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REVIEW ARTICLE Agricultural Science Digest, Volume Issue

Income Diversification of Artisanal Fishermen in Chilika Lagoon in Odisha: A Review

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ABSTRACT

Artisanal fisheries are an essential part of the socioeconomic fabric of coastal villages, supporting thousands of people and making a major contribution to local food security. These small-scale sectors provide a very fluctuating income. The present study investigates the diversification of income sources among Odisha's artisanal fishers, highlighting significant factors that impact their financial stability and suggesting measures to improve it. Seasonality, market dynamics, legal frameworks, loan availabilityand climate change influence income levels. Alternative livelihood initiatives, community-based resource management, enhanced market accessibility, microfinance, insurance and sustainable fishing methods are some of the strategies for income diversification which are discussed here. The diversity of income for artisanal fishers in Odisha is influenced by a complex interplay of environmental, economicand social factors. Addressing the challenges faced by these communities requires a multi-faceted approach that includes promoting sustainable practices, enhancing market access, providing financial supportand encouraging community participation.

Key words: Artisanal fisheries, Chilika, Chilika lagoon, Fish cooperatives, Income, Market dynamics.

Artisanal fisheries in Odisha, India, play a crucial role in the socio-economic fabric of coastal communities. These small-scale, often family-run operations provide livelihoods for thousands of people and contribute significantly to local food security. However, the income generated from artisanal fishing is subject to considerable variation due to multiple factors including environmental conditions, market dynamics, regulatory frameworks and socio-economic constraints. This article aims to explore the diversity of income sources for artisanal fishers in Chilika Lagoon of Odisha, examining the various factors that influence their economic well-being and proposing strategies to enhance their financial stability.

For most households near Victoria Lake, fishing is still the primary source of income, with yearly average earnings ranging from Ksh 30,000 to Ksh 90,000 (43.9%) (Magego *et al*., 2021). Being near a river meant that for the majority of people living across Chanyanya fishing camp, fishing was their primary source of income (Sonjiwe *et al*., 2015). Income diversification raises fish workers' earnings and is a tactic for reducing poverty in fishing communities (Olale and Henson, 2013). Diversifying fishing activities does not lessen the strain on the marine ecosystem. Quite the contrary: fishers with other onshore jobs fish less responsibly (Hoorweg *et al*., 2009). Diversifying one's sources of income can significantly increase it (Allan Degen *et al*., 2010). Reducing fishing efforts on overexploited fisheries may be possible with wealth creation and employment possibilities aimed at the poorest fishers. Still, the socioeconomic environment in which fishers operate must be understood for these interventions to succeed (Cinner *et al*., 2009). The distribution and abundance of target and by-catch species are greatly impacted by artisanal fishing, in addition to broader effects on biomass, biodiversity, assemblage structure, community dynamics and ecosystem functioning. Artisanal fisheries regulation and management remain challenging despite these clear and present risks. Families in the coastal tropical regions usually depend on fishing for income and food security, with local populations being extremely impoverished (Batista *et al*., 2014).

Understanding the relationships between people and aquatic resources is essential for managing fisheries and for native or indigenous populations, forestry resources are also taken into account for sustaining their way of life.

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How to cite this article: Nandy, A., Mishra, S.N., Barik, N.K., Das, A. and Das, S. (2024). Income Diversification of Artisanal Fishermen in Chilika Lagoon in Odisha: A Review. Agricultural Science Digest. 1-9. doi: 10.18805/ag.D-6211.

Submitted: 25-09-2024 **Accepted:** 27-10-2024 **Online:** 06-01-2025

For the management of artisanal fisheries, it is essential to get an understanding of local knowledge about fish and other resources, collective local arrangements and institutions, market interactions and fishers' decision-making processes (Begossi, 2014). Understanding how humans and aquatic resources interact is essential to managing fisheries and for native or indigenous groups, forestry resources are also taken into account for their means of subsistence. Fundamental to the management of artisanal fisheries is the acquisition of knowledge about local knowledge about fish and other resources, collective local arrangements and institutions, market contactsand the decision-making processes of fishers (Matera, 2016). Despite years of support for growth and technology, the region's overall fisheries productivity has, if anything, decreased; Some fishermen have profited at the expense of others, while others have not (Bailey, 1993).

Income diversification of artisanal fisheries in India

There is considerable variability in the characteristics of fishing communities and the predictors of poverty within and across geographies (Jadhav, 2018). The availability of non-farm activities influenced 22% of fishermen's decision to engage in non-farm activities (Dutta, 2022), however, the majority of fishermen expressed favourable opinions on conservation and fish diversity (Jamoh *et al*., 2024). In low-income areas, many fishers find themselves caught in economic structures that lead to relative poverty (Ogah *et al*., 2022). In addition to having few sources of income and an average household income, they also had a relatively low degree of diversification. A household's monthly income in the Bhagirathi–Hooghly stretch of the Ganga River was determined to be Rs 9391. Because there are more high-value fish in the bottom stretch of the harvest, there is a higher income there (Pandit *et al*., 2019). Unlike monopolized individual species-based focused commercialized fishing operations performed internationally, particularly in temperate and sub-tropical coastal waters, the vast array of fisheries resources is targeted with specific gear and boats. The fishing industry in India continues to primarily rely on less capital-intensive fishing methods. Except for the few industrial trawlers that previously operated under the government of India's letter of permission (LOP) regime, the whole Indian fishery can be considered small-scale given the rise in worldwide standards for commercialized fishing (Jena and George, 2018). The sharing pattern of fisheries resources among the crew members varied between fishery villages and fishery practices (Murugan *et al*., 2014). The distribution and quantity of target and by-catch species, as well as broader effects on biodiversity, biomass, assemblage structure, community dynamics and ecosystem functioning, are all greatly impacted by artisanal fishing. Artisanal fisheries regulation and management remain challenging despite these clear and present risks. Families in coastal tropical regions usually depend on fishing for both income and food security and local communities are often extremely impoverished (Batista *et al*., 2014). Fishers who have committed themselves to an excessively specialized sector are better prepared to adjust to changes in the environment (Coulthard, 2008). Fishers can adopt cluster-cage farming which has no negative effects on the quality of the water or sediment (Ghosh *et al*., 2024).

Overview of artisanal fisheries in Odisha

Odisha, located on the eastern coast of India, boasts a coastline of about 480 kilometers, with a rich diversity of marine and estuarine resources. The state's artisanal fisheries sector is characterized by the use of traditional fishing methods and gear, such as cast nets, gill netsand small boats, often without engines. These fishers primarily target a variety of species, including prawns, crabsand several types of finfish, which are crucial for their subsistence and commercial purposes.

Its survival depends critically on their sharing their knowledge and their special efforts to provide night work, which is a source of traditional fish and fisheries knowledge. The fishing sector will not grow to the expected rate if their socioeconomic conditions do not improve and they do not experience inclusive growth. Fishers may become dissatisfied due to differences in living standards, unequal access to financial resourcesand a lack of basic facilities, which could lower their willingness to engage in fishing operations (Kumar and Shivani, 2014).

In a comparative study it is seen that the fishers in Chennai were significantly more able to utilise the new technologies available in marine fishing, making them more economically stable. The fishers in Paradeep, on the other hand, were ranked second in terms of economic stability because of their relative adaptability. The fishers in the Sundarbans are the least wealthy since they are the least savvy about the advancements in marine fishing technology (Roy, 2021).

Artisanal fisheries in Odisha provide direct employment to over 1.4 million people, including fishers, fish vendors and those involved in ancillary activities such as boat building and net making (Annual Report, 2020). The sector also supports the livelihoods of millions more indirectly through supply chains and local markets. Despite its significant contribution, the income of artisanal fishers remains precarious and subject to numerous challenges.

Objectives of the study

The objectives of the present study are: (1) To study about the income pattern of the artisanal fishermen in different sectors of Chilika Lagoon (2) To study about the factors influencing the income diversity of artisanal fishermen (3) To discuss the different income-diversifying strategies of the artisanal fishermen.

With an emphasis on the Chilika Lagoon and coastal fishing communities, this study attempts to evaluate the difficulties faced by and options for diversifying their

income for artisanal fishers in Odisha. Chilika Lagoon was chosen as the study area as it is the home to 4,00,000 fishermen who depend on fishing and related activities for their livelihood. Two primary locations were chosen for data collection: Chilika Lagoon and coastal communities such as Gopalpur-on-Sea. These places were chosen due to their importance in artisanal fisheries and their exposure to environmental and policy issues. In order to obtain information on socioeconomic conditions, fishing practicesand diversification strategies, structured surveys were given to 230 artisanal fishermen from various fishing villages. Additionally, in-depth interviews were conducted with 50 key informants, including leaders of fisheries cooperatives, government officialsand local non-governmental organizations. Fishermen's perspectives on prospects for livelihood diversification, market accessibilityand environmental changes were investigated through focus group discussions (FGDs). The difficulties experienced by fishermen, problems with governanceand community viewpoints on resource management were among the recurrent themes found in the thematic analysis of focus group discussions and interviews.

Existing distribution of fishermen across different castes in Chilika Lagoon

Table 1 represents the proportion of the population across different castes of Chilika. Eight castes of people in Chilika belong to the class of artisanal fishers. They are identified by the type of gadgets used. These findings showed that the caste 'Keuta' or 'Kaibarta' constituted around 50 percent of the sample whose prominent gadget is 'Khepa Jaal' for fishing followed by 'Kandara' (20.0%) caste and 'Khatia' caste (10.0%) with their preferred fishing gadget as used by them to be 'Dhaudi Jaal' and 'Jaal' respectively.

Average income of artisanal fishermen in Chilika Lake

Table 2 represents the sector-wise average income of artisanal fishermen in the area for the period 2023-24. The average fishing, average non-fishingand average total income of fishermen across the four sectors of Chilika are shown. The average total income is the highest in the northern channel sector because of increased income from tourism (Dash and Balamurugan, 2024). The prominent tourist sites in like Mangalajodi, *Nalabana,* etc are located in the northern channel sector which attracts tourists creating income opportunities for the fishermen. In the southern sector, the major non-fishing activity is agriculture which provides an alternative source of income to the fishermen.

Challenges for artisanal fishers in Odisha

Artisanal fishers in the Chilika Lagoon, Odisha, face several challenges that impact their livelihoods. Here are some of the key issues (Fig 1).

Environmental Challenges

Climate change: Rising temperatures, changing rainfall patterns and increased frequency of extreme weather events disrupt fishing activities and affect fish populations.
Water quality: Pollution from agricultural runoff, industrial wasteand domestic sewage degrades water quality, affecting fish health and biodiversity.
Salinity variation: Changes in salinity levels, often due to alterations in water flow and the opening or closing of the lagoon mouth, impact fish species composition and productivity.

Economic challenges

Market access: Limited access to markets and fair pricing mechanisms often lead to exploitation by middlemen, resulting in lower income for fishers.

Table 1: Percentage proportion of population across different castes in the region. (n=230)

Caste	Gadget used	Population (%) of Chilika (approx.)
Khatia	Jaal	10.0
Kandara	Dhaudi Jaal	20.0
Keuta/Kaibarta	Khepa Jaal	50.0
Nalia	Jaal	5.0
Tiara	Dhaudi/Baja	5.0
Niali	Banishi	2.0
Ghadei	Jaal	5.0
Karatia	Jaal	2.0

Table 2: Sector-wise average income of artisanal fishermen in the region.

Types of income	Central sector (Rs.)	Outer Channel (Rs.)	Northern (Rs.)	Southern (Rs.)
Fishing	118279.07	200660.00	70650.82	109441.17
Non-fishing	34767.44	59733.33	77491.80	59803.92
Total income	153046.51	260393.33	148142.62	169245.09

Credit and finance: Lack of access to affordable credit forces fishers to rely on informal moneylenders with high-interest rates, trapping them in a cycle of debt.

Income diversification: Dependence on fishing as the sole source of income makes fishers vulnerable to seasonal variations and environmental changes. Limited opportunities for alternative livelihoods exacerbate this vulnerability.

Social challenges

Education and skill development: Low levels of education and lack of alternative skills limit opportunities for improving livelihood options outside of fishing.

Health and safety: Poor healthcare facilities and unsafe working conditions on boats and in the water pose significant risks to fishers' health and safety.

Social security: Inadequate social security measures, such as insurance and pension schemes, leave fishers and their families unprotected against economic shocks. *Governance* and *Institutional Challenges*

Regulatory framework: Inconsistent and poorly enforced fishing regulations can lead to overfishing and resource depletion, harming long-term sustainability.

Resource management: Lack of effective resource management practices and community participation in decision-making processes undermines conservation efforts and equitable resource distribution.

Conflict resolution: Disputes over fishing territories and resource access between different fishing communities or with other stakeholders, such as tourism operators, can lead to conflicts and reduce fishing efficiency.

Technological challenges

Fishing gear and techniques: Limited access to modern fishing gear and sustainable fishing techniques can reduce catch efficiency and increase environmental impact.

Post-harvest infrastructure: Inadequate infrastructure for processing, storing and transporting fish leads to significant post-harvest losses and lower income.

External pressures

Tourism development: Expanding tourism activities in and around the lagoon can disrupt fishing areas, leading to reduced access and potential conflicts.

Hydrological projects: Large-scale projects, such as dams and irrigation schemes, can alter water flow and sedimentation patterns, affecting fish habitats and breeding grounds.

Addressing these challenges requires a multi-faceted approach involving improved governance, community engagement, sustainable resource managementand diversification of income sources.

Factors influencing income diversity

Seasonal variations

The fishing season in Odisha typically spans from October to June, with peak activities occurring during the winter months when the seas are calmer. Seasonal monsoons and cyclonic storms, which are frequent in the Bay of Bengal, lead to periods of inactivity, significantly affecting the income of fishers. The off-season, which usually lasts for about three to four months, is a time of economic hardship for many fishing communities (Pritchard *et al*., 2024).

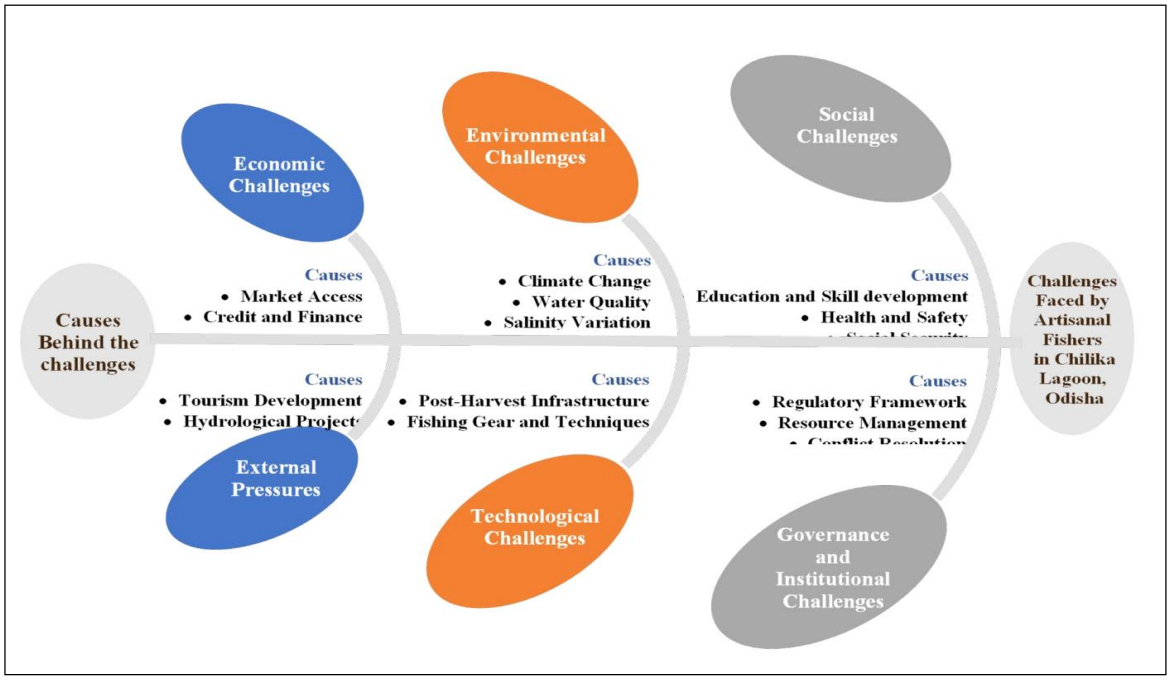

Fig 1: Visualizing the challenges faced by artisanal fishers in Chilika Lagoon, Odisha.

Market dynamics

The income of artisanal fishers is heavily influenced by market demand and prices, which can fluctuate widely. Factors such as local consumer preferences, competition from industrial fishing operations and the availability of alternative employment opportunities in urban areas play a critical role in determining market prices. Additionally, the lack of proper infrastructure, such as cold storage facilities and efficient transportation networks, often results in post-harvest losses and lower income for fishers (Chattopadhyay *et al*., 2016; Kumar Mandal *et al*., 2024).

Regulatory frameworks

Fishing regulations and policies implemented by state and central governments also impact the income of artisanal fishers. Restrictions on fishing zones, gear types and catch limits are designed to promote sustainable fishing practices but can also limit the fishing activities of artisanal fishers. Compliance with these regulations often incurs additional costs, such as the need for licenses and adherence to conservation measures, further straining their economic resources (Pradhan *et al*., 2024; Santhanam and Kundu, 2022).

Access to credit and financial services

Limited access to formal credit and financial services is a significant barrier for many artisanal fishers in Odisha. Without adequate financial resources, fishers find it challenging to invest in better equipment, adopt improved fishing techniques, or cope with periods of low catch. Informal money lenders often charge exorbitant interest rates, trapping fishers in cycles of debt and poverty (Pomeroy *et al*., 2020; Salagrama, 2006).

Climate change and environmental degradation

Climate change and environmental degradation pose long-term threats to the livelihoods of artisanal fishers. Rising sea levels, increasing sea temperaturesand changes in marine biodiversity affect fish stocks and their availability. Pollution from industrial and agricultural runoff further exacerbates the decline in fish populations, leading to reduced catches and income (Islam *et al*., 2020).

Income diversification strategies

To mitigate the economic risks and enhance the resilience of artisanal fishers in Odisha, several income diversification strategies have been proposed and implemented with varying degrees of success.

Alternative livelihood programs

Government and non-governmental organizations have initiated various alternative livelihood programs to reduce the dependency of fishers on traditional fishing activities. These programs include training in aquaculture, poultry farming, handicraftsand small-scale entrepreneurship. Such initiatives aim to provide supplementary income sources during the off-season and create more stable financial conditions (Mangar *et al*., 2023; Nayak and Berkes, 2022).

Community-based management

Empowering fishing communities to participate in the management of local resources as well as income has shown promise in enhancing their economic stability. Community-based management (CBM) approaches involve fishers in decision-making processes related to sustainable fishing practices, habitat restoration and conservation efforts for social capitals. By fostering a sense of ownership and responsibility, CBM can lead to better resource management and more predictable income streams (Wiber *et al*., 2009).

Improved market access

Enhancing market access through better infrastructure and value chain development is crucial for increasing the income of artisanal fishers. Investments in cold storage facilities, transportation networks and market information systems can reduce post-harvest losses and improve the bargaining power of fishers. Cooperative societies and fishers' associations can also play a pivotal role in aggregating produce, negotiating better pricesand accessing new markets (Chandegara *et al*., 2023).

Microfinance and insurance

Expanding access to microfinance and insurance products tailored to the needs of artisanal fishers can provide critical financial support. Microfinance institutions can offer affordable credit for purchasing equipment, repairing boats, or starting small businesses. Insurance schemes can help mitigate the risks associated with natural disasters, accidentsand health issues, ensuring a safety net for fishers and their families (Parappurathu *et al*., 2017).

Sustainable fishing practices

Promoting sustainable fishing practices is essential for the long-term viability of artisanal fisheries. Initiatives such as the adoption of eco-friendly fishing gear, adherence to seasonal fishing bans and participation in marine conservation programs can help maintain fish stocks and protect marine ecosystems. Sustainable practices not only ensure the availability of resources but also improve the market value of fish products by meeting consumer demands for environmentally responsible produce (Pradhan *et al*., 2022).

Government initiatives for raising the income of artisanal fishers in Chilika

To increase the revenue of artisanal fishermen, both state and central governments have introduced several programmes. These particular projects include specifics about the schemes.

Matsya Pokhari Yojana

Objective: To promote inland fisheries by constructing new ponds and tanks.

Assistance: Financial assistance for pond construction, seed stockingand inputs like feed and fertilizers.
Subsidy: Up to 50% of the cost, with a maximum limit depending on the type of beneficiary (SC/ST, womenand general categories).

Integrated coastal zone management project (ICZMP)

Objective: To enhance the livelihood of coastal communities, including fishers, through sustainable management of coastal resources.
Components:
- Development of fish landing centers.
- Training and capacity building for sustainable fishing practices.
- Financial support for eco-friendly fishing gear.

Development of Marine Fisheries, Infrastructure, and Post-Harvest Operations

Objective: To modernize marine fishing infrastructure and post-harvest facilities.
Components:
- Construction and upgradation of fish landing centers.
- Installation of ice plants and cold storages.
- Provision of insulated vehicles for fish transport.

Funding: Central and state government funding, with subsidies for fishers and fishery cooperatives.

Rashtriya Krishi Vikas Yojana (RKVY)

Objective: To promote holistic development in the fisheries sector.
Components:
- Assistance for the development of new fish ponds.
- Financial support for freshwater and brackish water aquaculture.
- Training and capacity building for fish farmers.

Subsidy: Up to 40-50% for different components, varying by beneficiary category.

Fish Farmers Development Agency (FFDA) and Brackish Water Fish Farmers Development Agency (BFDA)

Objective: To support freshwater and brackish water aquaculture.
Components:
- Subsidized inputs like seeds and feed.
- Technical training and extension services.
- Financial support for infrastructure development.

Subsidy: Up to 50% for pond construction and inputs.

National Fisheries Development Board (NFDB) Schemes

Objective: To promote fishery development and income enhancement.
Components:
- Assistance for the construction of hatcheries and nurseries.
- Financial support for fish processing units.
- Development of fish markets and retail outlets.

Funding: Central assistance through the NFDB, with varying subsidy rates.

Mukhyamantri Krushi Udyog Yojana (MKUY)

Objective: To promote entrepreneurship in the fisheries sector.
Components:
- Financial assistance for setting up fishery-based enterprises.
- Subsidized loans for fish farming, hatcheriesand processing units.
- Training and capacity building for fishery entrepreneurs.

Subsidy: Up to 50% for project costs, with additional benefits for women and SC/ST entrepreneurs.

Welfare schemes for fishers

Objective: To provide social security and welfare benefits.
Components:
- Group Accident Insurance Scheme for fishers.
- Savings-cum-Relief Scheme for financial support during lean periods.
- Old Age Pension Scheme for aged fishers.

Benefits: Insurance coverage, financial reliefand monthly pensions.

Fishery Resource Management and Conservation

Objective: To ensure sustainable fishery resources.
Components:
- Promotion of sustainable fishing practices.
- Enforcement of fishing bans during breeding seasons.
- Habitat restoration and conservation measures.

These schemes collectively aim to improve the livelihoods of artisanal fishers in Odisha by providing financial support, infrastructure development, trainingand market access, while ensuring sustainable and eco-friendly fishing practices (Fig 2).

Policy recommendations

To further enhance the income diversity and economic stability of artisanal fishers in Odisha, several policy recommendations can be made:

Strengthen institutional support: Enhance the capacity of local institutions and cooperatives to provide financial, technicaland marketing support to artisanal fishers. This includes access to credit, training programsand infrastructure development.

Promote sustainable practices: Implement and enforce regulations that promote sustainable fishing practices, protect marine habitatsand ensure the long-term viability of fish stocks. Support research and development in eco-friendly fishing technologies.

Enhance market linkages: Invest in market infrastructure, such as cold storage and transportationand develop value chains that connect fishers to national and international

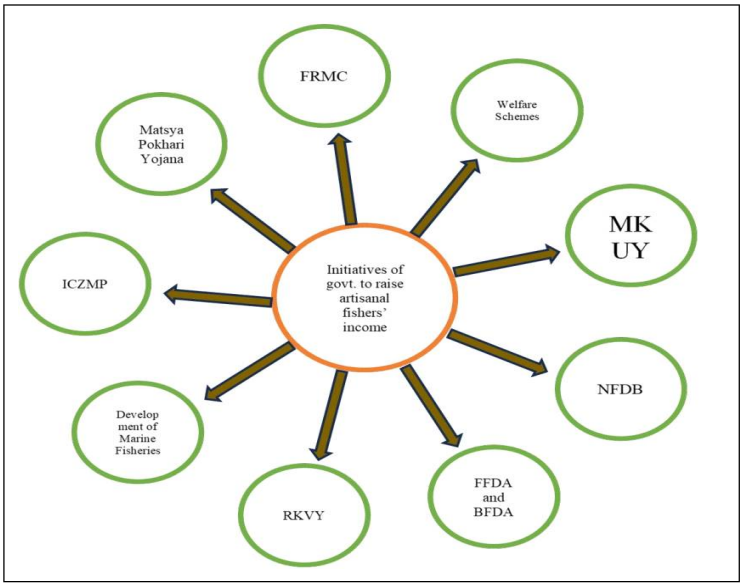

Fig 2: Government initiatives to raise artisanal fishers' income.

markets. Facilitate the formation of fishers' cooperatives to improve bargaining power and market access.

Expand social protection: Develop social protection schemes, including health insurance, accident insuranceand pension plans, tailored to the needs of artisanal fishers. These schemes can provide a safety net and reduce vulnerability to economic shocks.

Encourage community participation: Foster community participation in resource management and decision-making processes. Empower fishers to take an active role in conservation efforts and the sustainable use of marine resources.

CONCLUSION

The diversity of income for artisanal fishers in Odisha is influenced by a complex interplay of environmental, economicand social factors. Addressing the challenges faced by these communities requires a multi-faceted approach that includes promoting sustainable practices, enhancing market access, providing financial supportand encouraging community participation. By implementing comprehensive and inclusive strategies, it is possible to improve the livelihoods of artisanal fishers and ensure the sustainability of this vital sector for future generations.

ACKNOWLEDGEMENT

The authors also acknowledge the Indian Council of Social Science Research (ICSSR) for funding the research. The authors wish to express their profound gratitude to the Chilika Development Authority, Balugaon for allowing them to interact with the fishermen especially Mr. Trilochan sir, Assistant Fisheries Officer, CDA, Balugaon for his support during data collection.

Funding Sources

The authors also acknowledge the Indian Council of Social Science Research (ICSSR) for funding the research.

Disclaimers

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Informed consent

All data collection procedures were approved by the respective respondents.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the study's design, data collection, analysis, decision to publish, or manuscript preparation.

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