure remunerative prices for the producers on the one hand and access to fish supply at reasonable prices to the consumers on the other. In spite of five decades of development, the reality is that producers have not been able to realize remunerative prices for their products and consumers have not been able to get fish at reasonable price. An attempt was made to study the Inland fish marketing system of the Vidarbha region mainly with a view to examining its market structure, functional efficiency. This marketing study is based upon a primary investigation conducted amongst the fish wholesaler, retailer and vendor with following objective:

- To examine the marketing channels for fish in the region.
- To assess the market potential for fish from the region.
- To explore market margins involved and the possibilities of capturing value in different stages of the chain like auctioning, wholesaling and retailing.
- To assess characteristics of the fish market at the end consumer level in terms of variety, quality, pricing, purchase behavior including channel preference.

a. Methodology:

The study was carried out in all 11 districts of Vidarbha places at selected district level fish markets. The observation and survey through questionnaire were carried for this study to understand the overall market situation. Structured interview schedules were used to collect information about the respondents, type of function performed, market arrival, marketing cost, buying and selling prices of fishes, volume of trade, market infrastructure, marketing functions, supply condition of water and electricity, sanitation facility and major constraints from the selected markets through Focus Group Discussions (FGD) and Key Informant Interviews (KII) with local buyers, fish wholesaler, retailer and vendor. (Annexure VIII)

The data obtained through market survey were analyzed using descriptive statistics in terms of frequencies and percentages to summaries the marketing costs, margin and price spread was estimated using average and percentage analyses.

Prices received by fishermen (FP):

The price received by fisherman is calculated on the basis of average cost of fishes which contribute more than 5% landing in the market.

Marketing Cost:

Total marketing cost (MC) incurred by the producer/ seller and by various intermediaries was calculated as:

$$MC = \sum CM_i$$

Where, CM_i = marketing cost incurred by i^{th} middlemen

Marketing margin

The total marketing margin (MM) of the market intermediaries was calculated as:

$$MM = \sum MM_i$$

Where, MM_i = market margin of i^{th} middlemen

Modified Marketing Efficiency: The modified marketing efficiency formula has been applied for calculating market efficiency. (Source: Acharya and Agarwal, 2001)

$$MME = FP/(MC+MM)$$

Where, MME is modified measure of marketing efficiency, FP is price received by farmers, MC is marketing cost, MM is marketing margin.

b. Present status of fish markets and marketing:

When compared to the other commodity markets of the region, the fish trading market in Vidarbha is unorganized to large extent. In the entire 11 districts of Vidarbha, 34 fish markets are located in government own land and 4 markets are run in private premises of fisheries cooperative societies. The Mayo fish market of Nagpur; Bengali camp fish market, Chandrapur; Athawadi bazaar fish market, Yavatmal and Itwara bazaar fish market of Amravati can be easily identified as the core markets of Vidarbha in respect to the fish marketing system. The fish markets receive fishes daily from the local fishermen; cooperative societies, markets outside of the state and minor quantities from culture ponds within the Vidarbha. Fish collectors commonly known as distributors; procure fish from the catchers with the help of local brokers who get a profit margin or commission from the distributor. The fishes from distributors are supplied onward to the other fish markets of the Vidarbha region.

The information from 40 number of wholesalers and 466 retailers in selected fish markets were taken. The marketing activities begin at 6 A.M. and ends at 10 P.M. but in many cases the duration was found to be changed depending upon season, demand and supply of fish. It was observed during the survey that all the fish markets in Vidarbha region

lack basic infrastructure and services for fish handling and storage. The storage facilities are very poor in the markets and the auctions are done on the ground itself. The entry fee for operation in a market changes from market to market and as per locations. On an average the wholesalers are paying Rs 26 /day and retailers are paying Rs 13.5 /day in selected fish markets in Vidarbha. The detail selected fish market structure at district level in Vidarbha is given in Table 55.

Table 55. Selected fish market structure at district level in Vidarbha (2016-17)

Sr. no.	Market dimension	Nagpur	Bhandara	Gondia	Chandrapur	Gadchiroli	Wardha	Amravati	Akola	Washim	Buldhana	Yavatmal
1	2	3	4	5	6	7	8	9	10	11	12	13
1	Type of markets	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer	Wholesaler & retailer
2	Market conduct											
a	Number of wholesaler	15	2	1	5	2	2	7	3	1	1	1
b	Number of retailer	141	53	46	55	30	19	17	20	6	55	24
3	Market timing											
a	Wholesaler	05.30 - 12.30 A.M.	8.00 - 12.00 A.M.	8.00 - 12.00 A.M.	8.00 - 11.00 A.M.	6.00 - 10.00 A.M.	8.00 A.M. - 1.00 P.M.	8.00 - 12.00 A.M.	7.00 - 12.00 A.M.	8.00 A.M. - 1.00 P.M.	8.00 - 12.00 A.M.	6.00 - 12.00 A.M.
b	Retailer	8.00 - 12.00A.M. & 4.00 - 10.00P.M.	9.00 A.M. - 1.00P.M. & 4.00 - 09.00P.M.	9.00A.M. -1.00 P.M. & 3.00 - 07.00P.M.	9.00 - 12.00 A.M. & 3.00 - 6.00 P.M.	8.00 - 12.00 A.M. & 3.00 - 07.00 P.M.	8.00 -12.00 A.M. & 3.00 - 07.00 P.M.	9.00 A.M. - 1.00 P.M. & 2.00 - 09.00P.M.	9.00A.M. -1.00P.M. & 4.00- 08.00P.M.	10.00A.M. - 1.00P.M. & 3.00 - 06.00P.M.	9.00A.M. -1.00P.M. & 3.00 - 06.00P.M.	8.00A.M.- 1.00P.M. & 4.00 - 08.00P.M.
4	Peak hours											
a	Wholesaler	10.00- 12.00 A.M.	8.30- 10.00 A.M.	8.30 - 11.00 A.M.	9.00 - 10.00 A.M.	8.00 - 09.30 A.M.	8.30 - 10.00 A.M.	8.30 - 10.00 A.M.	8.30 - 10.00 A.M.	9.00 - 11.30 A.M.	9.00 - 11.30 A.M.	7.00 - 9.30 A.M.
b	Retailer	8.30 - 11.00 A.M. & 5.00- 7.00P.M.	9.30 - 11.00 A.M. & 5.00 - 7.00 P.M.	9.00 - 11.00 A.M. & 4.00 - 6.00 P.M.	9.30 - 10.30 A.M. & 5.00- 6.00 P.M.	9.00 - 10.30 A.M. & 4.00 - 5.00 P.M.	9.00 - 10.00 A.M. & 4.30 - 6.00 P.M.	9.00 - 10.00 A.M. & 4.00 - 7.00 P.M.	9.30 - 12.00 A.M. & 5.00 - 7.00 P.M.	10.30 - 12.00 A.M. & 5.00 - 6.00 P.M.	10.30 - 12.00 A.M. & 6.00 - 7.00 P.M.	09.30 - 11.00 A.M. & 5.30 - 7.00P.M.

Sr. no.	Market dimension	Nagpur	Bhandara	Gondia	Chandrapur	Gadchiroli	Wardha	Amravati	Akola	Washim	Buldhana	Yavatmal
1	2	3	4	5	6	7	8	9	10	11	12	13
5	Per day entry fee for operation in market											
a	Wholesaler	70	25	20	25	15	20	45	30	20	30	30
b	Retailer	35	15	10	10	10	10	25	10	10	20	15
6	Percentage source of fish to the market											
a	Within the district	40	85	80	70	95	80	60	60	65	77	70
b	Out of district	30	10	15	10	5	20	25	35	30	23	25
c	Out of state	30	5	5	20	0	0	15	5	5	0	5
7	Percentage status of fish landing in the market											
a	Insulated van	10	3	4	5	0	0	10	6	3	0	10
b	Insulated boxes	20	5	10	23	5	10	12	24	25	18	15
c	With ice	65	90	85	70	90	86	75	70	70	72	65
d	Without ice	5	2	1	2	5	4	3	0	2	10	10
8	Percentage mode of transportation of fish landing to market											
a	By road	68	95	85	80	100	60	67	75	100	100	100
b	By railway	33	5	15	20	0	40	33	25	0	0	0
9	Daily availability of marine fishes (in Kg)	500	50	100	200	0	50	300	200	0	0	0
10	Daily average quantity of fish landing (tonne)	49.76	9.44	7.98	14.07	2.12	3.27	9.53	4.75	2.91	1.11	10.06

Source: Structure interview schedule of fish markets and FGD.

c. Result and discussion:

Marketing channels:

The fish marketing channels are alternate routes through which fish and fish products flow from the point of production to the point of consumption. Fish marketing channel start with farmer/fishermen and ends with the fish consumer and in between intermediaries are involved. The involvement of these market intermediaries provides services of head loading, cleaning, sorting, grading, processing (icing), preservation, packaging and transporting of fishes. Such activities resulted in cost addition at every stage of marketing. The identified fish marketing channels in Vidarbha are shown in Fig. 14.

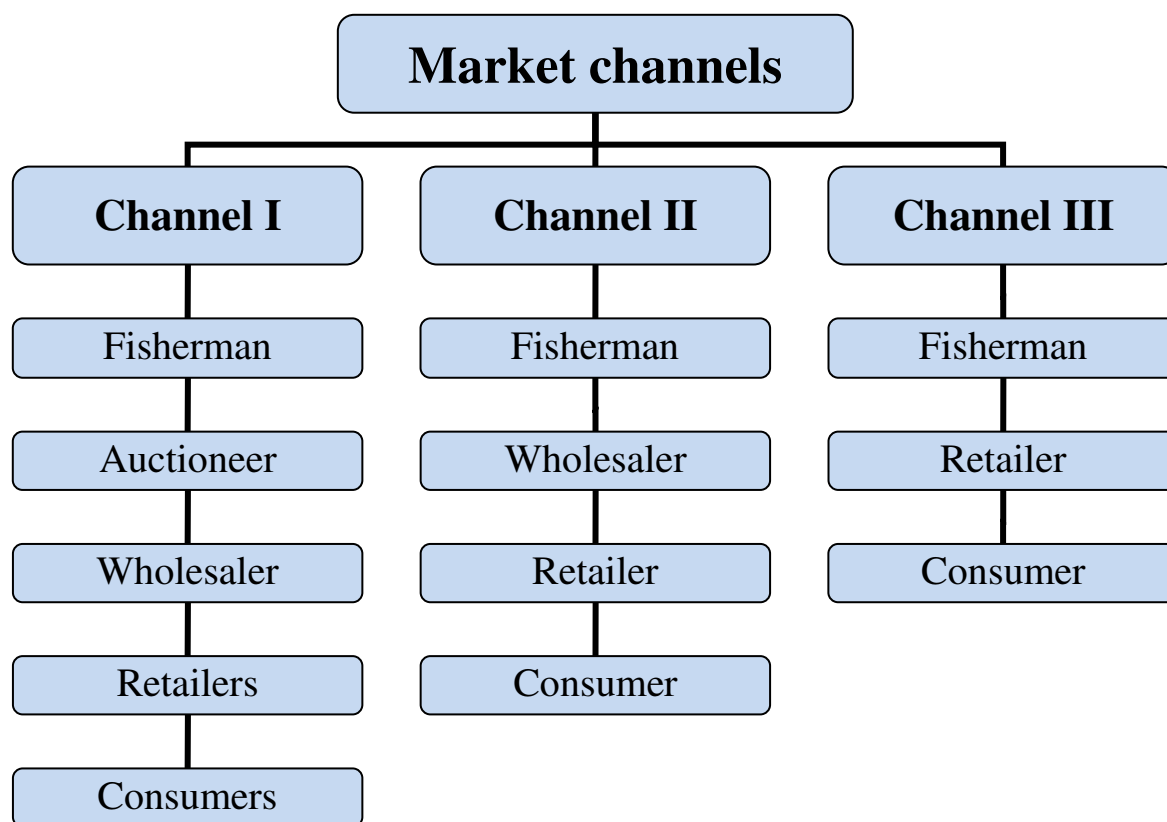


Fig. 14: Different marketing channels in selected fish market in Vidarbha region

Major intermediaries in the fish marketing channels in selected fish market were identified as fish traders, wholesalers, auctioneer and retailers. In this study it was found that the farmers are selling fish directly to the retailers or consumer's and also go through channels of wholesaler-cum-commission agents.

Market arrival:

On an average, the total fish arrival in all districts of Vidarbha was reported to be 115 ton/day and 40,940 tonnes in a year. The species wise landing of fishes in selected fish market at district level in Vidarbha is provided in Table 56.

Table 56. Species wise landing (kg) of fishes in selected fish market at district level in Vidarbha (2016-17)

Sr. No.	Species	Nagpur	Bhandara	Gondia	Chandrapur	Gadchiroli	Wardha	Amravati	Akola	Washim	Buldhana	Yavatmal	Total	Percentage
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Catla	10,200	1,800	2,100	3,400	450	700	2,140	1,400	700	350	3,300	26,540	23.06
2	Rohu	13,000	2,500	2,130	3,700	600	850	2,500	1,200	600	200	2,500	29,780	25.88
3	Mrigal	2,500	980	930	800	100	450	1,530	150	150	100	1,530	9,220	8.01
4	Silver carp	500	100	50	250	100	50	200	100	70	20	200	1,640	1.42
5	Grass carp	560	150	50	200	80	50	200	120	80	10	200	1,700	1.48
6	Pangassius	5,000	330	140	460	50	50	320	150	70	20	400	6,990	6.07
7	Other carps	1,500	600	300	560	150	100	40	200	150	20	40	3,660	3.18
8	Tilapia	9,800	1,750	1,100	2,500	400	600	1,300	700	500	200	1,000	19,850	17.25
9	Maral	500	60	250	100	0	50	40	50	15	5	40	1160	1.01
10	Freshwater prawn	500	600	400	300	100	60	200	50	15	10	200	2,435	2.12
11	Thai Magur	4000	100	300	1,200	0	125	400	150	330	50	350	7,055	6.13
12	Desi Magur	150	120	20	100	20	20	20	50	50	10	20	580	0.50
13	Singhala	150	50	10	50	10	0	10	10	10	5	15	325	0.28
14	Spiny eel	100	50	5	50	5	10	75	20	20	10	20	365	0.32
15	Marine fishes	500	50	100	150	0	50	300	200	0	0	0	1,350	1.17
16	Other	800	200	100	250	50	100	250	200	150	100	240	2,440	2.12
Total		49,760	9,440	7,985	14,070	2,115	3,265	9,525	4,750	2,910	1,110	10,055	1,15,090	100

Source: Structure interview schedule of fish markets and FGD.

In the species composition of the fish markets, the rohu accounts for 25.88 %, followed by catla (23.06%), tilapia (17.25%), mrigal (8.01%), thai magur (6.13%), pangasius (6.07%), other carps (3.18%), other (2.12%), freshwater prawn (2.11%), grass carp (1.47%) silver carp (1.44%), marine fishes (1.17%), murrel (1.01%) desi magur (0.50%), spiny eel (0.32%) and singhala (0.28%) etc.

The results indicate that highest market arrival is represented by IMC (Catla, Rohu and Mrigal) is mainly due to practice of cultured based capture fisheries in reservoirs of Vidarbha. The high share of Tilapia is due to indiscriminate stocking and its prolific breeding ability in reservoirs.

The trade of fishes in Vidarbha is also observed during the study. It revealed that the large sized catla, rohu, mrigal, murrals, prawn, tilapia and dry & smoked fishes are exported from markets of Vidarbha to Telangana, Andhra Pradesh, Mumbai, Chattisgarh, Madhya Pradesh, West Bengal, Uttar Pradesh, Assam as it fetches good price. Whereas, small sized low priced cultured fishes (IMC, thai magur, tilapia, pangasius) and marine fishes are imported to meet local demand. (Fig. 15)

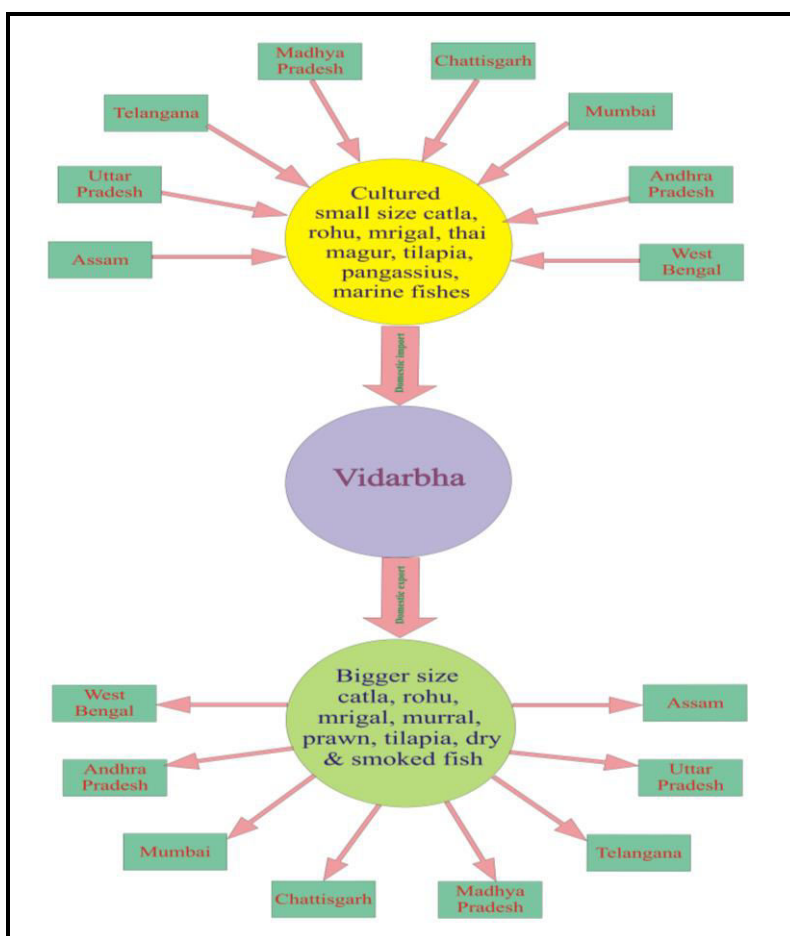


Fig. 15. Trade of fishes in Vidarbha

From the supply of fishes to the selected fish market at district level in Vidarbha it is observed that around 71 % of fish landed in market is consumed within the district, 19 % is supplied to other district and 10 % is exported to other State. The Nagpur and Amravati fish markets are exporting maximum quantity 35 % and 25 % respectively. (Table 57 and Fig.16)

Table 57. Percentage supply of fishes to the selected fish market at district level in Vidarbha (2016-17)

District	Within the district	Out of district	Out of state
1	2	3	4
Nagpur	40	25	35
Bhandara	70	20	10
Gondia	75	15	10
Chandrapur	70	20	10
Gadchiroli	85	15	0
Wardha	75	20	5
Amravati	45	30	25
Akola	70	20	10
Washim	85	15	0
Buldhana	78	22	0
Yavatmal	90	10	0
Average	71	19	10

Source: Structure interview schedule of fish markets and FGD.

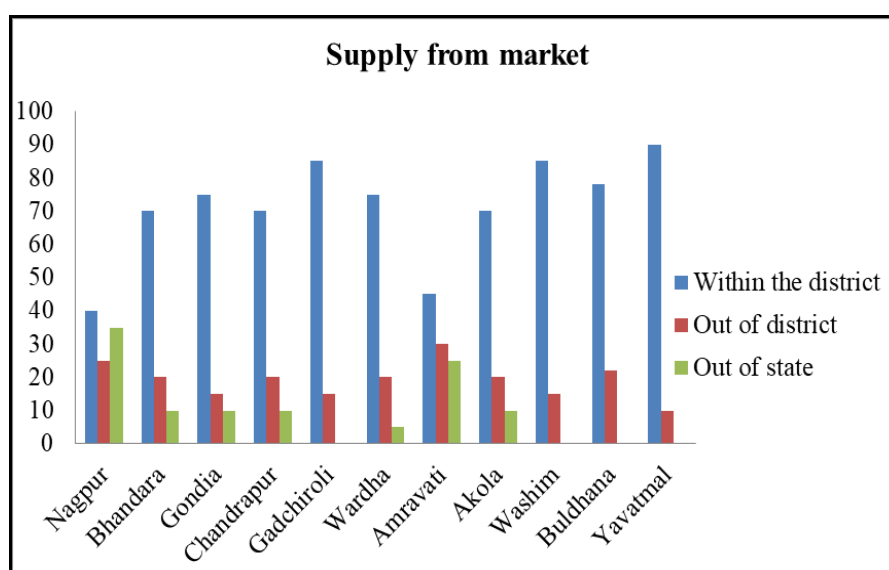


Fig 16. Source and supply of fishes at selected fish markets in Vidarbha

Marketing Cost:

The cost incurred by different marketing intermediaries is given in Fig 16. It is observed that per kilogram marketing cost of fish incurred by the intermediaries was highest in Channel I (20.79/kg) followed by Channel II (17.91/kg) and III (7.62/kg). In Channel I, fisherman sells their produce to fish auctioneer and the auctioneer bring the produce in market and sell it. Out of these total marketing cost fish auctioneer in Channel I incurred 2.87/kg, cost incurred by the wholesaler is 10.29/kg and retailers 7.62/kg. The total marketing cost excluding the margin of the intermediaries varies between 15.79%; 13.60% and 5.79% of the retail price in Channel-I; Channel-II and Channel-III respectively. Like other agricultural produce in fish marketing also the labour, commission charges, preservation, packaging and transportation are the major cost items.

Marketing margin and price spread:

Price spread is the difference on ultimate price paid by the consumer and the net price received by the fisherman for an equivalent quantity of fish product. It consists of marketing cost and margins of the intermediaries that determines the overall effectiveness of marketing system. The fisherman share in price paid by consumer's rupee was highest in Channel III (85.58%) and lowest in Channel I (65.82%). Large percentage share of fisherman in Channel III is due to the less number of middlemen between fisherman and consumers.

Next profitable channel of fisherman for sale of fish was through auctioneer in wholesale market (Channel II, 71.85%). Fishermen share is directly related to the number of market intermediaries involved in the marketing of fish as revealed by the study. The net margins earned by intermediaries were 24.21 Rs, 19.16 Rs. and 11.36 Rs. in Channel - I, Channel - II and Channel - III respectively.

In all, from the FGD held with the stakeholders, it was observed that the traditional fishermen/members of cooperative society involved in harvesting of fish get meagre price for their catch and the real money is accrued by the operators of the societies. The income redistribution to the traditional fishermen/members of cooperative society can be the subject of the separate detailed investigation.

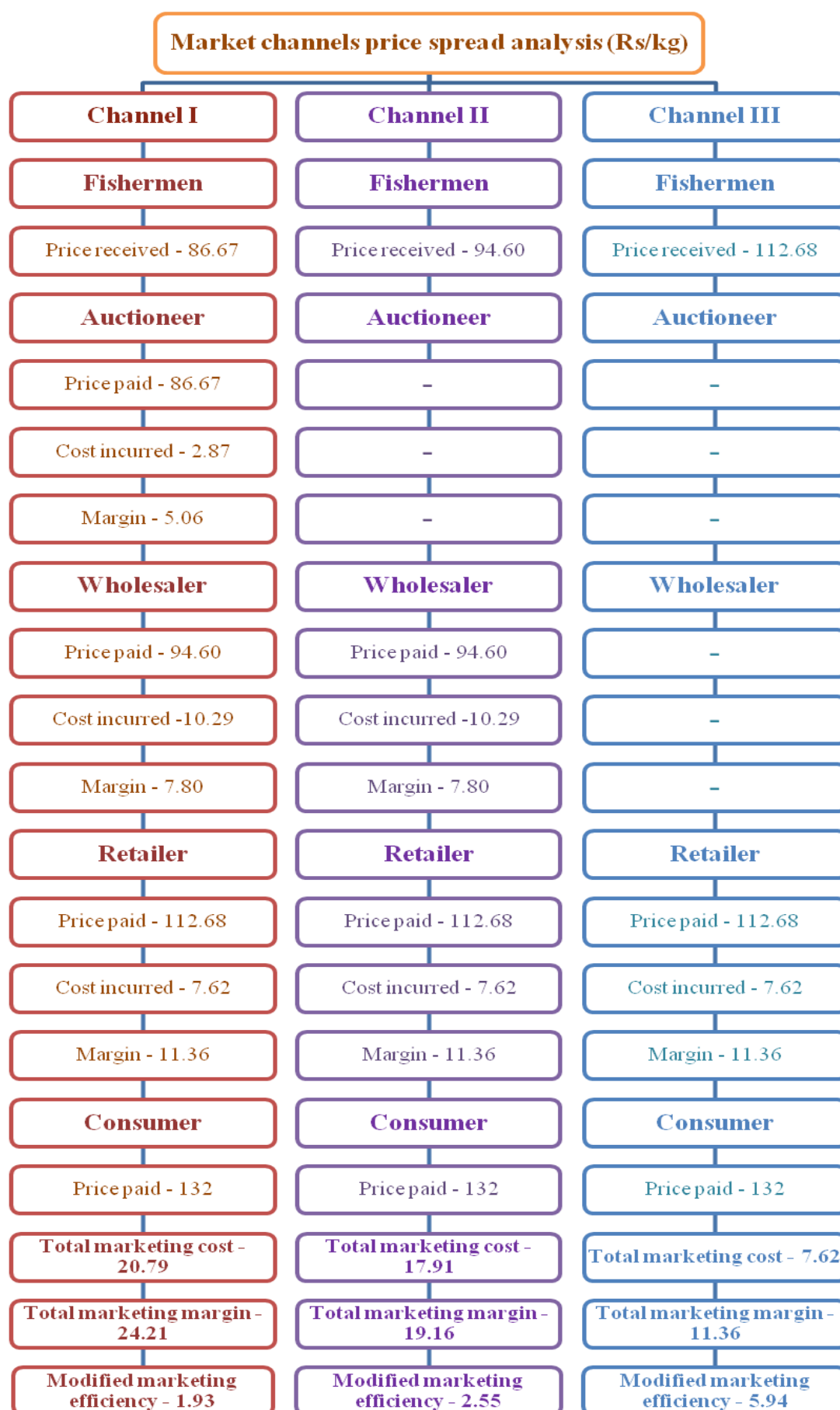


Fig 17. Price spread for fishes in different marketing channels in selected fish market at district level in Vidarbha

Modified marketing efficiency:

The modified marketing efficiency in Channel I, II and III is 1.93, 2.55 and 5.94 respectively. The modified marketing efficiency ratio was found to be highest in marketing Channel III. This high ratio indicates the less number of markets intermediate. The Channel III is the most efficient marketing channel of fish while Channel II was second most efficient channel. The study depicts that higher marketing margins pocketed by the intermediaries resulted in poor marketing efficiency of fish.

Challenges:

- Higher number of middlemen
- High marketing cost
- Fluctuations in prices
- Poor cold storage facilities
- Lack of market information on price
- Delay in settlement of sale proceeds
- Lack of basic infrastructure facilities and amenities
- High degree of dependency on middlemen for financial support
- Poor infrastructural facilities
- Absence of cooperative marketing

Conclusion:

The domestic fish marketing plays an important role, it is still highly unorganized and unregulated in Vidarbha. The native varieties of small fishes usually below 20 cm in length are consumed in the local village markets and sold by the fishermen itself. The quantification of which is not possible. At district level the sale of banned fish species like African magur is a serious concern and legislation for ban on its marketing should be brought up and strictly followed. The fish markets of Vidarbha have been found lacking in marketing infrastructure, high transportation cost. Assessment of markets, market channels, margin and market potential reveals that, there is demand for fresh water fishes. Although there is demand for fresh fish throughout the year, currently bulk supply of large fresh fish from local areas is fluctuating and thereby distorting the market. Icing of fish is generally not practiced and there is also delay in supply of fish. All this leads to low realization of income in case of local fishes.

Lack of systematic harvesting (harvesting in small lots with more frequency) seems to be critical gap in the value chain. Besides this, there is poor handling of fish during harvest

and inadequate/no use of ice in short distances transportation. There is scope for introducing scientific icing practices. There is limited practice of grading of fish (with regards to variety) which can be improved. At times, preference for bulk sale in distant market (than selling locally) leads to spoilage and low realization of fish. Currently, there is no preferential treatment for supply of fish to local retailers, who may be able to offer higher price. There is also scope to improve the smoking process of trash fishes.

There are number of new markets have been setup by State Government, under NFDB scheme in districts namely Nagpur, Bhandara, Gondia, Chandrapur, Amravati and Yavatmal. However, the response from fish marketers is not forthcoming for these newly established markets due to limited space allotted to the marketers, overall invisibility to the consumers and rental charges. At retail level, retailers continue to struggle to get enough space in markets for selling fish. There is need for advocacy effort so that local authorities designate space as per requirement of seller. Basic infrastructure like for keeping ice, water supply, common weighing facility and facility for storage of fish should be provided. Similarly, there is no market related infrastructure for handling of fishes nearer to waterbody.

The study also attempted to explore market access beyond the current value chain. Interaction with leading market players revealed that there is scope (limited) for export. There is demand for large size freshwater fish from Mumbai, Telanghana, Andhra Pradesh, West Bengal which is currently being met by culture fishes from Andhra Pradesh. Considering the road and railway network in Vidarbha, it would be possible to supply fresh fish to these areas.

Like marine fishes, inland fishes can be preserved for long duration by freezing, canning, smoking and drying. Freezing and canning is preferred in case of high value fishes. Smoking of low value fishes already in practice. As there is no demand to small fishes and also due to lack of bulk availability of low value fishes, drying of inland fishes is not practiced on large scale. However, in the long run if production goes up, and the demands meet up, high cost preservation like freezing may become part of the value chain and would lead to value addition.

Like Magur, live sale of carps can fetch higher price. This could be done for short distances as is practiced some of the fisherman in Nagpur are selling live carps to hotels. The technology is not standardized. Door step delivery of fish (like through internet marketing) could be an option. However, quality remains a concern in case of door step delivery. This also requires systematic brand promotion, logistics and planning.

6.2 Domestic and export market potential of fish and fishery products from Vidarbha:

The products of the fish industry are usually sold to grocery chains or to intermediaries. Fish are highly perishable commodity. A central concern of fish processing is to prevent fish from deteriorating, and this remains an underlying concern during other processing operations. Fish processing can be subdivided into fish handling, which is the preliminary processing of raw fish and the manufacture of fish products. Another natural subdivision is into primary processing involved in the filleting and freezing of fresh fish for onward distribution to fresh fish retail and catering outlets, and the secondary processing that produces chilled, frozen and canned products for the retail and catering trades.

Out of the total inland fish production of the Maharashtra State, the Vidarbha accounted for 46% (68,330 tonnes) of fish production during 2015-16. The high magnitude of inland fish production from Vidarbha is because of the numerous water bodies like village tanks, lakes and reservoirs etc. In Vidarbha region, as per MRSAC data total water spread area of 1,87,250 ha have production potential of 1.41 lakh tonnes of fish. In order to utilize huge potential production of fishes, setting up of fish processing plant in the region can become a very profitable activity. The region does not have any fish processing plant. The inland production can be utilized for the preparation of different fish products. The product can be exported to the foreign country which can give a valuable foreign exchange. It will also provide the employment and will promote the further boost up the inland production of the region.

Fish has retained its prime position as the principal export item in terms quantity and the second largest export item in terms of value, accounted for a share of about 37.05 percent in quantity and 17.59 percent in US\$ earnings. Chilled items have shown a positive growth in quantity (26.27 percent), rupee value (50.27 percent) and US\$ (34.91 percent). The unit value realization also increased by 6.84 percentage. South-east Asia continued to be the largest buyer of Indian marine products with a share of 23.12 percent in terms of US\$ value realization. The European Union (EU) was the second largest market with a share of 22.14 percent followed by the United States of America (21.29 percent), Japan (10.61 percent), China (7.67 percent), Middle East (5.96 percent) and other countries by 9.22 percent. (Source: [www. mpeda.gov.in](http://www.mpeda.gov.in), Sea food export, 2016-2017)

Potential for fresh water prawn (scampi):

Seafood exporters are paying an attractive price for scampi. The foreign exchange earnings through scampi production are estimated to be around Rs. 1120 crore during the current financial year and 85% of scampi is exported from Andhra Pradesh. The present rate of scampi is varying from Rs 650 to Rs.700/kg of 20-count and Rs 500 to Rs.550 / kg for 30-count. The eastern parts Vidarbha contribute significantly for the scampi production through reservoir and riverine fisheries. At present, the harvested scampi from Sironcha area of Gadchiroli district is procured by the traders of Andhra Pradesh and marketed. Further, there is enormous scope for boosting the scampi production from Vidarbha region by undertaking scientific aquaculture in existing ponds as well. By developing the marketing channels there is good potential for exporting scampi from Vidarbha region of Maharashtra. This can help in getting good foreign exchange to this region.

Potential for tilapia:

Apart from high demand to scampi for export market another fresh water fish species important for export market is tilapia. On a global basis, tilapia has become the second most commonly consumed farmed fish. The relative environmental friendliness of tilapia production, along with diversified production strategies and strong domestic markets in producing countries as well as growing international trade will continue to drive tilapia production and demand globally. Tilapia consumption in the US and EU continued its steady increase through 2016.

Middle East is the largest market for frozen tilapia from India with the United Arab Emirates (UAE) as the largest. Exports of whole frozen tilapia increased by 4.18 percent to the United Arab Emirates (UAE) reaching 329 tonnes during the first quarter of 2017. Tilapia also solidified its place as the fifth most popular seafood in the US. The huge demand for frozen fillets, frozen value added products, whole live tilapia accounted for imports and domestic consumption of 1,84,755 Metric Tonnes (MT) (Source: [www. mpeda.gov.in](http://www.mpeda.gov.in), Sea food export, 2016-2017). During the survey of District fish markets in Vidarbha, it was noticed that tilapia alone contributes around 17% of the total landing. Further, there are numerous new water bodies like aquaculture ponds & tanks where scientific farming of monosex tilapia or farming of new improved varieties like GIFT tilapia can be undertaken. This can result in continuous supply of fish thus catering the requirement of both domestic as well as export market. Processing plants can be established for processing of freshwater fishes like tilapia in various forms like fillets etc. Tilapia in the form of frozen whole and

frozen fillet which has enormous market in UAE, United State of America (USA), EU can be exported through export buyers.

Potential for pangasius:

Unlike tilapia another fish important for export market is pangasius. In 2015, USA, imports of frozen pangasius fillets made up 95% (1,07,626 tones) of total frozen volumes. Spain retained its position as the largest market within the European Union (EU) for pangasius. EU market continues to demonstrate growth in the whole frozen category. In 2015, Asia imported approximately 81,000 tonnes of pangasius (whole and fillets) according to national statistics, roughly 21% more than in 2014. Among the major markets in Asia were Thailand, China, Singapore, Malaysia, Taiwan, China, Hong Kong, Japan and the Republic of Korea. Thailand was the largest market and imported a total of 20,617 tonnes in 2015 followed by China. (Source: Globefish Highlights, FAO, United Nation)

India is also witnessing rise in domestic consumption of pangasius. According to statistics, India imported US\$ 2.7 million of pangasius products from Vietnam for domestic consumption in fish retail market. Pangasius is popularly available as Basa in many multi-cuisine restaurants of metro cities like Mumbai, Delhi etc. Consumers also buy packed pangasius steaks from supermarkets in metro cities. (Source: www.mseafood.vasep.com.vn, Report on Vietnam Sea food exports, 2016-17)

This data shows that there is a huge demand for Pangasius, Scampi and Tilapia in India and abroad. Small scale processing plants can be set up to process these products in the Vidarbha which have export market. Such plants will not only provide to employment to the local people but also enhance the income of farmers & members of cooperative society by many folds.

6.3 Marketing infrastructure and forward linkages:

Lack of diversified fish products and hygienic fish markets are responsible for low consumption level. Availability of clean and hygienic domestic fish markets is critical for attracting consumers and increasing acceptability. Apart from ensuring desired nutritional quality development of hygienic fish markets and cold chain also helps in minimizing post-harvest losses, creating more jobs and raising higher level of food quality and safety standards. The domestic fish markets in Vidarbha at present are in primitive stages. The fish is marketed mostly at road side having with minimal facilities available to maintain quality of fish.

There is a need to improve infrastructure facilities at fish landing centres along reservoirs and rivers, where large volume of catches is landed. Efforts to increase fisheries productivity need to be complemented by fish consumption, promotion and availability of wide ranging value added fish products making use of low value fish species. Culture of pangasius and tilapia is expected to catch up due to their higher yield. These species are quite suitable for boneless fish fillet production for which there is a growing demand in domestic and export markets.

Beside low level of per capita availability of fish in Vidarbha, fish consumption level is also relatively low. Among several factors the lack of proper fish landing centres along the reservoirs and other important landing centres and dearth of adequate and hygienic fish marketing infrastructure and cold chain in the transportation of fish and fish products is also responsible for low consumption of fish.

Marketing infrastructure and cold chain system will benefit the region even in the long term when surplus produce will be available to be spread and exported to the neighbouring states and other countries. Marketing infrastructure and cold chain will also open new vistas through processing and value addition. Presently the bulk of fish produced are supplied to the local markets as fresh or iced and very often the quality is not assured. Marketing infrastructure and cold chain will also open new vistas through processing and value addition.

Innovative marketing arrangements need to be developed to ensure that farmers and fishers get remunerative price with the development of local markets and cold chain. Most of the aquaculture production units are small and remotely located and hence farmers have problem in sending their small produce to city markets for fetching better price. These small producers are also not happy with the dealing of wholesalers with them. There is an emerging niche in marketing of fresh or live fish. There is need for opening a chain of modern and hygienic fish kiosks at district places in Vidarbha and can provide opportunity for fisheries professionals and other educated youth and young entrepreneurs. They need to get connected with cluster of small producers to give the farmers better deal and also to ensure continuous fresh or live fish supply for themselves. Marketing of fish in live condition is itself a value addition. Growing perception of fish as health food among civil society is also likely to boost public consumption of fish. The proposed activities for development of marketing infrastructure and forward linkages are provided under the recommendations and conclusion.

7. Fisheries Business models

7. Fisheries Business models

In Vidarbha, Inland fisheries and related businesses have played a crucial role in the socioeconomic development of the region and even in the new millennium, when technology has touched every aspect of our lives, a majority of farmer and fishermen continue to deploy antiquated fish rearing practices. These practices, along with issues like spiraling inflation, burgeoning imports, and a multitude of challenges faced by the sector, pose a serious threat to the aspiration of the fish farmer in the region.

It is realized that, there is need to highlight fisheries business opportunities for each element of the value chain - be it the product, inputs (like seed, feed, credit or crop insurance), farming practices, warehousing, logistics, food processing, or food retail.

The purpose of this chapter is to highlight a gamut of fish business opportunities in the context of Vidarbha. It shows cases emerging business models for each of these opportunities, including models that have worked successfully in various parts of India.

7.1 Opportunities in Inland fisheries sector:

There are four key dimensions where opportunities exist:

- **Value chain reorganization:** This dimension primarily relates to inefficiencies on account of a large number of intermediaries in the value chain, resulting in escalations of retail prices. E.g. the average price spread of consumer preferred fish is as high as 50% in comparison with producer's price.
- **Post-harvest management:** This aspect pertains to opportunities in reducing wastages through improved storage and integrated cold chain management. For example, In case of fish as a commodity 30% wastages are due to poor post-harvest management.
- **Branding of indigenous produced:** Opportunities related to branding indigenous produced such as mural, magur, freshwater prawns need to be explored.
- **Processed foods branding:** This dimension explores opportunities for branded retailing of secondary/tertiary processed products. E.g. smoke products (chela fish), boneless product (magur and rohu meat), steak and fillet products (tilapia and pangasius)

7.2 Key imperatives of successful fisheries business:

- **Improve farming output:** By closely working with the farmer, assisting him, and treating him as a partner, private players can help bring about better yields and quality of produce. Contract farming is an arrangement that has gained moderate acceptance but can be an example of more tight knit arrangements between farmers and corporations.
- **Create efficient supply chains, achieve scale and integrate:** Private players will benefit by building efficiencies and reducing costs. This can be achieved by various means, such as bypassing the traditional intermediaries, which will help in reducing their sourcing costs and wastage levels, thereby bringing down the cost to the consumer. Private players also need to make substantial investments in harvesting management, cold storage and transportations etc. in order to improve various supply chain elements.
- **Meeting quality standards:** Low quality of products fetches fewer prices in markets. Private players will have to overcome this challenge by partnering with farmers, making investments in infrastructure (such as cold chain management, testing, and packaging), and by helping farmers achieve the requisite quality.
- **Increase processing levels:** Fish processing is a high-growth sub-segment. However, in order to realize its potential and succeed in this space, private players will need to focus on critical areas such as tie-ups with large number of farmers, establishing processing facilities adjacent to farms, and tightly managing the entire chain to ensure strict control over costs.

Inputs:

Fisheries inputs play a critical role in extracting higher fish yield. The growth of Inland fisheries heavily depends on improving the quality and availability of inputs for the farmers. These key inputs identified are – seeds, feed, supplement & farm implements, credit, insurance and information.

- **Seed:** The use of the right variety of quality seeds is essential to ensure high yield. Seed requirement is the basic need of culture based capture fishery and aquaculture. There is huge gap between actual seed production and requirement in Vidarbha. Due to shortage of seed negligible quantity of fish seed is stocked. The reason for understocking of reservoirs is that most of Government hatcheries are not producing the required number of fingerlings. Since the beginning of fish culture practices in

Vidarbha, the farmers rely mostly on government fish seed hatcheries in the region or import from other state. This leads to stocking with seed of undesired size, inadequate numbers and undesired species of fish. This situation can be improved by participation of farmers and Public Private Partnership in seed production.

- **Feed:** Successful fish culture depends on nutritious feed and feeding management. Feeds must be nutritious and economical in any farming system. At present in Vidarbha region, the fish farming community have not yet realized the importance of feeding practice to increase fish production. The key reasons for non adoption of feeding practices are lack of knowledge, high cost, irregular feed supply, non availability of species specific feed, etc. Good, wholesome and cost-effective feed to meet the nutritional requirements at various stages of growth of different fish species is pre requisite in the fish culture. However, fish farmers are mostly relying on a crude mixture of rice bran and oil cakes. While these traditional feeds have been useful in extensive and semi-intensive practices, their role in sustainable intensification of aquaculture is limited. In this context, the region has potential for manufacturing of farm made feed by community participation and by establishing feed mill unit by Public Private Partnership model.
- **Supplements & farm implements:** In order to achieve higher production levels in intensive fish culture practices, supplements (feed additives, probiotics, medicines etc.) and farm implements (aerators, water & soil analysis kit, nets and net materials etc.) are critically required inputs. At present, the fish farmers are hardly using any of the above supplements and implements thereby achieving low production levels. In this context, there is a scope to start ups trading business by developing entrepreneurship among the farmers, SHG's and unemployed youth.
- **Credit:** Most farmers have limited resources at their disposal and also have little or no disposable income for re-investment in their farms. Credit, therefore, is indispensable to the farmer in meeting the crop-cycle expenses and the availability of credit is a key factor that will drive adoption of all other inputs. However, only limited farmers presently have access to institutional credit. Small and marginal farmers, who are in the greatest need of credit, have the lowest coverage. The industry faces several challenges due to high risk, high transaction costs and low end-use monitoring. Innovation in outreach and risk management is essential to propel growth in rural credit, and consequently, catalyze the adoption of quality inputs in fisheries. Spreading the risks across the system (such as by focusing on group lending, instead

of lending only to individual farmers), expanding reach (through steps such as appointing business correspondents), and ensuring appropriate lending and usage (e.g. through in-kind lending models) are critical to break the sub-optimal credit cycle and drive credit growth.

- **Insurance:** There are several risks associated with fisheries business that make farmers even more financially vulnerable. Some of these risks, such as weather, are beyond anyone's control. Therefore, insurance is a key input required to help manage the fallout of these uncontrollable risks in order to reduce the risk profile of the farmer. Insurance would also enable better access to low-cost credit and catalyze the adoption of other inputs.

Like agriculture, the fisheries business is not treated even for yield insurance as well as to weather-linked insurance. The complete absence of insurance policy for fish business leads to moral hazard among the farmers. Designing the insurance policy covering yield insurance as well as weather linked insurances and improving the pricing structure are essential to promote growth in the sector.

Information: A farmer's decision to grow a particular fish or use a particular input is based on the limited information available to him. Access to quality information can assist the farmer in taking more informed and timely decisions. Similarly, they can use timely information to improve yield and realization. There are three levels through which information can impact farmers' realization:

- **Richness and reach trade-off:** Providing customized guidance, while maximizing the reach of such valuable information to farmers.
- **Providing information at the right time:** especially with regard to precautions against unforeseen events disease and weather condition.
- Actionable and relevant content, as well as easy-to-use solutions.

More recently, there has been a re-evaluation of the role of small-scale Inland fisheries activity in rural livelihoods and its importance in poverty alleviation and household food security. It is also increasingly realized that farmer do not depend for their livelihood on the agricultural sector alone, but rather on a range of livelihood options, which together offer their families food security and reduce vulnerability to conditions over which they have no control.

There is wide scope for fisheries based enterprises such as seed production, grow out culture, processing and post harvest value chain so as to promote growth in the fishery sector of Vidarbha.

7.3 Location specific technology/Business model:

a. Carp seed production in FRP portable hatcheries:

Breeding and hatching of carps are undertaken traditionally using bundhs, hapas and recently by cement circular hatcheries. Once installed, the cement structured hatcheries cannot be shifted from place to place. The innovation of portable FRP carp hatchery is adding a feather to the blue revolution in the country by producing fish seed at the farmers' field. The transportation of seed from different far off places to the farm site involving substantial cost is getting reduced by introduction of this hatchery. Carp hatchery fully made up of fibreglass reinforced plastics (FRP) has been suitably designed and developed by CIFA, Bhubaneswar and the technology got commercialized. The system is so designed that it creates the environment suitable for fish breeding in the field conditions for 20-24 kg of carps (male to female ratio and weight to be approximately equal) in one operation. In one run 1.0-1.2 million spawn can be produced from the system. This hatchery can also be used as a tool for fish biodiversity conservation. In lean season the system can be used for ornamental fish rearing or common carp breeding or water storing. The unit can be operated by SHG, unemployed youth, Grampanchayat and Cooperative Society.

Table 58. Economics of carp seed production by FRP portable hatcheries

Sr. no.	Items	1.0 million spawn capacity	2.0 million spawn capacity	3.0 million spawn capacity
1	2	3	4	5
I.	Expenditure			
A.	Fixed Capital			
1	FRP Carp hatchery	2,00,000	2,50,000	3,00,000
2	FRP water storage tank	20,000	25,000	30,000
3	1 HP single phase mono block pump set (2 nos)	10,000	10,000	10,000
4	Miscellaneous accessories (Packing material & oxygen cylinders)	5,000	6,000	7,000
Sub-total		2,35,000	2,91,000	3,47,000

Sr. no.	Items	1.0 million spawn capacity	2.0 million spawn capacity	3.0 million spawn capacity
1	2	3	4	5
B.	Variable Cost per Cycle			
1	Brood fish (@ 250/kg)	5,000	10,000	15,000
2	Electricity and fuel	1,000	1,500	2,000
3	Inducing agent	800	1,600	2,400
4	Wages (@ Rs. 175/day for 8 man-days per operation)	1,400	1,400	1,400
5	Miscellaneous	500	1,000	1,500
	Sub-total	8,700	15,500	22,300
C.	Total variable costs (15 cycles)	1,30,500	2,32,500	3,34,500
II.	Gross Income (per cycle)			
1	Sale of spent brood (@ Rs. 100/kg)	2,000	4,000	6,000
2	Sale of spawn (avg. @ Rs. 1500/lakh)	15,000	30,000	45,000
3	Sub-total	17,000	34,000	51,000
	Gross Return (for 15 cycle)	2,55,000	5,10,000	7,65,000
III.	Net Income (Gross income - Total costs)	1,24,500	2,77,500	430,500

Note: Costs are indicative of current market prices.

Reference: Compendium 'National workshop on portable FRP carp hatchery technology', 2011.

Backward linkages:

- Components involving FRP Carp hatchery: Procurement from CIFA, Bhubaneswar/Private companies.
- Other assets: Locally procured.
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Inputs: Brood fishes from local water bodies.
- Technology support: CIFA, Bhubaneshwar; College of Fisheries Science, Nagpur and State Fisheries Department.

Forward linkages:

- Marketing: Sale of spawn to local fish farmers, fishermen cooperative societies and private entrepreneurs.
- Marketing scope: Potential of marketing through formation of seed production clusters in each district.

b. Fingerling production model:

Availability of required quantity of seed of the desired species at the appropriate time is one of the prime factors that lead to success of fish culture. Though remarkable success has been achieved over the years in spawning the carps, availability of seed of desired size still remains a constraint. The nursery rearing involve nurturing of 72-96 hours old spawn which have just begun to eat and continues for a period of 15-20 days, during which they grow to fry of about 25-30 mm. These fry are further reared in another pond for a period of 2-3 months to raise the fingerlings of about 100 mm in size.

Fry to fingerling ponds are comparatively bigger in size than that of nurseries and preferably up to 0.2 ha area is used for rearing. The different management steps involved fingerling production is:

Pre-stocking pond preparation: The first step in pre-stocking management is to eradicate aquatic vegetation and predatory & weed fishes. The ponds are fertilized with organic manures and inorganic fertilizers, the cow dung is applied generally at the rate of 5,000 kg/ha, urea and single super phosphate @ 100 kg and 50 kg/ha/year, respectively. The oil emulsion dose (diesel and detergent in the ratio of 3:1) should be applied prior to 2-3 days of stocking.

Stocking of spawn: The normal stocking density of spawn suggested for rearing ponds is 0.1-0.3 million/ha.

Post-stocking pond management: In fingerling production model, emphasis is given on boosting the primary productivity by fertilization. This will ensure enough availability of plankton as natural food. In addition, in final stage of rearing supplementary feed plays an important role. The stocked spawn are fed @ of 5-10% of body weight. The supplementary feed generally is the mixture of groundnut oil cake and rice bran at 1:1 ratio by weigh. Locally available ingredient such as soyabean cake, mustard oil cake etc. can also be used to compound the feed. The water levels are maintained up to 1.5 m depth and intermittent fertilization is practiced. By adopting of scientific methods of rearing, the fingerlings attain 80-100 mm/8-10 gm with a survival of 40-50% under rearing pond conditions.

Table 59. Economics of fingerling production in agriculture pond (Size 25m x 25m)

Sr. No.	Particulars	Unit	Quantity	Rate (Rs./Unit)	Amount (Rs.)
1	2	3	4	5	6
1	Spawn of catla, rohu & mrigal	No	1,50,000	0.015	2,250
2	Fertilizers				
	a. Cow-dung	Kg	1,000	0.5	500
	b. Inorganic fertilizers	Kg	5	10	50
3	Supplementary feed	Kg	30	35	1,050
4	Miscellaneous	-	-	-	2,000
5	Total expenditure	-	-	-	5,850
6	Yield	No	60,000	0.6	36,000
7	Net profit (6 - 5)	-	-	-	30,150

Note: Costs are indicative of current market prices.

Reference: Aquaculture technology for farmers, ICAR-CIFA, 2005.

Backward linkages:

- Seed rearing ponds: Own ponds, lease ponds.
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Inputs: Locally procured spawn from State Department hatchery and private seed producer, supplementary feed preparation by the local ingredient.
- Technology support: CIFA, Bhubaneshwar; College of Fisheries Science, Nagpur; State Fisheries Department and Feed Company or distributor.

Forward linkages:

- Marketing: Sale of fingerlings to local fish farmers, fishermen cooperative societies and private entrepreneurs.
- Marketing scope: Ready market owing to high fingerling demand, formation of seed banks in each district.

c. Monosex tilapia culture in farm ponds/aquaculture ponds:

Monosex tilapia farming has taken an important role in the fish farming business throughout the world. Monosex tilapia has great demand and value in the local and international market. The farming of monosex tilapia is getting popular due to feed acceptability, high FCR, surviving capacity in adverse weather condition and high diseases resistance power. The monosex tilapia can be cultured twice a year with high stocking

density. The commercial monosex tilapia farming is very profitable business. The 1 hectare water spread area with 3-6 feet depth is ideal for monosex tilapia farming. However, monosex tilapia culture can be practice in small water bodies. The management steps involved monosex tilapia farming is as follows:

Pre stocking Management: The first step in pre stocking management is to eradicate cannibalistic and weed fishes from the pond by drying, pulling net or using medicines or chemicals. The unwanted or predatory fishes and their eggs are eradicated by using bleaching power @ 350 kg/ha followed by liming @ 200 – 250 kg and the ponds are fertilized with organic manures and inorganic fertilizers such as cow dung @ 750 kg/ha, GOC @ 200 kg/ha and SSP @ 50 kg/ha.

Stocking: After 5-7 days of applying fertilizer, the seed of monosex tilapia (20-30 grams body weight) is stocked @ of 20,000-25,000 no/hectare.

Post stocking management: Nutritious feeding is considered as most important factor in commercial monosex tilapia culture. Commercial feed with balance nutrient is available in the market. The stocked seed are fed 3 to 4 times a day @ of 2-10% of body weight. If needed 5% water can be exchange when the fish reaches more than 100 grams body weight. By adopting of scientific methods of culture the monosex tilapia can attain 350-500 gm in 5 months with an average survival rate of 75% under rearing conditions.

Table 60. Economics of monosex tilapia culture in 1 ha farm ponds/aquaculture ponds for one crop

Sr. No.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
A	Capital Cost				
1	Aerator	Nos	2	20,000	40,000
2	Diesel pump set	5 HP	1	45,000	45,000
3	Bio security	-	-	L/s	35,000
4	Miscellaneous nets and implements etc.	-	-	L/s	15,000
Sub Total					1,35,000
B	Operational cost				
1	Preliminary pond preparation expenses	-	-	L/s	5,000
2	Lime and fertilizer	-	-	L/s	5,000
3	Fish seed with transportation	Nos	25,000	3	75,000
4	Feed (formulated pelleted feed)	kg	11,813	32	3,78,000
5	Probiotics, supplements and medicines	-	-	-	10,000
6	Harvesting including labour charges for cleaning, grading and packing	-	-	L/s	5,000
7	Miscellaneous expenditure	-	-	L/s	5,000
Sub Total					4,83,000

Sr. No.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
C	Production & Income				
1	Survival (%)				75
2	Average weight at harvest (g)				450
3	Total Production (Kg)				8,438
4	Farm gate price (Rs)				65
5	Income				5,48,438
6	Profit (Income - Operational Cost) (Rs)				65,438

Note: Costs are indicative of current market prices.

Reference: Economics of Tilapia Culture in Watershed Pond in Bangladesh.

Backward linkages:

- **Fish ponds:** Own ponds, lease ponds
- **Other assets:** Procured locally and/or from aqua traders across India.
- **Credit/finance support:** Support from finance institutions/subsidies from Govt. agencies.
- **Inputs:** Certified seed from RGCA, Chennai; and other government certified private hatcheries.
- Procurement of floating feed and feed supplement from local trader/feed companies.
- **Technology support:** RGCA, Chennai; CIFA, Bhubaneswar; College of Fisheries Science, Nagpur; State Fisheries Department and Feed Company or distributor.

Forward linkages:

- **Marketing:** Sale in local markets, hotel & restaurants. Domestic marketing in nearby states.
- **Marketing scope:** High processing quality due to filleting and white meat, ready to export market, suitability to develop value added products.

d. Grow-out culture of indigenous catfish (Indian magur):

The traditional culture of catfishes has been practiced in Indian subcontinents. Magur (*Clarius magur*) is suitable for culture in ponds. They are hardy and can survive in atmospheric condition due to its air breathing ability. Such live magur fetches high price and is becoming very popular in hotel industry due to its taste and therapeutic value. In Vidarbha there is high demand in market but its supply is restricted from natural flowing water bodies. This provides great opportunity for initiation and scaling up of grow out culture in seasonal as well as perennial farm ponds and aquaculture ponds. The ideal grow out culture of magur

can be carried out in small ponds of size 0.02 – 0.1 ha with water depth of about 0.50 – 1.0 m. The height of pond dyke should be above 100 cm from the water level to prevent its crawling ability. The management steps involved in grow out culture of magur is as follows:

Pre stocking management: The first step in pre stocking management is to eradicate cannibalistic and weed fishes from the pond by drying, pulling net or using medicines or chemicals. The unwanted or predatory fishes and their eggs are eradicated by using bleaching power @ 350 kg/ha followed by liming @ 200 – 250 kg and the ponds are fertilized with organic manures and inorganic fertilizers such as cow dung @ 750 kg/ha, GOC @ 200 kg/ha and SSP @ 50 kg/ha.

Stocking: The fingerling size seed of magur is generally stocked @ 5 no. /m² with average body weight of 3 – 5 gm.

Post stocking management: An improved growth and survival is obtained when feeding is adjusted according to the weight of the fish twice in a month. Fishmeal based compound feed with 30 – 32 percent is preferred protein is most suitable for growth. The fingerlings are fed twice a day @ of 3% – 5% of body weight. Magur attains marketable size of about 100 to 150 gm in 10 – 12 months. Harvest is done by hand picking method after complete dewatering of the pond. An average production is 2 – 4 tonnes/ha in 10 – 12 months.

Table 61. Economics of grow-out culture of indigenous magur in 1 ha farm ponds/aquaculture ponds

Sr. No.	Particulars	Unit	Quantity	Rate	Amount
1	2	3	4	5	6
A	Capital Cost				
1	Diesel pump set	5 HP	1	45,000	45,000
2	Bio security	-	-	L/s	35,000
3	Miscellaneous nets and implements etc.	-	-	L/s	15,000
Sub Total					95,000
B.	Operational cost				
1	Preliminary pond preparation expenses			L/s	5,000
2	Lime and fertilizer	-	-	L/s	5,000
3	Seed with transportation	Nos.	50,000	7	3,50,000
4	Feed (formulated pelleted feed) for growout phase	kg	5,850	40	2,34,000
5	Probiotics, supplements and medicines	-	-	-	20,000
6	Harvesting including labour charges for cleaning, grading and packing	-	-	L/s	5,000

Sr. No.	Particulars	Unit	Quantity	Rate	Amount
1	2	3	4	5	6
7	Miscellaneous expenditure	-	-	L/s	5,000
Sub Total					6,24,000
Total (Capital Cost + Operational Cost)					7,19,000
C	Production & Income				
1	Survival growout pond (%)				65
2	Average weight at harvest (g)				120
3	Total Production (Kg)				3,900
4	Farm gate price (Rs)				300
5	Income of total production (Rs)				13,50,000
6	Profit (Income - Operational Cost) (Rs)				7,26,000

Note: Costs are indicative of current market prices.

Reference: Aquaculture technology for farmers, ICAR-CIFA, 2005.

Backward linkages:

- Fish ponds: Own ponds, lease ponds
- Other assets: Procured locally and/or from aqua traders across India.
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Inputs: Certified seed of indigenous magur (*Clarius magur*) from State Government hatchery, Raipur, Chhattisgarh and other government certified private hatcheries. Preparation of high protein farm made feed and/or procurement of pelleted feed and feed supplement from local trader/feed companies.
- Technology support: CIFA, Bhubaneswar; College of Fisheries Science, Nagpur; State Fisheries Department and Feed Company or distributor.

Forward linkages:

- Marketing: Sale in local markets, hotel & restaurants. Domestic marketing in nearby states.
- Marketing scope: High local demand; live Magur fetches high price and is becoming very popular in hotel industry due to its taste and therapeutic value.

e. Culture of pangasius:

It is considered as economically important food fish because of its fast growth, versatile feeding habit and hardiness. Flesh of the fish ranges in color from creamy white to orange with a mild flavor and a medium firm texture. Pangasius are normally processed as fillet or steak and variety of value added products can be prepared. It is now considered as the

3rd most important freshwater fish group within the aquaculture sector. Pangasius is considered as low risk aquaculture species since it cannot reproduce naturally, fingerlings are produced by local hatcheries through induced spawning. The ideal grow out culture of pangasius can be carried out in small ponds of size 0.1 – 0.5 ha with water depth of about 1.5 – 2 m. The management steps involved in grow out culture of pangasius is as follows:

Pre stocking management: The first step in pre stocking management is to eradicate cannibalistic and weed fishes from the pond by drying, pulling net or using medicines or chemicals. The unwanted or predatory fishes and their eggs are eradicated by using bleaching power @ 350 kg/ha followed by liming @ 500 - 1000 kg and the ponds are fertilized with organic manures and inorganic fertilizers such as cow dung @ 750 kg/ha, GOC @ 200 kg/ha and SSP @ 50 kg/ha.

Stocking: The fingerling size seed of pangasius is generally stocked @ 2 no/m² with average body weight of 3 – 5 gm.

Post stocking management: Pangasius can be fed with pelleted commercial fish feeds (recommended for faster growth and better fish quality) at a rate of 5% of their average body weight (ABW) and will be adjusted bi-weekly down to 2.5% at end of culture period. Feed conversion ratio (FCR) averages from 1.3 -1.8, which makes it suitable for culture. Feeding is done twice a day. Pangasius is an air - breathing fish, thus it can tolerate low dissolve oxygen level. Harvesting can be done in partial (selective harvesting) or total harvesting. It can reach the weight of 1- 1.5 kg in 8-10 months of culture period.

Table 62. Economics of pangasius culture in 1 ha farm ponds/aquaculture ponds for one crop

Sr. No.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
A	Capital Cost				
1	Aerator	Nos	1	20,000	20,000
2	Diesel pump set	5 HP	1	45,000	45,000
3	Bio security	-	-	L/s	35,000
4	Miscellaneous nets and implements etc.	-	-	L/s	15,000
Sub Total					1,15,000
B.	Operational cost				
1	Preliminary pond preparation expenses	-	-	L/s	5,000
2	Lime and fertilizer	-	-	L/s	5,000
3	Fish seed with transportation	Nos	20,000	5	1,00,000
4	Feed (formulated pelleted feed)	kg	23,400	35	8,19,000
5	Probiotics, supplements and medicines	-	-	-	10,000

Sr. No.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
6	Harvesting including labour charges for cleaning, grading and packing	-	-	L/s	5,000
7	Miscellaneous expenditure	-	-	L/s	5,000
Sub Total					9,49,000
C	Production & Income				
1	Survival (%)				90
2	Average weight at harvest (g)				1000
3	Total production (Kg)				18,000
4	Farm gate price (Rs)				80
5	Income				14,40,000
6	Profit (Income - Operational cost) (Rs)				4,91,000

Note: Costs are indicative of current market prices.

Reference: NFDB guidelines for regulating introduction of *Pangasius sutchi* in India and Booklet on Culture of *Pangasius* spp. Bureau of Fisheries and Aquatic Resources, Department of Agriculture, Philippines 2008.

Backward linkages:

- Fish ponds: Own ponds, lease ponds.
- Other assets: Procured locally and/or from aqua traders across India.
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Inputs: Certified seed of *Pangasius* from RGCA, Chennai; INDIPESCA, Pench Nagpur; M.M. Fisheries, Raipur, Chhattisgarh. Procurement of floating pelleted feed and feed supplement from local trader/feed companies.
- Technology support: RGCA, Chennai; CIFA, Bhubaneswar; College of Fisheries Science, Nagpur; State Fisheries Department and Feed Company or distributor.

Forward linkages:

- Marketing: Sale in local markets, hotel & restaurants. Domestic marketing in nearby states.
- Marketing scope: High processing quality due to filleting and white meat, ready to export market, suitability to develop value added products.

f. Poly culture of giant fresh water prawn-Scampi (*Macrobrachium rosenbergii*) and Indian major carps:

Giant fresh water prawn is commonly known as “Scampi”, it is widely distributed in most of the river in Vidarbha. It is highly valued due to its high price, large size, rapid growth, good taste and high export demand. The ideal nursery phase culture of prawn is

carried out in pond size of 0.02-0.1 ha, and grow out culture can be carried out in ponds of size 0.2 – 1 ha with water depth of about 1.5 – 2 m. The management steps involved in culture is as follows:

Pond preparation: Pond is dried and pond bottom is exposed to sunlight for one week. If it is not possible to dry the pond then mahua oil cake or urea and bleaching powder are added for removal of predatory fishes. Liming is done @ 200 kg/ha or as per requirement based on soil pH. Cow dung @ 200 kg/acre or urea @ 10 kg and SSP @ 15 kg is added in the pond for plankton development at weekly interval. Then water is properly filtered and filled in the pond up to a level of 4 ft. As prawns grow by moulting (shedding of outer shell) and are very soft and are easy prey to other prawns, earthen tiles, small tree branches and tyres are provided in the pond as hideouts to save them from predators during moulting. The pond is covered with nylon net or threads to save them from predatory birds. For monoculture practice, they are stocked @ 3-4 prawn juveniles/m² and for polyculture, 1-2 prawn juveniles/m² along with 3,000-5,000/ha rohu and catla fingerlings.

Nursery phase rearing: During nursery phase, delicate post-larvae (PL) (15-20 mm) procured from prawn hatcheries are raised to juveniles (2-5 gm) in the small earthen ponds/tanks. The size of nursery pond may range from 0.02-0.1 ha, the recommended stocking density of seed (post-larvae) ranges from 2-6/m². Provision of floating weeds inside a Polyvinyl Chloride (PVC) frame covering 10% of pond surface is recommended to provide shade and shelter to PL. Commercially available prawn/shrimp feeds (starter feeds in crumble form) is recommended for good growth and survival. It should be fed @ 100% of the biomass/day for first two weeks and reduced to 20% of biomass towards the end. Nursery period may range from 45-60 days during which the PL grow to juveniles of 2-5 gm size.

Grow out phase rearing: Juvenile prawns (2-5g) are harvested from nursery ponds and stocked in larger grow out ponds (0.2 to 1 ha) @ 1-3/m². Prawns are fed with commercial feed @ 10% of their biomass which is gradually reduced to 2% towards the end of the culture period. The feed is broadcasted to the pond from the dykes. Feed can also be given in check trays placed 2-3 m away from the dyke for better feed management. Feed management should be done properly to ensure better growth and environment management. During culture period of 6-8 months, water quality need to be maintained at optimum levels (dissolved oxygen > 3 ppm; pH - 7 - 8; alkalinity - 60-100 ppm; transparency - 30-35 cm). Culture period including nursery may range from 8 to 10 months. Partial harvesting to remove larger prawns can start from 4 months of culture and final harvesting is done by

netting followed by complete draining of the pond. Survival is expected to be 75-85%; final average size 65 gm.

Table 63. Economics of grow-out culture of polyculture of prawn & IMC in 1 ha farm ponds/aquaculture ponds

Sr. no.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
A	Capital Cost				
1	Diesel pump set	5 HP	1	45,000	45,000
2	Aerators	-	2	20,000	40,000
3	Bio security	-	-	L/s	35,000
4	Sampling Nets, water testing kit, plastic buckets, secchi disk and other implements	-	-	L/s	10,000
5	Miscellaneous nets and implements etc.	-	-	L/s	6,000
Sub Total					1,36,000
B.	Operational cost				
1	Preliminary pond preparation expenses	-	-	L/s	5,000
2	Lime and fertilizers	-	-	L/s	5,000
3	Fish seed (yearlings of catla & rohu)	Nos	5,000	1	5,000
4	Seed (post larvae) for Nursery Grow out phase rearing	Nos	20,000	2	40,000
5	Prawn feed	kg	1,462.5	50	73,125
	Fish feed		4,462.5	30	1,33,875
6	Probiotics, supplements and medicines	-	-	L/s	20,000
7	Harvesting including labour charges for cleaning, grading and packing	-	-	L/s	5,000
8	Miscellaneous expenditure	-	-	L/s	5,000
Sub Total					2,92,000
Total					4,28,000
C	Production & Income			Prawn	Fish
1	Survival growout pond prawn & fish (%)			75	85
2	Average weight at harvest prawn & fish (g)			65	750
3	Total Production prawn (kg)			975	3,188
4	Farm gate price prawn (Rs.)			550	70
5	Income from total production (Rs)			7,59,375	
6	Profit (Income - Operational Cost) (Rs)			4,67,375	

Note: Costs are indicative of current market prices.

Reference: Freshwater prawn culture, ICAR, CIFA.

Backward linkages:

- Fish ponds: Own ponds, lease ponds
- Other assets: Procured locally and/or from aqua traders across India.
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Inputs: Certified seed from College of fisheries, Shirgaon, Ratnagiri; RGCA, Chennai; private certified hatcheries in coastal district of Andhra Pradesh and Tamilnadu; Procurement of pelleted feed and feed supplement from local trader/feed companies.
- Technology support: RGCA, Chennai; CIFA, Bhubaneswar; College of Fisheries Science, Nagpur; State Fisheries Department and Feed Company or distributor.

Forward linkages:

- Marketing: Sale in local markets, hotel & restaurants. Domestic marketing in nearby states.
- Marketing scope: Ready to export market, suitability to develop value added products.

g. Inland saline aquaculture:

The major salt affected groundwater areas in Vidarbha include Purna River Basin covering an area of about 7,500 sq. kms., is historically known for its inland salinity and the salinity in groundwater is an acute problem over an area of about 4,700 sq. kms within the basin area. The saline tract in Purna valley occurs in 14 taluka of Amravati, Akola, and Buldhana districts of Vidarbha region. This tract spreads on both sides of Purna River, affecting about 892 villages, covering an area about 4,692 sq. km. In Amravati, the saline tract covers some parts of talukas like Daryapur, Achalpur, Anjangaon, Amravati, Chandur Bazar and Bhatkuli; whereas, in Akola, it occupies adjacent parts of Akola, Akot, Murtijapur, Telhara and Balapur talukas. It also occupies certain areas of Shegaon, Nandura and Jalgaon talukas of Buldana district. Due to non-utilization of ground saline water, the water table in these areas is rising with an alarming rate causing secondary salinization and water logging conditions with poor quality water.

The development of suitable technologies for the utilization of inland saline soils and ground saline water is a national priority. Pumping of ground saline water therefore is necessary to lower down the water table to a safer root zone so that surface soil remains unaffected with salinity problem providing good soil conditions for agriculture crops. However,

this could be made economically viable through aquaculture practices in which large proportion of water could be evapo-transpired from aquaculture ponds along with production of high income generating fish/prawn/shrimp crops.

The pacific white leg shrimp, (*Litopenaeus vannamei*) has become a game changer in Indian shrimp farming in recent years. Since its commercial introduction in the year 2009, the farming of this exotic species has gained tremendous momentum in India owing to its faster growth rate, tolerance to high stocking density, lower dietary protein requirement and tolerance to wide ranges of salinity and temperatures. Following its tremendous success in coastal states, successful maiden attempts were made by Central Institute of Fisheries Education to develop package of practices for profitable aquaculture for the utilization inland saline soil. The farming of white leg shrimp is being successfully carried out in inland saline lands by farmers of Haryana and Punjab.

This preliminary sampling result shows that the few localities in Purna valley tract may have a hidden potential for development of inland saline aquaculture. In this regard it is suggested that the opportunities for use of inland saline water resources for commercial aquaculture must be identified through detail investigation on extent of degraded inland soil in Vidarbha, study of soil and water quality parameters, demonstration of proven aquaculture technologies in the farmers' field and capacity building of stakeholders. The commercial white leg shrimp culture is very profitable business. The ponds with 01 ha water spread area with 1 to 1.5 meter water depth is ideal for white leg shrimp farming. However, the culture can be practice in small aquaculture ponds ranging from 0.4 to 0.6 ha. The different management steps involved white leg shrimp farming in inland saline soils of Vidarbha is as follows:

Pre-stocking management: The pond bottom is scrap to remove organic sludge and dried till it gets cracks. Apply lime at the rate of 200-250 kg/ha. Arrange the bird net above the pond. Fill water up to 120-150 cm depth. Treat the water with 10 ppm chlorine and leave it for 4-5 days for dechlorination. Apply organic slurry prepared with molasses, rice polish, oil cake and yeast.

Stocking: Select specific pathogen free and resistant shrimp seed from shrimp hatcheries approved by Coastal Aquaculture Authority (CAA). Stock the seed @ 15 no/m².

Post stocking management: Procure good quality feed from reputed company having consistency. Use accurate size feed as per the stage of shrimp. The stocked seed are fed 3 to 4 times a day @ of 2-10% of body weight. Broadcast feed evenly throughout the pond give appropriate ration of feed by checking biomass at regular interval of every 15 days. Observe

the check trays after two hours of feeding to know the feed consumption. Check the health condition of shrimps every day, taking the samples from check trays. Observe any abnormalities such as antenna cut, opaqueness, white mussel, etc. Regularly apply water and soil probiotics to develop immunity in shrimps and maintenance of optimum water and soil quality. Check the pond bottom soil once in a week. Drag chain at pond bottom twice in a week to eliminate obnoxious gases. By adopting of scientific methods of culture the white leg shrimp can attain 40-60 gm in 3 to 4 months with an average survival rate of 75% under rearing conditions.

Table 64. Economics of white leg shrimp (*Litopenaeus vannamei*) culture in 1 ha farm ponds/aquaculture ponds

Sr. no.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
A	Capital Cost				
1	Aerator	Nos	1	20,000	20,000
2	Diesel pump set	5 HP	1	45,000	45,000
3	Lining of pond	m ²	10,000	150	15,00,000
4	Bio security	-	-	L/s	35,000
5	Miscellaneous nets and implements etc.	-	-	L/s	15,000
Sub Total					16,15,000
B.	Operational cost				
1	Preliminary pond preparation expenses	-	-	L/s	10,000
2	Lime and fertilizer	-	-	L/s	10,000
3	Shrimp seed with transportation	Nos	1,50,000	2	3,00,000
4	Feed (formulated pelleted feed)	kg	6,750	75	5,06,250
5	Probiotics, supplements and medicines	-	-	-	20,000
6	Harvesting including labour charges for cleaning, grading and packing	-	-	L/s	5,000
7	Miscellaneous expenditure	-	-	L/s	5,000
Sub Total					8,56,250
C	Production & Income				
1	Survival (%)				75
2	Average weight at harvest (g)				40
3	Total Production (Kg)				4,500
4	Farm gate price (Rs)				400
5	Income				18,00,000
6	Profit (Income - Operational Cost) (Rs)				9,43,750

Note: Costs are indicative of current market prices.

Reference: Technology for commercial farming of Pacific white leg shrimp (*Litopenaeus vannamei*) in inland saline soils using ground saline waters.

Backward linkages:

- Fish ponds: Own ponds, lease ponds
- Other assets: Procured locally and/or from aqua traders across India.
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Inputs: Certified seed from CAA, Chennai; Procurement of pelleted feed from reputed company's local trader/suppliers.
- Technology support; CIFE, Mumbai; Central Institute of Brackishwater Aquaculture (CIBA), Chennai, College of Fisheries Science, Ratnagiri & Nagpur; State Fisheries Department and Feed company or distributor.

Forward linkages:

- Marketing: Sale in local markets, hotel & restaurants. Domestic marketing in nearby states.
- Marketing scope: High international demand, high processing quality and ready to export market.

h. Fish pickle production unit:

Fish and fishery products are recorded highest increase in price in recent years, both in domestic and export markets, compared to any other food items, because of the changes that have been taken place in the dietary habits of the people all over the world and the fish products were considered as health food by the consumers. The conventional products are disappearing from the market and their places is being taken up by the hygienically prepared and attractively packed products in form of 'ready to cook' or 'ready to serve' convenience foods.

Pickling is the process of preserving or expanding the lifespan of fish by either anaerobic fermentation in brine or immersion in vinegar. Picking is the process of preserving fish by anaerobic fermentation in bring to produce lactic acid, or maintaining and strong it an acid solution, usually vinegar. The resulting food is called a pickle. Making fish pickles by using standardize ingredients & recipe developed by premium fisheries institute in India would have shelf life around 3-4 months.

In Vidarbha, this technology can be adopted by women SHG's, unemployed youth and small entrepreneur's etc. for economical benefit & social upliftment.

Table 65. Economics for fish pickle production unit (15 tonne/year)

Sr. no.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
A	Capital cost				
1	Deep freezer	-	1	40,000	40,000
2	Box wrapping machine	-	1	5,000	5,000
3	Bottle capping machine	-	2	10,000	20,000
4	Sealing machine	-	1	20,000	20,000
5	Knife, chopping board & other steel utensil	-	-	L/s	10,000
6	Gas stove system	-	1	10,000	10,000
7	Legal permission and licensing etc.	-	-	L/s	5,000
Sub Total					1,10,000
B	Operational cost				
1	Raw material fish	kg	15,000	100	15,00,000
2	Ingredients (Spices, vinegar, oil etc)	kg	7,500	80	6,00,000
3	Overheads (Electricity, labour, packaging etc.)	kg	L/s	20	3,00,000
Sub Total					24,00,000
C	Production & Income				
1	Production / year (kg)				15,000
2	Selling price/kg				350
3	Income				52,50,000
4	Profit (Income - Operational Cost) (Rs)				28,50,000

Note: Costs are indicative of current market prices.

Source: Assumption based on researcher's experience and focus group discussion.

Backward linkages:

- Raw Material: Fishermen, fish farmer, wholesaler and cooperatives societies & local traders.
- Machineries: Local Traders
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Legal permission: Local and or State/ Central Legal bodies.
- Technical support: CIFT, Cochin, CIFE, Mumbai & College of Fishery Science, Nagpur

Forward linkages:

- Marketing: Sale in retail shops, malls, domestic marketing within and other states of India.

i. Fish drying unit:

In the geographical scheme of Maharashtra Vidarbha (19° 22'W and 76° 8'E) forms the North –Eastern part of Maharashtra. Vidarbha region has tropical monsoon which is hotter in summer and colder in winter. In summer temperature rises upto 44°C sometimes reaching as high as 45°C - 47°C. The climatic condition of Vidarbha is suitable for fish drying. There are lots of advantages of dried fish such as reduced microbial activity & spoilage, highly concentrated food, less expensive, stable at ambient temperatures & most importantly no energy cost involved.

In Vidarbha fishermen are not involved in fish drying process on mass scale. During harvesting of commercial fishes the by-catch of very small size fishes such as Pershi, Katwa, Chandni, Chacha, Gani etc. are generally sold at low price. These fishes are abundantly available throughout the year and can be easily dried. By implementing this technique fishermen community or other small entrepreneurs of Vidarbha can increase their income as well as employment.

Table 66. Economics of drying unit (03 tonne for 06 months)

Sr. No.	Particulars	Unit	Quantity	Rate	Total
1	2	3	4	5	6
A	Capital Cost				
1	Drying yard construction (raised bamboo or cemented platforms)	-	1	L/s	2,00,000
2	Miscellaneous cost (Utensils and Other small equipments)	-	L/s		2,00,000
Sub Total					4,00,000
B.	Operational cost				
1	Raw material @ Rs.40 / kg x 04 cycles of 500 kg per month for 06 months)	kg	12,000	25	3,00,000
2	Overhead (wages, rent, packaging & transportation etc.	kg	L/s	25	75,000
Sub Total					3,75,000
C	Production & Income				
1	Dry fish production (25 % of raw material)				3,000
2	Selling price / kg of dry fish				250
3	Income				7,50,000
D	Profit (Income - Operational Cost) (Rs)				3,75,000

Note: Costs are indicative of current market prices.

Source: Assumption based on researcher's experience and focus group discussion.

Backward linkages:

- Land: Own or lease basis.
- Other assets: Procured locally
- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies.
- Technology support: College of Fisheries Science, Nagpur; State Fisheries Department.

Forward linkages:

- Marketing: High demand countries like Nepal & Bangladesh. Sale in local markets and domestic marketing in north eastern States and parts of West Bengal.
- Marketing scope: Easy to produce, no special storage requirement can be transported in non-refrigerated vehicles.

j. Fish Retail outlet / Co-operative store:

In Vidarbha fish markets the fishes are sold in unhygienic conditions by local vendors. The main reason for this is long supply chain involved in fish marketing which results in excessive handling, non-adherence of cold chain resulting in poor quality of fish. Further the waste material from the sold out fishes is kept in the vicinity of sale point which leads in generation of maggots and insects and makes the market area more filthy. The overall result of these conditions in market degrades the quality of fish and thus becomes unappealing to attract consumers.

A complete solution to all these problems can be establishment of modern and hygienic fish retail outlets which offers excellent business opportunity. Such retail outlets maintain high hygienic standards of pre-sale procedures which includes cleaning schedule, use of potable water, cold chain maintenance, chilled and refrigerated storage, attractive display and separate waste disposal system. In Vidarbha, meat and poultry retail outlets are already established at district levels and are running profitably. There is enormous scope for development of supply chain and establishment of such retail outlets by fisheries co-operative societies in Vidarbha for employment and livelihood support for the members. With rapid urbanization and expansion of smart cities such outlets are will attract more consumers and also help the co-operative societies in fetching greater for their produce.

Table 67. Economics of fish retail outlet/co-operative store

Sr. No.	Particulars		Unit	Quantity	Rate	Total
1	2		3	4	5	6
A	Capital Cost					
1	Deep freezer		-	2	40,000	80,000
2	Portable refrigerated display unit with facility for cutting, storage		-	1	1,00,000	1,00,000
3	Insulated Boxes		Nos.	20	1,000	20,000
4	Knife, chopping board and other utensil etc		-	L/s	50,000	50,000
Sub Total					2,50,000	
B	Operational cost					
1	Raw Material					
	a.	Fresh water fishes	kg	15,000	80	12,00,000
	b.	Marine water fishes	kg	3,600	400	14,40,000
	c.	Fresh water prawn	kg	1,500	350	5,25,000
	d.	Crabs medium size	kg	1,800	80	1,44,000
	e.	Frozen ready to cook products	kg	3,000	300	9,00,000
2	Ice (crushed / tube)		kg	12,000	5	60,000
3	Rent		L/s	12	7,000	84,000
4	Overheads Electricity, labour, packaging etc.		kg	L/s	15	3,73,500
Sub Total					47,26,500	
Sr. No.	Particulars		Unit	Quantity	Rate	Total
1	2		3	4	5	6
C	Sale					
	a.	Fresh water fishes	kg	15,000	125	18,75,000
	b.	Marine water fishes	kg	3,600	500	18,00,000
	c.	Fresh water prawn	kg	1,500	650	9,75,000
	d.	Crabs medium size	kg	1,800	125	2,25,000
	e.	Frozen ready to cook products	kg	3,000	400	12,00,000
D	Income					60,75,000
E	Profit (Income - Operational Cost) (Rs)					13,48,500

Note: Costs are indicative of current market prices.

Source: Assumption based on researcher's experience and focus group discussion.

Backward linkages:

- Shop /Co-operative Store: Own or lease basis.
- Other assets: Procured locally.

- Credit/finance support: Support from finance institutions/subsidies from Govt. agencies like NFDB, Hyderabad.
- Technology support: College of Fisheries Science, Nagpur; State Fisheries Department.

Forward linkages:

- Marketing: Domestic Sale, Popularization through advertisement.

7.4 Collaborative business models:

Collaborative business model is becoming increasingly important for developing inland fisheries sector. Many options exist for such partnership arrangements. The most common goal for collaborative model is to improve supply chain management and food safety to increase access to national and international markets. Product certification, product handling, food safety and marketing all fall into this category. Emphasis on this area probably reflects organizational and institutional weaknesses in the public sector for which private company expertise can compensate.

The objective of collaborative business model also includes business development, consultancy services, capacity building, training and development, research and development, disseminating quality seed and developing financial services for small-scale fishery and aquaculture enterprises etc.

There are two business model seem suitable for fisheries sector in Vidarbha.

a. Contract farming:

The fisheries sector, like any other sector of the economy, has got to put its act together to evolve a response mechanism to face this ineluctable reality. This may call for a paradigm shift in its focus and approach. Contract farming is billed to be a veritable instrument to address many of the traditional ills affecting the fisheries sector and the farmers, such as small scale operations at individual farm level, long chain of market intermediaries, ignorance about the requirements of the buyers, less level of technological knowhow, inadequacy of capital and distress sale and consequent heavy losses to farmers etc. Contract farming is an exciting way of giving the power of scale to the small farmers, transferring corporate management skills to the fisheries field, providing assured markets for the produce, reducing the transaction costs involved in the value chains of the commodities and of ensuring vertical integration through forward and backward linkages. The proposed

contract farming model involving roles and responsibilities of farmer, participating agency and publican private institution is given as under:

Table 68. Role and responsibilities in contract farming model

Components	Roles and responsibilities		
	Farmer/SHG's/Fisherie s cooperative society	Private firm/Agency	Public/Private institution
1	2	3	4
Farm pond /Aquaculture pond/Seasonal Village ponds & Malguzari talav	The ownership/lease right shall be with producer group	Agreement with farmers for sustainable business practices on mutual terms	Permissions shall be obtained from the respective government department
Credit & Microfinance for projects	-	Investment and financial support for working capital	Development banks, Public finance institutes and Subsidies from development departments
Inputs	-	Supply of Seed, feed, feed supplements, probiotics, medicines, nets and nets material etc.	Seed assurance and provision from DoF, Private hatcheries, Aqua traders etc.
Technology	Adoption of modern fish culture technologies	Technical advice and service through skilled fisheries professionals	Standardization and dissemination of sustainable technologies by National and international research institutions, Extension services from DoF
Management	Pre stocking & post stocking management such as pond preparation, fertilization, feeding and water quality management etc.	Planning, monitoring, record keeping, growth assessment, solution and suggestions for farming activities	Advisory and consultancy by Government department and fisheries institute
Harvesting	Preparation for harvesting such as nets, crates, ice etc. Harvesting of marketing sized fish	Planning of harvesting as per market rate & demand	-
Cold chain management	Icing immediately after harvest	Ice procurement, Grading, Packing, Chilled transportation and Cold storage	-
Marketing	-	Market research, processing, value addition, selling and business analysis	-

Source: Researcher's experience and focus group discussion.

b. Public private partnership:

PPP is a catch-all term to cover the many forms of collaboration among the private, public and civil sectors in fisheries sector. In most cases, governments look for ways to mobilize finance, skills and experience to secure private investment to support development. Despite this success, investment in fisheries remained low in Vidarbha. PPPs in support of Inland fisheries and aquaculture play an important role in supply chain management and food safety, resource and environmental management, product development and R & D, capacity building, seed dissemination, consulting and business development and financial services. In Vidarbha, there is a lot of scope to improve situation of fish seed and feed availability, reservoir fisheries management using modern technologies such as cage culture, value addition of fish products etc. The seed production through PPP model has been initiated since last five years in Vidarbha. However, during the survey it was observed that the projects to a certain extent are not performing efficiently. In some cases, the production potential is not achieved while in other cases the mandatory fish seed sale was not followed by the firm. The private player largely lacks technical skills and not employing fisheries professionals. The investments are also inadequate to achieve the targets. On the other hand cage culture model of PPP is recently taken up in Vidarbha. The suitable PPP models involving roles and responsibilities of government departments and private player are given as under:

Table 69. Role and responsibilities in PPP model of seed production

Model	Components	Roles and responsibilities	
		Private firm/Agency	Public/Private institution
1	2	3	4
Seed production	Rules and regulation of contracts	<ul style="list-style-type: none"> • Formulation of project report • Compliance of norms and regulation 	<ul style="list-style-type: none"> • Leasing of government fish seed production centers • Approval to new projects • Formulation and restructuring of rules and regulation of model by State Administration • Evaluation of performance of seed production units as per guidelines by DoF
	Credit & finance for projects	<ul style="list-style-type: none"> • Arrangement of capital • Investment in renovation and modernization 	<ul style="list-style-type: none"> • Development banks, • Public finance institutes and • Subsidies from development departments
	Inputs	<ul style="list-style-type: none"> • Procurement & rearing of broodstock • Arrangement of feed, feed supplements, probiotics, medicines, nets and nets material etc. 	<ul style="list-style-type: none"> • Supply of broodstock from Government fish farms and/or by private fish farmers

Model	Components	Roles and responsibilities	
		Private firm/Agency	Public/Private institution
1	2	3	4
Seed production	Technology	<ul style="list-style-type: none"> • Search for modern technologies in seed production • Adoption of technologies as per local demand of fish seed. • Appointment of skilled fisheries professionals 	<ul style="list-style-type: none"> • Standardization and dissemination of sustainable technologies by National and international research institutions • Extension services from DoF
	Management	<ul style="list-style-type: none"> • Maintenance of hatchery units • Planning, monitoring, record keeping • Augmentation of production capacities as per demand 	<ul style="list-style-type: none"> • Advisory and consultancy by Government department and fisheries institute
	Seed production and marketing	<ul style="list-style-type: none"> • Production of adequate quantities of fish seed as per district seed requirement. • Sale of fish seed as per prevalent government rates 	<ul style="list-style-type: none"> • Estimation of seed requirement of a district • Fixing seed selling rates • Distribution of fish seed to fish farms, societies etc.

Source: Researcher's experience and focus group discussion

Table 70. Role and responsibilities in PPP model for cage culture

Model	Components	Roles and responsibilities	
		Private firm/Agency	Public/Private institution
1	2	3	4
Cage culture	Water resources	<ul style="list-style-type: none"> • Proven competence and capability • Compliance of norms and regulation 	<ul style="list-style-type: none"> • Leasing rights in the reservoirs and other such open water bodies • Formulation of rules and regulation of model by State Administration • Site selection
	Credit & finance for projects	<ul style="list-style-type: none"> • Project formulation • Arrangement of capital 	<ul style="list-style-type: none"> • Development banks. • Public finance institutes • Subsidies from development departments
	Inputs	<ul style="list-style-type: none"> • Procurement and installation of cage unit • Arrangement of seed, feed, feed supplements, probiotics, medicines, nets and nets material etc. 	<ul style="list-style-type: none"> • Monitoring the cage installation, prescribed stocking (number and species), certified seed etc. by DoF
	Technology	<ul style="list-style-type: none"> • Adoption of sustainable technologies for cage culture of high yielding, eco-friendly varieties of fish species 	<ul style="list-style-type: none"> • Development of standard technologies by fisheries institutes • Capacity building & dissemination of latest technologies by DoF.

Model	Components	Roles and responsibilities	
		Private firm/Agency	Public/Private institution
1	2	3	4
Cage culture	Management	<ul style="list-style-type: none"> • Maintenance of cage units • Planning, monitoring, record keeping • Augmentation of production capacities as per market demand 	<ul style="list-style-type: none"> • Advisory and consultancy by Government department and fisheries institute.
	Fish production and marketing	<ul style="list-style-type: none"> • Achieving targeted production levels • Identification of potential markets • Harvesting • Preservation and Transportation • Sale involving minimum intermediaries 	<ul style="list-style-type: none"> • Promotion of cage produce fish through extension • Regulation of duties and taxes by administration.

Source: Researcher's experience and focus group discussion

7.5 Small and medium scale industry:

a. Fish feed mill industry:

Fish feeding increases growth and makes farming profitable. Feeds must be nutritious and economical in any farming system and feeding management plays the key role. Effective feed formulations are those which contain adequate levels and balanced proportions of essential nutrients and additives, optimally processed and produced in a form easily acceptable and palatable to the species under culture.

Mostly modified extensive or semi-intensive aquaculture practices are followed for fish and prawn culture, where external feeding is required to achieve higher production level. Feed accounts for around 60% of the total operational expenditure. Therefore fish feed formulation plays an important role in successful aquaculture operation.

At present in Vidarbha region, the fish farming community has started realizing the importance of feeding practice to increase fish production. The key reasons for less adoption of feeding practices are lack of knowledge, high cost, irregular feed supply, non availability of species specific feed, etc. Good, wholesome and cost-effective feed to meet the nutritional requirements at various stages of growth of different fish species and with fish farmers are relying on a crude mixture of rice bran and oil cakes. While these traditional feeds have been useful in extensive and semi-intensive practices, their role in sustainable intensification of aquaculture is limited. In these circumstances, production of formulated feed is necessary to meet the requirements of the aquaculture sector. However, the region does not have fish feed

manufacturing units. The most of the formulated feed comes from private companies operating from outside the state.

Efforts would be required at assessment and collection of agro-by products such as brans and oilcakes, for providing ready access to fish farmers. It is suggested that the small and medium scale fish feed manufacturing units are need to be established in areas within Vidarbha where fish culture activities are concentrated. The small units may undertake formulation and production of farm made aqua feeds. The customized feed mill designs are available at a cost of around Rs. 5 lakh, for producing about 100 kg feed in a day (about eight hours). This would suffice for a cluster of about 10 hectares, without adding much to the overhead costs. On a pilot basis, 20 units could be set up near the respective District Headquarters. On-farm preparation of feed mixture is a common practice in other States that could be propagated with some training in selection of feed ingredients, mixing, formulation and marketing.

The commercial medium and large scale feed manufacturing units are set up by private enterprises in various States such as Chhattisgarh, Andhra Pradesh and Tamilnadu. The daily production capacity of these plants is more than 50-100 tonnes. The manufacturing units of this scale can be set up in industrial areas such as Mihan, Nagpur. The manufacturers having proven capability can be invited to set up feed mill industry in Vidarbha.

Major assumptions and highlights of medium and large scale manufacturing unit:

- Location and land details of the proposed fish facilitation center: State – Maharashtra, District – Nagpur, Area: Mihan, Nagpur; Area required : 5 acres
- Type of feed: Pelleted & floating feed for fish, pelleted feed for prawns.
- Target market: Vidarbha, other parts of Maharashtra, Chhattisgarh, Madhya Pradesh, Telangana.
- Production capacity: 100 tonnes/day (@ 5-9 t/hour for 10 hours per day)
- Working days: 300 days.
- Components and project cost: The major non recurring components includes building, electrification, machinery erection, effluent system and equipments (hammer mill, pulverizer, horizontal feed mixer, flat die pellet mill, packing plastic bag etc.) and recurring component includes raw material, salary and wages. The total project cost would be 692 lakhs.
- Cost of production and sale: Monthly production 1200 tonnes @ Rs 20/kg and tentative selling cost would be @ Rs. 30/kg

- Revenue: The monthly revenue from sale feed is Rs. 360 lakhs.
- Sources of funds: Private entrepreneur with financial support from banks. NFDB's financial assistance for building infrastructure, purchase and installation of machinery and operational cost for first month.

b. Fish processing unit:

The fresh fish and prawn are available at wholesale and daily wet market, but to make available quality whole fish and ready to cook fish/prawn is a major hurdle in marketing of fresh chilled/frozen fish and prawn. Present market trends, consumer preference to new products, quality and hygiene requirements reflects a rapidly growing demand for ready to cook and ready to eat convenience fish product. Hence the rationale is to tap this niche market which presents immense business opportunity. The increased awareness and demand among the consumers about hygienic and quality fish and fishery products, the need for hygienic and quality fish has increased. Presently there are various fish processing industries in Maharashtra, but all are related to marine fishes and shrimps and congregated in coastal areas. Hence, there is need to establish fresh water fish/prawn processing unit involving various activities such as dressing, peeling, freezing, processing and value addition in products.

Major Assumptions and Highlights of unit:

- Location and land details of the proposed fish processing unit: State – Maharashtra, District – Nagpur, Area: Mihaan, Nagpur; Area required : 6 acres
- Type of value added fish products: Fresh chilled and frozen – Whole fish, fish steak, fish fillets, frozen prawns, Peeled and Undeined (PUD), Peeled and Deined (PD) etc.
- Target market: Domestic consumption and up country dispatch, import and export oriented.
- Production Capacity: 20 tonnes/day; Chill room- 20 tonnes; frozen Storage- 200 tonnes.
- Working days: 300 days; Working hours : 24 hrs/day
- Components and project cost: The major components in non recurring heads includes processing hall, packaging area, chilled storage, cold storage, dry storage & other infrastructures. individual quick freezer, horizontal plate freezer, air blast freezer, filleting machine, grading machine, descaling machine, vacuum packaging machine, tray packaging machine, flake ice machine, metal detector, refrigeration system etc.

The recurring components include manpower, raw material, electricity charges, water charges, packaging material etc. The total expected cost of project is Rs. 11,795 lakhs

- Revenue: The daily revenue from sale of product is Rs. 43 lakhs. Therefore, for one year (300 working days) the total revenue would be 12,900 lakhs
- Sources of funds: Private entrepreneur with financial support from banks.

8. Legislation, Act & Policy

8. Legislation, Act & Policy

8.1 Background:

The Constitution of India favors a political structure in which both the power and the responsibilities are appropriately divided among union and state governments, and therefore carries the feature of dual government. This clear demarcation of power to make Rules has been clearly explained under article 246 of India's Constitution. Further state laws mentions fisheries as one of its prime subjects. Therefore, there are various key legislations under state government which deal with the regulation of fisheries and related sectors. Fisheries in the maritime states of India, within the territorial limits of 12 miles, are dealt with under the Marine Fishing Regulation Act (MFRA). These Acts are formulated on the guidelines provided by the model piece of legislation prepared by the Ministry of Agriculture, Government of India in 1979, which was encouraged by the fishers operating unpowered fishing vessels to safeguard their fishing space and equipment from bottom trawlers. Currently, these legislations are not just restricted to the maritime states of the country but are quite widespread in other states as well, for regulating fisheries in inland waters. This development in particular can be seen as a positive initiative by other states that have and will help in taking such welfare measures to a higher level.

The important management measures adopted under the MFRA are prohibition on certain fishing gear, regulation on mesh size, establishment of closed season and areas, demarcation of zones for no trawling, in addition to other measures such as the use of turtle excluder devices and designation of no fishing areas. Other than this, there are specific provisions regarding appointment of adjudicating officers and other officials as per the need and requirement of the Acts, issuing of licenses upon meeting several standards, registration of fishing vessels, regulating the manner of fishing with least threat to the environment, penalties and fines in cases of non-compliance, and maintaining a balance between operators of mechanized boats and traditional fishermen using non-mechanized boats. Such provisions have been set in place to conserve fish and to regulate fishing on a scientific basis, and maintain law and order in the sea and inland waters. The legislations made by different states are quite successful in providing a proper framework for regulating this sector. However, there are still many questions being raised about the implementation of these laws, and this will remain a grey area for quite some time.

As already mentioned elsewhere in the report much of the legislation in Maharashtra Fisheries Act, 1960 and many of the other provisions do not focus on inland fisheries and

riverine sector including biodiversity conservation. The following aspects are important from development of fisheries in inland areas of Vidarbha but are not clearly defined and specified in the earlier legislations.

- Restriction on types of fishing gear and mesh size.
- Restriction on size and sex of the fish and shellfish to be caught.
- Closed season.
- Introduction and regulation of invasive and exotic species.
- Declaration of sanctuaries or protected waters.
- Prohibition on indiscriminate fishing etc.

Fisheries cannot be considered as a simple economic activity, it is an important means of providing livelihood and food security indirectly to many others dependent on this sector. The expansion of inland fisheries through the reservoir leasing, culture in agriculture farm ponds, introduction cage culture and high yielding fish species has high potential for development in this field. Further, associated responsibility of judicious use and protection of natural resources, have made it extremely necessary to enact legislation for regulation of fishing, reservoir fisheries, responsible fisheries in inland water resources. Vidarbha region being an inland region the Acts, Rules and Regulations should be focused on the inland fisheries, inland aquaculture, biodiversity, exotics species introduction, safeguarding the traditional fisher's rights, etc.

8.2 Review of existing Inland fisheries legislation, Act and Policies in India:

The subject of legislating for the protection of freshwater fishes was opened with an inquiry made so long ago as 1869 by Dr. Francis Day of the Madras Medical Services, who had been placed on special duty for that purpose. This was followed by a resolution issued in October, 1871 on Dr. Day's report for the North-Western Provinces, in which he recommended a Fisheries Act. Dr. Day's recommendations as well as the Action taken on proposals made upto 1888 by the various local governments were summarized in a note prepared for the Agricultural Conference held at Delhi in that year. The Government of India enacted the Indian Fisheries Act, which came into being in 1897. The objective of the enactment was to prohibit the use of dynamite and poison in all territorial waters and to make the provisions of the Bengal Private Fisheries Protection Act, 1889. It also empowers each State Government, with the previous sanction of the Central Government, to make Rules and to apply them to any selected streams or other waters which are the property of the State, or to any other streams or other waters with the consent of the persons owning them or interested therein.

This Act also provides suitable penalties for breaches of the proposed law and of the Rules made there under, and it confers on person specially empowered by the State Government, power to arrest without warrant for offences against such law or rules. This Act shall be read as supplemental to any other enactment for the time being in force relating to fisheries in the territories to which this Act extends. This is a small piece of legislation containing only seven sections. Section I deals with the extent of the Act, while Section 2 provides that Act is a supplement to other fisheries laws. Section 3 is a defining section which defines the expressions "fish", "fixed engines" and "private water". Section 4 provides for destruction of fish by explosives in inland waters and on coasts and Section 5 deals with destruction of fish by poisoning of waters. Section 6 provides protection of fish in selected waters by Rules of State Government, whereas Section 7 is a penal provision providing for arrest without warrant for offences under this Act.

There is a general impression that the Indian Fisheries Act, 1897 is an inland fisheries Act. The Act, of course, appears to be concerned only with inland fisheries, because the Act provides that the word "water" which includes the sea within distance of one marine league (3 nautical miles or 5.56 km) from the sea coast also (Explanation No. 4(2) of the Act).

Erstwhile Punjab (before partition) was perhaps the first state to introduce legislation for conservation of fisheries. The Punjab Fisheries Act II of 1914 was passed, and later amended and revised from time to time in 1941, 1966 and 1971. For regulating fisheries in canals, separate Rules were framed and notified by the Punjab Government in 1924 in the form of Rules for regulatory fishing in Government canals and Rules for regulating in head waters. States of Himachal Pradesh, Haryana and the Union Territory of Delhi also follow more or less Punjab Rules. The fishing rights of the notified public waters are put to open auction on or after 1st July every year and the period of lease extends from 1st September to 21st August of the next year. Some states like West Bengal, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Karnataka, Kerala, Tamil Nadu, and Jammu and Kashmir have some Rules for fisheries regulation. Many states in the North-East region have no fisheries legislation. Rajasthan enacted fisheries legislation in 1984. Some states like West Bengal, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh and Kerala have some Rules for the regulation of fisheries. (Source: Handbook of Fisheries and Aquaculture, ICAR New Delhi. 2006, pp 982-983).

The review of the fisheries legislation, Act and policies in different states reveals that Indian Fisheries Act, 1897 is used as the basic guideline for formation of the Legislation, Act and Policies by various states. The various legislation, Act and policies adopted for development of inland fisheries and aquaculture are discussed below.

Restriction on types of gear and mesh:

There is necessity to restrict the type of gear (i.e. Nets) and mesh size of the nets in order to avoid capture of small sized fishes, breeding fishes, destructive fishing methods etc to ensure sustainable harvest of fishes. Hence restrictions are imposed on types of gears and their mesh size.

Review of policies reveals that the minimum mesh size for nets permitted is 30 mm so that smaller fish are not caught. However, exception on allowing smaller mesh nets for use in the marginal areas as in Talaiya (Damodar Valley Corporation) and some reservoirs of Andhra Pradesh and Tamil Nadu also exist. In Delhi, since 1948 restriction have been imposed on fishing except with rod and line, hand line and long line or any other net more than 1.5 inch square mesh from July 1 to August 30, every year. Mesh regulation is also observed in Manipur, Andaman and Nicobar Islands. In Assam, the sizes of gaps in bamboo fencing used for fishing have been limited. Mesh Regulations are observed in many places such as Manipur, and Andaman and Nicobar Islands. Nets having a minimum mesh size of one inch are generally permitted for fishing in the reservoirs. (Datta, S., 2014)

Restriction have been imposed on the use of certain nets during specified parts of the year, as well as on the mesh sizes of nets in Assam, Maharashtra, M.P., Punjab etc. From 1st April to 5th June drag net of having mesh size of 2.2 inch are not allowed in any water body of Assam. (Datta, S., 2014). The use of explosives and poisonous substances for the capture of fish is prohibited in many states like Jammu and Kashmir, Himachal Pradesh, Andhra Pradesh, Karnataka, Uttar Pradesh and Kerala.

It is observed that clear cut definitions and guidelines are lacking in many of the legislative documents.

Restriction on size and sex of the fish and shellfish to be caught:

Every living organism has to be given at least one chance to breed in its lifetime so that the population perpetuates. Hence the minimum size of fish to be captured is determined for each fish considering the length and or weight after it attains maturity and breeds for the first time. Size and sex selectivity measures attempt to control the size and sex of fish that are caught and landed. Size selective gear restrictions, such as minimum mesh size, affect the minimum size at which fish are caught; and minimum fish size measures set the minimum size of fish that can be legally retained or landed if caught. Minimum size limits on retained or landed fish are particularly useful in the case of species, which can be returned to the water alive (e.g. prawn and crabs) although they are also used for finfish.

Many states have prohibited the catching of economical fishes having average size below 25 cm so that every fish get a chance to breed at least once in its lifetime. Restrictions are also imposed on the sale of undersized fishes. In 1956, Punjab state Government prohibited catching of rohu, catla, mahseer and mrigal smaller than 25.4 cm long. In Delhi, the capture and sale of these species below 20.4 cm in length has been prohibited since 1948. From 1953, in Madhya Pradesh, fishing of rohu, mrigal, catla and mahseer of less than 22.9 cm length are prohibited.

The State of Uttar Pradesh has put a ban on the capture and sale of juveniles (5.1 to 23.4 cm in length) from 15th July to 30th September and of spawn from 15th June to 31st July from the prohibited areas, except under a license issued by the proper authority. (Datta, S., 2014)

Himachal Pradesh Fishing Rule has enhanced the catchable size of golden mahseer from 300 mm to 500 mm (1.2 kg) giving the opportunity to each female to breed at least once before being caught. Since the incorporation of this clause in the Fisheries Act during 1998, the average size of mahseer has increased from 1.2 kg to 1.7 kg in Pong Dam and 0.6 kg to 0.9 kg in Govindsagar Reservoir. (Himachal Pradesh Fisheries Rules, 1979)

The legislation does not mention the restriction on capture of berried females of shellfish like prawn and crabs carrying eggs.

Closed season:

Closed season prohibit fishing in an area during a specific time interval. Time and area closures are often applied to protect resource stocks when and where they are particularly vulnerable, are of poor quality for market, and / or to prevent young fish from being captured too soon. Closed areas can effectively set minimum sizes where juveniles and adults live in different areas in a fishery. Closed seasons also can set minimum sizes for fast growing species with a short period of recruitment.

In Jammu & Kashmir, prohibition has been imposed on the extraction of Hakreza, water nuts, aquatic plants and gravel or stones during the spawning season of fish in reserved and protected waters from November to February except with the permission of authorities concerned.

Closed season is followed in Bihar, Madras, Jammu and Kashmir, Himachal Pradesh, Chhattisgarh, Madhya Pradesh. In all large reservoirs, fishery is closed from June-July to end of September so that fishes are not hampered during their spawning migrations and allowed to breed, at least, once. Fishing is closed from 1st July to 15th September in the entire state of Rajasthan. (Source: GR of respective State Government)

As all the available fish species in our natural water bodies (rivers and reservoirs) breed naturally and hatchery technology is not available for majority of the species the no fishing should be allowed during breeding migration of fish species (locally called Chadan) in the rainy season. Wherein, mass scale destruction of brooders of all species takes place. Such kind of regulation is formed in the states of Chhattisgarh and Rajasthan. (Source: GR & notification of Government of Chattisgarh and Rajasthan)

Introduction and regulation of invasive and exotic species

The fish species that are growing in a non-native environment as they have been moved by humans to areas outside of their native ranges are known as exotic species. These species do not have natural predators, diseases causing agents, etc in the introduced area and thus no natural control agents on their spread. Such species may be beneficial or harmful to the area where they are introduced. If they become harmful for the diversity and ecosystem of the introduced area they are termed as invasive species. An invasive species have capability to spreads rapidly and can harm the environment, the economy, or even human health.

The government of Assam, Chattisgarh has notified that *Clarias garipinus* (exotic magur) and *Hypophthalmichthys nobils* (big head carp) as “prohibited fishes” for the purpose of breeding, culture, import, export, sale transport and trade in the state.

The government of Andhra Pradesh impose ban on culture, seed production, racketing, transport, maintaining stocks (live or dead) of the exotic catfish (*Clarius garipinus*) in order to strengthen the officers on the field to destroy the existing stock and to control the import from other state.

The government of Karnataka on same line have imposed ban on *Clarias garipinus*, *Hypophthalmichthys nobils* (Big head carp) and *Piaractus brachypomus* (Pacu).

It is to mention here that all the banned species in the other states are freely cultured and traded in the Vidarbha region of Maharashtra and elsewhere in Maharashtra state. During the surveys carried by MAFSU faculty it was learned that the banned species have gained access to the natural water bodies (rivers and reservoirs). Further, the culture of some exotic species is restricted to pond based aquaculture and cage culture in view of the impacts on the biodiversity and ecosystem. The guidelines, which are issued by NFDB, Hyderabad and other advisory bodies but largely unfollowed in Vidarbha.

Declaration of sanctuaries or protected waters:

Declaration of certain Protected Areas/Biosphere Reserves for in situ conservation of resources appears to be the pragmatic approach aiming at conserving the fish germplasm by restoration management, regulation of gene flow in and out of the aquatic sanctuary and compensatory development of essential habitat values that contribute in preservation of fish germplasm resources.

In Himachal Pradesh, where the landing of prized mahseer fish is declining fast, the State Government has declared sanctuaries in Sidhpur and Machial (Mandi district), Renuka Lake (Sirmaur district), Baijnath and Chandra Tal (Kangra district) for protection of mahseer. There exist about 29 fish sanctuaries in the Himalayan regions (Jammu & Kashmir, Himachal Pradesh and Assam).

Some river stretches throughout the country are also protected due to religious sentiments as they are located vicinity to holy places and shrines (temples). Rishikesh, Har-ki-Pauri (Hardwar), Baijnath (Almora), Pushkar Lake (Ajmer), Sardamath (Shringeri) and Bichaligudda/Tirthahali (Tunga river in Karnataka) are some examples of religiously protected areas.

About 3.2 Km of river stretches below the dams Mettur, Tungabhadra (Karnataka) and Gandhisagar (M.P.) have been declared as sanctuaries. In Tamil Nadu fishing is prohibited in rivers Cauvery, Harangi, Sampaja and Barapole and their tributaries during the period march 15 to 1st June. In Haryana, conservation and developmental measures have been adopted in the portions of Uhi river and Lambadug and their tributaries situated in the Mandi district, Pabar river (Rohru upstream) and Bapsa river situated in the district of Mahasu.

Sanctuaries have been declared in Assam, Bihar (river son above and below the Anicut at Dehri and Barun of the Shahabad and Gaya district) and Punjab (specified waters of Gurdashpur, Hosiarpur and Ambala districts and near the specified bridges). Delhi, Uttar Pradesh, Madhya Pradesh, Tamil Nadu and Andhra Pradesh also observe restrictions on fishing in prohibited waters.

In Vidarbha, regulation on fishing in sanctuaries is not in existence. However, the existing Maharashtra Fisheries Act empowers the State Government to enact Rules for protection of fish in selected waters and to “prohibit or regulate the construction of temporary or permanent weirs, dams and bunds”. There are many existing wild life sanctuaries in Vidarbha but there is no provision and restriction on introduction of fishes and their capture

hence knowingly or unknowingly non-native fishes are being stocked and harvested in waterbodies in some of the sanctuaries.

Prohibition on indiscriminate fishing:

In Madhya Pradesh, Kerala, Maharashtra, Haryana, Punjab and in Delhi fishing by means of fixed engine or construction of weirs is prohibited. Ban on the use of explosives or poisonous substances is in effect in various states such as Uttar Pradesh (U.P.) (in 1948), Andhra Pradesh (A. P.) (formerly Hyderabad, in 1956), Kerala (formerly Travancore-Cochin, in 1950), Jammu & Kashmir (J & K) (in 1903), Karnataka (1931), Rajasthan (in 1953), Kerala (in 1950), Himachal Pradesh (formerly Bilaspur, in 1951), Delhi (1948). Also, Coorg (formerly Madras, in 1903) banned the use of poisons and explosives for fishing.

Besides these, now some Rules are enacted regarding prawn farming by Tamil Nadu government to monitor the aquatic pollution from all industries including aquaculture. Also Government of Tamil Nadu has constituted monitoring committee at district level with collector as Chairman of the monitoring committee and the members of the committee are from various department viz. Agriculture, Forest, Public Work Department, Fisheries and Pollution Control Board.

Much of these Regulations also exist in Maharashtra Fisheries Act but their relevance with inland fisheries sector is limited. There needs to be an inter-departmental committee for monitoring, control and implementation of such Regulations.

Additional legislation, Act and policies related to Inland fisheries in Vidarbha and Maharashtra needs focus on the following aspects:

- **Pollution:** In Maharashtra the pollution of water bodies comes under the purview of the Maharashtra Prevention of Water Pollution Act, 1969. Mass mortality of fishes due to domestic sewage and industrial waste release in rivers and reservoirs etc. is commonly observed in Vidarbha region. There have been several instances in the past where mass mortality of fishes was recorded due to release of stored industrial wastes at the onset of monsoon in river and reservoir water. However, in Maharashtra Fisheries Act the State Government is empowered to make Rules to regulate or prohibit any discharge of solid or liquid material deleterious to fishes as long as it does not affect the powers of local bodies to discharge sewage water.
- **Fishing Rights:** In Maharashtra state the fishing right in reservoirs are vested with department of fisheries and subsequently transferred to the leasee cooperative society and same is being followed in Vidarbha region. In Maharashtra, riverine fishing

rights are in existence in the districts of Sangli, Kolhapur and Nanded on Krishna, Warna, Panchaganga, Dudhaganga, Bhogawati and Godavari rivers respectively to the local fishermen. There is no such provision of river fishing rights in Vidarbha region. Further it is essential to issue biometric identity cards to all inland fishermen (riverine and reservoir fishermen separately) through the State Fisheries Department.

- **Leasing of waterbodies:** In the existing Rules and Regulations of leasing, the waterbodies are leased for fixed tenure and continuously leased after the completion of tenure. In Madhya Pradesh, lakes and reservoirs are leased every alternate year to protect the fish stock. Such kind of Regulations should be incorporated in the current leasing Regulations.
- **Fish breeding, seed production and marketing:** The fisher folk and fish farmers of Vidarbha are being duped by the private fish seed suppliers by selling adulterated seed, small sized seed, unwanted species seed, exotic species seed etc. Hence there is need to regulate the seed production and marketing of the fish seed.

The Government of Assam has introduced a policy on 'Fish Seed Industry' in the state in 2001 to augment quality fish seed production for advancement of aquaculture in the state and to protect the bio-diversity of economically important indigenous fish species of Assam in the natural ecosystem by adoption of adequate conservation measures. In order to translate these aims and objectives into Action, the State Government has proposed establishment of eco-hatcheries, standard size of broodstock, partial replacement of broodstock with wild stock, prohibition of breeding and propagation of banned exotic fishes, registration of fish seed producers and growers and easy and unrestricted transport of fish seed in the state.

In view of this a fish seed industry policy should be framed for Maharashtra so that fish breeding, seed production and marketing should be brought under licensing system including ornamental fish industry.

9. Recommendations and Conclusion

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The Vidarbha has total 30,650 number of waterbodies with 1,87,249 ha water spread area out of which 28,625 are seasonal (1,01,410 ha) and 2,025 are perennial (85,839 ha) water bodies. The different types of waterbodies suitable for aquaculture operation are abandoned quarries (622 ha); aquaculture ponds (93 ha) and farm ponds (1,810 ha) which are basically seasonal waterbodies. Similarly, there are water bodies in the form of lakes and ponds (60,418 ha), reservoirs (1,16,292 ha) and tanks (7,925 ha) which are perennial.

The total inland fish production of the Vidarbha during 2015-16 was 68,330 tonnes which comes mainly from reservoirs, village ponds, tanks, Malguzari talav etc. The fish culture in ponds is being practiced in community tanks, village ponds, farm ponds, or privately owned ponds. The average fish production from these culture practices is very meager as compared to the national average of 2.9 tonnes/ha/year. This production can be increased to the tune of 4-5 tonnes/ha/year by adopting improved aquaculture farming practices. Further, it has been established that fish yield from reservoir fisheries in Vidarbha is poor as that of Maharashtra, varying from 21 kg/ha/year, 12 kg/ha/year and 9 kg/ha/year for small, medium and large reservoir where as the estimated production potential of small, medium and large reservoir is 500, 250 and 100 kg/ha/year respectively, thus there is huge gap between actual production and potential from reservoirs of Vidarbha.

The adoption of suggested culture technologies as per the type of waterbody in Vidarbha region could fetch the annual fish production to the tune of 1.41 lakh tones. The inland fisheries sector of Vidarbha faces many challenges which need to be addressed in near future. The major thrust areas which shall be focused for the development of Inland fisheries sector are listed below:

- Development of sustainable inland fisheries and aquaculture in available water resource
- Strengthening and capacity building of DoF and other stakeholders
- Strengthening of fish seed production and rearing centres
- Sustainable development of reservoir fisheries
- Development of riverine fisheries
- Sustainable intensification of aquaculture
- Development of fish markets and marketing in Vidarbha
- Disaster management and welfare concerns.

Major Recommendation:

9.1 Fisheries database, monitoring and cross sectoral issues:

- Creation of an institutional mechanism for building a comprehensive database on resources and actual production shall be taken up immediately. A dedicated, fully equipped and accountable central unit with effective field level linkages and mechanism need to be established at offices of Regional Deputy, Commissioner of Fisheries. The publication of regional level Year Book on “Fisheries and Aquaculture Statistics” shall be mandatory to DoF.
- There is an urgent need for establishing a Regional Co-ordination Committee (RCC) involving members from other departments such as water resources, power, environment and forest, rural development, NABARD and other lead banks, fisheries research and education institutions and few experts of repute to provide cross-sectoral coordination support, overview progress and guide future course of development. Among other emerging issues the RCC will also address inter-sectoral differences related to resource use, promote environmental protection and rehabilitation programme, facilitate pollution reduction, bring convergence between the programme and projects of various sectors and improve research & development linkage.

9.2 Department of Fisheries and services:

- Filling up of all the vacant technical positions in Vidarbha on priority basis.
- Creation of additional positions in the DoF at district level for establishing dedicated, professional and efficient extension services system at par with their counterparts in Agriculture and allied sub-sectors like Animal Husbandry, Horticulture, Dairy, etc.
- The extension services system shall have its network reaching at Block and Panchayat levels to bring all aquaculture and fisheries resources, public, private, community and multi-owned under its fold.
- Conducting comprehensive training need assessment (TNA) and organizing quality training for field staff on technical, statistical, social and environmental aspects of fisheries and aquaculture.
- Organize demonstration on sustainable fisheries management in collaboration with COFS, Nagpur, CIFA, Bhubaneshwar, CIFRI, Barrackpore and other ICAR institutes.
- Comprehensive evaluation and impact assessment of welfare and other schemes should be conducted after every five years to make necessary revisions in the scheme.

- **Seed production and rearing centres:**

- Review of existing fish seed production and rearing centres for their strengthening and capacity development is must.
- Developing dysfunctional and under-performing fish production centres operational to their fullest capacity.
- The Fish seed production centres under the MFDC shall be withdrawn and handed over to DoF for development.
- Preparation of policy for long-term agreement with Water Resource Department for round the year supply of water to the centres.
- Effective monitoring and technical support to leased out fish seed production centres.
- The leased agreement shall include appointment of Bachelor of Fisheries Science (B.F.Sc.) personnel, adherence of mandatory guidelines regarding seed production and culture of monosex tilapia and pangasius species for PPP operated centres.
- Encouraging installation of portable carp hatcheries in each district at cluster level with technical support from COFS, Nagpur & CIFA, Bhubaneshwar and funding support from NFDB.
- The production capacity of the existing 13 fish seed production centres of the State Government in Vidarbha shall be enhanced. In addition 05 new hatchery centres with 100% assistance from NFDB are contemplated to be established in the Government sector with an additional installed capacity of 100 million spawn/ hatchery with rearing space.
- To cope up with the rising demand of fingerlings it is proposed to encourage setting up of 8 new private fish seed production & rearing centres with capacity of 50 million spawn. The rural unemployed youth, fisheries cooperatives and the SHGs will be motivated to take advantages of the scheme under NFDB to establish fish seed hatchery projects with matching contribution of Government subsidy prescribed under the programmes.
- There is an urgent need to take up brood stock management and upgradation programme to avoid inbreeding and poor seed quality through use of advanced technology like cryopreservation of sperm. The facilities in this regard shall be developed by DoF at Fish Seed Production Centres.

- Fish Seed Industry Policy including ornamental fish should be framed for Maharashtra for bringing the aspects of fish breeding, seed production and marketing under Certification and Licensing System.

9.3 Fisheries co-operative sector:

- Inland fisheries shall be treated at par with Agriculture sector in the context of taxes, electricity tariff, water charges and distress relief during natural calamities like drought and flood etc.
- Scientific and rational criteria shall be followed for fixing lease period and lease amount for different water resources by leasing authority.
- Revision of existing water usage policy with respect to minimum water level in the water bodies for fisheries use.
- The lease period of water bodies under Panchayats Extension to Scheduled Areas (PESA), Act shall be extended as per fisheries management system.
- The extension of credit facilities/bank finances to cooperative sector from private and nationalized banks, NABARD, NCDC etc.
- The loan interest rates for fisheries shall be modified at par with agriculture and allied sector.
- Immediate steps shall be taken to enhance management skills of executives of cooperative societies to improve professionalism and business performance of societies.
- The State policy for relief to fishers in case of natural calamity needs to be formulated on urgent basis.
- Training need assessment of fishers by Skill Development Department and organization of capacity building programmes on fish seed production, on-site feed production, fish farming and other fish based enterprises.
- The Pramod Mahajan Kaushalya Vikas and Udyojakata abhiyan of government of Maharashtra should include Skill Development programmes in fisheries.

9.4 Sustainable development of reservoir fisheries:

- The reservoir leasing policy needs revision to certain extent to bring more clarity in the existing system and to reduce sectorial problems such as lease charges, social conflicts and legal battles etc.

- The cooperative societies should have their own seed rearing ponds near waterbodies for fingerling stocking. The DoF should formulate new policy and guidelines in this regard.
- Small reservoirs (0- 60 ha water spread area) are suitable to be developed for aquaculture practices. The reservoirs with 60 - 1000 ha water spread area should be managed for culture based capture fisheries of indigenous fish & prawn species and reservoirs with 1000 – 5000 ha & above water spread area should be developed for stock enhancement based fisheries of indigenous fish and prawn species.
- The recommended fish species for stocking in reservoirs are the Indian Major Carps such as *Catla catla* (Catla), *Labeo rohita* (Rohu), *Cirrhinus mrigala* (Mrigal) and indigenous prawns.
- In categories of small and medium reservoirs, a regular seed stocking programme should be adopted. The large reservoirs would require supplementary stocking until a critical mass of breeding population is established. This approach is also useful for medium reservoirs where auto-stocking is taking place.
- The stocking decision will be based on the size of the reservoir, water holding capacity, depth, natural productivity as well as its inherent fisheries. The NFDB and DoF guidelines of standard stocking rate of fingerlings should be followed.
- The exotic fish species such as tilapia, pangasius, grass carp, thai magur, big head carp, common carps etc. shall be prohibited from stocking in the reservoir. Whereas, the certified seed of fish species such as monosex or GIFT tilapia, pangasius may be stocked exclusively in the impounded ponds and cages installed in the reservoirs.
- The societies and private entities shall be made aware of responsible fisheries management of reservoir so as to ensure effective conservation and management of the resource.
- Policy reforms are also essential for development of reservoir fisheries through installation of cage culture units with due care of environmental integrity and social equity.
- Though the cage culture in reservoirs of Vidarbha is demonstrated by MFDC on smaller scale, the result of the cage culture units installed and operated by MFDC were not encouraging. Presently, these units are leased out to private entities through PPP model. There is an urgent need to demonstrate ideal cage culture practice by involving technical advisors from organizations of repute like NFDB, CIFRI, CIFE etc. to overcome previous shortfalls. It is recommended that it should be made

mandatory for private entrepreneurs to hire services of qualified technical fisheries professionals.

9.5 Development of riverine fisheries:

- Empowerment of riverine fishing communities through mobilization and facilitating their organization in potential enterprises.
- Formation of riverine fisheries cooperative societies for upliftment of traditional fishermen.
- Allocation of fishing rights to traditional riverine fishermen.
- Mainstreaming sustainability, environment and biodiversity concerns by creating awareness.
- Introduction and promotion of fisheries co-management regime with fishing communities and their organization as partner in the management of riverine fisheries resources.
- Community based participatory plan for river ranching with technical support of CIFRI and National Bureau of Fish Genetic Resources (NBFGR).
- Participatory appraisal of riverine ecosystems and identification of appropriate sites for restoration.
- Participatory planning and implementation of conservation / protection and habitat restoration measures including demarcation and declaration of protected areas such as deeper pools, breeding ground, etc., as sanctuary and their management
- It is recommended to issue biometric identity cards to all inland fishermen (riverine and reservoir fishermen separately) through the State Fisheries Department

9.6 Sustainable intensification of aquaculture:

- All abandoned quarries with water, aquaculture ponds, farm ponds, seasonal village ponds and community ponds should be brought under scientific aquaculture practices. The special drive on the lines of ‘Talav Tethe Masoli’ shall be launched by DoF with technical support from MAFSU, Nagpur.
- Enhancing availability of quality fingerlings to meet the need of industry through fish seed rearing in abandoned quarries with water, farm ponds etc.
- The monitoring and quality inspection mechanism for seed imported from neighbouring states shall be developed by DoF at regional level.
- Policy for fish seed quality certification system needs introduction in the State.

- There is urgent need to diversify aquaculture practices to make the industry ever-growing and vibrant by popularizing culture of pangasius species, monosex Tilapia, native catfishes (Magur and Singhi) and giant freshwater prawn (*Macrobrachium* sp) etc.
- To augment fish productivity to the level of 6 tonnes/ha/year the quality feed would be a major input. Developing strategies for rigorous training of on-farm preparation of feed covering selection of feed ingredients, mixing, formulation and marketing needs priority.
- Setting of 20 units of customized feed mill designs with production capacity of about 100 kg feed in a day (about eight hours) at District headquarters on a pilot basis with subsidy support from NFDB.
- Establishment of commercial small and medium scale feed manufacturing units with daily production capacity of 50-100 tonnes under PPP model with financial support from NFDB.

9.7 Development of fish markets and marketing in Vidarbha:

- To minimized involvement of marketing intermediaries by evolving a cooperative fish marketing system with proper price monitoring mechanism.
- Fish is notified commodity under the Model Act circulated by union government “The State/UT Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017”. The APMC Act of the state shall follow the same and promote marketing of fish on the lines of APMC.
- The fishermen/producers do not have storage facilities to store fish or refrigerated vans to transport their produce. Like agricultural products fish and fishery products should have a minimum support price (MSP).
- Fish Market Price Information System shall be developed at the district level by DoF for providing information on fluctuating prices to fishermen.
- Capacity building of fish producers through training on scientific harvesting, handling of fish, icing and smoking shall be given due attention. The technical support in this regard can be given by CIFE, Mumbai; COFS, Nagpur and COF, Ratnagiri.
- Training and demonstration on maintaining food safety and quality standards for market intermediaries – packers, transporters, wholesalers, retailers, etc.
- Developing fish market with infrastructure facilities like water, storage facility and ice crushing units at weekly markets and whole sale markets through the financial support

from NFDB, NABARD etc. There is an urgent need to develop harvesting & post harvest infrastructure at water bodies such as platforms for grading, weighing facility, ice storage facility, etc.

- The state fisheries departments and state fish development corporation should formulate schemes to help fish farmers to market their harvest efficiently.
- The NFDB, Hyderabad promoted scheme for developing of hygienic and sanitary conditions in model fish markets need to be implemented in major fish markets of Vidarbha to reduce post-harvest losses and enhancing revenue.
- Establishing fish landing centres at places of bulk fish landings near reservoirs, lakes, etc.
- Installation of ice plants of capacity 20 tonnes per day at strategic locations in Vidarbha in private sector.
- Creating network of high quality retail markets (kiosks) and forming backward linkage with fish farmers.
- Promotion of fish processing and product diversification by designing and establishing atleast one fish processing unit under PPP model.
- Development of a range of value added fish products from freshwater fishes produced in the region and their promotion for Geographical Indications.
- Promotional campaign for marketing inside and outside the state of the fish and fishery products of Vidarbha shall be assigned to MFDC.

9.8 Legislations, Acts and Policy:

In view of the existing inland fisheries legislations, Act & Policies adopted and followed in various states of India, it is necessary to have better legislation, Act and policies for sustainable utilization of resources, management and control on fishing activities etc. in the State of Maharashtra. A separate Inland Fisheries and Aquaculture Act for the Maharashtra State should be enacted having background of the Indian Fisheries Act, 1897 and the Maharashtra Fisheries Act, 1960. Such Act would cover all the conservation and management aspects of the inland fisheries of Vidarbha.

- The proposed Maharashtra Inland Fisheries and Aquaculture Act shall have clear definitions of traditional inland fishermen, fish farmer, fish seller, fishing gear, fishing seasons, fish seed etc.
- The Act shall have provision for fish producers and fishermen's right to maintain minimum water levels in the waterbodies for fisheries management.

- The present water usage policy should be amended with enlarged scope that clearly recognizes the right of fish culturists to minimal water levels in their ponds and tanks.
- The Act shall laid emphasis on conservation and management of fisheries resources and fish biodiversity in downstream of reservoirs and other irrigation projects.
- Livelihood of the landless riverine fishermen displaced by the old and newly constructed irrigation projects shall be addressed through making special provisions in the Maharashtra Project Affected Persons Rehabilitation Act, 1999 by suitable amendments.
- The proposed Maharashtra Inland Fisheries and Aquaculture Act shall define strict fishing regulations on closed season during monsoon breeding migration of fishes, minimum mesh size of inland fishing gears, preventing use of destructive gears, wanton killing of juveniles and destructive fishing, etc. in rivers and reservoirs of the State.
- Stock enhancement of valuable native fish species by river ranching should be given priority in the Act.
- Unauthorized introduction of non-native, unwanted food fish and shellfishes for culture, ornamental fisheries, sport fishing and other uses shall be prohibited through provisions in the Act.
- Measures should be undertaken for control/eradication of invasive alien fish species from ecologically sensitive rivers, reservoirs and wetlands.
- Sale and culture of awful exotic food fish and ornamental fish species such as thai magur, big head carp, pacu, alligator fish, sucker fish etc. should be prohibited under the Act and the provision of penalty, prosecution and imprisonment of the persons involved shall be made into the Act.
- The Act shall include required permissions and conditions for farm registration required from state government for the culture of exotic fish species. The monitoring of such culture activities and the strict compliance to the guidelines under Act shall be entrusted to DoF.
- Instituting cadre based service with clearly defined roles and responsibilities of State Fisheries Development Officer specifically for development of inland fisheries.
- The supervisory role of DoF in case of fisheries in water bodies with Zilla Parishad, revenue and forest department shall be changed to mandatory role as Development Agency.

- The provisions shall be made into the Act regarding deliberate fish poisoning, indiscriminate fishing, size of the fish caught, fishing in protected waters and sanctuaries in inland water bodies and rivers.
- The proposed Maharashtra Inland Fisheries and Aquaculture Act should offer protection to riverine fisheries and conservation of fish & shellfishes thereof.

10. Annexures

10. Annexures

Annexure I: Questionnaire on district-wise details of Department of Fisheries

Sr. No.	Details	
1	2	
1	Address & contact details of District office	:
2	Total water spread Area (ha)	:
3	Total Water spread for Fisheries activity (ha)	:
4	Total length of Rivers (km), Number & Names of Rivers	: Total length : Number : Names :
5	Water spread area (ha) & Number of irrigation dams	: Below 200 ha. Area : Number : Above 200 ha. Area : Number :
6	Water spread area (ha) & Number of Minor irrigation tanks under Zilha parishad	: Area : Number :
7	Water spread area (ha) & Number of Nagarpalika talav	: Area : Number :
8	Water spread area (ha) & Number of Grampanchayat talav	: Area : Number :
9	Water spread area (ha) & Number of Maji Malguzari/Mama talav	: Area : Number :
10	Water spread area (ha) & Number of forest ponds and tanks under PESA	: Area : Number :
11	Water spread area (ha) & Number of Private ponds and tanks	: Area : Number :
12	Water spread area (ha) & Number of Farm ponds	: Area : Number :
13	Water spread area (ha) & Number of ponds of fish farmers	: Area : Number :
14	Most recently updated fishermen population	: Year : Number in lakh :
15	Fisheries Co-operative Society	: Number : Members : No. of active societies : No. of In-active societies : No. of deferred societies :

Sr. No.	Details		
1	2		
16	Fish seed Production Center	:	Number :
			Capacity (Spawn in lakh) :
			Actual production (in lakh) :
17	Fish seed rearing center	:	Number :
			Capacity (Spawn/Fry/Fingerling in lakh) :
			Actual production (in lakh) :
18	Actual fish production (mt) from Sr. No. 4 to 13	:	

Name of Officer : _____

Designation of Officer: _____

Signature with date : _____

Annexure II: List of stakeholders

- State Fisheries Department and other allied departments
- Fishermen / fish farmers
- Members of Primary Fishermen Co-operatives Societies
- Executive Members of District Fisheries Federations
- Fish wholesalers, retailers and vendors
- Self-employed Persons/Entrepreneurs/ Industry people
- Technical persons working in the field of fisheries
- State & Central Government Organizations
- Field technicians

Annexure III: Quantitative data on block wise distribution of seasonal and perennial water bodies in 11 districts of Vidarbha region

Details of district and blocks			Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
District Name	Taluka Name	Waterbody Type	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Akola	Akola	Abandoned quarry with water	12	19	12	19	-	-
		Farm Pond	627	89	627	89	-	-
		Lakes/Pond	57	269	53	202	4	67
		Reservoir	1	243	0	195	1	49
		Tank	17	8	17	8	-	-
	Akot	Farm Pond	411	61	411	61	-	-
		Lakes/Pond	30	256	23	146	7	110
		Reservoir	1	107	0	55	1	53
		Tank	12	7	12	7	-	-
	Balapur	Farm Pond	335	56	335	56	-	-
		Lakes/Pond	8	75	7	42	1	33
		Reservoir	1	222	0	37	1	186
		Tank	30	10	30	10	-	-
	Barshitakli	Abandoned quarry with water	11	21	11	21	-	-
		Farm Pond	78	10	78	10	-	-
		Lakes/Pond	73	515	65	423	8	92
		Reservoir	4	1609	0	1034	4	575
		Tank	19	26	18	16	1	10
	Murtijapur	Abandoned quarry with water	11	14	11	14	-	-
		Farm Pond	617	73	617	73	-	-
		Lakes/Pond	27	159	25	138	2	22
		Reservoir	3	640	0	471	3	169
		Tank	5	1	5	1	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Akola	Patur	Farm Pond	27	4	27	4	-	-
		Lakes/Pond	24	207	21	163	3	45
		Reservoir	3	994	1	764	2	230
		Tank	11	65	11	65	-	-
	Telhara	Farm Pond	349	51	349	51	-	-
		Lakes/Pond	7	16	7	16	-	-
		Tank	18	7	18	7	-	-
TOTAL			2829	5836	2791	4198	38	1638
Amravati	Achalpur	Farm Pond	81	9	81	9	-	-
		Lakes/Pond	48	250	44	186	4	63
		Tank	1	0	1	0	-	-
	Amravati	Abandoned quarry with water	27	37	27	37	-	-
		Farm Pond	79	10	79	10	-	-
		Lakes/Pond	59	602	52	489	7	113
		Reservoir	1	95	0	72	1	24
		Tank	7	12	7	12	-	-
		Anjangaon Surji	Farm Pond	110	12	110	12	-
	Tank		1	10	1	10	-	-
	Bhatkuli	Farm Pond	221	26	221	26	-	-
		Lakes/Pond	19	90	19	90	-	-
		Tank	2	1	2	1	-	-
	Chandur Railway	Abandoned quarry with water	1	2	1	2	-	-
		Farm Pond	70	6	70	6	-	-
		Lakes/Pond	40	391	36	322	4	69
		Reservoir	1	267	0	114	1	153
		Tank	9	3	9	3	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Amravati	Chandurbazar	Abandoned quarry with water	3	7	3	7	-	-
		Farm Pond	89	13	89	13	-	-
		Lakes/Pond	30	101	28	86	2	15
		Reservoir	2	442	0	129	2	313
		Tank	2	10	1	3	1	7
	Chikhaldara	Farm Pond	15	1	15	1	-	-
		Lakes/Pond	180	389	173	349	7	41
		Reservoir	3	851	0	372	3	479
		Tank	21	86	19	82	2	4
	Daryapur	Farm Pond	379	45	379	45	-	-
		Lakes/Pond	14	20	14	20	-	-
		Tank	7	6	7	6	-	-
	Dhamangaon Railway	Abandoned quarry with water	9	8	9	8	-	-
		Farm Pond	88	13	88	13	-	-
		Lakes/Pond	13	45	12	34	1	10
		Tank	10	7	10	7	-	-
	Dharni	Farm Pond	11	1	11	1	-	-
		Lakes/Pond	93	1022	74	829	19	193
		Reservoir	3	617	1	267	2	350
		Tank	37	110	34	100	3	10
	Morshi	Abandoned quarry with water	10	17	10	17	-	-
		Aquaculture pond	99	19	99	19	-	-
		Farm Pond	59	5	59	5	-	-
		Lakes/Pond	44	265	40	237	4	28
		Reservoir	2	7900	0	2570	2	5329
		Tank	15	16	15	16	-	-
	Nandgaon-Khandeshwar	Abandoned quarry with water	2	4	2	4	-	-
		Farm Pond	91	10	91	10	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Amravati	Nandgaon-Khandeshwar	Lakes/Pond	44	456	38	375	6	81
		Reservoir	1	117	1	117	-	-
		Tank	6	8	6	8	-	-
	Teosa	Farm Pond	41	5	41	5	-	-
		Lakes/Pond	41	390	31	278	10	111
		Tank	1	0	1	0	-	-
	Warud	Abandoned quarry with water	3	4	3	4	-	-
		Farm Pond	88	14	88	14	-	-
		Lakes/Pond	39	542	33	444	6	98
		Reservoir	5	578	1	400	4	178
		Tank	33	43	31	37	2	6
	TOTAL		2410	16010	2317	8332	93	7678
Bhandara	Bhandara	Aquaculture pond	1	6	1	6	-	-
		Farm Pond	46	8	46	8	-	-
		Lakes/Pond	160	827	144	688	16	139
		Reservoir	1	190	0	53	1	138
		Tank	42	84	40	70	2	14
	Lakhandur	Farm Pond	9	1	9	1	-	-
		Lakes/Pond	122	687	110	575	12	112
		Reservoir	2	183	0	113	2	70
		Tank	14	34	13	24	1	10
	Lakhani	Farm Pond	31	3	31	3	-	-
		Lakes/Pond	203	995	178	721	25	274
		Reservoir	1	97	0	67	1	29
		Tank	35	90	33	81	2	9

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Bhandara	Mohadi	Abandoned quarry with water	2	3	2	3	-	-
		Cooling pond/ Cooling reservoir	1	0	1	0	-	-
		Farm Pond	102	14	102	14	-	-
		Lakes/Pond	137	676	116	519	21	156
		Reservoir	1	104	0	68	1	36
		Tank	33	38	33	38	-	-
	Pauni	Farm Pond	50	4	50	4	-	-
		Lakes/Pond	203	887	182	667	21	220
		Tank	34	71	30	62	4	9
	Sakoli	Aquaculture pond	33	7	33	7	-	-
		Farm Pond	19	2	19	2	-	-
		Lakes/Pond	238	1590	199	1156	39	434
		Reservoir	1	408	0	244	1	164
		Tank	38	83	37	79	1	4
	Tumsar	Abandoned quarry with water	1	3	1	3	-	-
		Farm Pond	134	17	134	17	-	-
		Lakes/Pond	339	1283	306	975	33	308
		Reservoir	3	789	0	391	3	398
		Tank	32	48	30	38	2	10
	TOTAL			2068	9232	1880	6698	188
Buldhana	Buldhana	Farm Pond	108	14	108	14	-	-
		Lakes/Pond	60	611	40	463	20	149
		Reservoir	4	729	0	456	4	273
		Tank	46	101	40	87	6	14

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Buldhana	Chikhli	Farm Pond	238	32	238	32	-	-
		Lakes/Pond	112	827	83	523	29	304
		Reservoir	3	1145	0	822	3	324
		Tank	87	271	67	214	20	57
	Deolgaon Raja	Farm Pond	175	27	175	27	-	-
		Lakes/Pond	54	219	44	182	10	37
		Reservoir	2	2300	0	283	2	2018
		Tank	49	75	45	66	4	10
	Jalgaon (Jamod)	Farm Pond	108	14	108	14	-	-
		Lakes/Pond	10	94	9	73	1	21
		Reservoir	1	84	0	58	1	27
		Tank	6	16	6	16	-	-
	Khamgaon	Abandoned quarry with water	1	1	1	1	-	-
		Farm Pond	114	19	114	19	-	-
		Lakes/Pond	72	769	50	582	22	187
		Reservoir	5	1020	0	557	5	463
		Tank	21	78	19	72	2	6
	Lonar	Farm Pond	55	9	55	9	-	-
		Lakes/Pond	39	674	18	394	21	280
		Reservoir	3	374	0	248	3	126
		Tank	34	94	24	50	10	44
	Malkapur	Abandoned quarry with water	1	0	1	0	-	-
		Farm Pond	78	6	78	6	-	-
		Lakes/Pond	2	9	2	9	-	-
		Tank	9	31	8	29	1	1
	Mehkar	Aquaculture pond	28	5	28	5	-	-
		Farm Pond	96	10	96	10	-	-
		Lakes/Pond	31	395	18	259	13	136
		Reservoir	4	1041	0	490	4	551
		Tank	52	221	37	157	15	64

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies		
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)	
1	2	3	4		5		6		
Buldhana	Motala	Farm Pond	94	9	94	9	-	-	
		Lakes/Pond	36	515	17	402	19	113	
		Reservoir	2	1016	0	800	2	215	
		Tank	40	96	37	90	3	6	
	Nandura	Farm Pond	84	13	84	13	-	-	
		Tank	2	7	2	7	-	-	
	Sangrampur	Farm Pond	171	20	171	20	-	-	
		Lakes/Pond	6	21	6	21	-	-	
		Tank	2	2	2	2	-	-	
	Shegaon	Abandoned quarry with water	2	1	2	1	-	-	
		Farm Pond	391	41	391	41	-	-	
		Lakes/Pond	5	55	4	40	1	15	
		Tank	7	8	7	8	-	-	
	Sindkhed Raja	Farm Pond	187	23	187	23	-	-	
		Lakes/Pond	81	628	54	426	27	202	
		Reservoir	2	104	1	76	1	28	
		Tank	41	140	32	110	9	30	
	TOTAL			2861	14015	2603	8317	258	5698
	Chandrapur	Ballarpur	Abandoned quarry with water	1	5	1	5	-	-
Farm Pond			76	10	76	10	-	-	
Lakes/Pond			38	162	33	101	5	60	
Tank			4	12	4	12	-	-	

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Chandrapur	Bhadravati	Abandoned quarry with water	9	15	9	15	-	-
		Aquaculture pond	33	17	33	17	-	-
		Farm Pond	224	24	224	24	-	-
		Lakes/Pond	123	695	114	475	9	220
		Reservoir	1	4223	0	1298	1	2925
		Tank	41	100	39	80	2	21
	Brahmapuri	Farm Pond	43	4	43	4	-	-
		Lakes/Pond	105	1016	79	792	26	224
		Tank	117	373	102	282	15	92
	Chandrapur	Abandoned quarry with water	9	36	9	36	-	-
		Aquaculture pond	11	3	11	3	-	-
		Cooling pond/ Cooling reservoir	8	12	8	12	-	-
		Farm Pond	201	23	201	23	-	-
		Lakes/Pond	134	817	119	528	15	289
		Reservoir	3	291	0	170	3	120
		Tank	24	113	22	21	2	92
	Chimur	Cooling pond/ Cooling reservoir	1	2	1	2	-	-
		Farm Pond	1108	113	1108	113	-	-
		Lakes/Pond	145	1176	120	759	25	417
		Reservoir	2	216	0	150	2	66
		Tank	234	474	215	345	19	129
	Gondpipri	Farm Pond	189	19	189	19	-	-
		Lakes/Pond	50	510	38	333	12	177
		Tank	9	27	7	14	2	14

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Chandrapur	Jiwati	Abandoned quarry with water	4	6	4	6	-	-
		Farm Pond	11	1	11	1	-	-
		Lakes/Pond	21	78	20	0	1	78
		Reservoir	1	206	1	206	-	-
	Korpana	Abandoned quarry with water	11	34	11	34	-	-
		Cooling pond/ Cooling reservoir	5	7	5	7	-	-
		Farm Pond	60	9	60	9	-	-
		Lakes/Pond	13	51	12	35	1	15
	Mul	Aquaculture pond	13	3	13	3	-	-
		Cooling pond/ Cooling reservoir	1	0	1	0	-	-
		Farm Pond	92	8	92	8	-	-
		Lakes/Pond	219	1020	194	756	25	264
		Reservoir	3	328	0	268	3	60
		Tank	46	136	44	107	2	28
	Nagbhir	Cooling pond/ Cooling reservoir	2	2	2	2	-	-
		Farm Pond	112	8	112	8	-	-
		Lakes/Pond	105	1061	69	675	36	386
		Reservoir	3	1226	1	689	2	536
		Tank	118	572	85	364	33	208
	Pombhurna	Farm Pond	140	15	140	15	-	-
		Lakes/Pond	91	554	79	397	12	157
		Tank	9	28	8	23	1	5

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Chandra pur	Rajura	Abandoned quarry with water	16	45	16	45	-	-
		Aquaculture pond	10	3	10	3	-	-
		Farm Pond	201	22	201	22	-	-
		Lakes/Pond	116	301	112	268	4	33
		Reservoir	2	595	0	343	2	253
		Tank	17	9	17	9	-	-
	Sawali	Aquaculture pond	12	2	12	2	-	-
		Farm Pond	96	7	96	7	-	-
		Lakes/Pond	168	1225	146	949	22	276
		Reservoir	1	132	0	82	1	50
		Tank	54	132	50	99	4	33
	Sindewahi	Farm Pond	79	6	79	6	-	-
		Lakes/Pond	211	1834	177	1176	34	659
		Reservoir	6	2872	1	1708	5	1164
		Tank	58	176	57	160	1	16
	Warora	Abandoned quarry with water	14	13	14	13	-	-
		Aquaculture pond	94	8	94	8	-	-
		Cooling pond/ Cooling reservoir	1	1	1	1	-	-
		Farm Pond	244	28	244	28	-	-
		Lakes/Pond	69	424	64	253	5	171
		Reservoir	3	1642	1	1026	2	616
		Tank	52	111	52	111	-	-
TOTAL			5547	25429	5213	15578	334	9852
Gadchiroli	Aheri	Farm Pond	12	1	12	1	-	-
		Lakes/Pond	66	321	58	274	8	47
		Tank	1	2	1	2	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Gadchiroli	Armori	Farm Pond	9	1	9	1	-	-
		Lakes/Pond	318	697	292	539	26	157
		Tank	12	10	12	10	-	-
	Bhamragad	Farm Pond	9	2	9	2	-	-
		Lakes/Pond	94	144	92	128	2	15
		Tank	9	5	9	5	-	-
	Chamorshi	Farm Pond	246	25	246	25	-	-
		Lakes/Pond	243	679	220	524	23	155
		Tank	22	37	21	35	1	3
	Desaiganj (Vadasa)	Abandoned quarry with water	1	1	1	1	-	-
		Farm Pond	20	2	20	2	-	-
		Lakes/Pond	121	647	95	422	26	225
		Tank	5	2	5	2	-	-
	Dhanora	Farm Pond	63	8	63	8	-	-
		Lakes/Pond	493	708	473	601	20	107
		Tank	59	23	59	23	-	-
	Etapalli	Farm Pond	25	2	25	2	-	-
		Lakes/Pond	564	427	560	419	4	8
		Tank	32	21	32	21	-	-
	Gadchiroli	Aquaculture pond	11	2	11	2	-	-
		Farm Pond	26	3	26	3	-	-
		Lakes/Pond	181	617	158	479	23	137
		Tank	12	7	12	7	-	-
	Korchi	Farm Pond	74	16	74	16	-	-
		Lakes/Pond	214	252	207	232	7	20
		Tank	25	7	25	7	-	-
	Kurkheda	Farm Pond	77	8	77	8	-	-
		Lakes/Pond	459	917	427	757	32	160
		Tank	44	53	42	45	2	8

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Gadchiroli	Mulchera	Farm Pond	54	5	54	5	-	-
		Lakes/Pond	83	176	76	137	7	38
		Reservoir	2	1356	0	1146	2	210
		Tank	7	6	7	6	-	-
	Sironcha	Farm Pond	15	3	15	3	-	-
		Lakes/Pond	32	98	31	94	1	4
		Tank	1	0	1	0	-	-
TOTAL			3741	7292	3557	5996	184	1296
Gondia	Amgaon	Farm Pond	62	10	62	10	-	-
		Lakes/Pond	351	712	325	587	26	125
		Tank	33	53	30	36	3	17
	Arjuni Morgaon	Aquaculture pond	35	7	35	7	-	-
		Farm Pond	93	11	93	11	-	-
		Lakes/Pond	339	1944	283	1525	56	419
		Reservoir	3	7375	0	2146	3	5229
		Tank	17	6	17	6	-	-
	Deori	Farm Pond	192	24	192	24	-	-
		Lakes/Pond	556	1544	503	1195	53	349
		Reservoir	3	2271	0	1743	3	528
		Tank	59	37	59	37	-	-
	Gondia	Aquaculture pond	24	2	24	2	-	-
		Farm Pond	47	5	47	5	-	-
		Lakes/Pond	371	1199	330	1030	41	169
		Reservoir	2	461	0	378	2	83
		Tank	63	164	56	139	7	26
	Goregaon	Aquaculture pond	7	3	7	3	-	-
		Farm Pond	87	16	87	16	-	-
		Lakes/Pond	299	905	270	769	29	136
		Reservoir	4	1096	0	615	4	481
		Tank	30	28	30	28	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies		
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)	
1	2	3	4		5		6		
Gondia	Sadak-Arjuni	Farm Pond	69	11	69	11	-	-	
		Lakes/Pond	356	1581	306	1218	50	363	
		Reservoir	2	205	0	95	2	110	
		Tank	23	27	22	24	1	3	
	Salekasa	Abandoned quarry with water	1	0	1	0	-	-	
		Farm Pond	86	21	86	21	-	-	
		Lakes/Pond	365	727	346	641	19	86	
		Reservoir	2	388	0	294	2	94	
		Tank	43	43	42	37	1	7	
		Tirora	Farm Pond	104	10	104	10	-	-
			Lakes/Pond	282	777	260	659	22	118
	Reservoir		4	1100	1	909	3	191	
	Tank		38	61	35	53	3	8	
	TOTAL			4052	22825	3722	14284	330	8542
	Nagpur	Bhiwapur	Abandoned quarry with water	1	2	1	2	-	-
Farm Pond			177	45	177	45	-	-	
Lakes/Pond			32	525	24	453	8	72	
Reservoir			4	668	0	448	4	220	
Tank			33	123	31	119	2	4	
Hingna		Abandoned quarry with water	49	34	49	34	-	-	
		Farm Pond	63	11	63	11	-	-	
		Lakes/Pond	25	311	17	224	8	88	
		Reservoir	2	459	0	247	2	213	
		Tank	31	75	28	61	3	14	
Kalamesh-war		Abandoned quarry with water	29	34	29	34	-	-	
		Farm Pond	92	12	92	12	-	-	
		Lakes/Pond	9	167	6	98	3	69	
		Reservoir	3	863	0	393	3	469	
		Tank	33	64	29	45	4	19	

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Nagpur	Kamptee	Abandoned quarry with water	1	1	1	1	-	-
		Farm Pond	6	3	6	3	-	-
		Lakes/Pond	8	924	6	863	2	61
		Tank	17	20	17	20	-	-
	Katol	Abandoned quarry with water	3	2	3	2	-	-
		Farm Pond	33	5	33	5	-	-
		Lakes/Pond	28	243	17	170	11	74
		Reservoir	3	911	0	450	3	460
		Tank	77	232	57	141	20	91
	Kuhi	Abandoned quarry with water	3	2	3	2	-	-
		Farm Pond	227	60	227	60	-	-
		Lakes/Pond	78	595	70	555	8	39
		Reservoir	2	4290	0	669	2	3621
		Tank	76	152	73	144	3	8
	Mauda	Farm Pond	27	7	27	7	-	-
		Lakes/Pond	14	157	10	95	4	63
		Tank	42	72	41	69	1	2
	Nagpur (Rural)	Abandoned quarry with water	75	51	75	51	-	-
		Farm Pond	58	11	58	11	-	-
		Lakes/Pond	27	193	23	97	4	96
		Reservoir	2	3600	0	1932	2	1669
		Tank	64	135	58	109	6	25
	Nagpur (Urban)	Farm Pond	6	1	6	1	-	-
		Lakes/Pond	4	63	3	25	1	38
		Reservoir	2	304	0	99	2	205
		Tank	15	34	15	34	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Nagpur	Narkhed	Abandoned quarry with water	8	1	8	1	-	-
		Farm Pond	61	8	61	8	-	-
		Lakes/Pond	10	140	6	71	4	70
		Reservoir	1	199	0	48	1	150
		Tank	43	164	36	135	7	29
	Parseoni	Abandoned quarry with water	2	18	2	18	-	-
		Aquaculture pond	50	24	50	24	-	-
		Farm Pond	39	10	39	10	-	-
		Lakes/Pond	10	194	7	148	3	47
		Reservoir	2	2390	0	756	2	1635
		Tank	51	69	51	69	-	-
	Ramtek	Farm Pond	266	34	266	34	-	-
		Lakes/Pond	53	516	35	341	18	175
		Reservoir	3	10772	0	3007	3	7765
		Tank	272	620	247	544	25	76
	Savner	Abandoned quarry with water	18	21	18	21	-	-
		Cooling pond/ Cooling reservoir	5	6	5	6	-	-
		Farm Pond	67	13	67	13	-	-
		Lakes/Pond	12	119	7	51	5	67
		Reservoir	3	881	0	329	3	552
		Tank	28	62	25	47	3	16
	Umred	Abandoned quarry with water	78	62	78	62	-	-
		Cooling pond/ Cooling reservoir	1	2	1	2	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Nagpur	Umred	Farm Pond	33	5	33	5	-	-
		Lakes/Pond	31	592	20	508	11	84
		Reservoir	9	3477	0	2554	9	923
		Tank	36	100	35	94	1	5
TOTAL			2673	35958	2472	16742	201	19216
Wardha	Arvi	Farm Pond	47	8	47	8	-	-
		Lakes/Pond	42	741	19	445	23	295
		Reservoir	5	4270	1	1224	4	3046
		Tank	12	157	8	123	4	34
	Ashti	Farm Pond	9	2	9	2	-	-
		Lakes/Pond	8	139	0	80	8	59
		Tank	9	11	8	6	1	5
	Deoli	Farm Pond	222	26	222	26	-	-
		Lakes/Pond	12	60	10	45	2	15
		Tank	7	84	6	42	1	42
	Hinganghat	Farm Pond	245	23	245	23	-	-
		Lakes/Pond	11	52	10	39	1	13
		Tank	22	85	19	69	3	17
	Karanja	Farm Pond	3	1	3	1	-	-
		Lakes/Pond	19	246	5	164	14	82
		Reservoir	1	328	0	120	1	209
		Tank	19	66	17	52	2	15
	Samudrapur	Farm Pond	86	8	86	8	-	-
		Lakes/Pond	6	83	3	58	3	25
		Reservoir	2	2012	0	1450	2	562
		Tank	32	98	29	70	3	28
	Seloo	Farm Pond	203	25	203	25	-	-
		Lakes/Pond	3	111	1	81	2	30
		Reservoir	3	1639	0	711	3	928
		Tank	26	29	24	23	2	6

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Wardha	Wardha	Cooling pond/ Cooling reservoir	1	8	1	8	-	-
		Farm Pond	52	11	52	11	-	-
		Lakes/Pond	17	218	12	162	5	56
		Tank	10	31	9	21	1	9
TOTAL			1134	10571	1049	5096	85	5475
Washim	Karanja	Abandoned quarry with water	2	6	2	6	-	-
		Farm Pond	367	31	367	31	-	-
		Lakes/Pond	46	509	30	325	16	184
		Reservoir	4	657	1	459	3	198
		Tank	7	16	6	10	1	6
	Malegaon	Abandoned quarry with water	1	8	1	8	-	-
		Farm Pond	51	5	51	5	-	-
		Lakes/Pond	85	579	66	356	19	223
		Reservoir	5	964	1	479	4	485
		Tank	37	137	31	94	6	43
	Mangrulpir	Abandoned quarry with water	1	3	1	3	-	-
		Farm Pond	160	15	160	15	-	-
		Lakes/Pond	145	1092	120	805	25	288
		Tank	11	29	10	19	1	11
	Manora	Farm Pond	163	22	163	22	-	-
		Lakes/Pond	101	925	80	695	21	229
		Reservoir	1	860	0	360	1	500
		Tank	12	20	11	19	1	1

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Washim	Risod	Abandoned quarry with water	8	3	8	3	-	-
		Farm Pond	38	5	38	5	-	-
		Lakes/Pond	38	515	25	323	13	191
		Tank	54	188	49	158	5	30
	Washim	Farm Pond	114	11	114	11	-	-
		Lakes/Pond	132	1044	109	738	23	307
		Reservoir	3	368	0	191	3	177
		Tank	10	12	9	9	1	3
TOTAL			1596	8026	1453	5149	143	2877
Yavatmal	Arni	Abandoned quarry with water	4	2	4	2	-	-
		Farm Pond	120	19	120	19	-	-
		Lakes/Pond	39	85	35	66	4	19
		Reservoir	1	159	0	29	1	130
		Tank	7	2	7	2	-	-
	Babulgaon	Abandoned quarry with water	1	1	1	1	-	-
		Farm Pond	20	3	20	3	-	-
		Lakes/Pond	18	124	16	89	2	35
		Reservoir	1	6157	0	113	1	6044
		Tank	3	8	3	8	-	-
	Darwaha	Farm Pond	21	4	21	4	-	-
		Lakes/Pond	38	246	34	169	4	77
		Reservoir	3	1158	1	490	2	668
		Tank	7	39	6	31	1	7
	Digras	Farm Pond	41	5	41	5	-	-
		Lakes/Pond	46	136	43	89	3	46
		Reservoir	1	3123	0	950	1	2174
		Tank	3	1	3	1	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Yavatmal	Ghatanji	Aquaculture pond	8	5	8	5	-	-
		Farm Pond	46	8	46	8	-	-
		Lakes/Pond	23	308	16	162	7	146
		Tank	1	9	1	9	-	-
	Kalamb	Farm Pond	58	7	58	7	-	-
		Lakes/Pond	52	478	41	298	11	180
		Reservoir	1	80	0	21	1	59
		Tank	8	22	7	20	1	2
	Kelapur	Abandoned quarry with water	1	8	1	8	-	-
		Aquaculture pond	10	3	10	3	-	-
		Farm Pond	30	3	30	3	-	-
		Lakes/Pond	31	439	21	231	10	209
		Reservoir	2	779	0	326	2	453
		Tank	4	22	3	17	1	5
	Mahagaon	Farm Pond	18	2	18	2	-	-
		Lakes/Pond	52	347	38	205	14	143
		Reservoir	4	1963	0	776	4	1188
		Tank	1	0	1	0	-	-
		Farm Pond	51	5	51	5	-	-
		Lakes/Pond	26	358	13	127	13	231
		Reservoir	1	346	0	75	1	271
	Ner	Abandoned quarry with water	1	0	1	0	-	-
		Farm Pond	37	4	37	4	-	-
		Lakes/Pond	32	475	21	222	11	253
		Reservoir	4	612	0	332	4	280
		Tank	1	0	1	0	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Yavatmal	Pusad	Aquaculture pond	126	22	126	22	-	-
		Farm Pond	50	6	50	6	-	-
		Lakes/Pond	97	384	86	301	11	83
		Reservoir	2	10143	0	3991	2	6152
		Tank	4	27	1	13	3	14
	Ralegaon	Farm Pond	30	6	30	6	-	-
		Lakes/Pond	32	385	20	204	12	181
		Reservoir	2	236	0	66	2	170
		Tank	1	1	1	1	-	-
	Umarkhed	Farm Pond	37	4	37	4	-	-
		Lakes/Pond	35	460	22	247	13	213
		Reservoir	1	342	0	94	1	248
		Tank	4	11	4	11	-	-
	Wani	Abandoned quarry with water	13	67	13	67	-	-
		Farm Pond	211	25	211	25	-	-
		Lakes/Pond	43	268	36	203	7	64
		Tank	3	2	3	2	-	-
	Yavatmal	Abandoned quarry with water	1	0	1	0	-	-
		Cooling pond/ Cooling reservoir	2	1	2	1	-	-
		Farm Pond	41	6	41	6	-	-
		Lakes/Pond	61	736	50	488	11	248
		Reservoir	4	1028	0	118	4	910
		Tank	10	12	10	12	-	-

District Name	Taluka Name	Waterbody Type	Total waterbodies		Seasonal waterbodies		Perennial waterbodies	
			Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	2	3	4		5		6	
Yavatmal	Zari-Jamani	Farm Pond	38	5	38	5	-	-
		Lakes/Pond	23	321	17	188	6	132
		Tank	1	0	1	0	-	-
TOTAL			1749	32054	1578	11020	171	21034
GRAND TOTAL			30660*	187249	28635	101410	2025	85839

Source: MRSAC.

Note: As suggested by MRSAC *10 seasonal waterbodies (area 0.13 ha) are added to 30650 in district wise and category wise distribution of waterbodies in Vidarbha.

Annexure IV (Part A): Questionnaire on survey of fish seed production centres

1	Brief information		
1.1	Name of Seed Production Centre	:	_____
1.2	Location with complete address	:	_____ _____ _____
1.3	Total area of Seed Production Centre (ha)	:	_____
1.4	Distance from district headquarter and regional office	:	_____
1.5	Sanctioning year and year of completion of construction	:	_____
1.6	Year of first successful operation of centre	:	_____
1.7	Post-wise manpower details	:	1) 2) 3) (If needed, attach annexure separately)
1.8	Is the facility of staff accommodation is available	:	Yes / No, If Yes Please give the details
1.9	Is the technical and non-technical staff stationed at centre	:	Yes / No, If No reasons or remark if any

1.10	Status	:	Functional/Non-functional If Non-functional since when _____ Five major reason for Non-functional 1. 2. 3. 4. 5.
		:	If functional seed production details of last five year (Please fill the details as per Annexure I)
1.11	Renovation needed	:	Yes / No If yes, please specify, 1) Details of renovation or physical structure _____ 2) Budgetary requirement _____
2	Technical details		
2.1	Water source of hatchery	:	
2.2	Water source, seasonal or perennial	:	
2.3	Water quality parameter monitoring during operation	:	Yes / No
2.4	Soil quality at the centre	:	Sandy/Muddy/ Clayey/ Clayey – loam/

2.5	Number and area of brood-stock pond	:	Number: _____ & Area:_____ Ha.
2.6	Facility & capacity of overhead tank	:	Yes / No If yes, _____ No. & _____ litre
2.7	Number of spawning pools	:	_____
2.8	Broodstock holding capacity of spawning pool	:	_____ Kg
2.9	Number of incubation pool	:	_____
2.10	Eggs holding capacity of incubation pool	:	_____ Lakh
2.11	Is seed rearing space available	:	Yes / No
2.12	If, Yes number of spawn rearing ponds and area (ha)	:	Number: _____ & Area:_____ Ha.
2.13	Is fry rearing space available	:	Yes / No
2.14	If, Yes number of fry rearing ponds and area (ha)	:	Number: _____ & Area:_____ Ha.
2.15	Is pre-stocking management practices (Weed clearance, manuring, fertilization, insect control etc.)	:	Yes / No
2.16	Is brood stock available at present	:	Yes/No If Yes, _____ Kg If No, _____ (Date of last purchase)
2.17	Brood stock rearing ponds	:	Number: _____ & Area:_____ Ha.

2.18	Periodic replacement or brood stock followed	:	Yes / No
2.19	Brood stock used for multiple/repeated breeding	:	Yes / No
2.20	Offseason carp breeding followed	:	Yes / No
2.21	Whether culling practice is followed	:	<p>Yes/No</p> <p>If yes _____ %</p> <p>If No please specify reason</p> <p>1.</p> <p>2.</p> <p>3.</p>
2.22	Major constraint/problem	:	<p>1.</p> <p>2.</p> <p>3.</p> <p>4.</p> <p>5.</p>

2.23	Constraint related important suggestions	:	1. 2. 3. 4. 5.
2.24	Other remark/suggestion if any	:	

Name of Officer : _____

Designation of Officer : _____

Signature with date : _____

Annexure IV (Part B): Details on seed production, sale & revenue of fish seed production centres in Vidarbha

Sr. No	Year	Fish Seed Production (No. in Lakh)				Sale (kg)		Revenue (Lakh)
		Spawn	Fry	Semi-fingerlings	Fingerlings	Fish / Brood-stock	Others	
1	2013-14							
2	2014-15							
3	2015-16							
4	2016-17							
5	2017-18							

Name of Officer : _____

Designation of Officer : _____

Signature with date : _____

Annexure V (Part A): Questionnaire on survey of fish seed rearing centres

1	<u>Brief information</u>		
1.1	Name of Centre	:	_____
1.2	Location with complete address	:	_____ _____
1.3	Total area of Centre (ha)	:	_____
1.4	Distance from district headquarter and regional office	:	_____
1.5	Year of start and completion of construction	:	_____
1.6	Year of first operation	:	_____
1.7	Post-wise manpower details	:	
1.8	Is the facility of staff accommodation is available	:	Yes / No If Yes, Please give the details

1.9	Is the technical and non-technical staff stationed at centre	:	Yes / No If No, reasons or remark if any
1.10	Status	:	Functional/Non-functional If Non-functional since when _____ Five major reason for Non-functional 1. 2. 3. 4.
		:	If functional details of last five year (Please fill the details as per Annexure - I)
2	<u>Technical details</u>		
2.1	Water source of centre	:	
2.2	Water source seasonal or perennial	:	
2.3	Facility of pumping station	:	Yes / No
2.4	Facility & capacity of overhead tank	:	Yes / No If yes, _____No. & _____litre
2.5	Is the water quality parameter monitored during operation	:	Yes / No

2.6	Soil quality	:	Sandy/Muddy/ Clayey/ Clayey – loam/
2.7	Facility of reservoir pond	:	Yes / No If Yes, Number: _____ & Area: _____ Ha.
2.8	Number and area of nursery pond	:	Number: _____ & Area: _____ Ha.
2.9	Number and area of rearing pond	:	Number: _____ & Area: _____ Ha.
2.10	Number and area of stocking pond	:	Number: _____ & Area: _____ Ha.
2.11	Is fingerling to table size grow-out practice followed	:	Yes / No
2.12	Is pre-stocking & post stocking management practices (Weed clearance, manuring, fertilization, insect control, feeding, water quality monitoring etc.)	:	Yes / No
2.13	Major constraint/problem	:	1. 2. 3. 4. 5.

2.14	Constraint related important suggestions	:	1. 2. 3. 4. 5.
2.15	Other remark/suggestion if any	:	

Name of Officer : _____

Designation of Officer : _____

Signature with date : _____

Annexure V (Part B): Details on seed stocking, production, sale & revenue of fish seed rearing centres in Vidarbha

Sr. No	Year	Stocking (No. in Lakh)			Production (No. in Lakh)			Sale (kg)		Revenue (Lakh)
		Spawn	Semi-fingerlings	Fingerlings	Fry	Semi-fingerlings	Fingerlings	Fish / Brood-stock	Others	
1	2013-14									
2	2014-15									
3	2015-16									
4	2016-17									
5	2017-18									

Name of Officer : _____

Designation of Officer : _____

Signature with date : _____

Annexure VI: Questionnaire on Cage culture of MFDC

Sr. No.	Details		
1	Name of scheme under which cage culture was initiated by MFDC		
2	Name of sponsoring agency and share (Rs.)		1. Central government _____ (Rs.) 2. State government _____ (Rs.) 3. NFDB _____ (Rs.) 4. Any other _____ & _____ (Rs.)
3	Name of units & year of establishment in Vidarbha	:	1. _____ & Year _____ 2. _____ & Year _____ 3. _____ & Year _____
4	Name and area of dam used for cage culture		1. _____ 2. _____ 3. _____
5	Unit wise total water spread area used for cage culture (ha)	:	1. _____ 2. _____ 3. _____
6	Unit wise numbers of rearing and grow out cages	:	1. Rearing Cage no. ____ & Grow out cage no. ____ 2. Rearing Cage no. ____ & Grow out cage no. ____ 3. Rearing Cage no. ____ & Grow out cage no. ____
7	Unit wise size (L x B x H) of rearing and grow out cages	:	1. Rearing Cage Size. __ & Grow out cage Size. _ 2. Rearing Cage Size. __ & Grow out cage Size. _ 3. Rearing Cage Size. __ & Grow out cage Size. _
8	Mesh size (mm) of cages		Mesh size rearing cage _____ mm. Grow out cage _____ mm
9	Material of cage / Name of brand		
10	Unit wise cost of installation of cages	:	1. _____ 2. _____ 3. _____
11	Fish species stocked	:	1. _____ 2. _____ 3. _____

12	Species wise initial size/wt (gms) of seed stocked	:	1. _____ & _____ size/wt(gms) 2.. _____ & _____ size/wt(gms) 3. _____ & _____ size/wt(gms)
13	Species wise price of seed (Rs/no)	:	1. _____ & _____ (Rs/no) 2.. _____ & _____ (Rs/no) 3. _____ & _____ (Rs/no)
14	Source of seed (Name of Firms/ Agency)	:	1. _____ 2. _____ 3. _____
15	Feed brand & approximate quantity used (kg)	:	1. _____ & _____ (Kg) 2.. _____ & _____ (Kg) 3. _____ & _____ (Kg)
16	Brand wise average price/kg of feed (Rs)	:	1. _____ & _____ (Kg) 2.. _____ & _____ (Kg) 3. _____ & _____ (Kg)
17	Was the technical man-power appointed?	:	Yes/No, If Yes _____Number/unit
18	Is training provided to appointed staff	:	Yes / No, If Yes Name of training institute _____
19	Major constraints faced during cage culture	:	1. _____ 2. _____ 3. _____ 4. _____ 5. _____
20	Suggestion/Remark to be incorporated in proposed action plan	:	1. _____ 2. _____ 3. _____ 4. _____ 5. _____

Name of Officer : _____

Designation of Officer: _____

Signature with date : _____

Annexure VII (Part A): Questionnaire on survey of fisheries cooperative societies of Vidarbha

1	Name of cooperative society	:	_____
2	Address	:	_____
3	Year of formation and registration number	:	_____
4	Status of cooperative society	:	Functional/Non Functional
5	Constitution of executive committee	:	Election/Unanimous
6	Year of recent executive committee constitution	:	_____
7	Frequency of meeting of Executive committee	:	Weekly/ Monthly/Once in two moths/Quarterly / Bi-annual / Yearly once
8	Frequency of meeting of General body	:	Weekly/ Monthly/Once in two moths/Quarterly /Bi-annual / Yearly once
9	Is sub leasing practiced	:	Yes/No
10	Credit sources	:	Banks / Chit funds / Money lenders / Friends and relatives / others
11	Employment generation by society	:	Pre harvest operations / harvesting / Grading/Drying fish/ Selling fish in local market
12	Total Numbers of member	:	_____
13	Numbers of Active Member	:	_____
14	Numbers of Inactive Members	:	_____
15	Numbers of Fishing Families	:	_____
16	Number of tanks with water spread area covered by society	:	_____
17	Means of livelihood	:	Only Fishing Fishing + Agri Fishing + Labour Fishing + livestock Fishing +others (Specify)_____
18	Numbers of fishing villages	:	_____

19	Occupation based fishing community	:	_____
20	State fisheries schemes adopted	:	If yes Name of Scheme_____
21	Rearing space availability		Yes/No (Specify _____)
22	Mode of fishing operation	:	Group/Individual
23	Fishing Days		_____
24	Transportation mode		_____
25	Marketing points	:	Surrounding Villages/Mandal head quarter/ Head quarters and town and cities/Outside the State
26	Training required	:	Yes/No If yes_____

- Latest balance sheet Xerox
- Audit report

Annexure VII (Part B): Questionnaire on fisheries activities by fisheries cooperative societies of Vidarbha

1	First stocking year during Lease tenure	:			
2	Average stocking density	:			
3	Tentative Month of stocking	:			
4	Stocking stage	:	Spawn/Fry/Semi fingerling/Fingerling/Yearling		
5	Species stocked	:	Catla/ Rohu/ Mrigal/Common Carp/ Silver carp/Grass Carp/Bighead/Tilapia/Magur		
6	Species wise stocking ratio	:			
7	Seed source	:			
8	Natural seed Collection/ Hatchery produced fish seed	:	Yes/No _____		
9	Management practices if any	:	Yes/No _____		
10	Fishing Ban details if any	:	Yes/No _____		
11	Harvesting practice	:	Daily/Weekly/Monthly/seasonally/ annually		
12	Fishing gear used and mesh size	:	<u>Gear Type</u>	<u>Size</u>	<u>Month of Operation & Area</u>
			Gill Net		
			Long Line		
			Hook and line		
			Trap		
			Traditional gear		
			Drag Net		
			Cast net		
13	Craft used	:	<u>Craft Type</u>	<u>Size</u>	<u>Fabrication material</u>
			Dugout		
			Plank built		
			Inflated rubber tube		
			Others		
14	Fishing Days	:			
15	Daily catch	:			
16	Avg. production (Year wise/Monthly)	:			
17	Any incidence of mass mortality	:	Yes/No If yes Natural/Disease/Anthropogenic activity		

Annexure VIII: Structured interview schedule for fish markets survey of Vidarbha

Sr No	Market detail		
1	Name and contact number of respondent		Name_____ Contact No._____
2	Category of respondent		Auctioneer/ Wholesaler/Retailers/
3	Name of the market	:	_____
4	Address of the market	:	_____
5	Market days	:	Daily / Twice a week / Weekly / Monthly
6	Market timing	:	_____
7	Peak hours	:	_____
8	Market place	:	Private/ public
9	If private, name of owner	:	_____
10	If public, Authority	:	_____
11	Numbers of Wholesalers	:	_____
12	Numbers of retailers	:	_____
13	Source of fish to the market	:	Within the district / out of district / out of state (Percentage / /)
14	Status of fish landing in the market	:	Insulated van / Insulated boxes / With ice / without ice / any other method (please specify _____)
15	Mode of transportation of fish landing to market	:	By road / By railway / By Air (Percentage / /)
16	Availability of Marine fishes	:	Yes / No If Yes : _____ kg Source : _____

17	Purchase	:	Method Auctioning / Bulk /Grade Wise (Percentage / /)			
			Daily fish purchase of Wholesaler (Kg) _____			
			Daily fish sale of retailer (Kg) _____			
18	Sell	:	Selling practice : Fixed / Bargaining			
			Type of Purchase r	Average numbers	Approxima te quantity	Prefer red fish
			Retail			
			Wholesale			
			Hotelier			
			Outside district			
			Outside state			
19	Facility in market	:	Storage Facility Yes/No If yes, type of facility If no, procedure of storage			
			Water source : _____			
			Availability of ice in nearby vicinity : Yes / No			
			Ratio of Fish : ice _____ : _____			
			Platform : Yes / No			
			General Hygienic condition : _____			
20	Costs involved	:	Transportation charges		_____Rs.	
			Baskets		_____Rs.	
			Plates		_____Rs.	
			Knives		_____Rs.	
			Wooden Boards		_____Rs.	
			Ice		_____Rs.	
			Plastic bags		_____Rs.	
			Market rent		_____Rs.	
			Water charges		_____Rs.	
			Electricity charges		_____Rs.	
			Labour charges		_____Rs.	

21	Details of unsold fishes	:	Storage :- Cold storage / Iced / Deep freezer / Insulated box/ Any other		
22	Availability of banned fishes	:	Yes / No, If Yes :-		
			Name of Fish	Quantity	Source
23	Availability of fish roe	:	Yes / No, If Yes :-		
			Name of fish	Quantity	Source
24	Market Information of Fishes				
	Sr. No.	Major Species	Average Size	Percentage wise Quantity	Approximate Price range
25.	Major Constraint,				
	1.				
	2.				
	3.				
	4.				
	5.				

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12. Acronyms and Abbreviations

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ABW	: Average Body Weight
ACF	: Assistant Commissioner of Fisheries
ADF	: Agriculture, Animal Husbandry, Dairy Development & Fisheries Department, Government of Maharashtra
AFDO	: Assistant Fisheries Development Officer
A.P.	: Andhra Pradesh
APMC	: Agricultural Produce Market Committee
B.F.Sc.	: Bachelor of Fisheries Science
CAA	: Coastal Aquaculture Authority
CIBA	: Central Institute of Brackishwater Aquaculture
CIFA	: Central Institute of Fisheries Aquaculture
CIFE	: Central Institute of Fisheries Education
CIFRI	: Central Inland Fisheries Research Institute
CIFT	: Central Institute of Fisheries Technology
COF	: College of Fisheries
COFS	: College of Fishery Science
DAHD	: Department of Animal Husbandry, Dairying & Fisheries
DM	: Divisional Manager
DOB	: De-Oiled rice Bran
DoF	: Department of Fisheries
DPDC	: District Planning and Development Committee
EU	: European Union
FAO	: Food and Agriculture Organization
F.C.S.	: Fisheries Cooperative Society
FCR	: Food Conversion Ratio
FDO	: Fisheries Development Officer
FGD	: Focus Group Discussion
FI	: Fish Inspector
FISHCOPFED	: National Federation of Fishermen's Cooperatives Ltd.
FM	: Field man
FP	: Prices received by fishermen
FRP	: Fibre Reinforced Plastic

GIFT	: Genetically Improved Farm Tilapia
GI	: Geographical Indication
GIS	: Geographic Information System
GnRH	: Gonadotropin Releasing Hormone
GOC	: Groundnut Oil Cake
GoM	: Government of Maharashtra
GR	: Government Resolution
GVA	: Gross Value Added
GVP	: Gross Value Product
HDPE	: High Density Poly Ethylene
HRD	: Human Resource Development
IB Group	: Indian Broiler Group
ICAR	: Indian Council of Agriculture Research
ICT	: Information Communication and Technology
IMC	: Indian Major Carps
J & K	: Jammu and Kashmir
KII	: Key Informant Interview
M.P.	: Madhya Pradesh
MAFSU	: Maharashtra Animal and Fishery Sciences University
MC	: Marketing Cost
MFDC	: Maharashtra Fisheries Development Corporation Ltd.
MFRA	: Marine Fishing Regulation Act
MM	: Marketing Margin
MME	: Modified Marketing Efficiency
MMT	: Million Metric Tonne
MPEDA	: Marine Products Export Development Authority
MSP	: Minimum Support Price
MRSAC	: Maharashtra Remote Sensing and Application Center
MT	: Metric Tonnes
NABARD	: National Bank for Agriculture and Rural Development
NBFGR	: National Bureau of Fish Genetic Resources
NCDC	: National Co-operative Development Corporation
NFDB	: National Fisheries Development Board
NGO	: Non-Governmental Organisation

PAR	: Performance Assessment Ranking
PD	: Peeled and Deveined
PESA	: Panchayats Extension to Scheduled Areas Act
PL	: Post Larvae
ppm	: Parts per million
PPP	: Public Private Partnership
PUD	: Peeled and Undeveined
PVC	: Polyvinyl Chloride
P.W.D	: Public Work Department
RAMETI	: Regional Agriculture Management and Training Center
R & D	: Rural and Development
RCC	: Reinforced Cement Concrete
RDC	: Regional Deputy Commissioner
RGCA	: Rajiv Gandhi Centre for Aquaculture
RKVY	: Rashtriya Krishi Vikas Yojana
RS	: Remote Sensing
SHG	: Self Help Group
SIFFS	: South Indian Federation of Fish workers Societies
SIS	: Small Indigenous Species
SOFIA	: State of World Fisheries and Aquaculture
SSP	: Single Super Phosphate
SSS	: Senior Sale Supervisor
SWOT	: Strength, Weakness, Opportunity and Threats
T.N.	: Tamil Nadu
TNA	: Training Need Assessment
U.P.	: Uttar Pradesh
UAE	: United Arab Emirates
USA	: United States of America
UT	: Union Territory
USA	: United States of America
VANAMATI	: Vasantrao Naik State Agricultural Extension Management Training Institute
VDB	: Vidarbha Development Board
ZP	: Zilla Parishad