Scoping Study of the Shrimp Aquaculture Sector in Andhra Pradesh

Introduction

Aquaculture, particularly shrimp aquaculture, has been instrumental in India's growth as one of the leaders in fisheries production. India has seen rapid growth in aquaculture over the years, with notable contributions from Andhra Pradesh. The coastal state led the fisheries and aquaculture production in 2022-23, with a 40.9% share in the output.

With the second longest coastline in India (974 km) and 33,227 sq. km of continental shelf, 8 lakh hectares of inland water bodies, and 2.12 lakh hectares under aquaculture, Andhra Pradesh is the leading state in aquaculture production.

Brackishwater shrimp farming started in Andhra Pradesh with the intervention of the Marine Products Export Development Authority (MPEDA) in the early 1980s. Initially, black tiger shrimp (*Penaeus monodon*) was the dominant species. Its culture boomed and remained the dominant shrimp species for two decades before a fall in the late 1990s due to the white spot syndrome virus (WSSV). Despite regulating the culture, the species continued to have disease issues, And the Pacific white shrimp gradually replaced it. The introduction of specific pathogen-free (SPF) Pacific white shrimp (*Litopenaeus vannamei*) in 2009 was a critical turning point for shrimp aquaculture in India. The sector saw more-or-less steep growth for a decade until a slump since the COVID-19 pandemic.

Challenges, scope and importance of enhancing sustainability in shrimp culture

With both central and state governments emphasising their ambition to strengthen aquaculture, especially the shrimp sector, to boost the economy and India's position in the global seafood market, enhancing sustainability and traceability is imperative.

However, the sector faces many challenges across its supply chain. The supply chain disruptions and market fluctuations during the COVID-19 pandemic revealed the vulnerability of the shrimp sector. While it did open venues in the domestic market, it is still in the nascent stages. In contrast, the export market still needs to gain more robustness, especially in the face of competition from countries like Ecuador. The recent investigative reports on poor working conditions in processing factories have drawn international eyes towards Andhra Pradesh and questioned the current capacity of regulatory mechanisms and the efficacy of their enforcement in India. The impact also caused uproar against Indian exporters for being unable to meet the required demands.

Under the ambit of the Blue Economy, shrimp aquaculture has gained substantial recognition from the government as a sector that needs to invest significantly. This opens up many opportunities to access and widen the market reach of Indian shrimp. In addition to boosting production, interventions must be brought in at multiple levels across the supply chain to improve the sustainability quotient on all the SDG fronts. This rapid scoping study aimed to produce a broad

level of understanding and highlight the avenues for sustainable and equitable development of the shrimp aquaculture sector in India.

Aim and objective of the study

The study aimed to identify opportunities and barriers for improving shrimp farming within the larger framework of natural resource planning, management, and policy in Andhra Pradesh.

The particular objectives of the study were:

1. To gain a broad understanding of the current environmental, social, and regulatory aspects of shrimp farming.
2. To map and understand the stakeholders and their role, especially small-scale farmers, local communities, and women resource management.
3. To map the shrimp aquaculture supply chain at a broad level and understand major geographies for the sector in Andhra Pradesh.
4. To gain a broad understanding of the existing governance systems and issues with shared commons associated with shrimp aquaculture.
5. To chart out knowledge gaps and generate insights for further research and interventions.

Methodology

1. Site prioritisation - As this was a rapid survey, we prioritised sites for field visits based on insights from secondary literature and key informant interviews.

2. Stakeholder interviews - We used a purposive sampling approach to select stakeholders for in-depth interviews. A snowball sampling technique was used to identify the participants through key informants and the research team's networks, ensuring diverse perspectives from local farmers, suppliers, researchers, and industry experts. Interviews were conducted in Telugu (regional language). We ensured adherence to ethical guidelines in all interviews. We took informed and ongoing consent to conduct and record the interview where permitted by the participants. To protect participants' confidentiality, we anonymised the data during summarisation.

   Based on the data, a stakeholder mapping exercise was conducted to outline the roles and relationships within the aquaculture supply chain, providing a holistic view of the industry.

3. PESTLE situational analysis - The analysis was framed within the PESTLE framework, assessing the **p**olitical, **e**conomic, **s**ocial, **t**echnological, **l**egal, and **e**nvironmental (PESTLE) factors influencing aquaculture in the region. This approach aimed to capture the complexities of the aquaculture landscape in Andhra Pradesh, offering insights into knowledge gaps for further research.

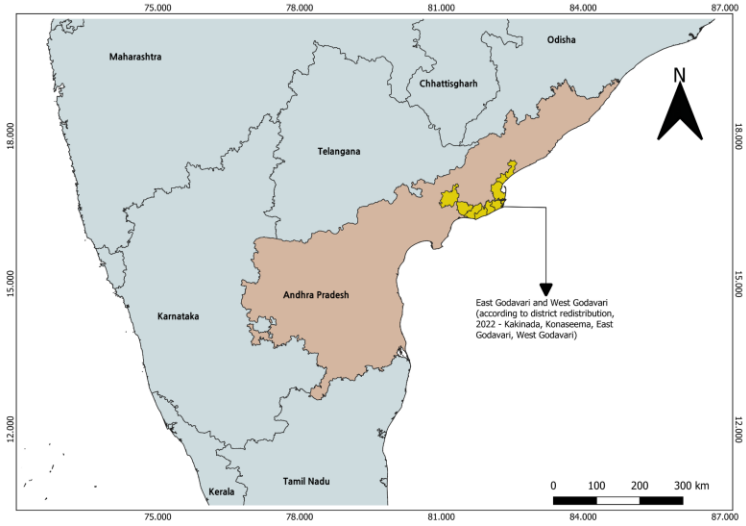

Figure 1 (left and right): Research team interacting with a hatchery worker; the areas marked in yellow represent the study sites in Andhra Pradesh, India

Results and Discussion:

1. Stakeholder Mapping

Figure 2: An onion peel diagram showing different stakeholders and their relative positions based on their roles and involvement

2. Supply Chain

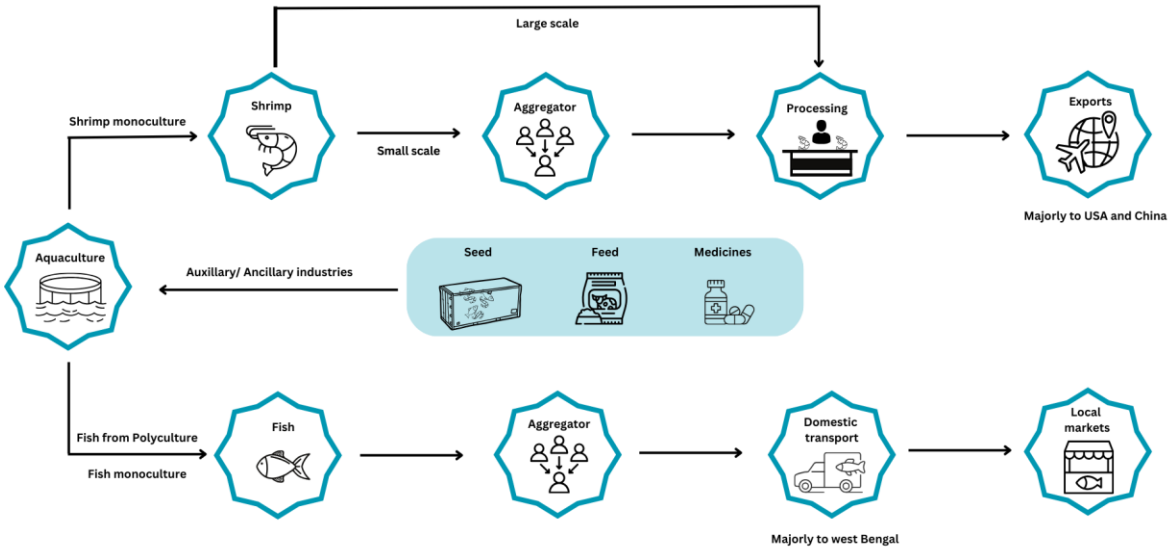

Figure 3: Supply chain diagram of aquaculture sector in Andhra Pradesh representing inflows and outflows of product

3. Situational Analysis based on PESTLE framework

Political

1. Political influence in shaping aquaculture markets

   Political interest in production-centric growth can sideline the socioecological considerations in any sector. Two of our key informant interview respondents - an interdisciplinary researcher and an environmental activist, believe that sustainability issues related to shrimp farming in Andhra Pradesh are often ignored to favour the production and exports of shrimp culture, which contributes significantly to the country's GDP.

2. Political influence on the subsidies and other relevant areas

   The political disruptions are found to impact the production end of the supply chain negatively. For instance, many farmers associated fluctuations in the electricity subsidy provisions with a change in the political party at the state level. These changes resulted in variations in their profit margins, threatening their livelihoods.

   Additionally, political interests were reported to impact the livelihood of communities located around Kolleru Lake. Recalling his experience, one of our respondents - an environmental activist, highlighted the unethical ways of destroying existing aquafarms near the lake area, leading to strong resistance among the local communities. The respondent recommended that this kind of top-down approach has never been successful in conserving natural resources.

   Therefore, given the history of illegal aquaculture and the forced displacement of local communities, Kolleru Lake is highly sensitive region. The villagers fear further investigations and show reluctance to share information on current issues.

Economic

1. Redefinition of the value chain of capture fisheries

   In Andhra Pradesh, the boom of aquaculture brought about a significant improvement in the value chains of capture fisheries through infrastructure development for processing and exports of fish caught in the sea. The infrastructure built for processing shrimps caught in aqua ponds has also facilitated value addition for capture fisheries.

   The shrimp value chains with small-scale farmers were found to be longer as more nodes are involved in inputs, aggregating, and exporting compared to the large farmers, who have their own feed companies, tie-ups, and distribution channels.

2. The recurring losses and shift towards polyculture

   Due to repeated instances of infections caused by pathogens such as EHP (*Enterocytozoon hepatopenaei*) and WSSV (White Spot Syndrome Virus), economic returns from crop yield have reduced significantly.

   In the case of EHP, the parasite retards shrimp's growth despite the continued supply of feed. If left undetected, this results in significant economic losses for the farmers. The farmers experience losses due to disease spread despite adopting biosecurity measures meant to prevent them. If there are two crops in a season, the aquafarmers presume one would be at a loss due to the diseases. This has led many aquafarm owners to lease out their lands to other farmers.

   One of the farmers from East Godavari we interviewed, with land of 8 acres of ponds, has been experiencing losses in shrimp farming for the past 7 to 8 years, compelling him to lease out his land to other farmers. In the early 1990s, out of 16 acres of his land, he transformed 50% into aquafarms. The returns quickly surpassed the profits he earned through only paddy cultivation. However, the profit margins gradually reduced. Today, he cannot cover even the input costs. Another farmer in the same area reported losses of over a crore rupee in the past three years (post-COVID). While farmers of his kind can continue paddy farming on their remaining non-transformed land, the situation wouldn't be as smooth for the farmers who converted all their agricultural land to aquafarms.


Figure 4 (from left to right): A farmer from Edurlanka (East Godavari) leasing out his pond due to recurring losses; a biosecurity fence over a pond in Gurajanapalli (East Godavari)

Besides, many farmers are moving towards polyculture, which includes rearing both fish and shrimp together. The fish culture was found to incur a lesser loss; therefore, this strategy helps the aquafarmers secure their income and assure some profits, irrespective of failure in shrimp harvest.

3. <u>The economic implication of workers shifting from agriculture to labour</u>
   A drastic change because of the shift from agriculture to aquaculture we observed was reduced requirements of workers. An aqua farmer mentioned that it requires only two workers per two acres of a pond, one for each morning and night shift, unlike agriculture, which is a labour-intensive sector, causing significant loss of livelihoods.

4. <u>Reduced profits in the aquaculture sector</u>
   Given the increased input costs and no changes in the shrimp export value, the profit margins for shrimp aquaculture have reduced. Farmers are coping with this by overstocking shrimp seeds by atleast 50% in the ponds to resist the change. The feed, which used to cost them ₹ 60 per kg, now costs at least ₹ 90 per kg.


Figure 5 (left and right): Shrimp feed pellets; fish feed

Social

1. Gender dynamics across the value chain

   While one can easily access the information from male workers across the shrimp value chain, there is limited documentation of the involvement and issues women workers face. A recent study by the Corporate Accountability Lab (CAL) revealed that women workers in this sector experience serious verbal abuse and gender discrimination. Having to work for long hours at a stretch, these workers often develop frostbite and skin inflammation from handling chemicals and brine.

   With the increasing backlash and scrutiny over human rights and health risks, investigation of issues faced by women workers has become even more difficult. Additionally, the informal nature of recruitment and lack of economic and social security often make it difficult for these women to unionise or question their employers, who are disproportionately more powerful and influential.

2. Implications on agriculture and capture fisheries

   Until the 1970s, mechanised trawl fisheries harvested abundant catches, and the fishers made high profits. However, by the 1980s, the fishers started to witness a decline in catch and profits, motivating the government to bring about transformations and invest in aquaculture. The idea was to empower fishers and help them transition from fishing to aquaculture; however, it was agriculturists who transformed their occupation from farming to shrimp aquaculture. The traditional paddy cultivation lands were converted into shrimp farms, leading to a substantial land-use change across Andhra Pradesh.

   As per interviews, these land use transformations have slowed down significantly now. Not many farmers are venturing into converting their lands into aquaculture ponds. One of the major reasons reported includes the increased incidents of diseases in ponds and reduced profit margins for shrimp in the export market.

3. Caste and class demographics in the aquaculture sector

   Demographically, heterogeneity was observed in terms of caste and class in the aquaculture sector across the coastal stretch of Andhra. While overall, aquaculture remains a capital-intensive occupation, there is a distinction in the extent of investments along the coastal stretch of Andhra. The farmers practising brackish water aquaculture with higher capital are dominant towards the south of Andhra (e.g. Nellore and Prakasham districts), while the others are concentrated in the north.

   Moreover, the farmer communities primarily involved in aquafarming are *Kamma*, *Kappu*, *Reddy*, and *Raju*. These communities practice more capital-intensive aquaculture. Most small aquafarm holders are usually former paddy farmers who converted their farms into

ponds. Very often, outsiders own the land titles, and the operations are given to local agents.

4. Migration

   In locations like Bheemavaram, respondents said that due to government initiatives to enhance livelihoods, many people from their region are choosing other alternative livelihood options over working in aquaculture farms. This has resulted in a scarcity of labour. However, this has also created avenues for the marginalised communities of the North-Indian belt, especially Bihar, Jharkhand, and Odisha, to find livelihood opportunities in the aquaculture sector. This migration can either be seasonal or long-term.

Technological

1. The shift in shrimp species in aquaculture

   In the 1980s, India started aquaculture with two species - the Tiger Shrimp (*Penaeus monodon*) and the White Shrimp (*Penaeus indicus*). However, by the 1990s, the White Shrimp was already being phased out due to low productivity compared to its counterpart, Tiger Shrimp. By the early 2000s, freshwater shrimp (*Macrobrachium rosenbergii*) was introduced, which did not work as expected.

   Later, the farmers also experimented with crab cultivation, which also failed. After almost a decade, when the Pacific white shrimp (*Penaeus vannamei*) was introduced in India, it was found to be far more disease-resistant and faster-growing than the *monodon* species in Andhra.

2. Monoculture to Polyculture

   In contrast, Odisha and West Bengal continue the culture of Tiger Shrimp. Andhra aquafarmers are exploring new strategies to counter the incidents of diseases and losses. One solution being practised includes undertaking polyculture by incorporating fish with shrimp in one of the seasons (as also discussed under this section's 'Economic' subheading).

3. Infrastructure and labs to analyse feed, seed, and pond water samples

   NABL-accredited labs like SIFT (State Institute of Fisheries Technology) play an essential role in enabling the testing of seed quality and water samples from the pond to analyse for infections. They also have 'Mobile labs' facilities that provide on-site analysis kits to farmers to assess key water parameters directly. Besides, over 160 government and private labs across the state are analysing similar aspects.

   The National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) project, under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), has developed an app, 'Report Fish Disease,' to enable farmers to report diseases on their farms.

   While established institutions are working on knowledge transfer to farmers, we received responses stating no formal training was provided to the farmers while transitioning from farming to aquaculture. Some farmers mentioned being asked to consult other farmers to seek knowledge on aquafarm management. If addressed and built capacities, there is vast scope for paving the way for sustainable aquaculture in India.

Figure 5 (left to right): Shrimp seeds of a farmer to be prepared for analysis at SIFT lab facilities; App introduced to report diseases by NSPAAD

4. Inclusion of motor farming techniques
   When the aquaculture sector started to boom in Andhra Pradesh, farmers mainly depended on tidal amplitude as the source of water inlet into the farms. Hence, most farms were smaller, making using the tidal amplitude for water sourcing feasible. However, due to technological advancements, farmers have shifted to using pumps, facilitating the expansion of farm sizes.

5. Introduction of biosecurity to prevent risks of diseases
   Due to widespread diseases in shrimp culture, several farmers have adopted mechanisms to prevent the spreading of these diseases through biological vectors, such as birds and stray animals, called biosecurity. It involves shielding the farm from all sides using fences and a series of strings across the farm to prevent birds from diving into the ponds in search of food.

Figure 6: Tanks for different growth stages of shrimp in a hatchery under sterile conditions

Legal

There are many regulatory mechanisms for aquaculture in Andhra Pradesh. While further study is needed to critically analyse these mechanisms and pinpoint the gaps, our overall observation and response from key stakeholders suggest that enforcement could be strengthened and made more operable at various points across the supply chain, especially at the feed level. Here are some of the major institutions involved in the regulation of aquaculture in India:

Table 1: Important government organisations playing a role in the regulation of shrimp aquaculture in Andhra Pradesh

Abbreviation	Important Government Institute/Organizations
CIFRI	Central Inland Fisheries Research Institute
CAA	Coastal Aquaculture Authority
NACSA	National Center for Sustainable Aquacullture
MPEDA	Marine Produce Exports Development Authority
RGCA	Rajiv Gandhi Center for Aquaculture
NGT	National Green Tribunal
CIBA	Central Institute for Brackish Water Aquaculture
NFDB	National Fisheries Development Board
PCB	Pollution Control Board

1. Coastal Aquaculture Authority (CAA)
   The Coastal Aquaculture Authority (CAA) was established under the Coastal Aquaculture Authority Act enacted by the Parliament of India on 23 June 2005, to regulate the activities connected with coastal aquaculture in coastal areas. It provides regulations across the aquaculture supply chain, from importing and quarantining shrimp seeds to registering farms.

2. Andhra Pradesh State Aquaculture Development Authority (APSADA)
   In 2020, the Government of Andhra Pradesh enacted the Andhra Pradesh State Aquaculture Development Authority Act, establishing APSADA. Its objective is to develop, sustain, promote, and regulate aquaculture and its business operations in the state, as well as the production, sale, and distribution of aquaculture products. It resolves the issues at the state

level. If APSADA cannot resolve any issue dealing with coastal and brackish water aquaculture, the CAA steps in.

3. MPEDA - Marine Products Export Development Authority (MPEDA)
   MPEDA is a statutory body under the Ministry of Commerce and Industry. Its main objective is to promote the export of marine. Its main objective is promoting and developing seafood production, processing, marketing, and exports in India. Shrimp farming and exports are major components of MPEDA's work.

4. The National Centre for Sustainable Aquaculture (NaCSA)
   It facilitates the farmers in adopting best farming practices to produce high quality and safe shrimp for exports in an environmentally safe and sustainable manner. It also provides extension activities and infrastructure facilities for farming. It also has a role in establishing disease diagnostic testing laboratories like Aqua One Centres (AOCs). Its role extends beyond production to provide better marketing opportunities for direct sales of shrimps with increased price realisation for farmers.

5. The State Fisheries Department
   The state fisheries department is responsible for regulating all types of fisheries, including inland and marine fisheries within the state. In line with the government's ambition to 'promote and sustain the blue revolution' amidst raising concerns regarding the impact of unregulated growth of aquaculture on agriculture and the environment, the state government brought zonation of inland areas to regulate the development of aquaculture. The zonation is based on a wide range of criteria including soil quality, vulnerability of area to flooding, salinity, etc. The objective of aqua zones also includes provision and training on eco-friendly farming techniques such as proper drainage systems, water quality monitoring, disease surveillance, and provision of common ETPs. The objectives also include infrastructure development in the aqua zones, like providing transportation facility, power supply, and approach roads.

   The management of land under the aqua zones lies with the fisheries department and revenue department, and these zones receive faster clearances and certification for the conversion of agricultural land to aquaculture ponds. The government is subsidising electricity to aqua farmers cultivating in areas of less than 10 acres falling under aqua zones. According to a 2023 news article, approximately 26,000 aquaculture farmers currently receive power subsidies. The aquazones also aim to prevent the unauthorised conversion of fertile land into aquaculture. While there are published reports on the objectives and criteria for zonation, there is scope to understand the implementation process and on-ground limitations.

6. National Fisheries Development Board (NFDB)
   It is an autonomous organisation under the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India. It aims to develop the fisheries sector holistically by enhancing fish production and productivity. This can be achieved in a big way by adopting new and innovative production technologies, managing and using unutilised and underutilised water resources, establishing adequate infrastructure for post-harvest operations, and proper market tie-ups.

In addition to these, the agriculture, revenue, and labour departments of Andhra Pradesh also regulate the sector in varying capacities. While many critical guidelines and good practices are published by agencies like FAO, MPEDA, and CAA, there is scope to improve enforcement and monitoring to ensure the best practices are followed and to promote sustainable aquaculture.

Environmental

1. Groundwater depletion and salinisation

   Shrimp farmers in Andhra Pradesh primarily rely on canals, creeks, and groundwater for their aquafarms. Excessive groundwater usage has led to seawater intrusion into aquifers, increasing its salinity and threatening the well-being of the local communities. Moreover, currently, the salinity that farmers want to undertake brackish water shrimp aquaculture is achieved by mixing groundwater extracted from bore wells and freshwater from creeks.

   Based on our interviews, there has been a significant decline in freshwater groundwater. It has become unfit for consumption for local communities, who now depend on water provided by municipal cooperatives.

Figure 7: The pump (left) and the drain (right) from an aquafarm in Gollapalem (East Godavari) used to let the canal water into the farm and direct wastewater directly into the same canal, respectively

2. Soil and water quality degradation

   The lands used for aquaculture in Andhra have historically been utilised for agriculture, especially paddy cultivation, which requires soil with a higher percentage of clay (compared to aquaculture). By practising brackish water shrimp farming, the physical-chemical properties of soil have gradually changed, making it unsuitable for other purposes. While literature highlights the issue of eutrophication, many on the ground did not perceive it as a concern for the ecosystem.

   Ideally, ponds must be drained, dried, and ploughed after every crop season to prevent the accumulation of organic matter and salts as sediments at the bottom. As a result of the

settling of biological wastes, unconsumed feed, and biological wastes, these sediments are found to reduce the productivity of the next crop season.

However, due to the incessant pressure to make higher profits and pay the lease amounts, the farmers opt for four crop seasons (one season = three months) without drying the ponds. The farmers bleach the water between the two crops, chlorinate it, and use disinfectants to clean the bottom of the pond. By the end of the year, there is a high concentration of contaminants, which are then drained into the nearby canals or creeks.

The CAA mandates the establishment of Effluent Treatment Plants (ETP) for the aquafarms with an area of 5 hectares and above within the CRZ, which means all the small-scale shrimp farms have no regulatory obligation to treat the water before discharging. Besides, if discharged untreated, the wastewater can compromise the overall health of the ecosystem by causing eutrophication and reduced dissolved oxygen. This can further decrease the productivity of other aqua farms that depend on the same water bodies.

Figure 8 (left and right): Aquaponds being dried and ploughed for the next season. Aquaponds are dried every two seasons.

Conclusion and Way Forward

This report consolidates the reflections gained from a 10-day rapid, impressionistic survey of the shrimp aquaculture sector in Andhra Pradesh. This report provides critical insights into prevalent issues and challenges experienced by the diverse stakeholders across the shrimp value chains.

The report covers narratives primarily from three districts: Kakinada, East Godavari and West Godavari. In the past two decades the sector has witnessed tremendous growth, overlooking the associated socio-ecological aspects. The global demand for shrimp, the state's vision of the Blue Economy, and the growing focus on aquaculture compared to capture fisheries are contributing to the change in landscape which often remains obscure.

Andhra Pradesh is one of the largest exporters of farmed shrimp. The aquaculture sector in state has witnessed changes across various dimensions, including land reforms, the scale of operations, technological advancements, value chain transformations, and the interplay between political and economic aspects. Therefore, there is an urgent need to document micro and macro changes in this region.

One of the key takeaways from our study is the presence of the non-binary nature of the issues faced by the communities dependent on shrimp aquaculture. To address these issues, we must approach the problems from an interdisciplinary perspective, necessitating a deeper dive into the sector. Our study illuminates significant gaps and makes recommendations for addressing them.

Based on the insights gained, the following are the detailed recommendations:

Political:

- The scoping infers possible connections between the feed companies and exporters, which may affect shrimp pricing. The next phase of the project can explore this subject further.
- We have observed variations in power dynamics among the community members of various regions; while some areas lack cooperation among the farmers, some areas practice unity farming and have shown a positive impact on the production and management of aquafarms. In the later stages of the study, community power dynamics can be studied, which would help create sustainable solutions in the sector.

Economic:

- To combat the reduced profit margins in shrimp exports, it will be critical to explore the avenues of expanding the infrastructure for the domestic shrimp market, which would help farmers manage their ponds more efficiently.

Social:

- While the literature highlights cases of wastewater seepage in adjacent agricultural lands, we didn't encounter such issues. An extensive survey will be crucial to understanding the impacts of aquaculture on paddy cultivation in Andhra Pradesh, including the lease systems.
- To understand the holistic nature of the aquaculture sector, it will be helpful to conduct a detailed investigation of its evolution and the impacts on capture fisheries, both mechanised and artisanal.
- Recent reportage on the unethical working situations in shrimp peeling and processing plants has been crucial in unravelling the inequities and injustice in shrimp aquaculture value chains. However, one needs to be cautious and aware while reporting and interviewing marginalised sections of the communities working in these plants, as this may threaten their livelihoods.
- Literature highlights the critical contributions of women in the aquaculture sector. However, this scoping phase could not elaborate on their role across Andhra Pradesh. For the next phase, it will be essential to dive deeper into the gendered roles of the sector along with the issues related to them.

Legal:

- There is a discrepancy in the descriptions and characteristics of small—and large-scale farmers and other actors. The definitions seemed inconsistent across secondary sources and key informants. It will be crucial to revisit the definitions and what they entail in terms of availing subsidies and loopholes in legal definitions.

Environmental:

- Given that Kolleru Lake is deeply impacted by aquaculture farming, there is a dire need to study the social-ecological aspects of this landscape. The communities residing near Kolleru Lake are highly marginalised and require close attention.

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