



Documenting and Analyzing Targeted Interventions of State Fishery Department of Andhra Pradesh, India

Katta Sravan Naga Parimala Kumar ^{a++*}
and Mohammad Aslam Ansari ^{a#}

^a Department of Agricultural Communication, GBPUA&T, Pantnagar, Uttarakhand, 263145, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2023/v41i102211

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/107490>

Original Research Article

Received: 02/08/2023

Accepted: 04/10/2023

Published: 07/10/2023

ABSTRACT

Aims: Though Andhra Pradesh acts as an aquaculture hub, several targeted interventions were implemented by the State Fishery Department of Andhra Pradesh for the benefit of farmers. But lack of awareness among the fish farmers about these interventions leads to severe economic loss. Hence, this study aims to document and describe the interventions implemented by the Andhra Pradesh Fisheries Department which helps the fish farmers to make well-informed decisions.

Study Design: Descriptive study design was used to describe the purpose of documented interventions

Place and Duration of Study: Interventions provided by State Fishery Department of Andhra Pradesh for fish farmers were documented from Fish Development Officers during March 2023.

Methodology: The study collects data from various sources, including fish development officers, government reports, and other publications to document the interventions provided by Fisheries

⁺⁺Ph.D. Scholar;

[#]Professor;

^{*}Corresponding author: E-mail: KSNPkumar@gmail.com;

department of Andhra Pradesh. Focus Group Discussion was conducted with the fish development officers to critically analyze these interventions.

Results: The interventions can be categorized into five broad categories; which were, fisheries inputs, infrastructure, capacity-building programs, financial assistance, and others/ miscellaneous. Under fisheries inputs; fish seed, fish feed and aerators were given. Infrastructural interventions such as feed analysis, water analysis, soil analysis, microbial analysis, PCR, fish hatchery units, fish processing units, mobile aqua labs, fish kiosks, Fish Andhra Fit Andhra, Traditional fish farming implements were provided. Simultaneously, capacity building programmes like training, demonstration, workshops, FFPO, extensive awareness programmes, training for other interns and other professionals were also conducted. Financial assistance was provided through KCC, YSR pension kanuka scheme, Electricity subsidy, Matya Kara Barosa and other facilities like licensing, assistance to new fish farmers were also carried out.

Conclusion: Interventions of State Fisheries department was classified into five categories for better understanding and to make effective use of the interventions by the farmers. Lack of awareness about the interventions lead to severe economic loss among fish farmers. Hence, this study aims to address the information gap and empower the stakeholder through proper documentation of fisheries interventions by State Government which enables the fish farmers to make well-informed decisions.

Keywords: Fish farmers; knowledge gap; fisheries interventions; documentation; Andhra Pradesh.

1. INTRODUCTION

Fish serves as an inexpensive and nutritious food source for a large section of economically disadvantaged people in India. It provides direct and indirect income and employment [1] to approximately 28.06 million people at the primary level of the production system across the value chain [2]. India's fisheries sector accounts for 7.56 percent of global fish production and is regarded as the second-largest fish-producing and third-largest aquaculture country [3]. It has been popularly recognized as a 'sunrise sector' because of its double-digit annual growth (10.87%) since 2014–15 [4]. It is a rapidly growing sector due to its immense potential and its importance as a significant source of income, employment, and food security [5].

Among several Indian states, Andhra Pradesh has emerged as one of India's largest farmed fish and shrimp producer as a result of the planned expansion of inland aquaculture farms [6] and is recognized as the aquaculture hub of India. Andhra Pradesh stood first with a production of about 34,49,560 metric tons (28,44,610 metric tons of inland fish and 6,04,950 metric tons of marine fish). Additionally, it accounts for approximately 5.1% of the state's GDP in the fiscal year 2019–20 (Year End Review, 2021). Therefore, the aquaculture and fisheries industry has been recognized as a significant driver of economic growth, food security, and livelihood within the state (Muralidharan, 2015); [7]. Though ecological

factors favour fish production, several constraints hinder the quality and sustainability of production (Muralidharan, 2015). But the growth and sustainability of the fisheries sector depend on the adoption of relevant and sustainable practices.

Further, as fish farming in Andhra Pradesh benefits over 1.5 million individuals and serves as a major source of rural livelihood [8], State Fisheries Department of Andhra Pradesh has implemented several interventions and policy measures to promote fish farming and ensures its sustainability. Though State Fisheries Department has taken up measures to address their concern of the fish farmers, the researcher during his primary survey found that most of the fish farmers remain unaware of these interventions and face economic losses. Nevertheless, different stakeholders in the fisheries sector face significant difficulties due to lack of proper documentation and limited accessibility to interventions by the Andhra Pradesh Fisheries Department. This information gap hinders the success of the sector and the dissemination of information, which leads to lost opportunities to adopt best practices, receive financial incentives, and participate in training programs that can significantly enhance productivity and revenue. Since proper documentation and validation of management practices are essential for farmers to effectively address various challenges [9] and empower them to make well-informed decisions [10], this study attempts to document the interventions

implemented by the Andhra Pradesh Fisheries Department to bridge the knowledge gap.

2. METHODOLOGY

A descriptive research design was adopted to document and describe the interventions implemented by the Fisheries Department of Andhra Pradesh. Being an important tool to increase transparency [11] and expand knowledge, the process of documentation encourages evidence-based, informed decision-making (Saur, 2013); [12]. Documentation as a research method can be defined as the systematic process of recording, preserving, and organizing information, data, procedures, actions, and outcomes in a structured and accessible manner.

As an aquaculture hub, the Fisheries Department of Andhra Pradesh has implemented several targeted interventions for the benefit of fish farmers. Whereas, on evaluating the fish farmers' perception towards these interventions by the researcher during his pilot study figured out that many of the fish farmers remain unaware of these interventions. This factor motivated the researcher to take up this research, since most of the fish farmers in the two top most fish farming villages (i.e.) Kalidindi village of Eluru district and Undi village of West Godavari district were unaware of the interventions. While, it has to be taken into consideration that, the researcher couldn't analyse the farmer's perception on these interventions as they were unaware of them and comprehensively documented and analyzed the interventions based on its need and purpose. The study utilized a cross-sectional survey design to systematically record the interventions implemented by the fisheries department. The detailed information on the activities of the Fisheries Department and its interventions was collected from primary and secondary sources. This comprehensive approach provides an overview of how the fisheries sector functions. The census method of sampling was employed to select the fish development officers (FDOs). A total of 22 FDOs working under the Fisheries Department of Andhra Pradesh were selected from Eluru district (8 FDOs) and Godavari district (14 FDOs). The interventions were identified and documented through personal interviews. The secondary information was gathered from statistical reports, policy notes, previous studies, and publications related to the fisheries sector. The information, thus gathered, was

documented, analyzed and categorized into five distinct and concise categories. The categorization highlights the main activities and support services provided by the State Department of Fisheries. The categories made were: Fisheries Inputs, Infrastructure, Capacity Building Programs, Financial Assistance, and Others. Further, it should be noted that the interventions were categorized based on researcher's perspectives towards the interventions, to enable better understanding of these interventions and to promote effective utilization among fish farmers.

3. RESULTS AND DISCUSSION

The interventions provided by the Fisheries Department of Andhra Pradesh were categorized into five broad categories. They were: Fisheries inputs, Infrastructure, Capacity-building programs, financial assistance, and others/miscellaneous. The interventions provided under each category are described below.

3.1 Fisheries Inputs

In order to improve the aquaculture practices adopted by fish farmers and promote sustainable growth, the Fisheries Department of Andhra Pradesh facilitates the provision of vital inputs to fish farmers. The inputs provided by them comprised a wide range of resources and support services that were essential for the success of fish farming activities in the region. Table 1 presents the different inputs provided by the fisheries department.

Table 1. Interventions provided by fisheries department as input

S. No.	Interventions
1	Fish Seed
2	Fish Feed
3	Aerator

From Table 1, it can be inferred that the Fisheries Department provides an extensive supply of high-quality fish seeds, nutritionally balanced fish feed, and efficient aerators. As the success of aquaculture production depends on uninterrupted and timely supply of quality fish seed [13], State Fishery Department of Andhra Pradesh provides good quality fish seeds in timely manner. While the Government of Andhra Pradesh [14] highlighted that the state has 28 feed mills to prepare fish feed, the provision of these inputs in good quality and a timely manner

enables fish farmers to effectively maintain their ponds. This, in turn, increases fish production and productivity, thereby contributing to the improvement of fish farmers' livelihoods and the overall growth and sustainability of their aquaculture practices. Since lack of input supplies [15] and shortage of fingerling supply [16] are the major problem experienced by fish farmers, provision of quality and timely inputs can improve production and productivity in fish farming.

3.2 Infrastructure

The interventions provided by the fisheries department under infrastructure are shown in Fig. 1. The fisheries department provides infrastructure facilities for the purposes of feed analysis, water analysis, soil analysis, and microbial analysis. It also provides various facilities, including disease diagnosis with PCR, fish hatchery units, fish processing plants, mobile aqua labs, the Fish Andhra initiative, insulated vehicles, three-wheelers with iceboxes, fishing nets, seaweed culture rafts, deep-sea fishing vessels, fish traps, open sea cages, and established fish kiosks.

Each of the infrastructural interventions was strategically designed to enhance the management of fisheries.

- a) **Feed analysis:** As feeding characteristics of fish play a key role in determining its successful colonization [17,18], the fish feed was formulated to ensure it is nutritionally balanced and specifically tailored to meet the needs of different fish species. In addition, the feed was tested for protein, fat, fiber, ash, and moisture content.
- b) **Water analysis:** Since the aquatic ecosystem primarily depends on water, the analyzing the physical, chemical and biological characteristics of water ensures the well-being of the fish population [19] and facilitates the fish farmer's ability to maintain a suitable aquatic environment. In addition, a fishery unit may be supplied with groundwater (from wells and underground aquifers), surface water (from rain and runoff) or both; since these water sources might contain high level of dissolved gases like carbon-di-oxide and hydrogen sulfide and metals; it become necessary to well test the water quality [20]. Water has been analyzed for its many

parameters, such as pH, temperature, hardness, alkalinity, calcium, magnesium, total dissolved solids (TDS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), iron, ammonia, salinity, nitrate, nitrite, chlorine, hydrogen sulfide, and phosphate.

- c) **Soil analysis:** As soil properties have a direct influence over fish productivity (Delince, 2013), analyzing the soil condition provides valuable insights about the soil condition and its impact on fish farming. The soil analysis includes tests for soil pH, organic carbon, nitrogen, phosphorus, and minerals, as soil properties have the ability to influence farming practices and enhance fish productivity through chemical transformation, exchange of nutrients and recycling role of soil.
- d) **Microbial analysis:** It enables fish farmers to effectively manage water quality, as certain micro-organisms can affect human health through direct contact or consumption of fish cultivated in contaminated water [19]; which avoids potential disease outbreaks and supporting sustainable aquaculture practices. In this regard, the microbial test carried out were Total Plate Count, Total Vibrio Count, Aero monas, Luminescent Bacteria, Biochemical Test, Fungal Test, Drug Sensitivity, Streptococci, E. coli, and Shilgealla Bacteria. All these tests were conducted at the district-level Fisheries Departmental Office and also in the aqua labs situated in the main fish cultivation areas. The state had 234 Aqua labs and was about to establish a large Integrated Aqua lab with high-end equipment for testing. With the advancement of technology, the department has implemented many innovative approaches.
- e) **Polymerase chain reaction (PCR):** It is a groundbreaking approach that enables fast and reliable identification of fish bacterial diseases at reduced cost and necessary time for disease control [20]. Separate training was given to technicians who operate PCR. Though there are many PCR machines, none of them were functional at the time of the researcher's field visit because of lack of qualified persons to operate it [21].
- f) **Fish hatchery units:** Earlier, supply of fish seeds was depended on natural sources. But environmental degradation and other

anthropogenic consequences deteriorated the natural sources of fish seeds; which leads to dependency on artificial fish seed production and distribution [13]. In order to meet the present demand of fish seed, fish hatchery units were established by the State Fishery of Andhra Pradesh, which enables the department's ability to control breeding and propagate quality fish species. Further, it contributes to the preservation and enhancement of aquatic biodiversity. The state has 357 hatchery units for aquaculture operations [22].

- g) **Fish processing plants:** Value addition or processing acts as a strategy to ensure food security [23], increase the income of farmers and minimize the post-harvest loss. In this regard, the state has established 64 processing plants to streamline the post-harvest stage.
- h) **Mobile Aqua Labs:** Mobile aqua labs were established by Fishery department of Andhra Pradesh; through which scientific expertise and extension services were brought closer to fish farmers in remote regions through mobile trucks. This has catalyzed knowledge transfer and fostered sustainable fishing practices among fish farmers in unreachable regions.
- i) **Fish Andhra Fit Andhra:** It was one of the very recent initiatives by the State Department of Fisheries that aims to support local fish vendors in establishing live fish meat selling outlets with financial and technical assistance from the state department of fisheries. This initiative is aimed at empowering unemployed youth and ensures hygienic meat for the public. The main reason behind this initiative was to increase not only the state's fish production but also the consumption of fish [24].
- j) **Fish kiosks:** Kiosks acts as a best way to provide customers with food traceability information. They were established by fishermen with the guidance and support of the fisheries department. These kiosks serve as fish outlets near coastal areas. The infrastructural interventions of the Fisheries Department of Andhra Pradesh were available at kiosks.
- k) **Traditional fish farming:** Because of the socio-cultural practices of the fish farmers (Das, 2002), some of the fish farmers (laggards) prefer traditional fish farming techniques than modern techniques. In this regard, State Fishery Department of

Andhra Pradesh provides certain interventions for traditional fish farmers, to conserve fish stock and promote sustainability in fish farming. The interventions include;

- Deep-sea fishing vessels
 - Fishing nets
 - Fish traps
 - Open sea cages
 - Seaweed rafts given to traditional fishermen.
- l) **Others:** Absence of regular subsidy programmes [15] imposes difficulties in fish cultivation among farmers. While, through state subsidy programmes, the Fisheries department of Andhra Pradesh deploys
- ✓ Motorcycles with iceboxes
 - ✓ Insulated vehicles and
 - ✓ Three-wheelers with iceboxes.

There were 235 ice plants operated in the state to preserve fish in iceboxes for domestic and international export [22].

3.3 Capacity-Building Programs

Developing the capacities of fish farmers through periodic and regular training programmes is necessary to sustain the livelihood of fish farmers. In this regard, certain interventions were provided by the fisheries department as capacity-building programs, which aim to empower fishers and other stakeholders by equipping them with the necessary skills, knowledge, and resources needed to enhance their productivity and efficiency, thereby improving their livelihoods and profitability. The capacity building interventions includes;

- **(a) Training:** Since commercial fishing is regarded as a risky occupation [25]; fishermen and other stakeholders in the fisheries sector had to undergo specialized training and skill development sessions. These trainings cover a wide range of topics, including sustainable fishing methods, aquaculture techniques, marketing tactics, and value chain management. The state department develops a culture of continuous learning that empowers fish farmers to adapt to emerging trends and challenges in the sector.

- **(b) Demonstrations:** Rather than the other extension methods, fish farmers and other stakeholders prefer demonstrations as it offers hands-on experience and practical knowledge which enables them to easily understand [26]. These interactive meetings present best practices in fishing, fish farming, and post-harvest processing, enabling fishermen to learn and apply innovative approaches effectively.
- **(c) Fish Farmer Producer Organizations (FFPO):** The fisheries department emphasizes the significance of collective action and promotes the formation of Fish Farmers Producer Organizations (FFPO), as FFPO focus on empowering small scale fish farmers by providing collective bargaining power, access to resources and improved market opportunities. Though the department has received the proposals, no proper initiative has been taken, and we may see many FFPOs in the future.
- **(d) Extensive awareness programs:** As fish farming has greater potential to mitigate the ill-effects of climate change, pollution, over-exploitation and use of obnoxious fishing methods [27], there is a need to conduct awareness programs to educate fishers and local communities about sustainable fishing practices, the importance of environmental conservation, and the significance of adhering to fisheries regulations. These awareness programs were mostly conducted for fishermen residing in coastal areas.
- **(e) Workshops:** As participation in relevant workshop programmes helps to building farmer's capacity, increase resilience and improve profit of the business [28]; fishery department conducts workshops to provide a space for in-depth discussions and information sharing among experts, fishermen, and stakeholders. These forums foster conversations on significant issues, such as climate change impacts on fisheries, market trends, and policy frameworks, helping in the formation of evidence-based solutions for the future.

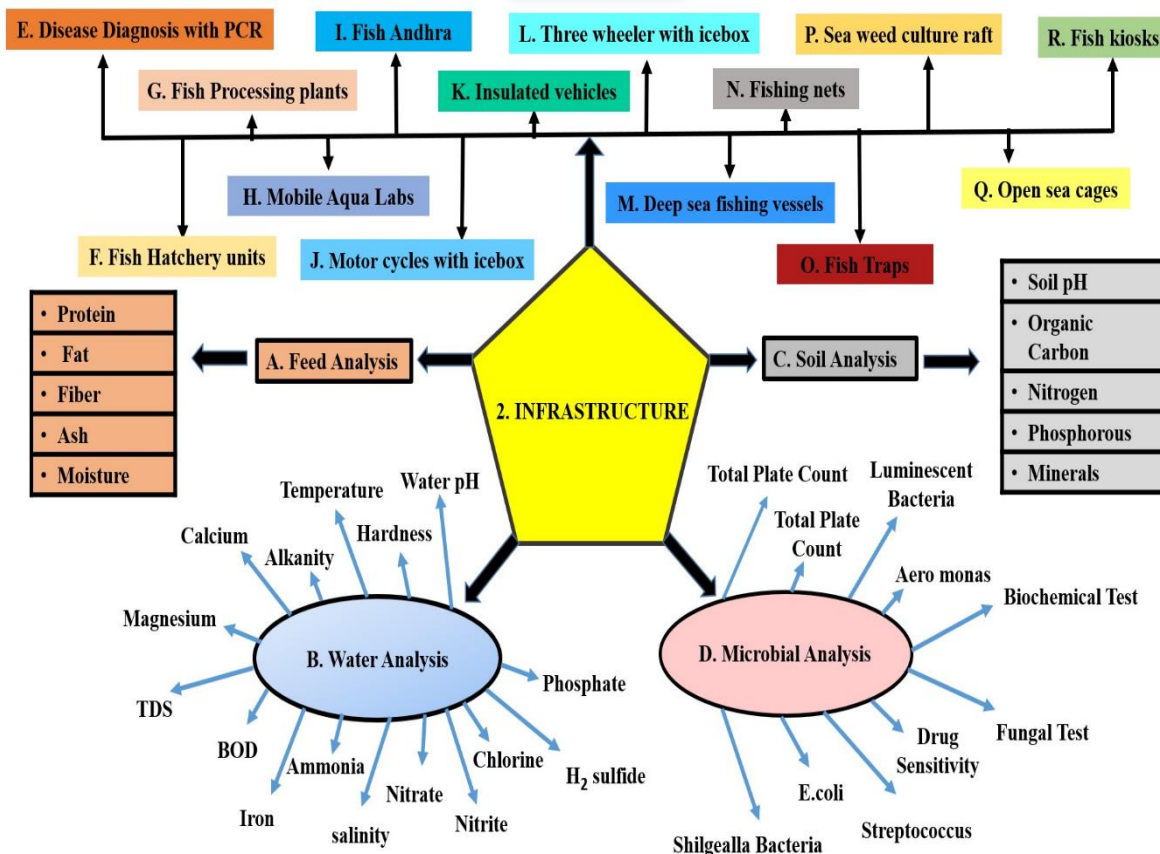


Fig. 1. Infrastructural interventions provided by fisheries department

- **(f) Training programs for interns and fisheries students:** Recognizing the critical importance of nurturing the next generation of fisheries experts, the department conducts training programs for intern fisheries students. The activities expose young minds to practical problems and real-world experiences, polishing their talents, preparing them for future challenges, and providing alternative or supplementary employment in the fishing sector [29-25].
- **(g) Training for other professionals:** Besides, the department expands its cooperation efforts by delivering training to other departments that helps to build interdisciplinary connections and promotes the implementation of knowledge-sharing systems. Combining experience from various sectors, the fisheries sector gains valuable insights and innovative solutions, leading to increased overall performance.

Thus, it can be concluded that the capacity-building programs were strategically designed to empower fishermen and stakeholders through education, skill development, and collective action. Through allocating resources to capacity-building initiatives, the department not only enhances the efficiency and long-term sustainability of the fisheries sector but also takes on a vital role in promoting the socio-economic well-being of fishers and local communities.

4. FINANCIAL ASSISTANCE

The financial interventions provided by the Fisheries department of Andhra Pradesh can be understood from the Fig. 2.

Typically, the financial interventions of the fisheries department encompass financial

support were in the form of Kisan Credit Cards (KCC), electricity subsidy, YSR Pension Kanuka, and Matya Kara Barosa.

- Kisan credit cards (KCC):** KCC was made available to fish farmers in the state through extensive promotional campaigns benefiting both inland and marine fish farmers by providing minimum short-term credit requirements. The credit limit was Rs. 3 lakhs per year, with an annual interest rate of 4%. These credit cards provide a quick and accessible way for farmers to obtain financing, enabling them to invest in their fishing operations and acquire essential equipment. However, the researcher did not find many farmers using this facility.
- YSR Pension Kanuka scheme:** Another important intervention initiated by the state government of Andhra Pradesh in 2019 was the YSR Pension Kanuka scheme. It would enable the fishermen over the age of 50 to earn a pension of Rs. 2250 every month, which would support them in their elder years.
- Electricity subsidy:** Under this scheme, fish farmers were given reduced power rates, which decreased their operational expenses and motivated them to employ contemporary technology such as aerators, pumps, and other electricity-dependent equipment. Farmers who grow shrimp and fish on less than five acres of land are required to pay Rs 1.50 per unit, whereas farmers who cultivate more than five acres have to pay Rs 3.85 per unit. Many farmers were disappointed with the tariff rates, as they had been low previously and the government had just increased the power tariffs.



Fig. 2. Financial Interventions provided by Fisheries department of Andhra Pradesh

d) **Matya Kara Barosa:** It provides monetary relief of Rs. 10,000 (currently) during the marine boycott and lean season (which occurs annually from April to June) and provides support to fishermen aged 21 to 60. The plan also includes a diesel subsidy, which has been increased from Rs 6.03 to Rs 9 per liter for a consecutive period of 10 months. This subsidy on diesel was applicable to automated boats (3000 liters) and mechanized boats (300 liters). A compensation of Rs 10 lakh will be provided to victims or their families in the event of accidental death or permanent disability while fishing in the sea or freshwater bodies. Eventually, these measures will indicate the proactive approach of the Fisheries Department towards the welfare of fish farmers and their support for the development and resilience of the fishing industry.

4.1 Others

Some of the other interventions provided by the Fisheries Department of Andhra Pradesh includes:

1. **Licensing:** Aquaculture farms require legal licensing and regulation of their operations. The fisheries department provides licenses to ensure that aquaculture operations comply with applicable standards, environmental regulations, and legal requirements. Now that the state has divided the land into aqua zones and non-aqua zones, it is not possible to convert the land in the non-aqua zone into a fish pond.
2. **Inspection Activities:** The Fisheries Department conducts regular inspections of fishery-related facilities, including aquaculture farms, processing units, and storage areas, to ensure compliance with safety standards, hygiene procedures, and legislation.
3. **Assistance to new fish farmers:** Many individuals who are interested in aquaculture approach the department, and a designated officer guides them and provides all necessary assistance, from starting a fish pond to choosing aquatic species and other cultivation practices.

Thus, it could be concluded that by implementing thorough inspections, the department aims to identify any flaws or inadequacies and provide

guidance and corrective measures to enhance the overall quality and safety of fisheries products. By developing and empowering young fish farmers, the department aims to promote the overall competitiveness and sustainability of the fishing sector.

5. CONCLUSION

Fisheries sector acts as an instrument for the socio-economic development of the country and a powerful tool for improving the livelihoods of marginalized and vulnerable communities. Andhra Pradesh, being the first and largest fish-producing state, has implemented several interventions to promote the growth and sustainability of fish farming practices. The interventions provided by the Fisheries Department of Andhra Pradesh were strategically designed to benefit the fish farming community. These interventions include providing quality inputs, infrastructure facilities to minimize post-harvest loss and promote processing, improving the farmers' abilities through capacity building programs, offering financial assistance such as pensions and monetary relief during lean seasons, and implementing legal interventions. In order to ensure food and nutritional security for the growing population, it is crucial to harness the immense potential of the fisheries sector for generating income and employment. Further, the researcher was unable to provide the farmer's perspective on these interventions as most of the fish farmers in the top two fish farming districts of Andhra Pradesh remain unaware. This study aims to empower fish farmers by providing comprehensive and relevant information about the interventions of the State Fisheries Department. Despite the efforts of the Andhra Pradesh State Government, the lack of information regarding departmental interventions raises questions about the effectiveness of the fisheries sector. Hence, this study was conducted purposefully in Andhra Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Teh L C, Sumaila U R. Contribution of marine fisheries to worldwide employment. *Fish and Fisheries*. 2013;14(1):77-88.
2. Hand Book on Fisheries Statistics. Department of Fisheries, Ministry of

- Fisheries, Animal Husbandry & Dairying, Government of India, New Delhi; 2020. Retrieved on August 14, 2023. Available:https://dof.gov.in/sites/default/files/2021-02/Final_Book.pdf
3. Press Information Bureau. Year ender review 2021 on highlight key initiatives and achievements pertains to Department of Fisheries, Ministry of Fisheries, Animal husbandry and Dairying of the year 2021; 2021. Retrieved on August 22, 2023. Available:<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1786303>
 4. Bhargavi K, Chirwatkar BB, Das A, Behera S, Bhakta D. Socio-economic status of fisherwomen community in coastal Vizianagaram district of Andhra Pradesh. *Indian J. Fish.* 2020;8(1):741–745.
 5. Mir S A, Ojha S N, Ananthan P S, Qureshi N W, Argade S D, Gul S, Thangavel, V. Assessment of Fisheries and Management- Insights from Dal Lake, Kashmir. *Indian j. Ext. Educ.* 2022;58(4):60–65.
 6. NASA. Earth observatory; 2012. Retrieved on August 22, 2023. Available:<https://earthobservatory.nasa.gov/images/148581/an-abundance-of-aquaculture-in-andhra-pradesh>
 7. Swarna Pragathi M, Anitha M, Sreenivasulu G, Jayaraju N. Sustainable aquaculture and economic development in coastal areas: The case of Andhra Pradesh, India. In *Coasts, Estuaries and Lakes: Implications for Sustainable Development Cham: Springer International Publishing*; 2023.
 8. Madhu A, Venkata Rao P. Fisheries sector in India and Andhra Pradesh: An overview. *Int. Jol. of Creative Research Thoughts.* 2021;9(4):423–433.
 9. Das S K., Tripathi H. livestock diseases and health care facilities in Sundarbans delta of India. *Indian j. ext. educ.* 201147(1&2):23-26.
 10. Sauer F. A GIS-based digital documentation protocol for high-resolution documentation of Paleolithic sites. *J. of Paleolithic Archaeology.* 2023;6(1):1-20.
 11. Sharma G D, Yadav A, Chopra R. Artificial intelligence and effective governance: A review, critique and research agenda. *Sustainable Futures.* 2020;2:10004.
 12. Indraningsih K S, Ashari A, Syahyuti S, Anugrah I S, Suharyono S, Saptana S, et al. Factors influencing the role and performance of independent agricultural extension workers in supporting agricultural extension. *Open Agriculture.* 2023;8(1):1-7.
 13. Faruk M A R, Mony S F A, Hasan M M. Status of biosecurity and health management in fish hatcheries. *Knowledge is Power.* 2012;1(5):02.
 14. Government of Andhra Pradesh, Principal Secretary of Fisheries, Fisheries Department- Fisheries Policy of Andhra Pradesh; 2015-20. Retrieved on August 11, 2023. Available:<https://smallscalefishworkers.org/wp-content/uploads/2019/01/Fisheries-Policy-of-Andhra-Pradesh-2015-2020.pdf>.
 15. Chowdhury A, Mamun-ur-Rashid M, Hossain S. Effect of Public Fisheries Extension Service on the Selected Socioeconomic Aspects of the Clients in Two Selected Sub-districts under Barisal District in Bangladesh. *Asian j. Agric. Ext. Economics social.* 2016;13(1):1-13.
 16. Gopika, MH. Study on participation in decision making, job performance and job Satisfaction of Assistant Horticulture Officers. M.Sc. (Agri.) Thesis, Univ. Agri. Sci., Bangalore, Karnataka, India. 2014;156.
 17. Tonella L H, Fugli R, Vitorino O B, Suzuki H I, Gomes L C, Agostinho A A. Importance of feeding strategies on the long-term success of fish invasions. *Hydrobiologia.* 2018;817:239-252.
 18. Gorlach-Lira K, Pacheco C, Carvalho L C T, Melo Júnior H N, Crispim M C. The influence of fish culture in floating net cages on microbial indicators of water quality. *Braz. J. Biol.* 2013;73:457-463.
 19. Stone N M, Shelton J L, Haggard B E, Thomforde H K. Interpretation of water analysis reports for fish culture. *Southern Regional Aquaculture Center*; 2013.
 20. Sebastião F A, Furlan L R, Hashimoto D T, Pilarski F. Identification of bacterial fish pathogens in Brazil by direct colony PCR and 16S rRNA gene sequencing. *J. Adv. Microbiol.* 2015;5(06):409.
 21. Karki N P. Fish farming in Nepal: trends, opportunities and constraints. *Nep. J. Agric. Sci.* 2016; 14:201-210.
 22. Directorate of Economics and Statistics. Government of Andhra Pradesh. *Andhra Pradesh Economy in Brief*; 2021. Retrieved August 24, 2023. Available:https://des.ap.gov.in/jsp/social/AP_Economy_in_brief-2021.pdf

23. Lucas J S. Southgate P C. Aquaculture: farming aquatic animals and plants (2nd ed.). Wiley-Blackwell; 2013. Retrieved on September 12, 2023. Available:<http://site.ebrary.com/id/10526580>
24. Deccan Chronicle. Andhra Pradesh to increase fish consumption locally; 2023. Retrieved on September 12, 2023. Available:<https://www.deccanchronicle.com/nation/current-affairs/290723/andhra-pradesh-to-increase-fish-consumption-locally.html>
25. Thorvaldsen T. The importance of common sense: How Norwegian coastal fishermen deal with occupational risk. Mar. Policy. 2013;42:85-90.
26. Yanfika H, Listiana I, Mutolib A, Rahmat A. Linkages between extension institutions and stakeholders in the development of sustainable fisheries in Lampung Province. In Journal of Physics: Conference Series. IOP Publishing. 2019;1155(1):012014.
27. Aphunu A, Nwabeze G O. Fish farmers' perception of climate change impact on fish production in Delta State, Nigeria. J. Agric. Ext. 2012;16(2):1-13.
28. Onyeneke R U, Igberi C O, Aligbe J O, Iruo F A, Amad, M U, Iheanacho S C, et al. Climate change adaptation actions by fish farmers: Evidence from the Niger Delta Region of Nigeria. Aust J Agric Resour Econ. 2020;64(2):347-375.
29. Das D N. Fish farming in rice environments of North Eastern India. Aquaculture Asia. 2002;7(2):43-47.
30. Delincé, G. The ecology of the fish pond ecosystem: with special reference to Africa (Vol. 72). Springer Science & Business Media; 2013.
31. Indian Brand Equity Foundation. Economic Survey;2020-2021. Retrieved on August 28, 2023. Available:<https://www.ibef.org/economy/economic-survey-2020-21>
32. Lynch A J, Elliott V, Phang S C, Claussen J. E, Harrison I, Murchie K J, Steel E A, Stokes G L. Inland fish and fisheries integral to achieving the Sustainable Development Goals. Nat. Sustain. 2020; 3(8):579–587.
33. National Fisheries Development Board. Annual Report; 2015. Retrieved on August 22, 2023. Available:https://nfdb.gov.in/PDF/ANNUAL%20REPORTS/Annual%20Report_2015-16.pdf
34. Shah R H, Bukhari R. Strengthening the role of women in fisheries and aquaculture. J. Entomol. Zool. Stud. 2019;7(3):648-654.
35. Shilpa B, Jirli B. Documentation and analysis of ICT initiatives of agricultural research institutions in Telangana: Application of nudge theory India. Indian j. Ext. Educ. 2023;59(2):88-92.

© 2023 Kumar and Ansari; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:

<https://www.sdiarticle5.com/review-history/107490>