



**Report of  
Working Group on  
FISHERIES DEVELOPMENT  
in Haryana**



# Report of Working Group on Fisheries Development in Haryana



Dr. R. K. Gupta: Chairman  
Prof. S. K. Garg: Member  
Dr. Babitha Rani: Member  
Dr. Rachna Gulati: Member  
Sh. Sunil Lather: Member  
Sh. Jaipal Singh: Member



Submitted to:

**Haryana Kisan Kalyan Pradhikaran  
Panchkula  
2025**

*Not for sale,  
Official use only*

## **Report of Working Group on Fisheries Development in Haryana**

### **Chairman**

**Dr. R. K. Gupta**

Prof. & Head, Deptt of Zoology & Aquaculture, CCSHAU, Hisar.

### **Members**

**Prof. S. K. Garg**

Former Prof. & Head, Department of Zoology & Aquaculture, CCSHAU, Hisar.

**Dr. Babitha Rani**

Senior Scientist, Aquaculture Division, ICAR-Central Institute of Fisheries Education, Lahli, Rohtak.

**Dr. Rachna Gulati**

Officer-in-charge, College of Fisheries Science, CCS HAU, Hisar.

**Sh. Sunil Lather**

Progressive Farmer, VPO: Jhumpa Kalan, Siwani, Bhiwani.

**Sh. Jaipal Singh**

Progressive Farmer, VPO: Dawala, Jhajjar.

### **Nodal Officer**

**Smt. Vandana**

Research Fellow, Haryana Kisan Kalyan Pradhikaran,  
Krishi Bhawan, Sector 21, Panchkula.

### **Published by:**

Haryana Kisan Kalyan Pradhikaran  
Krishi Bhawan, Sector-21, Panchkula  
Tel.: 0172-2551764  
Website: [www.hkkp.org.in](http://www.hkkp.org.in)  
Email – Id: [hkkppkl@gmail.com](mailto:hkkppkl@gmail.com)

**© 2025**

All rights reserved with Haryana Kisan Kalyan Pradhikaran, Panchkula and no part of this document be utilized in any form, print or otherwise without the prior permission from the Pradhikaran.

नायब सिंह  
NAYAB SINGH



मुख्य मन्त्री, हरियाणा,  
चण्डीगढ़।

CHIEF MINISTER, HARYANA,  
CHANDIGARH

Dated ..... 25. 07. 2025 .....

### Message

It is a matter of great pride that Haryana, which played a pioneering role in the Green Revolution, is now taking significant strides towards the Blue Revolution, following the success of the White Revolution. The efforts being undertaken in mission mode by the Haryana Agriculture and Farmers Welfare Department and the Haryana Kisan Kalyan Pradhikaran in this direction are truly commendable.

A substantial part of Haryana's land is affected by saline, alkaline, and brackish water conditions that hold immense potential for fish farming. In addition, the state is endowed with rich water resources such as rivers, canals, drains, natural and man-made lakes, reservoirs, micro watersheds and village ponds, all of which can effectively support and promote aquaculture on a large scale.

The fisheries sector plays a vital role in the socio-economic development of Haryana. The state ranks second in the country in terms of average annual fish production per unit area. This sector not only serves as a robust source of income and employment but also fosters the growth of various ancillary industries. Moreover, it offers an affordable and accessible source of high-quality animal protein, especially for the economically weaker sections of society.

I extend my heartfelt congratulations and best wishes to all the officers and staff of the department for preparing a forward-looking and effective roadmap document focused on tapping the full potential of the fisheries sector.

(Nayab Singh)

**Shyam Singh Rana**  
**Agriculture Minister, Haryana & Vice-Chairperson**  
**Haryana Kisan Kalyan Pradhikaran**



## *MESSAGE*

Haryana is one of the most progressive agricultural states. In recent years, the state has successfully integrated fisheries in its basket of agrarian goods. It ranks second in fish productivity, which is twice the national average.

Fish farming is emerging as viable enterprise, which will ensure sustainable use of land and water bodies and provide a continuous flow of income to the families. Diversification and intensification will ensure economic viability as well as ecological sustainability of fish culture in the state. In Haryana, sustainability and productivity gains can be achieved by bringing new areas especially waterlogged and salt affected areas suitable for fish culture under scientific & productive aquaculture.

The human capital of Haryana in the form of highly progressive and innovative farmers is perhaps its biggest strength, as evidenced by great strides made in agricultural crop production, dairying and poultry. It may also be explained by very fast growth in fish production during the last two decades in an otherwise traditionally non-fish farming and consuming state.

This report is an effort to take stock of the present status of fisheries resource use, identify the potential opportunities and indicate the action points for the next ten years for fisheries development in Haryana. The extensive consultations with various stakeholders including farmers, personnel of fisheries department, experts from fisheries institutes and Universities will surely help policy makers to bring a progressive change in fisheries sector.

I hope that this report will be able to bring a reform by integrating fisheries with other farming systems, strengthening of marketing system and recommending policy measures and incentive schemes required for fisheries development among others. I believe that the present report has outlined a number of policies, technological and developmental measures that can boost up fish production in Haryana.

**(Shyam Singh Rana)**

**Pankaj Agarwal, IAS**  
**Principal Secretary to Govt. of Haryana**  
**Agriculture and Farmers' Welfare**



## *MESSAGE*

Haryana has a proud history of agricultural achievement. However, challenges like shrinking land holdings and climate change demand a fresh look at farming practices to maintain growth. The over-exploitation of groundwater and uneven irrigation patterns have resulted in problems such as depleting water tables in some regions and waterlogging and salinity in others, leading to soil degradation and reduced productivity. We need cost-cutting solutions and technologies that boost income for our resource-poor farmers.

Fortunately, Haryana is excelling in inland fisheries & currently, ranked second nationally in fish productivity. This success, coupled with the potential for diversified fish farming, presents a golden opportunity to increase farmer income and contribute to national food security. By adopting innovative practices, new technologies and supportive policies, Haryana can potentially quadruple its fish production in the next five years. Arid regions with brackish groundwater hold immense potential for fish farming, representing nearly half the state's land area. Additionally, riverine fisheries, canal bank utilization and field ponds using canal water can all be expanded. For high-yielding and high-value species like shrimp, prawn and tilapia, re-circulatory water systems offer a sustainable solution.

The report on Fisheries Development in Haryana, led by Dr. R.K. Gupta, is very comprehensive that analyses the state's fisheries through a SWOT lens (Strengths, Weaknesses, Opportunities and Threats). It identifies key issues and proposes policy interventions to integrate fisheries into diversified agricultural practices, ultimately increasing farmer income. The Working Group's inclusive approach, involving fish farmers, entrepreneurs, researchers and policymakers ensures these recommendations are practical and effective. I commend Dr. Gupta and his team for their valuable contribution. This report, entitled "Working Group Report on Fisheries Development in Haryana," will undoubtedly be a valuable resource for planners, administrators, scientists and farmers. By implementing its recommendations, we can empower resource-poor farmers through sustainable and diversified agriculture by utilizing underutilized water resources and marginal lands.

A handwritten signature in black ink, appearing to be 'Pankaj Agarwal', written in a cursive style.

**(Pankaj Agarwal)**

**Dr. R. S. Chauhan**  
**Chief Executive Officer**  
**Haryana Kisan Kalyan Pradhikaran**



## *MESSAGE*

The fisheries sector is an essential contributor to India's food security strategy. It offers a dependable source of nutrient-rich, affordable protein, especially for populations with limited resources. Furthermore, it acts as a catalyst for allied industries, generating significant economic benefits through job creation and income generation. Fish farming holds a long tradition in India and Haryana has positioned itself as a frontrunner in this domain.

Haryana stands out with the second-highest average annual fish production per unit area nationwide. The state achieved an impressive 7,000 Kg per hectare compared to the national average of 2,900 Kg. However, with the looming threat of climate change, prioritizing the sustainable development of fisheries and aquaculture is paramount.

Haryana can solidify its leadership in sustainable fisheries development, contributing significantly to India's food security and economic well-being by enhancing market access for fish farmers through improved transportation, cold chain infrastructure to minimize post-harvest losses and ensure fair prices for their produce. We must focus on strengthening the teaching, research and extension capabilities of universities and research institutions in collaboration with the state government and ICAR. This will ensure a continuous cycle of knowledge creation and dissemination.

I highly appreciate and compliment the Working Group for their efforts in bringing out this holistic report. Through this report, we can identify research priorities to address key challenges and opportunities for further development in the fisheries sector. This study proposes a roadmap for empowering stakeholders and propelling the sustainable growth of the fisheries sector in Haryana. By implementing these recommendations, we can cultivate a thriving and responsible fisheries industry that fosters environmental well-being and economic prosperity for the people of Haryana.

  
**(R. S. Chauhan)**

**Hitesh Kumar Meena, IAS**  
**Additional Chief Executive Officer,**  
**Haryana Kisan Kalyan Pradhikaran**



## *FOREWORD*

It gives me immense pleasure to present the Working Group Report on Fisheries Development in Haryana, an important initiative undertaken by the Haryana Kisan Kalyan Pradhikaran to explore the untapped potential of the fisheries sector in Haryana. This report is a result of extensive consultations and deliberations with subject matter experts, government functionaries, field officers and progressive fish farmers.

Fisheries offer a unique opportunity for enhancing income generation, nutritional security and employment, especially in rural and water-abundant regions. With growing concerns over sustainable agriculture, water utilization and livelihood diversification, fisheries can play a pivotal role in Haryana's agricultural economy. This report rightly identifies the key constraints, emerging opportunities and strategic interventions required to boost fish production, strengthen/improve market linkages and adoption of modern technologies.

I would like to place on record my deep appreciation for the Chairman and members of the Working Group for their dedicated efforts in preparing this comprehensive document. I also thank all the departments and institutions that contributed data, insights and field experience, making this report truly collaborative and grounded in reality.

I also gratefully acknowledge the sincere efforts of the dedicated staff of the Haryana Kisan Kalyan Pradhikaran, whose logistical, technical and administrative support was instrumental in coordinating the working group activities, conducting stakeholder consultations and shaping the final report. Their professionalism and commitment ensured timely and effective completion of this important assignment.

The recommendations of this report provide a roadmap for promoting fisheries as a commercially viable and environmentally sustainable sector in Haryana. I am confident that this report will serve as a guiding reference for policymakers, planners, entrepreneurs and all stakeholders involved in fisheries development in the state.

  
**(Hitesh Kumar Meena)**

**Dr. R. K. Gupta**  
**Chairman**  
**Working Group on Fisheries Development in**  
**Haryana**



## *PREFACE*

India's fisheries and aquaculture sectors have seen explosive growth over the past four decades, ranking as one of the fastest-growing food production segments. With a staggering 16.25 million metric tonnes (MMT) of fish production, India boasts the third-highest global output, contributing 7.96% of the world's total and a significant 1.09% to the nation's GDP and an impressive 6.72% to its agricultural GDP. This industry is a vital lifeline, supporting the livelihoods of 10-12% of the global population – a staggering 660 to 820 million people. At the primary level alone, the sector employs an impressive 20 million fishers and fish farmers, with countless others engaged along the entire value chain across the country. The annual export revenue generated by this sector surpasses a remarkable Rs. 1.75 lakh crores.

Haryana is a powerhouse driving India's aquaculture growth forward. The state boasts a potential of 58,632 hectares of water resources, with 19,100 hectares currently dedicated to aquaculture and over 2 lakh hectares with the potential for fish production. The average productivity in these areas is a commendable 10.94 tonnes per hectare. Unutilized salt-affected and waterlogged areas present the most significant untapped potential for immediate fisheries development.

This report, compiled by the Working Group on Fisheries, meticulously assesses the current state of fisheries development in Haryana. We identify exciting opportunities alongside the challenges that must be addressed to achieve further progress. The report proposes appropriate technological advancements, developmental strategies and policy options for the coming years, all designed to propel Haryana towards its ambitious target of 3,60,471 tonnes of fish production by 2030.

Given Haryana's track record of progressive farmers and visionary leadership that fosters entrepreneurship and innovation, achieving this targeted fish production is a well-defined and achievable goal.

We extend our deepest appreciation to each team member for their invaluable contributions over the past few months. Our sincere hope is that this report serves as a guiding light, facilitating the continued development of Haryana's fisheries sector with a focus on enhanced productivity, sustainability and profitability.



**(R. K. Gupta)**

## ACKNOWLEDGEMENTS

The Haryana Kisan Kalyan Pradhikaran (HKKP), Panchkula, constituted a working group to make recommendations for advancing Haryana's fisheries sector and propose policy improvements.

Words are inadequate to express our gratitude to the Hon'ble Chief Minister, Chairperson of Haryana Kisan Kalyan Pradhikaran, for his visionary approach in identifying fisheries as one of the key sectors for rural prosperity and nutritional security of the teeming millions. We express our sincere gratitude for the invaluable guidance provided by the Agriculture, Animal Husbandry & Dairying and Fisheries Minister, Vice-Chairperson of HKKP and the Vice Chancellor, CCSHAU, Hisar.

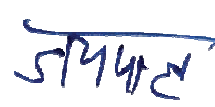
We also acknowledge with thanks the insightful contributions of Chief Executive Officer, Addl. CEO of HKKP and the progressive farmer-entrepreneurs involved in the consultation process. Without their invaluable contributions, the report would not have taken its current shape.

The study of this dimension and preparation of a comprehensive report would not have been possible without the invaluable support and valuable suggestions of Mr. Dharmender Singh, Director, Fisheries, Haryana and the dedicated staff of the Fisheries Department, Govt. of Haryana. We would like to express our sincere gratitude to Dr. S.C. Aggarwal, former Director of the Fisheries Department, Government of Haryana, for his invaluable insights and contributions to this report. Our deepest appreciation extends to Sh. Sri Pal Rathee, the current Director of the Fisheries Department, Government of Haryana, for his invaluable support.

The working group takes immense pleasure in thanking Sh. Sultan Singh (Sultan Fish Seed Farm) a progressive fish farmer and entrepreneur (Bhutana, Nilokheri, Haryana) and other farmers for sharing their success stories/and or participants of various interactive meetings held at Delhi and at Sultan fish seed farm.

The contributions of all participants in the consultative workshops held across Haryana and New Delhi are deeply appreciated. These workshops included fish farmers, DoF staff, esteemed fisheries faculty, fishing contractors, insightful industry representatives, bankers and experts. Their diverse perspectives and constructive suggestions have significantly enriched this study report. We are also grateful to Dr. Gajender Singh, Assistant Scientist for his logistical support, which was instrumental in completing this project.

Special thanks are extended to Smt. Vandana, Nodal Officer, Working Group & Research Fellow, HKKP, Dr. Sanjay Yadav, Research Fellow, HKKP, Ms. Priya Singh, Research Scholar, Dept. of Aquaculture, CCSHAU, Hisar; and the entire dedicated team at Haryana Kisan Kalyan Pradhikaran for their effective organization of consultative meetings and providing essential logistical support.



Prof. S. K. Garg   Dr. Babitha Rani   Dr. Rachna Gulati   Sh. Sunil Lather   Sh. Jaipal Singh

## CONTENTS

Message	i,ii,iii,iv
Foreword	v
Preface	vi
Acknowledgements	vii
Abbreviations	ix
Notification	x
Executive Summary	xi-xvi
1.0 Introduction	1
2.0 Goals of Working Group Report	4
3.0 Current Status of Fisheries in Haryana	5
4.0 Capture fisheries Resources of Haryana	16
5.0 Main Objectives and extension Activities of directorate of Fisheries	19
6.0 Status of Fisheries Development in Haryana	22
7.0. Role of Haryana fisheries Department and Research Institutions/Universities in fisheries Development in Haryana	26
8.0 Observation, suggestion and Recommendations	46
Meetings/Field visits Held	54
List of Tables and figures	55

## ABBREVIATIONS

ARTI	Aquaculture Research and Training Institute
AUC	Area under Culture
BFSc	Bachelor of Fisheries Science
CCSHAU	Chaudhary Charan Singh Haryana Agricultural University
CIBA	Central Institute of Brackish water Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFRI	Central Inland Fisheries Research Institute
CSSRI	Central Soil Salinity Research Institute
DFO	District Fisheries Officer
DoF	Department of Fisheries
FDO	Fisheries Development Officer
FEO	Fisheries Extension Officer
FO	Fisheries Officer
FY	Financial Year
FYP	Five Year Plan
GDP	Gross Domestic Product
GIC	General Insurance Corporation
GoH	Government of Haryana
GoI	Government of India
GVA	Gross value added
HQ	Head Quarter
HRD	Human Resource Development
ICAR	Indian Council of Agricultural Research
IMC	Indian Major Carps
KCC	Kisan Credit Card
KVK	Krishi Vigyan Kendras
MFSc	Master of Fisheries Science
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MNC	Multi National Corporation
NCR	National Capital Region
NFDB	National Fisheries Development Board
NGO	Non-Governmental Organization
PPP	Public Private Partnership
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PWD	Public Works Department
R&D	Research and Development
RAS	Recirculating Aquaculture Systems
RKVY	Rashtriya Krishi Vikas Yojana
SHG	Self Help Group
SWOT	Strengths, Weaknesses, Opportunities and Threats
ToR	Terms of Reference
WA	Water-logged Area
SA	Salt Affected Area

## NOTIFICATION

The Haryana Kisan Kalyan Pradhikaran is pleased to constitute the Working Group on Fisheries Development in Haryana & make recommendations for improvement, as under: -

Dr. R. K. Gupta Prof. & Head, Deptt of Zoology & Aquaculture, CCSHAU, Hisar	Chairperson
Prof. S. K. Garg Former Professor & Head, Department of Zoology & Aquaculture, CCSHAU, Hisar	Member
Dr. Babitha Rani Senior Scientist, Aquaculture Division, Central Institute of Fisheries Education, Lahli, Rohtak.	Member
Dr. Rachna Gulati Officer-in-charge, College of Fisheries Science, CCS HAU, Hisar.	Member/ Convener
Sh. Sunil Lather Progressive Farmer, VPO: Jhumpa Kalan, Siwani, Bhiwani	Member
Sh. Jaipal Singh Progressive Farmer, VPO: Dawala, Jhajjar	Member

- To review the current status of fish farming in Haryana and suggest measures for improvement.
- To analyze the current support system (schemes, policies, technical and infrastructural support) for promotion of fisheries in Haryana from the State /Central Governments and propose measures/ methods for further improvement in this area.
- To assess the present status of training programs and extension facilities for farmers and suggest measures for skill development of persons engaged in fish farming.
- To review the current status of the present marketing system, available infrastructure and policies and suggest measures for further improvement in linking the farmers to the market.
- To review the status of research and development & suggest measures to address current gaps as per the specific needs of the farmers.
- To recommend the most appropriate strategies for adoption for the overall growth of fisheries in the State.

\*\*\*

(x)

## EXECUTIVE SUMMARY

Fisheries and aquaculture represent a pivotal opportunity to drive economic growth and enhance food security within Haryana. By leveraging its unique strengths, the state is poised to transform its aquatic resources into a significant economic driver.

Haryana's fisheries sector has already demonstrated remarkable success, particularly through its innovative integration with traditional agriculture. This unique model has established a foundation for sustainable expansion, showcasing the sector's potential to complement and diversify the state's agricultural economy.

Despite these achievements, key challenges must be addressed to unlock the sector's full potential. These include the need for advanced water quality management, the adoption of modern technologies, and the implementation of efficient feed practices. Concurrently, a major opportunity lies in the strategic utilization of the state's vast inland saline groundwater resources for aquaculture, providing a new avenue for large-scale, sustainable production.

This report serves as a strategic roadmap for the sector's development. Our key recommendations focus on enhancing feed management systems, implementing robust water quality monitoring protocols, and actively promoting public-private collaboration to accelerate innovation and investment.

By adopting these recommendations, Haryana's fisheries sector can overcome its current hurdles and emerge as a national leader in sustainable, inland aquaculture, contributing significantly to the state's economy and ensuring long-term food security for its population.

Aquaculture is poised to become the dominant source of seafood production, with projections from the FAO indicating it will be crucial in meeting global demand as traditional capture fisheries stabilize. By 2030, total seafood production is expected to reach 182 million tons, with aquaculture accounting for 106 million tons and capture fisheries for 62 million tons (The difference of 14 million tons is largely accounted for by the production of aquatic plants, such as seaweeds like algae).

### **Strategic Opportunities and Challenges**

This report highlights the immense, yet often untapped, potential of inland waters, which could produce over 10 million tons of fish. Furthermore, the use of resources like inland saline groundwater presents an opportunity for further growth. However, this potential is threatened by environmental issues such as overfishing, ocean warming, and pollution. Realizing this potential requires a collaborative approach involving aqua culturists, entrepreneurs, and government agencies.

### **Fostering Sustainable Growth**

To ensure sustainable and secure food production, the report examines methods that balance economic growth with environmental and social responsibility. Key strategies include the judicious use of feeds and fertilizers, effective water quality management, and conservation practices. It also explores the efficient and responsible sourcing of all inputs, including fishmeal. The report's analysis of both freshwater and inland

saline environments aims to boost fish growth and production while preserving ecosystems.

### **Actionable Insights**

Inspired by Haryana's successful integration of fisheries into agriculture, this report provides a comprehensive analysis of current resource utilization. It identifies key growth opportunities and outlines actionable steps for the sector's development over the next decade. The findings are based on a wide range of insights from fish farmers, fisheries departments, Fishers, and academic experts.

### **Status of fish farming in Haryana**

Fish farming has seen a remarkable increase in Haryana, with over 80% of village ponds now utilized for fish cultivation. This has created a significant revenue stream for Village Panchayats, which collectively earn more than 125 crores annually by leasing these ponds. Furthermore, fish farmers have privately constructed over 2,500 new pond units. The State ranks second nationally in productivity, greatly exceeding the national average of 2,900 kg/ha.

### **Haryana's Fisheries Potential**

Haryana possesses a potential water resource of 58,632 hectares for fisheries. As of 2023-24, the state has brought 20,518.29 hectares under fish culture (Department of Fisheries data), which includes lakes, rivers, canals, and both private and village ponds. This has resulted in a total fish production of 216,310 metric tons (MT) for the same period, with an impressive average productivity of 10.54 tons/ hectare. Notably, nearly half (47%) of this area is in arid regions, where underground brackish water presents significant potential for the further development of aquaculture

### **Challenges and Opportunities:**

Currently, fishing in rivers and streams primarily relies on capture fisheries, which exploit wild fish populations. A lack of proper management and stock enhancement has led to overexploitation and declining productivity. In contrast, aquaculture, or fish farming, is already widespread in village ponds, with over 91% utilization. This suggests that future growth in the sector will likely focus on developing aquaculture in inland saline groundwater and waterlogged areas.

To ensure the long-term viability of capture fisheries, we must prioritize restoring natural fish habitats and biodiversity. Implementing measures like establishing fish sanctuaries and ranching native species is crucial for enhancing wild fish populations and maintaining a sustainable supply of high-quality fish stocks. While intensive cage culture can boost overall production, it must be implemented responsibly to minimize its impact on both wild fish and the surrounding ecosystem.

## **Land and Water Constraints**

Haryana's rapid development has coincided with a significant challenge: waterlogging and salinity. Approximately 10% of the state's total geographical area, primarily in its southwestern districts, is affected by these issues, equating to roughly 0.45 million hectares. This has severely impacted agricultural productivity, leading to substantial economic and social consequences. However, the use of inland saline groundwater (ISGW) has created a huge scope for the culture of different finfish as well as shellfish species, resulting in the expansion of commercial aquaculture in the states of Punjab and Haryana.

## **Government Initiatives**

The Pradhan Mantri Matsya Sampada Yojana (PMMSY), launched by the Prime Minister in September 2020, is a centrally sponsored scheme with a significant investment of Rs. 20,050 crores aimed at propelling the growth and expansion of India's fisheries sector. In Haryana, the Department of Fisheries distributed a total of Rs. 2,226.69 lakh as subsidy to fish farmers during the year 2021-22 under this scheme. This initiative holds promise for supporting the development and sustainability of Haryana's fisheries sector.

## **Fishery Achievements (2020-2021)**

Over 18,200 hectares were dedicated to fish farming, producing over 203,000 metric tons of fish. State fish seed farms successfully produced nearly 20 million high-quality fish seed (Indian Major Carp and Common Carp). Private hatcheries also contributed an additional 98 million fish seed, generating revenue of Rs. 54.98 crore. These figures highlight the significant growth and development of the fisheries sector in Haryana, which has been aided by government initiatives like the Pradhan Mantri Matsya Sampada Yojana (PMMSY).

## **Recent Developments in Shrimp Farming (2022-2023)**

Shrimp farming is gaining traction, with over 650 hectares cultivated against a target of 1,000 hectares (as of January 2023). Over 16 million shrimp seed were stocked, and production reached 5,257 metric tons, exceeding the initial target of 4,000 metric tons.

## **Soil Salinization and Inland Water Salinity: A Growing Threat**

Soil salinization is a critical ecological issue with severe consequences for agriculture and rural communities. The problem is particularly acute in North India, where inland salinity is rapidly increasing. Vast tracts of saline soil remain underutilized, hindering agricultural productivity.

Intensive irrigated farming in arid and semi-arid regions has exacerbated salinization, affecting nearly 9 million hectares. The states of Haryana, Punjab and Uttar Pradesh are particularly impacted, with a staggering 41-84% of their groundwater suffering from salinity. While subsurface drainage can help mitigate this issue, the high costs often render it impractical for small and marginal farmers. Underutilized but highly

promising resources exist across Haryana in the form of waterlogged and saline areas suitable for fish farming. These areas span approximately 88,900 hectares, offering significant potential for expansion.

### **Current Status**

Haryana's freshwater fish and shellfish farming currently operates on a limited scale, encompassing roughly 17,016 hectares and yielding approximately 1,11,203 tonnes annually. To address this problem, aquaculture has emerged as a promising solution. By transforming barren, saline land into productive aquaculture farms. Farmers in Haryana, for instance, have significantly increased their income through shrimp cultivation. This innovative approach has converted a significant ecological challenge into an economic opportunity. As a result, the state has emerged as a pioneer in harnessing saline water for shrimp farming.

### **Researchable issues and efforts**

- **Harnessing Inland Saline Water for Thriving Aquaculture in Haryana:** Effective expansion of fish and shellfish production necessitates exploring untapped resources. With its substantial reserves of inland saline water, Haryana possesses a remarkable opportunity to substantially increase its aquaculture output by harnessing these underutilized waterlogged and saline areas
- The working group recommends identifying fish species suitable for culture in inland saline water bodies or ponds without the need for potassium and magnesium supplementation. Studies indicate that some fish species, such as *Mugil cephalus*, *Chanos chanos*, *Etroplus suratensis* and *Oreochromis niloticus* can be cultured in such environments without fortification. While optimal salinity levels for the growth of these species have been worked out, however, large-scale trials are necessary to validate the technology.
- Development of Sustainable Fish Culture/aquaculture technology through the Management of inputs in the form of feeds and fertilizers.
- To curb pollution, the use of biofertilizers should be encouraged as they are being employed in raising crops.
- *In vitro* food production technology should be adopted using periphyton to reduce feed inputs and mitigate pollution.
- Consider promoting and popularising the Hi-Tech Aquaculture Technology, *i.e.* the use of the Recirculatory Aquaculture System (RAS) and Biofloc technology or automated feeding systems to improve production and sustainability
- To explore the potential of integrating fish farming with agricultural practices—such as rice-fish systems, integrated aquaculture-agriculture (IAA), and aquaponics, or the synergistic use of animal waste in aquaculture (often termed integrated livestock-fish farming)—to enhance overall sustainability, resource efficiency, biodiversity, and food security in rural and developing economies.

- Prioritize the development of environmental manipulation techniques to induce early maturity and precocious gonadal development in air-breathing or non-air-breathing fish species.
- Identification and introduction of high-value species like prawns and hardy fish species.
- Breeding and aquaculture of air-breathing/non-air-breathing fish species needs to be taken up on priority.
- **To improve reproductive potential:** This is a core application of biotechnology in aquaculture, often involving techniques like hormonal manipulation, induced breeding, and *in vitro* fertilization.
- **Accelerate the propagation of superior fish germplasm:** This refers to speeding up the breeding and growth of fish with desirable traits (e.g., faster growth, disease resistance, salinity tolerance, better feed conversion). Improving efficiency, increasing yields, and preserving valuable genetic resources.
- **The following are the primary goals of applying biotechnology in this field:**
- **Efficiency:** Using fewer resources (like feed or space) for more output.
- **Yields:** The total amount of fish produced.
- **Genetic resources:** Maintaining the diversity and valuable traits of fish populations.
- Diversification and intensification of fish farming in Haryana can boost both economic profitability and environmental sustainability. (Diversification is about farming a wider variety of fish or aquatic species, while intensification is about farming or increasing production in the same space).

Given the increasing scarcity of freshwater resources, which are also crucial for agriculture, diversifying aquaculture practices is imperative. Prioritising the cultivation of hardy fish species, such as air-breathing varieties (e.g., *Heteropneustes fossilis* (Singhi), *Clarias batrachius* (walking catfish/Magur), *Anabas*, *Pangasius pangasius*, silver pompano (*Trachinotus blochii*), *Mystus*, *Ompak* (Pabdah catfish), etc., which can mitigate water scarcity challenges. These species exhibit higher tolerance to adverse conditions, require less intensive care, and often command premium prices due to their nutritional value.

### **Technology and Innovations**

Given the increasing scarcity of freshwater resources, it will be imperative to utilize Hi-tech aquaculture such as recirculating aquaculture systems (RAS) and biofloc technology.

Offering regular training programs tailored to seasonal activities is a crucial component of supporting the aquaculture industry. By aligning training with seasonal needs, we can ensure that farmers, traders, and service providers have the most relevant and up-to-date knowledge to optimize their operations.

### **Policy and regulatory framework**

Analyze existing policies and regulations related to fish farming, responsible fishing and identify potential barriers or opportunities for development. By addressing these research issues, it will be possible to generate valuable insights into the potential of fish farming as a sustainable and profitable enterprise in Haryana.

### **Strengthening of Fisheries Research and Teaching**

The establishment of a College of Fisheries at CCS Haryana Agricultural University represents a critical step forward. While the University has successfully launched the college and recruited assistant professors/scientists in different disciplines, a crucial gap remains. The college currently lacks a senior faculty member to provide mentorship for the new hires and serve as the College head.

### **Linkage**

The Haryana Fisheries Department plays a crucial role in implementing various fisheries development schemes formulated by the state Government, research institutions, and universities. However, for these schemes to be truly effective, strong collaboration/linkage between the Haryana Fisheries Department and research bodies is essential. Without a consistent influx of new directions and technologies, the department's capacity to advance the fisheries sector is inherently limited.

Research institutions possess the expertise to develop new methodologies, techniques for fish culture and breeding and identify promising new fish and shellfish species for aquaculture. Thus, for the welfare of the state, the working group stressed the need for a strong interaction of state fisheries department personnel as well as State Agriculture Universities and other Research Institutes.

## 1.0 INTRODUCTION

### Review of the status of Fisheries/Aquaculture

#### *Fish as food and fisheries/aquaculture as a means of subsistence*

The importance of fish as a food source becomes increasingly clear as we consider the limitations of other options. Global supplies and consumption of staple plant-based foods like grains and legumes have plateaued. Additionally, meat production is dominated by a small number of bird and mammal species (around four and five, respectively). With limited potential for growth in traditional protein sources, fish emerges as a crucial player in ensuring a nutritious diet for the Indians, whose diet is largely composed of cereals. Fish are a rich source of protein, and increased consumption can help combat malnutrition, particularly as dairy and poultry may not be sufficient to meet everyone's needs.

#### **Globally, fisheries and aquaculture play a critical role in sustaining livelihoods.**

Based on the most recent data from the Food and Agriculture Organization of the United Nations (FAO), specifically their 2024 report, shows that:

An estimated 61.8 million people were employed in the primary production sector of fisheries and aquaculture in 2022. The majority of these workers are in Asia. The sector's role in global food security and nutrition continues to be vital.

Fish remains a popular and widely consumed food source worldwide, with production steadily increasing. In 2022, global fisheries and aquaculture production of aquatic animals reached a new high of 185.4 million metric tons. For the first time on record, aquaculture production surpassed capture fisheries. This production was split between:

- Aquaculture (farmed fish): 94.4 million metric tons
- Capture fisheries (wild-caught fish): 91.0 million metric tons

#### *India's Thriving Fisheries and Aquaculture Sector*

India boasts the title of the world's third-largest fish producer, contributing 7.56% to global food production in this sector. Notably, India ranks second globally in aquaculture production, trailing only China. This thriving industry has not reached its full potential yet, with vast underutilized land resources available.

#### **Fish consumption and production**

Since the 1960s, global seafood consumption has surged. Average annual consumption has increased by about 3% each year, outpacing population growth (1.6%).

#### **Per Capita Consumption Trends:**

Per capita seafood consumption has more than doubled since the 1960s. In that decade, people ate an average of just 9.9 kg of seafood annually. By 2019, this figure had reached a record high of 20.5 kg. While there was a slight decline to 20.2 kg in 2020, experts anticipate continued growth.

**Outlook:**

Rising incomes, urbanization, improved food preservation, and changing dietary preferences are expected to drive a 15% increase in seafood consumption by 2030. This translates to an average annual consumption of approximately 21.4 kg per person.

**Growth and Potential of India's Fisheries Sector**

Fish is a staple food for a large portion of the Indian population, generating strong domestic demand that fuels the country's fishing industry, with shrimp aquaculture being a particularly strong area. India's fish production has shown impressive growth, averaging 8% annually over the last eight years. In the financial year (FY) 2021-22, the sector achieved a record-breaking total of 16.24 million metric tonnes (MMT), comprising 4.12 MMT from marine fisheries and 12.12 MMT from aquaculture. This ranks India as the world's third-largest fish producer and the second-largest aquaculture producer. Inland fisheries are the major contributor to the sector, with freshwater aquaculture being the primary component, accounting for approximately 76% of all inland fish production. While India has achieved significant growth in fish production since independence, there remains substantial untapped potential. For instance, as of FY 2020-21, estimates indicated that only about 66% of the marine fisheries potential and 51% of the inland fisheries potential had been realized.

**Key Points:**

- Fish is a major dietary component for many Indians.
- Shrimp aquaculture is a significant growth area.
- India is the world's third-largest fish producer and second-largest aquaculture producer.
- Inland fisheries contribute substantially to total production.

There's significant untapped potential in both marine and inland fisheries.

**Note:** While the overall growth in the Indian fisheries sector is undeniable, it is essential to consider regional variations, challenges such as overfishing and the need for sustainable practices.

**India's fisheries and aquaculture sector is a global powerhouse.** The nation is a leading exporter of seafood, commanding over 15% of the world's shrimp market. India also exports significant quantities of frozen fishlike catfish, pangasius and tilapia, etc.

This thriving industry contributes substantially to the Indian economy, accounting for 1.09% of GDP and a remarkable 6.72% of agricultural GDP. As the world's fifth-largest exporter of fish and fisheries products, India has successfully established "Brand India" on the global stage.

The sector employs over 20 million people directly and sustains countless more jobs across the value chain. Generating annual revenue exceeding Rs. 1.75 lakh crore through exports, fisheries, and aquaculture is vital to India's economic growth.

Haryana, primarily an agricultural state, has traditionally faced challenges in fish culture due to limited water resources and a predominantly vegetarian population. However, the state is transforming.

### **Aquaculture Practices in India**

India supports two primary forms of aquaculture: freshwater and brackish water cultivation. Freshwater aquaculture encompasses the rearing of aquatic life in inland water bodies. Popular freshwater species include carp varieties like catla, rohu, mrigal and magur, along with freshwater prawns and ornamental fish species.

Brackish water aquaculture, on the other hand, involves cultivating marine species in water with a salinity level between freshwater and seawater. Common brackish water inhabitants raised in Indian states like Haryana, Panjab, Rajasthan and Uttar Pradesh include tiger shrimp and mud crabs, etc. Fish farmers in these areas typically nourish their aquatic stock with a diet composed of fishmeal, oil cakes, and rice bran etc.

**Haryana's Thriving Fish Culture:** Haryana, once a less developed region carved out of Punjab in 1966, has become a prosperous state in India. Its abundant water resources, including rivers, canals, lakes ponds, provide a strong foundation for fisheries development. However, fish farming faces some challenges due to the limited presence of traditional fishing communities and a largely vegetarian population. Despite these challenges, Haryana's fish culture has seen impressive growth. In 1966-67, only 58 hectares of pond area were used for fish farming, producing a mere 600 tonnes annually, which has been increased by covering 20518-hectare area under fish culture by stocking 8164 Lakh fish seed raising 2.15 Lakh MT of fish during the year 2023-24. It is targeted to bring about 24765-hectare area under fish culture and to produce 2.33 Lakh MT of fish during the financial year 2024-25.

Motivated by the economic benefits, farmers adopted fish farming in the 1980s. Today, Haryana is a major supplier to the Delhi market. The state has achieved self-sufficiency in fish breeding and is recognized as a "fish disease-free state."

### **Future Challenges and Solutions**

With most village ponds already utilized, future growth requires innovation. Limited land availability due to population pressure and development necessitates exploring alternative areas like waterlogged and saline lands. Sustainable practices, diversification, and technological advancements are crucial for future success. Addressing aquatic biodiversity conservation, market linkages, research and development and a supportive policy framework are also essential.

## 2.0 GOALS OF WORKING GROUP REPORT

The Sustainable Development Goals (SDGs) are the foundation of the 2030 Agenda, adopted by all UN member states in 2015. To achieve them, eradicating poverty and hunger is essential, especially as we work to feed a projected 9.7 billion people by 2050. The fisheries sector, a vital component of this effort, generates income, employment, and a source of low-cost protein, particularly for vulnerable populations, thereby bolstering food security and providing valuable foreign exchange.

### Purpose and Objectives

The working group report on fisheries development in Haryana will examine the interplay between fish production and sustainability. While focusing on progress towards sustainable fisheries, environmental protection and resource management, the report will also seek to:

- **Foster collaboration:** Facilitate dialogue between the production and sustainable development sectors to achieve a comprehensive understanding of both.
- **Enhance fisheries management:** Manage and conserve natural fisheries resources, optimize utilization of water resources for fish farming and create a skilled workforce in the sector.
- **Boost fish production:** Increase quality fish seed production, explore alternative aquaculture sites, and generate rural employment.
- **Improve fish value chain:** Ensure hygienic fish marketing, efficient transportation, and promotion of value-added products.
- **Strengthen social and economic aspects:** Provide social and economic security for fishers.
- **Develop integrated management approaches:** Identify practical methods for addressing the complex relationship between production and sustainability at all levels of decision-making.

### Main Challenges

- **Conceptual framework:** Developing a comprehensive approach to balancing production and sustainability.
- **Policy integration:** Aligning policies, strategies, laws and regulations to support both production and sustainability.
- **Decision-making:** Incorporating production and sustainability considerations into decision-making processes.
- **Stakeholder engagement:** Integrating societal perspectives, including technical, environmental, social and economic factors, into decision-making.
- **Practical implementation:** Gaining practical experience in integrating production and sustainability.
- **Capacity building:** Developing the necessary skills and knowledge for sustainable fisheries management.
- **Collaboration:** Fostering cooperation at regional and national levels to achieve shared goals.

### 3.0 CURRENT STATUS OF FISHERIES IN HARYANA

#### Status of Fisheries: Resources and Production

##### Fisheries Resources

The main aquatic resources from a fisheries perspective in the Haryana are shown in Table 3.1, while the total available aquatic resources from a fisheries perspective in the state of Haryana, including rivers, canals and drains as on 2021-22 as reported by DoF are shown in Table 3.2, which also shows Fisheries production from different aquatic sources during the year 2021-22.

**Table 3.1. The main sources of fisheries development in the State during the year 2021-22 are given as under:**

S. No.	Item	Unit
1.	Number of Ponds	11800 (approx.)
2.	No. of farmers (directly and indirectly)	16993.00 (approx.)
3.	Saline/Water Logged Area (Ha)	145054.00
4.	Critically Saline Affected area (Ha)	20000.00
5.	Rivers and its tributaries (Km)	5000.00
6.	Govt. Fish Seed Farms (No.)	15
7.	Private Fish Hatcheries (No.)	19
8.	Research & Training Institutes (No.)	1
9.	Training Sub-Centres, Jyotisar (No.)	1
10.	Fish Markets (No.)	5
11.	Field Offices (No.)	114

**Table 3.2. Fisheries production from different sources during the year 2021-22**

S. No.	Resources	Production (in tonnes)
1.	River & Canals	10231.26
2.	Lakes & Reservoirs	200
3.	Private Ponds	40876.83
4.	Lease Ponds	156177.93
5.	Other Resources	1547.3
	<b>Total fish production</b>	<b>209,033.32</b>

Progress report of the Fisheries Department, Haryana, for the years 2020-21, 2022-23 and 2023-24 is shown in Table 3.3. 3.4 and 3.5. These tables show an increasing trend in the area brought under fish culture, seed stocking, production, training imparted to fish farmers and fish seed production (both under the Government and

the private Sector). This indicates good efforts on the part of the Directorate of Fisheries, Haryana.

**Table 3.3. Progress report of Fisheries Department Haryana up to March 2021**

Sr. No.	Items	Unit	Achievements	
			Targets	Achievements
<b>A.</b>	Physical			
1.	Area under fish culture	Hect.	22000.00	18207.06
2.	Fish seed stocking	Lakh	1882.00	2925.31
3.	Fish Production	Tonne	260000.00	203160.11
4.	Training to Fish farmers	No.	3000.00	5579.00
<b>5.</b>	<b>Fish Seed Production</b>			
	(i) Govt. Sector	Lakh	1881.00	958.71
	(ii) Pvt. Sector	Lakh	9240.00	6506.00

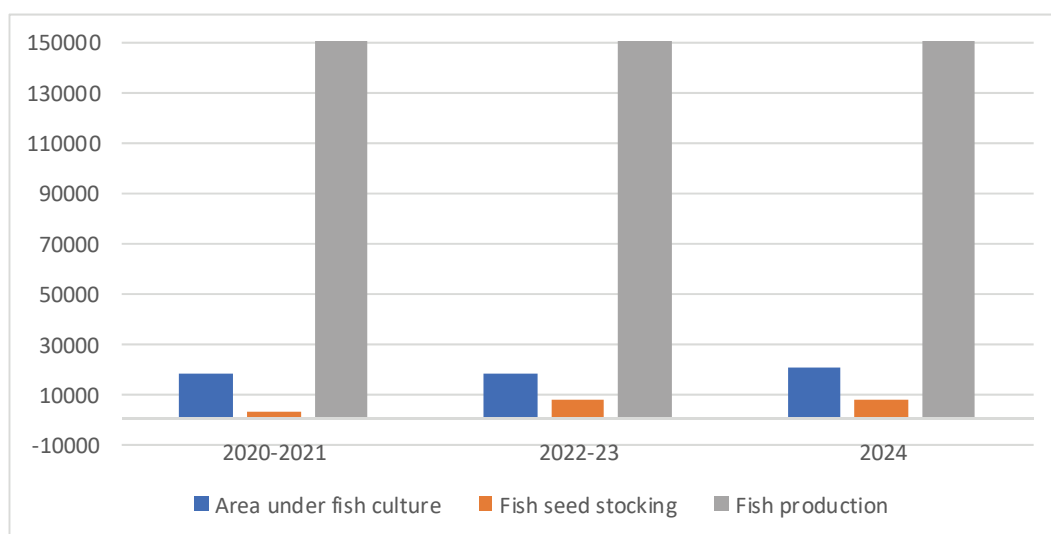
**Table 3.4. Progress report of the Fisheries Department Haryana up to 2022-23**

Sr. No.	Items	Unit	Achievements	
			Targets	Achievements
<b>A.</b>	Physical			
1.	Area under fish culture	Hect.	22650.00	18015.00
2.	Fish/Shrimp seed stocking	Lakh	5300.00	7862.00
3.	Fish Production	Tonne	210500	212042.00
4.	Training to fish farmers	No	8527.00	5766.00
<b>5.</b>	<b>Fish Seed Production</b>			
	(i) Govt. Sector	Lakh	2500	2272.5

**Table 3.5 Progress report of the Fisheries Department, Haryana up to March, 2024**

Sr. No.	Items	Unit	Achievements	
			Targets	Achievements
<b>A.</b>	Physical			
1.	Area under fish culture	Hect.	24250.00	20518.29
2.	Fish/Shrimp seed stocking	Lakh	5575	8164.2
3.	Fish Production	Tonne	216310	215173.55
4.	Training to fish farmers	No.	8500	5226
<b>5.</b>	<b>Fish Seed Production</b>			
	(i) Govt. Sector	Lakh	2500	2264.69

**Fig 3.1: Progress report of the Fisheries department, Haryana from 2020-24**



The State's fisheries development program focused on pond aquaculture, as detailed in Table 3.6, which presents annual fish seed stocking data. The department brought 19,100 hectares of water under fish cultivation by stocking 634.65 crore high-quality fish seeds in 9,530 ponds. This resulted in a fish production of 212,042.51 metric tons from private/leased ponds, RAS and Biofloc units, etc. In the financial year 2021-22, an additional 1,009.95 hectares were incorporated into fish culture. The Department extended financial support of Rs. 222.67 crore to fish farmers for aquaculture activities during the same period, as reported by the Department of Fisheries.

**Table 3.6. Year-wise Fisheries development programme of the State in ponds**

S. No.	Year	Area (ha)	Stocking (lakh)
1.	2013-14	16350.09	5193.85
2.	2015-16	17800	6400.00
3.	2016-17	18975	7665.65
4.	2017-18	18550	2205.87
5.	2018-19	16430.23	2216.5
6.	2021-22	19100	6346.5

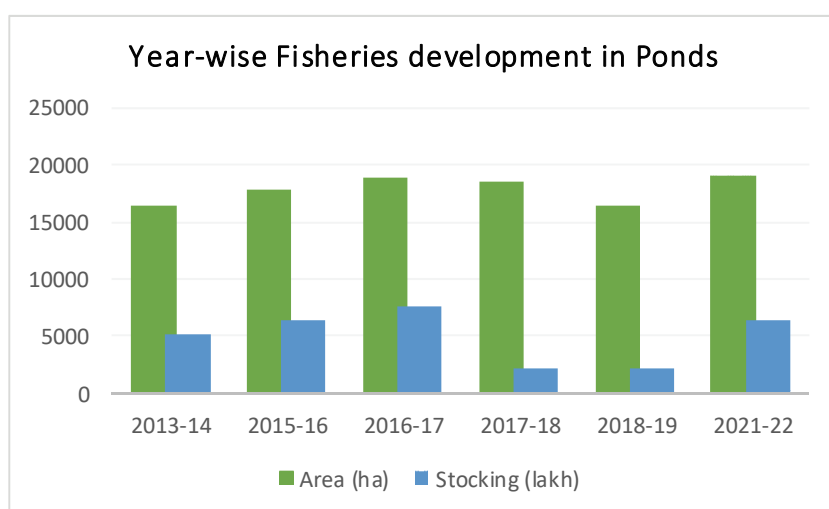
Source: - DoF, Haryana

### Utilization of Water Bodies for Fisheries

**Conservation and Management of Fish Stocks:** The Fisheries Department oversees the protection and management of fish populations in designated rivers, canals and lakes (Notified Waters) under the Punjab Fisheries Act, 1914 and Haryana Fisheries Rules, 1996. Fishing rights in these areas are granted through a transparent public online auction process. In the financial year 2021-22, this generated Rs. 141.74 lakh in revenue for the department. Contractors harvested a

total of 10,231.26 metric tons of fish from Notified Waters during the same period. No cases of illegal fishing were penalized under the Act in 2021-22.

**Fig 3.2: Year-wise Fisheries development programme of the State in ponds**



**Fisheries Development Program:** As outlined in Table 3.7, the state implements a fisheries development program for lakes and reservoirs. This program involves stocking fish fry and monitoring fish production. In 2021-22, the department stocked 37 lakh fish fries in lakes and reservoirs covering a total water area of 36.40 hectares. This resulted in a fish production of 200 metric tons.

**Challenges and Opportunities:** Fish production in ponds, lakes and reservoirs is increasing, while fisheries in rivers, streams and drains (3406.8 km) are declining. The extensive network of irrigation canals and distributaries (16647.3 km) offers significant potential for fisheries development but is currently underutilized and susceptible to unsustainable fishing practices.

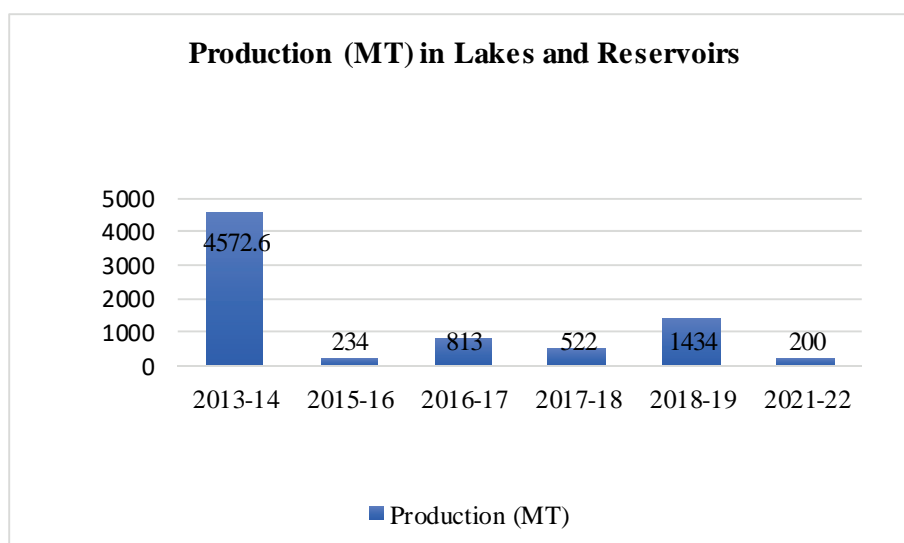
**Leasing Arrangements:** The state leases lakes and reservoirs to fisheries cooperative societies or private contractors through a competitive auction process as stipulated in the Haryana Fisheries Rules, 1996 (enacted under the Punjab Fisheries Act, 1914).

**Table 3.7. Year-wise Fisheries development program of the State in Lakes and Reservoirs**

S.No.	Year	Area (ha)	Stocking (lakh)	Production (MT)
1.	2013-14	12	6	4572.6
2.	2015-16	96	44.8	234
3.	2016-17	152.9	67.7	813
4.	2017-18	95	26.25	522
5.	2018-19	51	68	1434
6.	2021-22	36.4	37	200

Source- DoF, Haryana

**Fig 3.3: Production from Lakes and Reservoirs**



**Fish Production during the year 2021-22: A Remarkable Journey**

Haryana's fish production has witnessed a remarkable surge from a mere 600 metric tons (MT) in 1966-67 to an impressive 210,500 MT in 2022-23. This substantial growth is particularly noteworthy given the challenges posed by declining fish populations in natural water bodies.

The Department of Fisheries has played a pivotal role in optimizing fish production within the state's limited water resources. By effectively utilizing all available water bodies for aquaculture and providing comprehensive support to fish farmers through training, guidance and financial assistance, the department has successfully brought over 80% of Haryana's village ponds into fish farming. Moreover, the department is committed to increasing fish productivity from 9,600 kg/ha/yr to 10,000 kg/ha/yr during 2022-23.

Data from 2021-22 indicates that lease ponds were the most productive fish farming source, followed by private ponds. Lakes and reservoirs recorded the lowest production levels (Table 3.8).

**Table 3.8. Fish production from different sources during the year 2021-22**

S. No.	Resources	Production (in tonnes)
1.	River & Canals	10231.26
2.	Lakes & Reservoirs	200
3.	Private Ponds	40876.83
4.	Lease Ponds	156177.93
5.	Other Resources	1547.3

**Haryana: A Leader in Aquaculture:** While fish farming has been a tradition in many parts of India, Haryana's journey in this sector is relatively young. Yet, in less than four decades, it has become a significant player. Notably, Haryana boasts the second-highest average annual fish production per unit area in the country compared to the national average. The state has also attained self-sufficiency in seed production for Indian Major Carp and Common Carp.

Table 3.9 represents Haryana's total fish production in 2022-23 reached a commendable 212,042.51 MT, cultivated across 19,100 hectares with an impressive average productivity of 10.94 tons/ha.

**Table 3.9. Year-wise total fish production of the State (Source- DoF, Haryana)**

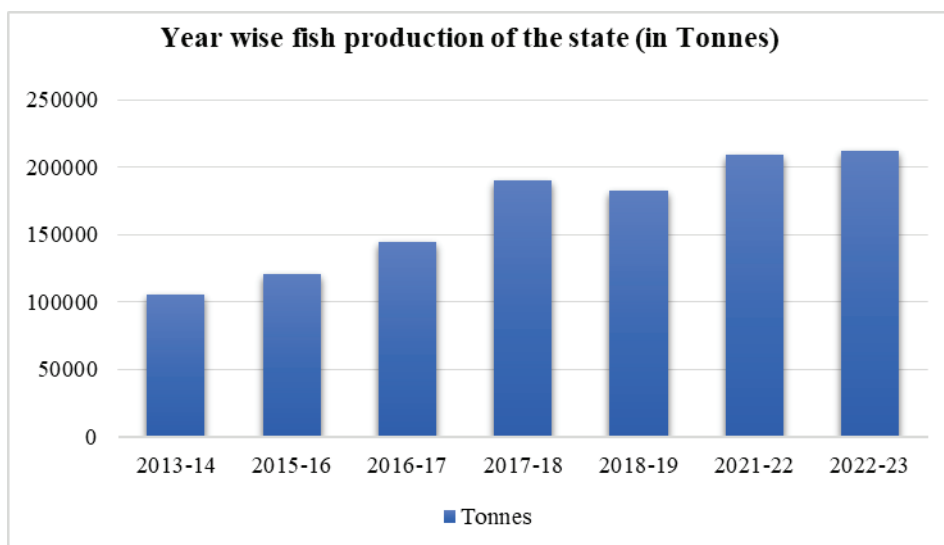
S.No.	Year	Tonnes
1.	2013-14	105266.9
2.	2015-16	121000
3.	2016-17	144210
4.	2017-18	190000
5.	2018-19	182147.6
6.	2021-22	209033.3
7.	2022-23	212042.51

The Gross Value Added (GVA) from agriculture, including crops and livestock, was estimated at Rs. 81,378.74 crore in 2021-22, growing by 2.3%. Meanwhile, forestry and logging contributed Rs. 3,946.55 crore (4.8% growth) and fishing added Rs. 1,842.38 crore (8.0% growth). Together, agriculture and allied sectors comprised 16.9% of the overall GVA at constant 2011-12 prices (Table 3.10).

Forestry and fishing accounted for only about 5% and 2% of the agricultural GVA, respectively, which limited their impact on overall agricultural growth. Although the fisheries sector demonstrated impressive growth in 2021-22, in line with a national trend, its relatively small contribution to Haryana's agricultural GVA hindered its ability to significantly influence the state's overall agricultural growth rate.

When reviewing district-wise growth, fish production grew much faster than the state average in the districts of Sirsa, Kaithal, Hisar, Panipat, and Fatehabad. Meanwhile, productivity grew faster than the average in the major districts of Gurugram, Karnal, Hisar, Rohtak, and Mewat. The almost negligible or negative productivity growth in the districts of Sirsa, Faridabad, Jind, Jhajjar, Kaithal, and Yamunanagar requires further investigation and attention.

**Fig 3.4: Graphical representation of year-wise total fish production of the State (Source- DoF, Haryana)**



**Table 3.10. GVA from Agriculture & Allied Sectors at Constant (2011-12) Prices (Rs. in Crore) in the year 2021-22, Haryana**

S.N o.	Sector	Crops & Livestock	Forestry & Logging	Fishing	Agriculture & Allied
1.	2011-12	59785.53	3894.90	858.43	64538.86
2.	2014-15	58778.74 (-2.8)	3897.24 (6.0)	900.64 (5.3)	63576.61 (-2.2)
3.	2015-16	61034.66 (3.8)	3984.38 (2.2)	1003.17 (11.4)	66022.21 (3.8)
4.	2016-17	67216.40 (10.1)	2871.82 (-27.9)	1178.37 (17.5)	71266.59 (7.9)
5.	2017-18	71349.75 (6.1)	3372.29 (17.4)	1567.94 (33.1)	76289.98 (7.0)
6.	2018-19	77912.76 (9.2)	3735.89 (10.8)	1537.34 (-2.0)	83185.99 (9.0)
7.	2019-20	81901.41 (5.1)	3739.50 (0.1)	1558.18 (1.4)	87199.09 (4.8)
8.	2020-21 (Q)	79524.82 (-2.9)	3764.76 (0.7)	1705.98 (9.5)	84995.56 (2.5)
9.	2021-22 (A)	81378.74 (2.3)	3946.55 (4.8)	1842.38 (8.0)	87167.66 (2.6)

Q: Quick Estimates A: Advance Estimates \* Figures in brackets show the percentage growth over the previous year. Source: Department of Economic & Statistical Analysis, Haryana (Source-Economic Survey 2021-22, GoH)

### **Performance of Pradhan Mantri Matsya Sampada Yojana (PMMSY) Scheme**

India's fisheries and aquaculture sectors have grown significantly in recent years, driven by a focus on modernization and sustainable economic development. To align with the Prime Minister's vision of doubling farmer income and achieving self-sufficiency (Atmanirbhar Bharat), the Pradhan Mantri Matsya Sampada Yojana (PMMSY) was launched in the 2019-20 Union Budget.

### **Aims and objectives of PMMSY**

The PMMSY is a major government initiative with a substantial investment of 20,050 crores. Its core objective is to promote the comprehensive growth and development of India's fisheries sector. The scheme specifically addresses key challenges by:

- Bridging significant productivity and production gaps.
- Introducing innovation and cutting-edge technology.
- Improving post-harvest infrastructure and management.

### **Ambitious Goals for 2025**

The Pradhan Mantri Matsya Sampada Yojana (PMMSY) has set ambitious goals for 2025 to boost economic growth and consolidate gains in the fisheries sector. The primary targets include:

- Increasing fish production by 70 lakh metric tonnes (MT) and boosting aquaculture productivity from 3 to 5 tonnes per hectare.
- Doubling exports from 46,589 crores to 100,000 crores.
- Doubling the incomes of fishers and fish farmers.
- Creating over 55 lakh job opportunities.
- Ensuring the social, physical, and economic security of fishers and fish farmers.
- Utilizing the potential of fisheries in an equitable, responsible, inclusive, and sustainable way.
- Creating a robust regulatory and management framework for the sector.

As of December 2021, under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), proposals totaling Rs 11295.12 crores were received from various States and Union Territories (UTs). Of these, project proposals worth Rs 5584.74 crores have been approved, with the Centre contributing Rs 1975.63 crores.

During the financial year 2021-22, the department disbursed a total of Rs 2226.69 lakhs in subsidies to fish farmers in Haryana. These subsidies were distributed under the centrally sponsored PMMSY scheme and various State schemes, including the "Intensive Fisheries Development Programme" and the "Welfare of Scheduled Cast Families under the Fisheries Sector."

- **Kisan Credit Card (KCC)**
- The Kisan Credit Card (KCC) scheme was extended to fishers and fish farmers in 2018-2019. This was done to help them meet their working capital needs, such as for fuel, ice, and other operational costs.
- The credit limit for KCC holders in the fisheries sector is typically up to 2 lakh. However, those with existing KCCs may have a higher limit, often up to 3 lakh, under a different scheme for agriculture. The limit can also vary based on the bank and the farmer's credit history.

- As of early 2022, a significant number of KCCs had been issued to fishers and fish farmers. The specific number 1.09 lakh as of December 31, 2021, is consistent with reports from that period, indicating the scheme's growing reach.

### Fish seed production and hatcheries

During the year 2020-21, 18,209 ha area was brought under fish culture by stocking of 2,925.31 lakh fish seeds producing 2,03,160.11 MT fish.

Similarly, during the year 2021-22 (up to October 2021) an area of 15,929.48 hectares has been brought under fish culture against the target of 23,652 ha by stocking of 3,931.69 lakh fish seed against the target of 4,400 lakh fish seed and 1,09,407.20 MT fish produced against the target of 2,20,000 MT fish production.

Table 3.11 illustrates the fisheries development of Haryana during the year 2021-22. To produce fish seed through induced breeding, 6399 pairs of Indian Major Carp fish and 3295 pairs of Common Carp fish were bred at different Govt. Fish Seed Farms of the State during the year 2021-22. Quality fish seed of Indian Major Carp (IMC) and Common Carp (CC) to the tune of 1305.88 lakh and 622.00 lakh seed respectively, i.e. total of 1927.88 lakh seed was produced at various fish seed farms of the State. In addition to this, 9814.60 lakh fish seed were produced by the private fish hatcheries with a total revenue of Rs. 549.80 Lakhs.

**Table 3.11. Data regarding fisheries development during different years and in different districts**

Year/ District	Area stocked in hectares	Fishing licenses issued (Number)	Total receipts from fisheries (` 000)	Number of cases detected without licenses	Compen sation realized (`)	Sale of confiscat ed fish (`)
1966-67	222	161	367	81	553	--
1970-71	155	2,789	578	116	1,797	609
1980-81	295	2,975	2,583	66	1,245	178
1990-91	2,078	3,189	8,728	8	1,135	320
2010-11	17,094	7,239	50,84,326	388	5,640	850
2018-19	17,935	6,440	2,00,000	5	45,765	34,820
2019-20	17,119	2,936	10,355	--	--	--
2020-21	18,209	1,016	15,446	169	3,100	--
Ambala	448	52	251	--	--	--
Bhiwani	1,020	1	196	--	--	--
Charkhi	614	--	--	--	--	--

<b>Dadri</b>						
<b>Faridabad</b>	472	--	--	--	--	--
<b>Fatehabad</b>	912	2	--	--	--	--
<b>Gurugram</b>	318	--	443	--	--	--
<b>Hisar</b>	1,664	--	1,803	--	--	--
<b>Jhajjar</b>	1,389	--	1,161	--	--	--
<b>Jind</b>	893	11	562	--	--	--
<b>Kaithal</b>	902	--	149	--	--	--
<b>Karnal</b>	852	1	1,837	--	--	--
<b>Kurukshetra</b>	481	--	388	--	--	--
<b>Mahendragarh</b>	158	--	--	--	--	--
<b>Nuh</b>	1,632	--	--	--	--	--
<b>Palwal</b>	1,234	--	--	--	--	--
<b>Panchkula</b>	149	--	--	--	--	--
<b>Panipat</b>	845	10	2,940	--	--	--
<b>Rewari</b>	604	--	73	--	--	--
<b>Rohtak</b>	860	10	931	--	--	--
<b>Sirsa</b>	1,187	--	--	--	--	--
<b>Sonapat</b>	1,119	4	3,286	150	1,500	--
<b>Yamunanagar</b>	<b>456</b>	<b>925</b>	<b>1,426</b>	<b>19</b>	<b>1,600</b>	--

**Source- Fisheries Department, Haryana, 2022, Department of Economic and Statistical Analysis, Haryana, 2022**

### **Fish Hatcheries**

The state has a total of 31 fish seed hatcheries: 15 are government-operated under the Department of Fisheries (DoF) and 16 are privately owned. These hatcheries, which span 74.51 hectares, primarily focus on producing Indian major carps like Catla, Rohu, and Mrigal.

Fish seed is a vital component of aquaculture, and the 15 government farms are responsible for supplying quality seed to farmers throughout the state. To obtain

seed, farmers must deposit Rs. 65 per thousand fish with the respective Fisheries Farm Manager. The seed is then delivered within 15 days of the deposit.

Seed distribution is seasonal. Major carps are typically available between June and August, while other species are distributed from February to March. While all culturable fish species—including Catla, Rohu, Mrigal, Common Carp, Silver Carp, and Grass Carp—are available from government farms, recent production data reveals a significant disparity. In 2021-22, the 15 public farms supplied only 30% of the state's total fish seed, with private hatcheries accounting for the remaining 70%. This highlights a concerning underperformance within the public sector's fish seed production.

**Public Sector Hatchery and Seed Farm Performance:** The underperformance of many hatcheries (DoF) and seed farms can be attributed to a complex interplay of factors. While infrastructure constraints such as water scarcity, seepage and outdated designs certainly contribute, management issues seem to be the primary culprit. These include:

- **Insufficient broodstock:** Lack of adequate brooders hinders production capacity.
- **Inbreeding depression:** It is another bottleneck in enhancing breeding programs
- **Staffing shortages:** Inadequate technical personnel limit hatchery operations and expertise.
- **Bureaucratic hurdles:** Delays in procuring essential supplies due to administrative procedures can disrupt operations.

**Shifting Focus:** Given the readily available and well-established technology for carp seed production and considering the private sector's proven track record of higher efficiency in this area (as evidenced by data from Haryana and other Indian states), it might be prudent to reallocate public sector funds to domains where private participation is less prominent or where government intervention can offer a distinct advantage.

#### 4.0 CAPTURE FISHERIES RESOURCES OF HARYANA

Rivers, lakes, dams, canals, and drains are indeed significant sources for capture fisheries in Haryana; however, capture fishery resources have already attained a plateau. The state's primary focus has shifted towards aquaculture in recent years due to declining natural fish populations.

##### Key Points:

**Water Bodies:** Haryana boasts 14 rivers and rivulets, with the Yamuna and Ghaggar being the most prominent for fisheries. There are also 94 drains and three major canal systems (Western Jamuna Canal System, Bhakra Canal System and Lift Canal System).

**Fish Production:** Haryana's ranking as the second in average annual fish production per unit area in India is commendable. Nevertheless, it is essential to note that this achievement is primarily attributed to aquaculture and not to capture fisheries.

**Declining Natural Fisheries:** Fish production from natural water bodies has seen a considerable decline due to factors like pollution, overfishing or irresponsible fishing and habitat degradation.

**Conservation Efforts:** To mitigate the decline, authorities have implemented measures such as stocking Mahseer and Indian major carp fish seed in natural waters, imposing a closed season during the monsoon and promoting angling/sports fisheries with a conservation focus.

**Challenges:** Despite the progress, the fisheries sector in Haryana still faces several challenges. These include water scarcity, water salinity, and waterlogging, which are particularly acute due to the state's landlocked geography. Additionally, pollution and the lack of a robust market infrastructure hinder growth. Other significant challenges are the shortage of quality fish seed and feed, frequent disease outbreaks, and inadequate post-harvest management, which lead to substantial losses. Moreover,

A key challenge for India's fisheries sector is its low biodiversity index of cultivable aquatic species. The country's aquaculture is highly dependent on a narrow selection of only 13-15 species, a number that is likely even smaller in states like Haryana. This includes popular freshwater and brackish water species like Major carps (catla, rohu and mrigal), and certain species of shrimp and prawns. This limited range is a stark contrast to nations like China, which cultivates around 86 species, and Bangladesh, which utilizes approximately 31.

**NB:** The lack of species diversity is a major constraint on the sector's growth, resilience, and long-term sustainability. Expanding the range of cultivable species is crucial for mitigating risks and unlocking the full potential of India's Blue Economy.

Furthermore, **limited access to credit and insurance** and the growing threat of **climate change** present significant risks to the sustainability and profitability of the sector.

### **Ornamental Fisheries**

#### ***Ornamental Fish in India: A Vibrant Hobby with Untapped Potential***

The captivating beauty of ornamental fish has enthralled people for centuries. Fishkeeping has become a popular hobby worldwide. India has a large domestic market but a small share of the global trade. There's potential for growth in aquaculture. Most ornamental species can be bred in India. By harnessing this potential, India can become a major player in global trade. These fish can be categorized as egg-layers or live-bearers. For hobbyists in Haryana, many captivating ornamental fish species are perfect for aquariums, including goldfish, angelfish, fighter fish, gouramis, guppies, platies, mollies, barbs, swordtails and koi carp.

The department provides Technical and Financial Assistance for establishing an Ornamental fish hatchery. Hi-tech and Ultra-Modern Ornamental Fish Hatchery in Jhajjar is the only project in North India approved by the Govt & will be established at a cost of 13.68 Crore.

#### **Social Significance of Ornamental Fisheries**

**Employment generation:** Provides livelihood opportunities, especially for rural and peri-urban populations.

**Community development:** Can foster a sense of community among fish enthusiasts and breeders.

**Aquascaping and therapy:** Ornamental fishkeeping is a popular hobby with therapeutic benefits, reducing stress and promoting relaxation.

#### **Economic Significance of Ornamental Fisheries**

- **Export potential:** A global industry with high export value, contributing to foreign exchange earnings.
- **Income generation:** Offers a stable income source for fish farmers and related businesses.
- **Market creation:** Stimulates the growth of related industries like aquarium equipment, feed and accessories.
- **Diversification:** Provides an alternative income source for farmers and fishers.

Overall, ornamental fisheries contribute to economic growth, poverty reduction, and social well-being.

### **Fish Markets and Consumption: Improving the System**

Efficient fish marketing is crucial for both fish producers and consumers. It ensures timely availability and fair prices for fish, while also supporting the growth of the fishery sector. To support fish producers, the Fisheries department has established five fish markets in Faridabad, Panipat, Yamuna Nagar, Bahadurgarh and Gurgaon. The Haryana State Agriculture Marketing Board oversees these markets. To facilitate transportation, vehicles are available at subsidized rates for fish farmers to

transport their catch/produce from ponds to the markets. Given the large and growing Delhi/NCR market and Haryana's proximity, fish marketing is generally unhindered. Additionally, farmers near Delhi have developed a successful strategy of harvesting fish at 600-700 grams and transporting them live to the Delhi fish market for premium prices.

### **Current Challenges**

**Limited infrastructure:** Fish farmers often struggle to reach consumers due to inadequate local markets. This forces them to transport fish to distant markets like Delhi, incurring extra costs.

**Shrimp marketing problems:** Shrimp farmers in specific regions (Bhiwani, Jhajjar, Hisar) face difficulties in marketing their produce.

### **Initiatives and Solutions**

**Market development:** The establishment of new fish markets and strengthening existing ones will create more local selling opportunities.

**Training and infrastructure:** Providing training on post-harvest practices and establishing cold storage facilities would minimize spoilage and maximize profits for farmers.

## **5.0 MAIN OBJECTIVES AND EXTENSION ACTIVITIES OF THE DIRECTORATE OF FISHERIES**

**Presently, the DoF is undertaking following objectives and activities that are focused on the following objectives:**

- To manage and conserve the natural fisheries in rivers, canals, drains and other water bodies.
- To utilize available village ponds and tanks for fish farming.
- To provide technical and financial assistance to fish farmers
- To create a class of trained fish farmers in the state.
- To increase the production of quality fish seeds of all species.
- To utilize unused waste agricultural land for fish farming.
- To create additional employment opportunities in rural areas.

**The following infrastructure facilities are already available with DoF for fisheries activities:**

- 15 State Govt. seed farms and 16 private seed hatcheries; One Training Institute (ARTI) at Hisar
- One Training Sub-Centre at Jyotisar and 114 Field officers with DoF.
- In addition, DoF has one Health Care Centre in each district, though Haryana has been declared as a disease-free State. Fifteen poly clinic aqua shops are available at every seed farm, while a full-fledged State diagnostic lab has been set up at ARTI, Hisar.

### **Technical and Financial Assistance**

- DoF provides technical assistance for several purpose like help in getting village ponds on lease for fish farming, help for loan for construction of fish culture unit, arranging training and refresher courses, soil and water analysis of pond sites, preparation of plan and estimates of ponds, supply of quality seed and feed, checking of fish growth, checking of fish diseases, help in fish harvesting and help in fish transportation and Marketing.
- **Subsidies to farmers:** The Department has enhanced the subsidy from 20% to 60% under the Central Sector Scheme on Blue Revolution for Excavation, renovation and inputs of ponds and development of waterlogged and saline-affected areas.

**Building a Skilled Workforce and Capacity Building for Fisheries Development in Haryana:** Developing a skilled workforce (human resource development) is essential for ensuring the long-term health of Haryana's fisheries industry.

- The World Bank Project played a key role in establishing the Aquaculture Research and Training Institute (ARTI) at Hisar.
- To further strengthen this initiative, the Haryana State Fisheries Department created a sub-training centre at Jyotisar (Kurukshetra).

**Boosting Efficiency through Training:** Training is essential for creating a skilled fish farming workforce and boosting efficiency. Structured training programs should be implemented for farmers, Department of Fisheries (DoF) personnel at all levels, and the trainers themselves. A comprehensive program should include:

- **In-service training:** Equipping departmental officers and officials with the latest knowledge and skills.
  - **Hands-on training:** Providing practical skills development for fish farmers.
  - **Refresher courses:** Keeping existing knowledge sharp and adapting to industry advancements.
  - **Study tours:** Exposing participants to best practices from other regions.
  - **Expanding Horizons:** Looking ahead, the training institute aims to train departmental officers/officials and fish farmers.
1. Fish farmers are imparted training regarding fish culture for 10 days in all District Offices. Training stipend @ Rs. 100/- per day is paid for 10 days and a Rs. 100/- as lump sum to and fro fair for trainees of Scheduled Caste Families.
  2. Five-day refresher courses and other trainings are imparted at Aquaculture Research and Training Institute, Hisar. Training stipend is paid as per Government-approved rates.
  3. Different study tours of Fish Farmers, Fishermen, Department employees/officers are organized from time to time, to make the training programmes more practical.

### **Strengthening ARTI**

**A Revitalization Plan:** The Aquaculture Research and Training Institute (ARTI) in Hisar requires significant enhancement. To achieve this, ARTI should be revitalized through adequate staffing, strategic collaborations, and expert recruitment. Partnerships with the Fisheries Faculty at Chaudhary Charan Singh Haryana Agricultural University (CCSHAU), Hisar and the Central Institute of Fisheries Education (CIFE) Rohtak Centre are essential.

**Expanding on Regular Training Programs for Aquaculture:** Offering regular training programs tailored to seasonal activities is a crucial component of supporting the aquaculture industry. Seasonal Aquaculture Practices include:

- Water Quality Management (Monitoring of DO, Temperature, pH, and salinity, etc.)
- Nutrients and Waste Management: Feed and Nutrient Optimization and Waste Identification and Minimization
- Feeding and Stocking Practices (Adjusting Feeding Regimes, Stocking Density)
- Pond and System Maintenance (Pond Preparation, Aeration, etc.)
- Harvesting techniques: Optimizing yield and quality based on seasonal factors.
- Disease prevention: Understand seasonal disease risks and their prevention.
- Feeding strategies: Keeping a check on seasonal nutritional requirements
- Care of brood fish, Breeding, and spawning

## Emerging Technologies and Trends

- **Sustainable aquaculture practices:** Exploring Hi-Tech aquaculture systems such as recirculating aquaculture systems (RAS), biofloc technology and also integrated farming.
- **Aquaponics:** Combining fish farming with hydroponic plant cultivation.
- **Automation:** improving efficiency and reducing labour costs.
- **New species and varieties:** Exploring the potential of emerging aquaculture species and their suitability for seasonal production.
- **Market analysis:** Identifying potential markets and export opportunities.
- **Promotion of value-added products:** Processing and packaging techniques

## 6.0 STATUS OF FISHERIES DEVELOPMENT IN HARYANA

### Shrinking Biodiversity

**Decreasing Production:** The contribution of rivers and lakes to overall fish production has dwindled to just 5%. This decline is attributed to the lack of knowledge of responsible fisheries among the masses, depletion of fish stocks in rivers like the Yamuna and Ghaggar, and the degradation of lakes due to human activities. These activities include shrinkage, siltation and even the complete disappearance of some water bodies.

- **Decline in fish diversity:** A study conducted by T. S. Rana and B. D. Joshi in 2014 found that the number of fish species in Haryana had declined from 82 species in 2004 to 59 species by 2014.

### Key Findings

- **Decline in Diversity:** The study documented a significant drop of 23 fish species over a decade.
- **Primary Causes:** The report attributed the decline to several factors, including:
- **Habitat Destruction:** Physical changes to the aquatic environment.
- **Pollution:** Contamination of water bodies from industrial and agricultural runoff.
- **Introduction of Exotic/invasive Species:** Non-native fish species competing with and displacing native ones, e.g., species like African Magur, Tilapia and Silver Carp
- **Fishing and Irrigation:** Unsustainable practices that reduce fish populations and alter water flow.

**NB: The decline is a serious ecological issue, as fish species are often indicators of a river's health. The study highlighted the urgent need for conservation efforts to protect the remaining native fish population.**

**In addition to the above, the decline could also be attributed to:**

- Overfishing
- Water usage for irrigation
- Global climate change

**Biodiversity Restoration:** A comprehensive study needs to be undertaken to document fish biodiversity and identify indigenous species requiring conservation. Initiatives should focus on protecting fish habitats and spawning grounds. Ranching of endemic fish species may be explored to gradually restore the aquatic ecosystem

**Fisheries Enhancement:** Lakes should be designated as fish sanctuaries, with commercial fishing replaced by sustainable practices like pen culture, cage culture and unobtrusive running water systems in canals. These practices will utilize the canal network for fish production without harming the environment. High-intensity cage culture systems in canals can also be explored for increased efficiency. The program aims to develop these water bodies as a source of high-quality broodstock and fish seed to support aquaculture in the state.

**The Path Forward:** Community-based management of water bodies, supported by effective policies and regulations, is seen as the most viable long-term solution. This approach would involve:

- Empowering fishers and farmers living near these water bodies as primary stakeholders in their management.
- Developing location-specific plans that consider eco-tourism potential.
- **To Create a Comprehensive Fisheries Policy:** Haryana needs a well-defined Fisheries and Aquaculture Development Policy addressing all key challenges. This should be accompanied by necessary legislative reforms and budgetary allocations for all programs. Advocate for equitable treatment of aquaculture compared to agriculture regarding water charges, electricity tariffs, farm loan interests, and export promotion policies. To mitigate financial losses, establish comprehensive calamity relief measures against floods, diseases, and other threats.

### Marketing and Infrastructure

**Invest in Marketing Infrastructure:** Priorities infrastructure and institutional support for marketing fish. Implement subsidies for transportation, cold storage facilities, and live fish markets. Encourage PPP (Public-Private Partnership) models for establishing fish retail shops in major cities to connect producers directly with consumers.

- The Delhi, Punjab and NCR regions exhibit robust demand for fish products. However, the sector's full potential remains untapped due to deficiencies in post-harvest management, storage, transportation, and value-added processing.

**Underutilized Processing Capacity:** The state's sole fish processing plant, a joint venture with the National Fisheries Development Board, operates below capacity. Marketing constraints are suspected to be a primary factor hindering its performance.

**Critical Need for Local Feed Production:** To sustain the aquaculture industry's growth trajectory, the establishment of local feed production facilities is imperative. The creation of at least one or two feed mills, potentially through public-private partnerships or private sector incentives, is recommended.

### Soil Salinization and Inland Water Salinity

**Aquaculture has emerged as a promising solution for barren, saline land.** Haryana has successfully transformed such areas into productive shrimp farms, significantly increasing farmers' incomes. This innovative approach has turned an ecological challenge into an economic opportunity. The Central Institute of Fisheries Education (CIFE) developed a technology for cultivating white leg shrimp using inland saline groundwater. With government support, Haryana has successfully implemented this technology, pioneering the use of saline water for shrimp farming. The state has made substantial progress in converting saline-affected areas into shrimp and brackish water fish farms through initiatives like the Rastriya Krishi Vikas Yojana (RKVY). And thus, groundwater salinity turns blessing in disguise for

the shrimp farmers.

Haryana aims to expand shrimp cultivation to 700 hectares of saline wasteland in the coming year. This initiative not only addresses the pressing issue of soil salinization but also contributes to the state's economy and food security.

ii) CCS Haryana Agricultural University, Hisar, has also conducted extensive studies on using inland saline water for promoting the culture of various euryhaline finfish species, such as mullet, milkfish, pearlspot and Nile tilapia, etc.

### **Environmental Issues or Environmental Perils of Shrimp Farming**

Inland shrimp farming using saline water can be a boon for Indian farmers, but it presents significant challenges. While these waters are a potential resource, they lack the necessary potassium and magnesium levels found in seawater and require fortification.

Maintaining potassium levels is a key challenge. The constant depletion of potassium due to soil absorption, harvesting, and water loss through drainage and seepage requires frequent replenishment.

Additionally, the large-scale use of saline water in shrimp ponds can lead to soil salinization and groundwater contamination. Releasing untreated wastewater pollutes nearby water bodies, threatening safe drinking water supplies and future agricultural productivity. If left unaddressed, these practices could leave the land barren, compromising long-term sustainability.

### **Key Environmental Concerns**

- **Water Contamination:** Untreated wastewater from shrimp ponds pollutes water sources, posing a threat to drinking water supplies and agricultural productivity.
- **Ecosystem Imbalance:** The use of large volumes of saline groundwater for shrimp farming increases soil salinity and contaminates nearby water sources. This increased salinity disrupts delicate ecosystems and impacts biodiversity.

### **Urgent Actions**

- **Soil degradation and Water Contamination:** Using large volumes of saline groundwater for shrimp farming can increase soil salinity and contaminate nearby water sources.
- **Wastewater Management:** Implement proper treatment systems for shrimp pond wastewater to prevent contamination of water sources.
- **Salinity Control:** Develop and use farming methods that minimize the use of saline groundwater to prevent soil degradation and the salinization of surrounding areas.
- **Ecosystem Protection:** Take measures to protect local ecosystems and biodiversity from the disruptive effects of shrimp farming.
- **Currently,** there are no clear guidelines for treating and managing wastewater from shrimp ponds, further amplifying this risk. Unprotected aquaculture practices may leave communities without safe drinking water in the future.

### **Sustainable Solutions for Shrimp Farming**

- **Water and Soil Management:** Promoting sustainable shrimp farming requires clear guidelines for water and soil safety. This includes using pond liners and implementing on-site wastewater treatment and safe discharge practices.
- **Land Reclamation:** Government and development agencies should focus on reclaiming affected lands through large-scale subsurface drainage projects. Rainwater harvesting can be combined with these efforts to dilute soil salinity and replenish groundwater.
- **Prioritize large-scale drainage projects to restore affected lands.**
- **Sustainable practices:** Implement strict guidelines for water and soil management, including pond liners and wastewater treatment.
- **Policy intervention:** Enforce regulations for responsible shrimp farming and provide support for sustainable alternatives.
- Failure to address these issues will have catastrophic consequences for both the environment and local communities.

“If we go with the definition of sustainability-“Sustainability can be defined as a balance between resource utilization and development to meet current needs while preserving future opportunities through planned and regulated management by communities and governments”.

Act now to protect our water resources and preserve future livelihoods.

- ii) Furthermore, **white leg shrimp is an exotic species**, and government regulations prohibit the cultivation of other species alongside it. Consequently, relying solely on white leg shrimp aquaculture may not be a sustainable approach for enhancing aquaculture production in Haryana or other regions.

## **7.0 ROLE OF HARYANA FISHERIES DEPARTMENT AND RESEARCH INSTITUTIONS/UNIVERSITIES IN FISHERIES DEVELOPMENT IN HARYANA**

The Haryana Fisheries Department plays a crucial role in implementing various fisheries development schemes formulated by the Government, research institutions, and universities. However, for these schemes to be truly effective, strong collaboration between the Haryana Fisheries Department and research bodies is essential. Without a consistent influx of new directions and technologies, the department's capacity to advance the fisheries sector is inherently limited.

Research institutions possess the expertise to develop new methodologies, techniques for fish culture and breeding and identify promising and emerging new fish and shellfish species for aquaculture. Thus, for the welfare of the state, the working group stressed the need for a strong interaction of state fisheries department personnel as well as State Agriculture Universities and other Research Institutes. These academic bodies possess the necessary know-how, are equipped with research facilities and trained personnel to conduct the required studies and develop practical solutions. By effectively transferring knowledge and expertise, they can empower the Fisheries Department to implement innovative strategies and enhance fisheries productivity. To maximize the impact of research, fostering closer ties between the Fisheries Department and research institutions is critical.

### **Education and Research**

#### **Uplifting Haryana's Fisheries Sector: The Contribution of Research Institutions and Universities**

**Research institutions and universities play a crucial role in driving fisheries development through their interdependent efforts:** These entities serve as the knowledge generation hubs. Their role is to conduct research, develop new technologies and provide technical guidance to the Fisheries Department. Additionally, they contribute to fisheries-related fields and human resource development by training skilled personnel for the fisheries sector or fisheries-related fields. Therefore, a robust and synergistic partnership between the Fisheries Department, research institutions and universities is pivotal for the sustainable growth of the fisheries sector in Haryana. Effective communication, collaboration, and knowledge sharing are essential to optimize the impact of research and ensure the Fisheries Department is equipped with the necessary tools and information to drive sector development.

#### **Key areas for focus include:**

**Strengthening collaboration:** Fostering a successful partnership between the Fisheries Department and research institutions within Haryana.

**Identifying challenges:** Analyzing the obstacles hindering knowledge transfer and technology adoption in the fisheries sector.

**Developing strategies:** Implementing effective approaches to enhance collaboration and knowledge sharing among stakeholders.

**Government leadership:** Activating the Haryana government to direct research institutions and universities, with expert guidance, to generate technologies aligned with evolving fisheries sector needs.

By addressing these aspects, a comprehensive understanding of the dynamics between stakeholders can be developed, leading to more informed decision-making and accelerated fisheries growth in the state.

### **Role of the Central Institute of Fisheries Education (ICAR-CIFE) in Developing Haryana's Fisheries Sector (Lahli-Rohtak Centre)**

#### **Inland Saline Shrimp Farming: A Technology for Wealth Creation**

Inland saline shrimp farming: A technology that creates wealth from waste-Technology package of practice developed by ICAR-CIFE, Rohtak centre.

**Secondary Salinity:** A Global and Indian Problem: Secondary salinity is a significant global issue affecting over 380 million hectares across 20 countries, including Australia, the US, Vietnam, Thailand, and India. In India, 8.62 million hectares are saline, with 40% concentrated in the northwest (Haryana, Punjab, Rajasthan, and Uttar Pradesh). This region's arid climate, erratic rainfall, high temperatures and intense agriculture have exacerbated the problem. Corrected: Secondary salinity is a significant global issue, affecting over 380 million hectares across 20 countries, including Australia, the US, Vietnam, Thailand, and India. In India, 8.62 million hectares are saline, with 40% concentrated in the northwest (Haryana, Punjab, Rajasthan, and Uttar Pradesh). The region's arid climate, erratic rainfall, high temperatures, and intense agriculture have exacerbated this problem.

#### **Pioneering efforts at Sultanpur, Haryana, as an Operational Research Project by ICAR-Central Institute of Fisheries Education during 1982 were carried out in inland saline aquaculture.**

- Over the years, several technologies were developed, and a package of practices (PoP) was created for the rearing of Pacific white shrimp (*Penaeus vannamei*) and, to a lesser extent, the tiger shrimp (*Penaeus monodon*). The shift from *P. monodon* to *P. vannamei* was due to the latter's superior growth rate, higher stocking densities, and disease resistance.
- The suitable package for the commercial culture of Pacific white shrimp (*Penaeus vannamei*) was standardized using mineral amendments to supplement the water chemistry of inland saline groundwater. This practice was a breakthrough, as it supported the physiology of the marine shrimp in a non-traditional environment.
- Commercial trials for inland saline aquaculture in Haryana began around 2014-2015. Demonstrations and training programs helped spread the technology. By 2019, the area under shrimp cultivation had expanded significantly, with adoption by numerous farmers. However, the exact numbers (e.g., 450 farmers, 1000 acres, and 2000 tons) can vary based on specific sources. The average productivity of 2.2 tons/acre is a reasonable estimate for intensive farming.

## The status of production

- **Species Dependence:** At present, inland saline aquaculture farmers are almost entirely dependent on a single species, Pacific white shrimp (*Litopenaeus vannamei*), due to its hardiness and high market demand.
- **Area and Production:** According to official data from the Department of Fisheries, Haryana, the area under shrimp farming has seen significant growth. The area spread in Haryana reached 1781 hectares (ha), and the production of shrimp reached 7685 tons during the 2023-2024 period.
- **Major Districts:** The major districts in Haryana where shrimp farms are concentrated include: Rohtak, Fatehabad, Charkhi Dadri, Hisar, Sirsa, Jhajjar, Jind, Bhiwani, Palwal, Nuh (formerly Mewat), Gurugram, Karnal, and Kaithal. The list is accurate and reflects the expansion of this farming practice across the state's saline-affected regions.

## ICAR-CIFE Research Projects on Inland Saline Aquaculture

ICAR-CIFE, Rohtak, has been at the forefront of inland saline aquaculture research since 1984. Initial studies focused on exploring the potential of saline soils and brackish water bodies for aquaculture in the Gurgaon district. Subsequent projects expanded to include seed production, culture of *Macrobrachium rosenbergii* and brackish water fish and prawn cultivation across Haryana, Punjab, Uttar Pradesh, Madhya Pradesh, and neighbouring states.

### Key research areas and achievements include:

- **Seed production technology:** Standardization of techniques for giant freshwater prawn seed production using inland saline water.
- **Species diversification:** Successful culture of brackish water fish in arid ecosystems through an Indo-Australian collaboration.
- **Technology transfer:** Demonstration of various farming technologies for inland saline soils at the farm level.
- **Shrimp aquaculture:** Evaluation of nursery-based systems for Pacific white shrimp using inland saline water, and assessment of physiological and immunological parameters.

These research efforts have significantly contributed to the development of sustainable aquaculture practices in saline environments.

### The National Fisheries Development Board funded a technology aimed at developing sustainable and efficient aquaculture practices for saline and degraded environments. Key findings include:

- Developed technologies for GIFT tilapia rearing using sustainable methods like nutraceuticals and biofloc.

- Standardized practices for white shrimp cultivation, including multiple stocking and harvesting, biochar-based effluent management, and best management practices.
- Established a state-of-the-art laboratory to monitor water quality, screen for diseases, and provide consultancy to shrimp and fish farmers in Haryana, Punjab, Rajasthan, and Uttar Pradesh.
- Developed saline-resistant strains of common carp through selective breeding.
- Investigated the microbial community and pathogens in inland saline farmed shrimp and their environment.
- Developed ICT tools for knowledge management in the aquaculture sector.

## **Research and Technological Advancements in Aquaculture**

Ongoing research has led to the standardization of biofloc culture systems for Singhi and Anabas fish species. Additionally, research has focused on developing a saline-resistant common carp to improve its growth and adaptability in saline environments.

### **Inland Saline Shrimp Farming**

The ICAR-CIFE has successfully developed and standardized a semi-biofloc-based zero water exchange technology for inland saline shrimp farming. This project also initiated a comprehensive study on White Feces Syndrome (WFS) in farmed *Penaeus vannamei* within inland saline regions. This research involved documenting various WFS cases, conducting detailed etiological investigations and developing preliminary management strategies.

### **Technological Interventions**

- **Optimal Site Selection:**
  - Farms should have clay loam soil with high water retention and low organic carbon content.
  - Sites should be at least 100 meters from human settlements.
  - Accessible underground saline water is needed within 50–100 feet.
- **Pond Design:**
  - Ponds should be at least 0.5 hectares for semi-intensive culture and up to 2 hectares for intensive systems.
  - For sandy soils with low water retention, ponds can be lined with HDPE or LDPE materials.
- **Water Quality Management:**
  - Maintain salinity levels between 5 and 30 ppt in northern India.
  - An appropriate Ca:Mg ratio of 1:2.5 is essential.
  - Potassium levels should be adjusted according to water salinity.
  - Regular monitoring of ionic ratios is crucial for optimal culture conditions.

## **Pre-stocking Pond Management**

- **Pond Preparation:**
  - Dry and plough the pond bottom to release gases.
  - Apply lime at a rate of 200 kg/ha.
  - Avoid acidic sulfate soils.
- **Water and Slurry Application:**
  - Gradually fill the pond with water.
  - Enrich the water with a fermented organic slurry (50 kg/ha) containing molasses, probiotics, groundnut oil cake, rice polish, and yeast.
- **Aeration:**
  - For a one-acre pond with a water depth over 1.2 m, install four 2.0 HP paddle wheel aerators.
  - Position aerators at the corners (3–5 m from dikes) to maximize water flow and maintain optimal dissolved oxygen (DO) levels.
- **Water Conservation:**
  - Directly use water in an evaporation reservoir (minimum 10% of farm area) to prevent salinization and facilitate water reuse.
  - This technology has successfully transformed wastelands into profitable shrimp farms in Haryana

## **Challenges and Management**

Inland saline water differs significantly from marine environments, especially in potassium content, essential for shrimp growth. Maintaining a calcium to magnesium ratio of approximately 1:2.5 is crucial, though specific mineral interactions vary. Regularly test water quality to monitor potassium, calcium, magnesium and salinity (2-25 ppt). Use muriate of potash to supplement potassium and ensure alkalinity exceeds 75 ppm.

Strict biosecurity measures are essential. Procure Specific Pathogen-Free (SPF) shrimp from certified hatcheries and conduct PCR tests for diseases. Follow standard protocols for transportation and stocking, including acclimatization. Regularly assess shrimp survival through salinity stress tests and hapa-based analysis.

Feed shrimp based on survival rates and biomass estimates. Use check trays to monitor feed consumption and adjust quantities accordingly. Store feed in a cool, dry and ventilated area. Provide sinking feed four times daily, varying size and protein content based on shrimp size and growth stage. Reduce feeding during algal blooms, water exchanges, chemical treatments, extreme temperatures and molting.

Effective stress management is crucial. Implement best management practices and biosecurity measures. Time stocking, feeding and sampling to minimize stress caused by climatic conditions.

## **Major Outcome**

The implementation of improved pond preparation, water quality management, biosecurity protocols and feeding strategies has enabled successful shrimp farming in inland saline conditions, particularly in the state of Haryana, contributing to economic growth and land reclamation.

### **Key elements of the successful approach include:**

- Pond preparation and water quality enhancement
- Nutrient management through organic inputs
- Oxygenation through aeration
- Water management to prevent salinization
- Disease prevention through biosecurity
- Appropriate feeding practices
- Stress management

By addressing the specific challenges of inland saline shrimp farming, these practices have demonstrated the potential for profitable and sustainable aquaculture in challenging environments.

### **Training and demonstration-Extension activities**

ICAR-CIFE, Rohtak centre, is also involved in the extension activities through training and demonstration of inland saline aquaculture technologies on a day-to-day basis. Intensive training and demonstration activities are being carried out at ICAR-CIFE, Rohtak centre, for farmers and entrepreneurs of inland saline areas. More than 1739 trainees benefited from training programs. Training on advanced aquaculture technologies, such as biofloc technology, is also provided, and 36 participants benefited from 4 phases of training. Also, SCSP training programs were conducted to uplift the community through training and handholding for various aquaculture technologies like inland saline shrimp farming, induced breeding and seed production of common carp. Under these programs, the participants were given farm facilities and inputs for learning and practical demonstration purposes.

A state-of-the-art Aquatic environment and animal health laboratory was developed at the centre with the funding support of the National Fisheries Development Board, Hyderabad. The water quality parameters, which include physico-chemical parameters and microbial load, are being evaluated from time to time on regular basis.

Suitable consultancy services were also provided along with the analysis report to the farmers of all four inland saline affected states. In addition, the microbial health status of the pond culture environment is also assessed and reports were produced and suitable consultancies were given. The disease diagnosis services are also carried out on a case-to-case basis through visiting, sample collection and diagnostic services. The laboratory facilities with PCR are also developed in 2023-24 to screen the emerging and existing pathogens in the cultured shrimp of Northern region. The routine screening of pathogens affecting shrimp will be carried out from the current year.

## **Role of the CCS Haryana Agricultural University (HAU), Hisar, in Developing Haryana's Fisheries Sector**

**As a leading Agricultural university in India, CCS HAU has played a pivotal role in the development of fisheries in Haryana**

**Research and Development:** HAU has been at the forefront of researching various aspects of fisheries, including i) Reproductive physiology and endocrinology and ii) Development of sustainable aquaculture technology with special reference to culture fisheries (both freshwater and brackish water) and fish nutrition. These studies aimed to understand basic mechanisms and to generate information for technology development.

Understanding the hormonal control of reproduction is indeed crucial for developing improved breeding techniques and optimizing culture conditions. This knowledge allows for induced breeding, a key technology that enables fish farmers to control the timing and success of spawning, which is essential for consistent and reliable fish production. It is also vital for developing broodstock management protocols that ensure the genetic health and quality of farmed fish.

Findings from these studies will have wide applications in identifying new candidate species for aquaculture, essential for the future development and diversification of aquaculture.

By understanding the reproductive and nutritional needs of various fish, scientists can identify and domesticate new species for aquaculture, which diversifies the industry and reduces pressure on a few common species, like carp and tilapia, etc.

**Sustainable Aquaculture Technology:** Haryana Agricultural University) has been at the forefront of researching sustainable aquaculture is plausible. Sustainable aquaculture also encompasses: I) Reduced environmental impact, i.e. minimizing water pollution from fish waste, and using inputs (feeds and fertilizers) efficiently.

**Optimizing culture conditions:** Knowledge of reproductive processes helps in creating optimal environmental conditions for fish to spawn and produce healthy offspring.

**In addition:**

**Technology Transfer:** CCS HAU, Hisar has successfully transferred its research findings to farmers through extension programs, demonstrating the practical application of new technologies and practices. This has helped improve fish production and productivity in the state.

**Education and Training:** The university offers undergraduate and postgraduate programs in fisheries science, equipping students with the necessary knowledge and skills to contribute to the fisheries sector. HAU also conducts various training programs for fish farmers and extension workers, enhancing their capabilities

### **Infrastructure Development:**

- **Fish farm:** The university has well-established research farms, providing essential infrastructure for fisheries development. These facilities support research, training, and technology dissemination activities.
- **Research Laboratory facilities:**
- Monitoring physiological changes during the digestibility of nutrients: This relates directly to the study of digestive physiology and how efficiently fish utilize their food.
- Monitoring and analysing the chemical composition of feeds (protein, crude fibre and fat contents, etc.) and feed ingredients: Essential for formulating balanced diets and assessing the nutritional value of different feed components.
- Water quality: A critical factor in aquaculture that significantly impacts fish health, stress levels, and nutrient absorption.
- Identification of plankton species: Relevant for understanding natural food sources, especially in larval rearing or pond-based systems

**In conclusion,** CCS Haryana Agricultural University, Hisar, has been a driving force behind the development of fisheries in Haryana. Its commitment to research, education, extension, and policy advocacy has had a positive impact on the sector, contributing to the state's overall agricultural growth and economic development.

### **Building a Legacy in Fisheries and Aquaculture Education**

#### **The Department of Zoology and Aquaculture at CCSHAU: A Legacy of Excellence**

The Department of Zoology and Aquaculture at CCS Haryana Agricultural University (CCSHAU), Hisar, has a distinguished history of training future leaders in fisheries and aquaculture. Since its inception, the department has offered a comprehensive curriculum that combines both theoretical knowledge and practical skills.

#### **Academic Programs and Research Focus**

Its **undergraduate and postgraduate programs** (Master's and Doctoral) provide students with a deep understanding of various disciplines within fisheries and aquaculture. The graduate programs are particularly focused on **research methodologies** for freshwater and inland saline water aquaculture, addressing the specific needs of the state.

#### **The establishment of a College of Fisheries at Haryana Agricultural University**

To bolster teaching and research in fisheries, Haryana Agricultural University established an independent College of Fisheries in 2019. This marked a significant advancement, with the college tasked with equipping graduates with contemporary fisheries techniques and management skills. Through education, research and training, the college aims to support fishers, entrepreneurs, and stakeholders in overcoming challenges within the rapidly expanding fisheries sector.

For further improving the functioning of the college, **ICAR** Accreditation will be needed to ensure quality education to meet national standards. It will help students gain international recognition of their degrees. Focus on qualified professionals with fisheries science backgrounds.

### **Researchable issues**

**Development of sustainable fish/aquaculture culture technology:** The outcome of this technology is: Reducing inputs like feeds and fertilizers in fish culture is a commendable step towards sustainable aquaculture. It can have significant impacts on aquaculture, ecology and the economy.

#### **Impact on Aquaculture**

- **Increased efficiency:** By reducing feed and fertilizer inputs, farmers can potentially lower production costs, improving profitability.
- **Improved water quality:** Less feed and fertilizer runoff can lead to better water quality in aquaculture ponds and surrounding ecosystems.
- **Reduced disease outbreaks:** Improved water quality can contribute to a healthier fish environment, reducing disease risks.

#### **Impact on Ecology**

- **Reduced environmental pollution:** Lowering feed and fertilizer use can significantly reduce nutrient loading into water bodies, preventing eutrophication and algal blooms.
- **Biodiversity conservation:** Improved water quality can benefit aquatic ecosystems and support biodiversity.
- **Climate change mitigation:** Some sustainable fish culture practices, such as integrated aquaculture-agriculture systems, can contribute to carbon sequestration.

#### **Impact on the Economy**

- **Reduced production costs:** Lower input costs can improve the profitability of aquaculture businesses.
- **Enhanced brand reputation:** Adopting sustainable practices can enhance the reputation of the aquaculture industry and its products.

**Harnessing Saline Groundwater for Aquaculture: Research at Haryana Agricultural University:** The Following studies were taken up

- Chemistry of inland ground saline water.
- Development of eco-friendly and economically viable sustainable fish culture technology for inland saline water and for freshwater.
- Impact of inland water salinity on growth performance, reproductive cycling and spawning in common carp.
- Influence of inland water salinity on growth performance of Indian major carps.
- Growth performance of mullet, milkfish, Nile tilapia and pearlspot in inland saline waters at different salinities.
- Effect of salinity on fish physiology with special reference to nutrient utilization and digestibility.

- Exploration of substrate-supported aquaculture technology (*In vitro* food production).
- Research on the application of microbial biofertilizers in aquaculture as is being done in agriculture, to reduce the use of inorganic fertilizers.

In addition, the use of supplementary diets and dietary inclusions for the development of **eco-friendly, economically viable, sustainable fish culture technology**, the following studies were also taken up:

- Replacement of fishmeal in aqua diets and use of plant-origin protein sources
- Determination of optimum protein levels, Protein sparing (Alternate use of high and low protein diets), Feeding frequency and role of scheduled meal timings.
- Use of additives and growth accelerators in aqua feeds.

#### **Fish Reproduction:**

- To obtain high-quality seed for experiments, we undertook the breeding of common carp and the induced breeding of Indian major carps using Synthetic hormones like gonadotropin-releasing hormone (GnRH).
- Environmental manipulation techniques, like altering photoperiod (day length) and water temperature, are crucial for accelerating the reproductive cycle of fish, especially in seasonal breeders. By inducing precocious maturity, farmers can ensure a consistent and reliable supply of fish seed (eggs and larvae) for commercial production, reducing dependence on wild stocks and enabling year-round breeding.
- Environmental manipulation techniques were applied to induce precocious maturity by altering photoperiod (day length) and water temperature. This was done to obtain early maturity in fish species such as major carps, Singhi, and Murrel or spotted snakehead.
- **The effects of inland water salinity on the gonadal cyclicity and spawning of common carp (*Cyprinus carpio*) have been studied.** While this freshwater species can tolerate a certain level of salinity (up to 7 ppt), higher concentrations negatively impact its growth and reproductive success. Spawning does occur at moderate salinities, but the spawn/offspring do not survive. Upon returning these fish to freshwater, they resume their normal gonadal activity and spawning.

#### **Freshwater Challenges and the Rise of Inland Saline Aquaculture**

The global scarcity of freshwater is a critical challenge, further amplified by climate change, which impacts its availability. In this scenario, inland saline groundwater presents a promising alternative for aquaculture. This method utilizes salt-tolerant (euhaline) fish and shellfish species, making it ideal for regions with limited rainfall and high evaporation rates, such as semi-arid and arid areas. Inland saline aquaculture offers a much-needed innovation to boost seafood production and meet the growing demand for sustainable food sources.

## Naryana Focus on Inland Saline Resources

The development of technologies for harnessing inland saline soils and groundwater is a national priority in India. This is reflected in its inclusion as a thrust area under the 11th Five-Year Plan of the Indian Council of Agricultural Research (ICAR). The issue of salinity and alkalinity in Indian soil is growing annually. Secondary salinization alone affects about 8.6 million hectares of land.

### **Haryana: A Pioneering Example (Vegetarian Haryana is leading a fish revolution)**

#### **Current Status:**

- **Production:** Based on data from the Department of Fisheries, the fish production in Haryana in 2023 was **2.12 lakh tonnes** (212,000 metric tonnes). This shows an increase from the previous year.
- **Area:** The latest data from the Department of Fisheries in Haryana indicates that the water area under fish farming was 18,702 hectares as of December 2023. This is slightly more than the 17,016 hectares mentioned.

#### **Key Developments in Haryana's Fisheries Sector**

- **Productivity:** According to a report on fisheries in Haryana, the state's average inland fish productivity is 5,600 kg (5.6 metric tonnes) per hectare per year. This figure is double the national average. **The state's success is due to its focus on diversified farming and the utilization of brackish water for aquaculture.**
- **National Average:** The national average for inland fish productivity is around 3 tonnes per hectare. The goal of the Pradhan Mantri Matsya Sampada Yojana (PMMSY) is to increase this to 5 tonnes per hectare.
- **This increase is part of a broader set of goals to boost India's fisheries sector, which also includes increasing overall fish production, enhancing exports, and generating employment.**
- **Government Initiatives:** The government is actively promoting the sector through schemes like the Pradhan Mantri Matsya Sampada Yojana (PMMSY). These initiatives provide subsidies and support for various activities, including the establishment of fish hatcheries, recirculatory aquaculture systems (RAS), and cold storage facilities.

#### **Haryana's Unique Landscape and Approach**

- Haryana is a landlocked state in northern India, situated between 27°39' to 30°35' N latitude and 74°28' and 77°36' E longitude. The state's total geographical area is 44,212 sq. km, which constitutes about 1.34% of India's total geographical area (Fig. 7.1).
- Haryana experiences a semi-arid to sub-humid climate with erratic rainfall. A significant portion of its groundwater is brackish, and about 60% of the state's underground water resources are moderately to highly saline. To address this issue, various institutions are conducting studies on drainage and reclamation, including laying subsurface drainage systems with built-in reuse mechanisms.

### A Strategic Opportunity: Aquaculture

- While groundwater salinity and waterlogging pose challenges for traditional agriculture, they present a unique opportunity for aquaculture in Haryana. The state has an estimated 88,900 hectares of waterlogged and saline areas that are suitable for fish farming.

### Unlocking Potential

- By strategically utilizing its abundant reserves of inland saline groundwater, Haryana can significantly expand its fish and shellfish production. This shift offers several benefits:
- **Economic Growth:** Increased aquaculture activity will stimulate job creation and boost farmer income.
- **Food Security:** Enhanced production contributes to meeting the rising demand for seafood, improving global food security.

**Fisheries Sector Development:** This initiative fosters the advancement of Haryana's fisheries sector.

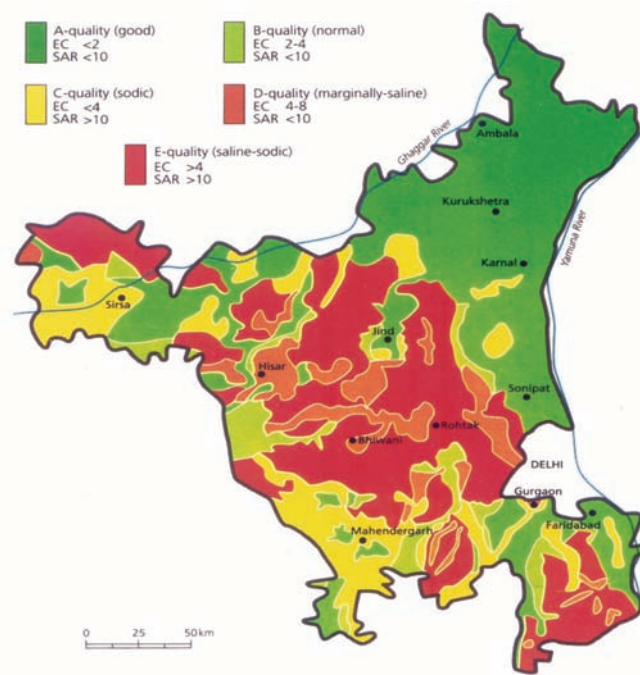


Fig 7.1. Map of Haryana showing the quality of underground water

### Inland Saline Water for Aquaculture

A collaborative research project involving the Indo-Dutch Operational Research Project, the National Agricultural Technology Project (NATP), the Fisheries Department of the Government of Haryana, and the Indian Council of Agricultural Research (ICAR) helped in investigating the potential of inland saline groundwater for aquaculture. The study focused on leveraging unproductive, saline, and waterlogged lands for fish farming.

## Extension activities

The research findings were shared with the Directorate of Fisheries, Haryana, and other relevant funding agencies through various channels. These included research reports, a joint seminar/symposium, Kisan Mela (farmers' fair), extension lectures, and a summer school for college and university teaching faculty. In addition to these methods, research findings were effectively shared in the following ways:

- **Publications:** The findings were published in peer-reviewed journals and technical reports.
- **Workshops & Trainings:** Hands-on workshops were organized for stakeholders to share the results directly.

Haryana Agricultural University undertook a research program to establish commercial aquaculture of both indigenous and exotic carp species (common carp and Indian major carps) in low-salinity inland saline waters.

To diversify aquaculture practices, culture of euryhaline finfish species in inland saline waters with higher salinity (10 ppt and above) was also taken up. These species exhibited tolerance to such conditions. Before these trials, a comprehensive analysis of the inland saline water's ionic composition was conducted to assess its suitability for aquaculture.

## Research activities

### Use of inland saline water in finfish culture

#### i. Water chemistry of Inland saline groundwater and natural seawater

Inland saline water in Haryana is a unique composition with saline-sodic and alkaline characteristics, indicating the presence of sodium bicarbonate in its sediments. It differs from seawater in several ways, particularly in its chemical composition and salinity, which vary significantly depending on the source, such as aquifers, drainage basins, evaporation ponds, or mines.

Notably, inland saline water has a much higher total hardness—primarily due to bicarbonates and carbonates of calcium and magnesium—which can reach up to 12,000 ppm, compared to seawater's 3,000 ppm. Conversely, it contains significantly lower levels of sodium, potassium, and sulfates than seawater. Seawater, in contrast, is characterized by very high concentrations of sodium, potassium, and chlorides (Fig. 7.2 and 7.3).

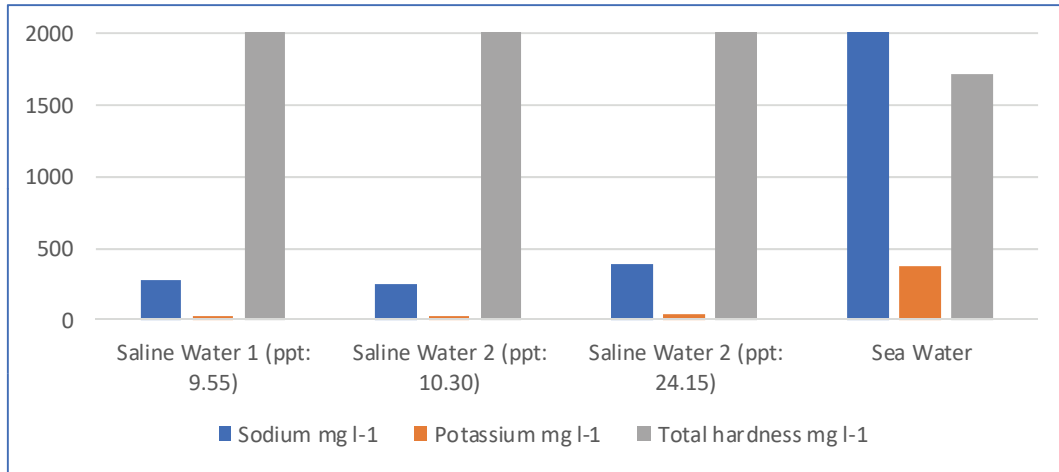


Fig 7.2

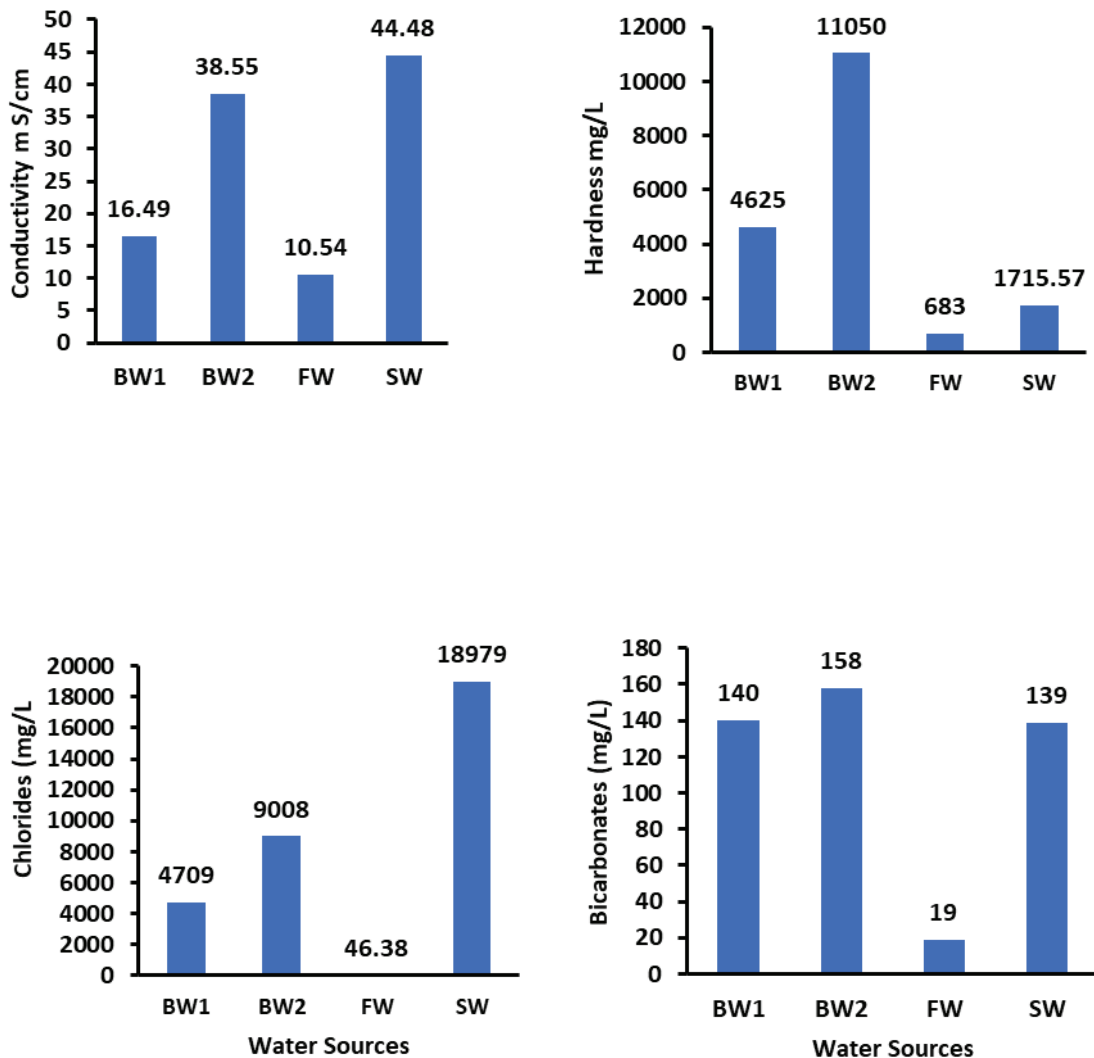


Fig. 7.3. Variations in values of conductivity, hardness, chlorides and bicarbonates in brackish water, fresh water and seawater. (BW 1=Brackish water Tube well 1; BW 2=Brackish water Tube well 2; FW=Fresh water; SW= Sea water)

Unlike seawater, inland saline water often lacks the right balance of ions needed by marine species. Notably, it is deficient in potassium (K<sup>+</sup>). Fortunately, this deficiency can be rectified through the addition of potassium supplements like potassium chloride (KCl) or K-Mag. Studies have shown that replenishing K<sup>+</sup> in inland saline water allows for the successful culture of white shrimp and many other fish/shellfish species, transforming what was once unusable water into a productive resource.

Many other studies have shown that potassium (K<sup>+</sup>) deficiency negatively impacts the growth performance of several valuable aquaculture species, including Pacific white shrimp (*Litopenaeus vannamei*), barramundi or sea bass (*Lates calcarifer*), tiger shrimp (*Penaeus monodon*), mullet (*Argyrosomus japonicus*) and giant river prawn (*Macrobrachium rosenbergii*). Species become more susceptible to K<sup>+</sup> deficiency at lower salinities. Fortifying water with K<sup>+</sup> has proven beneficial for shrimp and fish species in low-salinity environments, such as Australian snapper, western king prawns, mullet, barramundi, and tiger prawns. However, maintaining adequate K<sup>+</sup> levels requires repeated applications due to losses through soil uptake, harvest, drainage, and seepage.

#### **ii. Future Directions in Inland Saline Aquaculture**

Optimizing K<sup>+</sup> supplementation strategies for different species and salinity levels needs further research. Exploring alternative, cost-effective K<sup>+</sup> sources and application methods is crucial. Additionally, identifying K<sup>+</sup> tolerant species suitable for inland saline aquaculture without fortification could be a game-changer. By addressing the K<sup>+</sup> challenge, we can unlock the immense potential of inland saline groundwater for sustainable and productive aquaculture

#### **iii. Identification of Euryhaline fish species**

In contrast, species like milkfish (*Chanos chanos*), flathead mullet (*Mugil cephalus*), pearlspot (*Etroplus suratensis*) and Nile tilapia (*Oreochromis niloticus*) exhibit greater tolerance to K<sup>+</sup> deficiency and show satisfactory growth. A review of the work done at CCS Haryana Agricultural University, Hisar, suggests that the culture of these euryhaline fish species is feasible in inland saline waters. Furthermore, these fish do not require any fortification of salts like potassium chloride (KCl) or K-Mag in the culture medium.

#### **iv. Experiments on the Growth performance of grey mullet, Milkfish, Pearlspot, and Nile tilapia**

**Grey mullet** fingerlings showed remarkably high growth performance between 10-15 ppt, revealing that this is an optimum salinity level for the growth of this species in inland saline groundwater. This is likely due to a combination of factors: habitat suitability, efficient digestion at this salinity and the ionic composition of inland saline groundwater compared to seawater. At higher salinities, growth performance declines.

**Milkfish (*Chanos chanos*):** Monoculture trials with milkfish (*Chanos chanos*) revealed the highest growth at 25 ppt salinity under field conditions. Since only 25‰ salinity water was available at the CCS HAU farm, milkfish fish may tolerate

higher salinity levels and may potentially grow better. Some other studies conducted elsewhere have shown a repressive effect of higher salinity levels on the growth performance of milkfish.

**Pearlspot (*Etroplus suratensis*) and Nile tilapia (*Oreochromis niloticus*)** appear to grow well at salinity levels fluctuating between 12 to 15 ppt, although at low salinity levels, the growth of Nile tilapia was a bit better.

**a) Culture operation:** These fish are cultivated in inland saline water using standard freshwater aquaculture techniques. For optimal growth, it is essential to maintain the appropriate water salinity.

**b) Caution in the use of organic fertilizers in Inland saline water fish ponds.** With minor modifications, such as improved water exchange systems and aeration, to existing freshwater fish pond technology, organic fertilizers can be employed to fertilize brackish water fish ponds. However, application rates should be reduced by 25-30% due to the slower rate of degradation of manure under higher salinity conditions (typically above 10 ppt).

**c). Feeding:** To achieve high fish production and compensate for the reduced nutrient availability, supplementary feeding with protein-rich diets is essential for brackish water fish culture.

**v. Aquaculture is a rapidly growing industry** that provides a versatile solution for producing a diverse range of aquatic foods, from fish to shellfish. However, the industry's rapid growth has raised environmental concerns that must be addressed for long-term sustainability. Developing sustainable technologies is crucial to sustaining these farming systems, enhancing production, and minimizing costs and environmental impact.

Aquatic animals, primarily fish, play a significant role in addressing the global shortage of animal protein. However, the intensification of these farming systems can lead to a host of new problems.

### **Enhancing Sustainable Aquaculture for a Growing Population**

To meet the increasing demand for food, researchers at the Department of Zoology and Aquaculture at CCS HAU Hisar have been dedicated to improving sustainable aquaculture technologies, particularly in freshwater and brackish water culture fisheries. Their research focuses on understanding the core principles and generating knowledge essential for future innovation and diversification in aquaculture.

#### **Key Strategies for Sustainable Fish Production**

To boost fish production while minimizing environmental harm, a multi-pronged strategy is recommended. This approach aims to enhance fish growth and yields in both freshwater and inland saline water environments.

**Optimising Fish Nutrition: Regulating supplementary diets with appropriate levels of dietary protein, feeding frequency** is crucial. This helps promote responsible resource management and improves feed conversion efficiency.

**Judicious Use of Fertilizers:** Applying fertilizers precisely and in a controlled manner helps reduce nutrient pollution in aquaculture systems.

**Leveraging Biofertilizers:** The use of microbial biofertilizers promotes a healthy, naturally fertile environment, supporting robust fish growth.

#### **vi. Periphyton: A Cornerstone of Sustainable Aquaculture: *In vitro* food production**

Periphyton, a complex ecosystem of microorganisms attached to submerged surfaces, is emerging as a pivotal component of sustainable aquaculture. By serving as an *in vitro food source*, periphyton-supported culture systems offer a revolutionary approach to fish nutrition. This diverse community, comprising algae, bacteria, protozoa and small invertebrates, provides a rich and balanced diet for fish, significantly enhancing growth rates and overall health.

##### **Key benefits of periphyton-based aquaculture:**

**Enhanced growth and production:** Periphyton provide a continuous supply of natural, high-quality food, leading to accelerated fish growth and increased biomass production. It offers several other advantages, such as:

- **Improved water quality:** Periphyton acts as a biofilter, efficiently removing nutrients and organic matter from the water, creating a healthier environment for fish. **Economic viability:** By reducing reliance on expensive commercial feeds and fertilizers, periphyton-based systems offer a cost-effective approach to aquaculture.
- **Sustainability:** This method aligns with sustainable aquaculture practices by promoting ecosystem balance, reducing environmental impact and enhancing resource efficiency.
- **Biosecurity:** Periphyton-based systems can help prevent disease outbreaks by providing a natural barrier against pathogens.
- **Biodiversity:** The diverse community within periphyton supports a rich aquatic ecosystem, fostering biodiversity and ecological resilience.

**In conclusion**, periphyton-based aquaculture presents a promising avenue for sustainable and efficient fish production. By harnessing the natural productivity of periphyton, aquaculture can become more environmentally friendly, economically viable and resilient to challenges such as climate change and resource scarcity.

- **Feeding:** For long-term aquaculture sustainability, research efforts should prioritize the identification of alternative protein sources. Developing diets with optimal levels of essential nutrients and protein content can significantly reduce nitrogen and phosphorus inputs. These advancements will pave the way for eco-friendly, farmer-friendly, and economically viable sustainable fish culture technologies.

##### **Experiments on the use of periphyton**

- Mullet, milkfish, and Nile tilapia exhibit superior growth and productivity with periphyton substrates compared to those receiving supplemental feed or no treatment ( $P < 0.05$ ). Fish in these environments also display enhanced digestive

enzyme activity and improved muscle protein, glycogen, and viscerosomatic/hepato-somatic indices.

- *O. niloticus* grew significantly better than *E. suratensis* in the polyculture experiment that tested the effects of periphyton ( $P < 0.05$ ).
- For optimal periphyton growth and fish production, a substrate density of 560 bamboo poles per 375 square meters (54% submerged surface area) is recommended.
- Poultry droppings are more effective than cow dung as an organic fertiliser for pond productivity.
- Periphyton samples obtained from ungrazed conditions at 50 cm depth show significantly higher protein, fat, and energy content. These findings collectively highlight periphyton's immense potential for enhancing fish production in saline groundwater ponds.

By embracing these advancements, one can ensure a thriving and sustainable aquaculture industry that meets the needs of a growing population while safeguarding the environment.

#### **Adoption of feeding strategies:**

Fish nutrition is a cornerstone of sustainable and profitable fisheries. Understanding and optimizing fish diets is crucial for enhancing growth, reproduction, disease resistance, and overall fish health. Research can optimize feeding strategies for fish by restricting fish meal use, scheduling meal timings, adjusting feeding frequency and rates and employing mixed feeding plans. This will improve nutrient utilization, reduce feed costs, and pave the way for an eco-friendlier, economically viable and sustainable fish farming technology.

#### **Importance of microbial biofertilizers:**

Inorganic fertilizers are expensive, scarce, and lost quickly through leaching, volatilization and rapid breakdown. Excessive use of nitrogen and phosphorus fertilizers contaminates water bodies (eutrophication), disrupts microbial populations and fish life, and poses health risks to humans and animals. Therefore, alternative sources of nitrogen and phosphorus are needed to reduce dependence on costly chemical fertilizers and ensure food security.

To achieve this, aquaculture scientists recommend using eco-friendly microbial biofertilizers that can fix atmospheric nitrogen and solubilize phosphate.

**Experiments on the application of microbial biofertilizers:** The work on nitrogen-fixing biofertilizers, such as *Azotobacter* and *Azospirillum*, has revolutionised the nutrient cycle in aquaculture, potentially reducing the need for chemical nitrogen fertilisers by 45-50% and significantly increasing pond productivity and fish production. Similarly, research on phosphate-solubilising agents enhances phosphorus accessibility, promoting strong root development and overall resilience of aquatic plants. By leveraging these biological solutions, aquaculture becomes more environmentally friendly and productive, contributing to food security without compromising ecological balance.

**The technology for developing sustainable aquaculture using inland saline water for certain euryhaline fish species already exists and needs to be implemented or transferred to fish farmers.**

### **Observations of the Working Group on Aqua farmers/fields**

- Member of the Working group visited many aquafarms and observed that most of the aquafarmers were focusing only on the culture of *Vannamei* (*Litopenaeus vannamei*, syn. *Penaeus vannamei*) and were following almost similar techniques and methodologies for rearing/culturing *Vannamei*.
- They were using plastic sheet-lined ponds for culture operations and raising two crops, each of 3-4 months duration.
- Salinity is a very important factor. While inland saline water can be suitable for *L. Vannamei* culture. However, farmers were observed culturing *L. vannamei* regardless of the available salinity. Only one farmer informed the visiting team that 9.0 ppt to 13.0 ppt salinity appears to favour good growth of *L.Vannamei*, however, this statement lacks any scientific support.
- *L.Vannamei* can tolerate higher salinities (of seawater). However, inland saline waters are often deficient in potassium. Therefore, inland waters of higher salinities cannot be profitably used for their culture.
- Therefore, managing salinity and potassium levels is crucial for profitable inland *L. vannamei* culture.
- Since *Vannamei* is an exotic species, and there is a clear guideline from the Government that no other species should be grown/cultured along with this exotic species.

### **Contributions of Kurukshetra University, Kurukshetra, in Developing Haryana's Fisheries Sector**

Teaching, Research and Extension Activities at The Department of Zoology, Kurukshetra University, Kurukshetra, Haryana

Since its inception, the Department of Zoology has been imparting instructions on different aspects of fisheries and aquaculture at the Graduate level (Master's and Doctoral studies). The students are imparted instructions on both basic and applied aspects of fisheries and aquaculture.

- For the past over two decades, the Aquaculture Research Unit of the Department of Zoology at Kurukshetra University, Kurukshetra, has been conducting studies on different aspects of sustainable aquaculture.
- **Investigations on Alternative Disease Management in Aquaculture:**
- **Studies on combining probiotics and plant extracts to improve fish health**
- Research also investigated the benefits of supplementing fish diets with a combination of *Ocimum sanctum* (holy basil) and a specific probiotic strain, *Bacillus cereus* SL1.

**The Key findings show that** combining these supplements had a synergistic effect, meaning it was more beneficial than using them individually.

- Fish fed the combined supplement showed: Improved growth, Stronger immune system, Enhanced antioxidant activity, better gut and liver health, Increased activity of genes related to antioxidant defences.
- The combination also improved the absorption of nutrients from the diet.

These findings suggest that combining probiotics and plant extracts could be a promising strategy for promoting **sustainable aquaculture**.

### **Boosting Fish Health and Farm Efficiency with Probiotics**

Fish farmers can unlock significant advantages by incorporating probiotics into their fish feed. These live microorganisms promote overall fish health, enhance growth rates and improve the efficiency of aquaculture operations.

The key lies in selecting the right probiotic strains. Different fish species benefit from specific bacterial strains, such as *Lactobacillus*, *Bacillus*, or *Enterococcus*. Thankfully, commercially available probiotic formulations cater to aquaculture needs. These can be directly mixed into fish feed during manufacturing or coated onto pellets to ensure they survive the sometimes-high temperatures of pellet production.

For optimal results, it is crucial to follow the recommended dosage from the probiotic manufacturer. Consistent administration according to a regular feeding schedule is essential to maintain a stable and healthy gut microbiome in your fish.

### **Extension activities:**

#### **Enhancing Aquaculture Knowledge and Practices**

The Department of Zoology and Aquaculture go beyond traditional methods of disseminating knowledge through seminars, symposia, and Extension lectures.

## 8.0 OBSERVATIONS, SUGGESTIONS AND RECOMMENDATIONS

- 1) During the meeting with the Directorate of Haryana Fisheries, it was learnt that over 100 RAS and 200 Biofloc units were established, but their outcomes were disappointing due to insufficient farmer knowledge. The working group believes that farmers and the fisheries department personnel should receive adequate training and expertise before implementing such measures. Moreover, such experts from the fishery department should be allocated permanent assignments and may be sent for refresher courses to update their knowledge.
- 2) **Assessment of the State's Ornamental Fish Unit:** Members of the working group have also learnt during the meeting that a unit of ornamental fishes has been established by the State Department of Fisheries, which is also not functioning up to the mark.
  - i. Members of the working group concluded that the deployment of untrained staff in such units might be contributing to the observed issues. Given the commercial nature of these units and their significant revenue generation, it is recommended that Department personnel undergo training in the breeding, identification, and upkeep of ornamental fish species. These individuals should not be transferred to other locations until a trained replacement is available.
  - ii. Additionally, ornamental species with higher market value should be identified and their cultivation promoted. Aggressive or difficult-to-maintain species, including locally available should also be catalogued.
- 3) **Ban on the culture of African Magur:** Exotic fish species like African Magur are posing a serious threat to Haryana's natural water bodies by drastically reducing the habitat for indigenous fish fauna. Their continued presence is likely to further colonize these water bodies. The cultivation of African Magur is illegal in Haryana, and yet some farmers are cultivating this fish fearlessly. This practice is impacting the biodiversity of our water bodies, and strict action may be planned to curb this illegal practice.
- 4) **Responsible fishing:** Further, Illegal, unreported, and unregulated (IUU) fishing that is also degrading our captured fishery resources and thus negatively impacting biodiversity and local livelihoods, food stability needs to be checked.
- 5) To better protect fish during their most active breeding season, a seasonal fishing ban is in effect. This measure, also called a moratorium, prohibits fishing during the monsoon season when many species reproduce. This helps safeguard both fish populations and their habitat. The role of a seasonal fishing ban in responsible fisheries is to ensure the long-term sustainability of fish populations. It achieves this by:
  - **Protecting Spawning Stock:** It allows mature fish to reproduce without interference, ensuring the next generation of fish and preventing the depletion of the species.

- **Preventing Overfishing:** Temporarily halting fishing pressure helps to prevent overexploitation of fish resources.
  - **Allowing Ecosystem Regeneration:** The ban provides a period for ecosystems to recover from the impacts of fishing activities.
  - **Increasing Future Catch:** By allowing fish stocks to replenish and grow to a larger size, the ban can lead to a more abundant and valuable catch for fishermen after the ban is lifted.
  - **Conserving Biodiversity:** It helps to protect marine biodiversity by allowing various species to thrive and maintain a healthy ecosystem.
- 6) The Members of the working group emphasized the need for conservation of fisheries resources in natural waters and the development of low-altitude Hill Fisheries in the districts of Ambala and Yamuna Nagar.
- 7) A key point from the discussion was the need to establish a fish seed certification agency to provide quality fish seed and, in turn, increase productivity.
- 8) **Suggestions for the administration/Haryana Govt.**
- To strengthen the fisheries and aquaculture sector in Haryana, the Haryana Government should constitute a formal advisory body composed of technical experts in these fields, and the members/experts should be chosen based on demonstrable expertise in aqua farm management, not simply appointed based on a panel provided by the Directorate of Fisheries.
- 9) **Celebration of Fish Farmers Day:** To make Fish Farmers Day more interesting and effective, suggestions from farmers/progressive farmers on how to enhance production in the State should be initiated, and some expert/s give their views and apprise the farmers of new or emerging developments in the fisheries sector in and around Haryana.
- 10) **Problems of Aqua-farmers**
- i. A reduction in the electricity tariff for fish and shrimp farmers is recommended, bringing it on par with the tariff for agriculture. This measure would enable fish and shrimp farmers to achieve significant progress in their field. Additionally, waiving penalty charges would provide interim relief to consumers in the fisheries sector, recognizing it as an allied agricultural activity that should receive the same benefits as the agricultural sector.
  - ii. At present, the govt. is providing electricity @ 475 paise/ kW up to 20 kW to the shrimp farmers. The demand for electricity to run the shrimp unit of one hectare is approximately. 40 kW. So, the Government. may reconsider the matter to increase the load for the shrimp unit of one hectare to 40 kW at subsidized tariff rates.
  - iii. The requirement of electricity is high in the shrimp production system, and the policies are required to be formulated to provide electricity at subsidized rate/s at par with agriculture.

- iv. In Haryana, shrimp farmers depend upon the underground saline water and must add minerals/ions to make the water parameters suitable for shrimp culture. This increases their cost of production. When the project was first proposed, its estimated cost was 25 lakh per hectare. The cost was later reduced to 18–19 lakh per hectare in 2018–19 because of the abundant and inexpensive availability of capital goods. Given current market conditions, the original farming package for vannamei shrimp would now cost an estimated 25–28 lakh per hectare. The use of additional additives would further increase this cost.
- v. In Haryana, 70% of fish farming takes place in community ponds. Many of these ponds are currently out of use and require renovation due to frequent silting. The quality of the water in these ponds often deteriorates because village wastewater is drained into them, making it unsuitable for fish farming. There is currently no provision for the renovation of these ponds in any central or state government scheme, and such a provision should be included.

#### **11) Technical Skill Deficiencies**

A deficiency in technical know-how exists among shrimp farmers. The Department of Fisheries is advised to organize exposure visits to the leading shrimp-producing States and Countries. These visits will be instrumental in enhancing the farmers' skills, knowledge, and confidence, enabling them to effectively adopt sustainable and modern technologies in shrimp farming. The qualifications of technicians interacting with farmers should be determined, and their involvement regulated to prevent farmers from being misled into excessive use of additives.

#### **12) Impact of the technology of inland saline shrimp farming- Challenges:**

The challenges in inland saline shrimp farming are many.

- i. The most important challenge is getting the quality seed from the certified farms and ensuring biosecurity for the specific pathogen-free (SPF) stock. There should be a proper facility to screen the seed for quality and pathogenic load.
- ii. For quality seed production, brooder banks at the district level or ICAR-CIFE, Lahli centre should be established
- iii. At present, India is wholly dependent upon the import of its brood stock for the production of seed for shrimp farming, and new diseases in *L. vannamei* are being reported every year

#### **13) Disaster management: Heavy rain, drought (scarcity of rain) and flood**

- i. Crop insurance needs to be provided to the farmers to address the challenges from climate change-related problems and crop losses due to any uncertainty. The Haryana Fisheries Department should take up the matter with the Haryana Government

- ii. Recent years have witnessed significant fluctuations in farmed shrimp prices due to volatilities in supply and demand. This directly impacts the profitability of shrimp aquaculture.
  - iii. Domestic consumption of shrimp is very limited in the northern sector. This is one reason for the market volatility of farmed shrimp.
  - iv. Maintaining hygienic practices for export commodities should be mandatory throughout the entire process, right up to the processing facility. Therefore, it is crucial to raise awareness among the aqua farmers about the importance of proper hygiene when handling/transporting these products.
  - v. The overuse of additives on large farms can cause harmful chemicals to accumulate in effluent water. To address this critical gap, there is a need to develop effective management strategies for effluent treatment. This will require collaboration through consultation meetings to minimize potential environmental damage. There should be mandatory effluent management guidelines developed and extended to large farms and implemented strictly.
- 14) Ways and means to address the challenges**
- i. The specific guidelines need to be set to regulate farming in inland saline areas to prevent any possible environmental problems through farming.
  - ii. More feed mills need to be developed in the state, which can supply low-cost feed using locally available and low-cost ingredients.
  - iii. To ensure the supply of disease-free seed, there should be aquatic disease screening facilities in the state.
  - iv. To screen pathogens during the culture period, periodic screening is required for possible diseases, for which well-equipped mobile laboratories are needed in various districts of the state.
  - v. Need to focus on more species of shrimp and fish that can grow in an inland saline environment.
- 15) Facilities of cold storage:**
- i. Cold storage and mini processing plant facilities are the highest requirement in various districts where shrimp farming is prevalent. This will help farmers to store their product till they get a better market price. This will also address market fluctuation issues through storage and then marketing.
  - ii. Establishment of a proper marketing facility or cold chain in the State to procure and market the shrimp, as it is a highly perishable commodity.
  - iii. Standard operating protocols or best management practices need to be implemented in progressive and model farms and evaluated for certification. The certification will add value to the product in the export market.
- 16) Planned activities in research and demonstration**
- i. More research and surveillance on existing and emerging diseases in shrimp
  - ii. Aquaculture is required to make it sustainable.

- iii. Value addition prospects of cultured shrimp need to be made aware of and demonstrated to the farmers. ICAR-CIFE, Mumbai, may be able to extend the required training and demonstration for the same.
- iv. Semi-biofloc technology for inland saline aquaculture can be promoted as a measure to control effluent discharge from farms.
- v. The white feces syndrome commonly occurring in inland saline shrimp farms is under various stages of evaluation in project mode and will be coming out with the management measures to control the same in the culture environment, as elaborated by the ICAR-CIFE centre, Lahli.

**17) Strengthening the Fisheries Sector in Haryana:** The primary obstacles to the sector's growth have been a **critical shortage of high-quality fish seed** and a **lack of scientific aquaculture expertise**

- **Breeding and aquaculture of air-breathing/non-air-breathing fish species needs to be taken up on priority:** To bolster Haryana's fisheries sector and reduce its dependence on other states, it is crucial to prioritize the development of advanced induced breeding techniques for fish. Currently, the state heavily relies on external sources for its supply of fish seed, fry, and fingerlings, which creates a significant vulnerability.
- **To improve reproductive potential:** This is a core application of biotechnology in aquaculture, often involving techniques like hormonal manipulation, induced breeding, and *in vitro* fertilization.
- **Accelerate the propagation of superior fish germplasm:** This refers to speeding up the breeding and growth of fish with desirable traits (e.g., faster growth, disease resistance, salinity tolerance, better feed conversion). Improving efficiency, increasing yields, and preserving valuable genetic resources.
- To overcome these challenges, a strategic approach is necessary:
- Establish a strong collaboration with research institutes and universities to drive innovation in induced breeding and hatchery technology.
- Invest in the development of modern hatchery infrastructure to ensure a consistent and reliable supply of superior quality fish seed.
- Implement knowledge transfer programs to equip local fish farmers with the latest scientific aquaculture methods, moving beyond traditional practices.

By focusing on these key areas, Haryana can build a self-sufficient, robust, and sustainable fisheries industry.

**18) Genetic Management in Aquaculture: Mitigating Inbreeding Depression**

High-quality seed is essential for successful aquaculture. A decline in seed quality, manifested by weak or undersized offspring, poses a significant challenge. Inbreeding depression, a major factor contributing to this decline, is characterized by reduced survival, fertility, and growth rates within fish populations. This occurs

when fish from the same lineage are repeatedly bred, leading to a loss of genetic diversity.

### **Strategies for Improvement**

- To counteract inbreeding depression and enhance seed quality, aquaculture operations should focus on two key strategies:
  - **Genetic Diversification:** Introduce new, genetically distinct broodstock from natural waters or other suitable sources. This infusion of new genes revitalizes the genetic potential of the population, improving overall health and performance.
  - **Education and Training:** Educate hatchery operators and farmers about the detrimental effects of using the same broodstock repeatedly. By raising awareness of the long-term consequences of inbreeding, they can implement better genetic management practices. Implementing these measures is crucial for ensuring the long-term sustainability and profitability of aquaculture operations.
- 19) **Optimizing Water Usage:** To enhance water efficiency in aquaculture, the adoption of Hi-tech Aquaculture Practices is strongly recommended:
- i. **Promoting Recirculating Aquaculture Systems (RAS) can revolutionize fish farming by enabling year-round production.** These closed-loop systems can be established even in saline areas by utilizing low-salinity groundwater.
  - ii. **Promoting biofloc technology:** It is an innovative aquaculture method that promotes a sustainable "blue revolution" by recycling nutrients within the system. This eco-friendly technique relies on cultivating beneficial microorganisms (biofloc) in ponds or tanks.
  - iii. **Promoting Integrated Farming:** Haryana can foster diversified and sustainable livelihoods by promoting **integrated farming systems**. These systems optimize resource use and provide multiple income streams by combining aquaculture with livestock, poultry, and crop cultivation. This approach helps farmers maximize their resources and enhance their overall economic resilience.
- 20) **Given the increasing scarcity of freshwater resources, which are also crucial for agriculture, diversifying aquaculture practices is imperative.**
- i. **Identification and introduction of high-value species like prawns and hardy fish species:** Prioritizing the cultivation of hardy fish species, such as air-breathing varieties (e.g., *Heteropneustes fossilis* (Singhi), *Clarias batrachus* (walking catfish/Magur), Anabas, *Pangasius pangasius*, Ompak (Pabdah catfish), and *Mystus*, etc., can mitigate water scarcity challenges. These species exhibit higher tolerance to adverse conditions, require less intensive care, and often command premium prices due to their nutritional value.

- ii. Emphasis may also be laid to take up the culture of fish species like *Labeo calbasu*, Mahseer, Labeo. Dero, Schizothox sp., and Mirror Carp (low altitude of hill fish), etc.
- 21) **Managing Tilapia Cultivation with caution:** Tilapia, although widely farmed, is an invasive species that poses a significant threat to indigenous fish populations. To safeguard the ecological balance of Haryana's water bodies, strict measures must be implemented to prevent the escape of tilapia from aquaculture farms.
- 22) **Sustainable Fish Nutrition:** Effective fish nutrition is essential for building sustainable and profitable fisheries. Optimizing diets is crucial for enhancing growth, reproductive potential, and overall fish health.  
**Here are key strategies for adoption:**
- **Promote locally available feedstuffs:** Utilize plants like water hyacinth, duckweed, azolla, and algae (such as Spirulina and Chlorella) as a promising approach.
  - **Replace fishmeal:** Make efforts to find and promote a plant-origin protein source to replace fishmeal.
- i. Most fish farmers use a combination of plant-based and animal-based feeds for optimal growth and health. By effectively utilizing aquatic plants, farmers can enhance their aquaculture sector while promoting sustainable practices.
- 23) **Harnessing Inland Saline Water for Thriving Aquaculture in Haryana:** Effective expansion of fish and shellfish production necessitates the exploration of untapped resources. Haryana offers a substantial opportunity with approximately 2.75 lakh hectares of inland saline water. By harnessing these underutilized waterlogged and saline areas, the state can significantly increase its aquaculture output. This strategic shift will not only stimulate economic growth through job creation and increased income but also contribute to global food security by addressing the rising demand for seafood.
- i) Currently, whiteleg shrimp (*Litopenaeus vannamei*) aquaculture dominates the utilization of saline-affected lands in Haryana. This practice has proven to be a viable livelihood strategy for local farmers.
  - ii) While whiteleg shrimp cultivation is prevalent, some farmers are also exploring aquaculture of other brackish water fish species, *albeit* on a smaller scale.
- 24) **Culture of salt-tolerant fish/shellfish species:**
- i. The Culture of the following fish species for aquaculture should be promoted whose technology is already available. *Mugil cephalus* (grey mullet), *Chanos chanos* (milkfish), *Etroplus suratensis* (Pearlspot), *Oreochromis niloticus*

(Nile tilapia). These fish species can be easily grown in inland saline groundwater without the need for fortification with muriate of potash, etc.

- ii. Identification of new or other fish/shellfish (fresh or saline water) species needs to be explored, which can be grown in inland saline water without fortification with murate of potash, etc.-Attention CIFE Centre Lahli, CCS Haryana Agril. University, Hisar.

**25) To further enhance the training programs, the fisheries college could consider collaborating with other institutions or organizations with expertise in aquaculture technology.**

Expanding on Regular Training Programs for Aquaculture: Offering regular training programs tailored to seasonal activities should be a crucial component of supporting the aquaculture industry. By aligning training with seasonal needs, we can ensure that farmers, traders, and service providers have the most relevant and up-to-date knowledge to optimize their operations. By providing comprehensive and timely training programs, we can empower aquaculture stakeholders to make informed decisions, improve their operations, and contribute to the sustainable growth of the industry.

**The way forward for making Aquaculture sustainable**

- i. Cluster-based approach for shrimp farming districts for which the Department of Fisheries, Govt of Haryana should take the lead, along with ICAR-CIFE, Rohtak centre for development activities under the guidance and support of the Department of Fisheries, Govt of India.
- ii. Registration is necessary for farmers, qualified technicians, and registered input providers (like feed and seed suppliers) under each cluster.
- iii. The cluster should manage the value chain availability in an organised manner to manage the perishable nature of the product.
- iv. The open market price fluctuations need to be regulated for farmed commodities to ensure a reasonable profit for the farmers.
- v. Fish farmers from Bhiwani, Hisar, Karnal and Rohtak expressed frustration during interaction meetings about the lack of accessible healthcare centres or aqua polyclinics. They had been struggling to address the high mortality rates in their overstocked and polluted village ponds, which were burdened with excessive organic loads. The Department of Fisheries (DoF) has not provided sufficient information to allow for a comprehensive evaluation of the effectiveness of public sector seed farms, healthcare centres and training programs at Hisar.

### Meetings/Field visits Held

<b>Date</b>	<b>Venue</b>	<b>Remark</b>
<b>Mar 09, 2023</b>	COBS&H, CCSHAU, Hisar	<b>1st Meeting of the Working Group on Fisheries Development in Haryana</b>
<b>May 07, 2023</b>	NASC Complex, ICAR, New Delhi	<b>Meetings with Executive Officer, Senior Officers (DoF), Fish Farmers, Researchers, Entrepreneurs and Experts</b>
<b>May 29, 2023</b>	Conference Room of Maharaja Hotel, Rohtak	<b>Meeting with Dr. Babitha and the Scientists of Lahli (CIFE, ICAR), Farmers and some entrepreneurs</b>
<b>June 14, 2023</b>	The team of the working group gathered at Jumpa Kalan at 9.0 am	<b>To visit aqua farms where venami culture was going on in farms situated in and around Jumpa Kalan (Siwani), Sirsa and Jind, etc.</b>
<b>August 1, 2023</b>	Directorate of Fisheries, Panchkula,	<b>Meeting of the working group along with the Director of Fisheries and his team of other senior technical staff</b>
<b>September 23, 2023</b>	Fish seed farm Bhutana	<b>A meeting was held at the fish seed farm of Mr Sultan Singh at village Bhutana (Nilokheri), along with fish farmers and members of the Directorate of Fisheries</b>
<b>March 11, 2024</b>	Haryana Kisan Kalyan Pradhikaran Government of Haryana Krishi Bhawan, Sector-21, Panchkula	<b>Regarding the preparation of the report of the working group.</b>
<b>August 8, 2024</b>	HKKP Office, Krishi Bhawan, Panchkula	<b>Regarding the discussion on the draft of the Report.</b>
<b>September 09, 2024</b>	Conference room, Krishi Bhawan, Panchkula	<b>One day brainstorming session on Fisheries and their status in Haryana for incorporating suggestions of the stakeholders.</b>

### **List of Tables**

- 3.1 The main sources of fisheries development in the State during the year 2021-22.
- 3.2 Fisheries production from different sources during the year 2021-22
- 3.3 Progress report of Fisheries Department Haryana up to March 2021
- 3.4 Progress report of Fisheries Department Haryana up to 2022-23
- 3.5 Progress report of Fisheries Department Haryana up to March, 2024
- 3.6 Year-wise Fisheries development programme of the State in ponds
- 3.7 Year-wise Fisheries development program of the State in Lakes and Reservoirs
- 3.8 Fish production from different sources during the year 2021-22
- 3.9 Year-wise total fish production of the State (Source- DoF, Haryana)
- 3.10 GVA from Agriculture & Allied Sectors at Constant (2011-12) Prices (Rs. in Crore) in the year 2021-22, Haryana
- 3.11 Data regarding fisheries development during different years and in different districts

### **List of Figures**

- 3.1 Progress report of Fisheries department Haryana from year 2020-24
- 3.2 Year-wise Fisheries development programme of the State in ponds
- 3.3 Production from Lakes and Reservoirs
- 3.4 Year-wise total fish production of the State
- 7.1 Map of Haryana Showing quality of underground water
- 7.2- 7.3 Water chemistry of Inland saline groundwater and natural sea water





## **HARYANA KISAN KALYAN PRADHIKARAN**

**Krishi Bhawan, Sector-21, Panchkula**

**Tel.: 0172-2551764**

**Website: [www.hkkp.org.in](http://www.hkkp.org.in)**

**Email – Id: [hkkppkl@gmail.com](mailto:hkkppkl@gmail.com)**