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A Bottom-Up Approach for a Private Fisheries Extension System

**A Framework and Action Plan for an Aqua-Chamber of Commerce
in India**

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ABSTRACT

Aquaculture and fisheries continues to be a sector that has not received adequate attention for its contribution to food security goals across the globe. This sector is predicted to grow at a fast rate in the next 40 years. In the Indian context, the government has prioritized the aquaculture and fisheries sector by establishing an independent federal ministry. However, the public extension system in India still lacks resources and strategies to address the needs of fish farmers and fishers. This has created a space for the private extension system to play a pivotal role in providing appropriate skills and training to farmers and fishers. Considering the present challenges in the aquaculture and fisheries sector, this paper proposes the creation of an Aqua-Chamber of Commerce (ACC) as a viable bottom-up approach to improve the performance of the sector by providing adequate support to private extension system. Additionally, the ACC will also help in improving the public extension system, facilitating the business ecosystem and strategies, and advocating for major policy reforms in the sector.

Keywords : Fisheries, Extension, Aquaculture, Chamber of Commerce, Private Extension System, Aquapreneurship, Entrepreneurs, Policy Ecosystem, Pluralism, Inclusiveness

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ACRONYMS

ABI	Agri-business Incubation Centre
AC&ADP	Aqua-Clinic & Aquapreneurship Development Programme
ACC	Aqua-Chamber of Commerce
AI	Artificial Intelligence
AIC-FR-EP	All India Coordinated Fisheries Research and Extension Programme
AICRP	All India Coordinated Research Project
AOC	Aqua One Centres
ATMA	Agricultural Technology Management Agency
ATREE	Ashoka Trust for Research in Ecology and the Environment
B2B	Business-to-Business
BMPs	Best Management Practices
BRMP	Blue Revolution Mission Plan
CBFM	Community-Based Fisheries Management
CGIAR	Consultative Group on International Agricultural Research
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CoF	Colleges of Fisheries
CSS	Centrally Sponsored Scheme
DAHDF	Department of Animal Husbandry, Dairying & Fisheries
DBEMS	Data-Based Extension Management System
DBMS	Data Based Management System
DoFs	Department of Fisheries
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization
FIDF	Fisheries and Aquaculture Infrastructure Development Fund
FRI	Fisheries Research Institute
GDP	Gross Domestic Product
GIS	Geographic Information System
GVA	Gross Value Added
IAAS	Integrated Agriculture–Aquaculture Systems
ICAR	Indian Council of Agricultural Research
ICT	Information and Communications Technology
IMTA	Integrated Multi-Trophic Aquaculture
IPAS	Integrated Periurban-Aquaculture Systems
KI	Key Informant
KII	Key Informants Interview
KVK	Krishi Vigyan Kendras
LLP	Lab-to-Land Programme
MEDC	Maharashtra Economic Development Council
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MMT	Million Metric Tonnes
MPEDA	Marine Products Exports Development Authority
MSME	Micro, Small and Medium Enterprises
MUDRA	Micro Units Development and Refinance Agency
NAHEP	National Agricultural Higher Education Project
NAIP	National Agricultural Innovation Project
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project

ND	National Demonstration
NFDB	National Fisheries Development Board
NFDC	National Fisheries Development Council
NGOs	Non-Governmental Organizations
NMFA	National Marine Fisheries Authority
NRLM	National Rural Livelihood Mission
ORP	Operational Research Project
PGIS	Participatory Geographic Information System
PIM	Policies, Markets, and Institutions program
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PPCP	Public- Private- Community Partnership
PPP	Public Private Partnership
RKVY	Rashtriya Krishi Vikas Yojana
RKVY-RAFTAAR	Rashtriya Krishi Vikas Yojana – Remunerative Approaches for Agriculture and Allied Sectors Rejuvenation
RRA	Rapid Rural Appraisal
SDG	Sustainable Development Goals
SE	Social Entrepreneurship
SFSA	Syngenta Foundation for Sustainable Agriculture
SHG	Self-Help Groups
SIA	State Implementing Agency
SVEP	Start-up Village Entrepreneurship Programme
UT	Union Territories
Y/N	Yes / No

I. INTRODUCTION

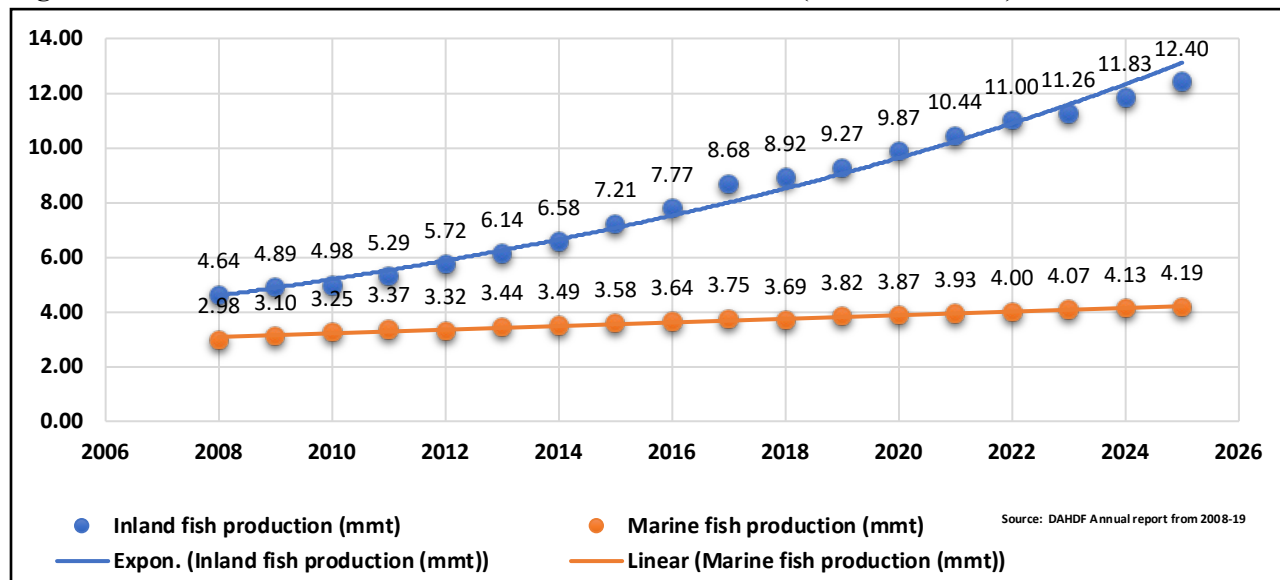
Achieving the goal of a world free of hunger and malnutrition by 2030 – as defined by the UN Sustainable Development Goal (SDG 2) – requires a food system transformation that will effectively and sustainably use all its production components (HLPE, 2017). Recognizing the importance of aquaculture and fisheries in food systems, the Government of India has prioritized the aquaculture and fisheries sector by establishing an independent Ministry at the federal level. However, translating policies relating to aquaculture and fisheries into action on the ground requires concomitant implementation strategies. In addition, there is a need to revisit the goal of doubling fish production by 2025, as the existing scenario reveals that from 2020 to 2025 India's total fish production will only increase from 13.74 MMT to 16.59 MMT (Ojha and Dey, 2019).

A key component of transforming the sector the creation of a well-functioning private extension system to create more business opportunities. Such efforts should begin by addressing the following questions: Who are the actors and players currently engaged in aquaculture and fisheries sector development? What role do they currently play and what action should they take towards developing private extension in the aquaculture and fisheries sector? How could national and state level actors be brought together under one umbrella? What are the next steps to establish functional mechanisms for private extension in aquaculture and fisheries sector in India?

An estimated 482.6 million people will be at risk of hunger by 2050 (IFPRI, 2019). Despite this, fish is often overlooked as a means to achieve the goal of zero hunger (Grafton et al., 2015). Fish provides 20 percent of animal protein to 3.1 billion people. The global aquaculture growth rate is about 5.8 percent (FAO, 2018). The aquaculture and fisheries sector has the potential to address the gap between aquatic food demand and supply and may help countries achieve their economic, social, and environmental goals and contribute to the 2030 SDG Agenda (Hambrey, 2017; FAO, 2017). The sector has the potential to expand and intensify sustainably to meet food demand for the next 40 years, through integrated agriculture-aquaculture systems (IAAS), integrated peri-urban-aquaculture systems (IPAS), open-water Integrated Multi-Trophic Aquaculture (IMTA), land-based IMTA, and through the implementation of their Best Management Practices or BMPs (Edwards, 2015). Therefore, unleashing the potential of aquaculture requires high levels of investment, which requires collaboration among the public, private, and community organisations (Roy, 2019).

India, like many other developing countries, has great culture and capture fisheries potential. India's total fish production during 2017-18 was estimated to be 12.60 million MT, of which nearly 65 percent is from the inland sector and about 50 percent of total production is from culture fisheries. Fish and fish products have emerged as the largest group in agricultural exports from India, with 13.77 lakh MT in terms of quantity and Rs. 45,106.89 crore in value. This accounts for around 10 percent of total exports and nearly 20 percent of agricultural exports. In addition, the sector contributes about 0.91 percent of GDP and 5.23 percent of agricultural GVA of the country (NFDB, 2019). Figure 1 depicts the trend of India's inland and marine fish production, calculated from the Annual Reports of the Department of Animal Husbandry, Dairying & Fisheries (DAHDF) from 2008 to 2019. Further, production has been forecast up to 2025. It is observed that from 2020 to 2025, India's total fish production will increase from 13.74 million MT to 16.59 million MT.

Figure 1: Inland and Marine Fish Production Trends of India (forecast to 2025)



Source: Adopted from Ojha and Dey (2019)

To accomplish the goal of doubling fish production from 2020 to 2025, the following steps need to be taken: 1) Increasing growth in aquaculture; 2) Decreasing disease; 3) Increasing consumption; 4) Expanding use of fish processing; 5) Sustaining harvest of global capture fisheries; and 6) Reducing effect of global warming (Msangi et al., 2013). The above stated themes (1) & (2) can be categorized under production extension; (3) & (4) under marketing extension; and (5) & (6) under environmental extension. India’s public extension system has been failing to meet the knowledge and information needs of the country’s fish farmers and fishers. The private sector—through “aquapreneurship”—presents an alternative and a complementary extension system to the public extension system; yet development and implementation of such strategies to promote private extension in aquaculture remains a challenge. This paper, therefore, proposes an approach to strengthen private extension services through an Aqua-Chamber of Commerce (ACC) for effective and sustainable development of the aquaculture and fisheries sector in India.

India’s public extension system faces several challenges. These include lack of a single line of command, undefined visit schedules, and irregular training of farmers. The inability of the public extension to reach out to all farmers and the increased demand of food has created space for private extension system (Chandra Sekhara, 2001; Saravanan, 2001). The financial constraints faced by public sector extension have paved the way for the private sector to take part in marketing, research and extension, value added services, and cost-sharing arrangements among stakeholders (Mukherjee and Maity, 2015). Private extension systems have a particular interest in sharing knowledge with farmers because their economic returns are tied closely to farmers’ productivity (Zhou and Babu, 2015). In today’s changing world, when well-tested technologies largely developed by the private sector are available, there is an increasing need for the private sector to engage in the extension system to ensure farmers use the technology effectively (Satapathy and Mangaraj, 2001). Alternate sources of funding for private extension systems working for inclusive growth have been identified, including: 1) farmers’ willingness to pay (Claire et al., 2010), 2) promoting social entrepreneurship, and 3) entrepreneur-led extension.

The next section of the paper presents a conceptual framework for the establishment of the ACC, mapping the potential actors in the aquaculture value chain. Section III focusses on the gaps in the existing policy system for aquapreneurship and the role of the ACC in reducing these gaps. The final section provides concluding remarks.

II. CONCEPTUAL FRAMEWORK

Promotion of the private sector in aquaculture and fisheries extension requires a business approach and an entrepreneurial focus so that it can be self-sustaining. However, approaches and mechanisms for involving the private sector in the development and delivery of advisory services has been largely missing in India. In order to propose an aquapreneurship platform that will address the need for a private extension system in India, we develop a conceptual framework in this section.

In the Indian context, the concepts of private extension, chamber of commerce, entrepreneurship-led extension, and social entrepreneurship have a complementary relationship. While public extension is confined to transfer of technology through various subsidy-driven schemes, private extension should be more concerned with the transfer of business models that can benefit all the participating stakeholders. This will increase total business volume and participant's individual shares in the total business. To institutionalize this comprehensive private extension, a chamber of commerce is required. However, as fisheries and aquaculture is mostly practiced using common property resources, this system will work on specific principles that ensure conservation and alternative livelihood options through social entrepreneurship. The concept of social entrepreneurship may also be promoted for implementing the welfare schemes. Therefore, through entrepreneurship-led extension, the informal sector needs to be organized, and through social entrepreneurship the development interventions need to be strengthened. An institution such as the ACC can be used to promote entrepreneurship-led extension and social entrepreneurship, which can lead to more business and better incomes for the stakeholders.

Aqua-Chamber of Commerce

A need for extension services and continuous development of the entrepreneurs to address livelihood issues of the farmers/fishers has emerged. To move in these directions, a chamber of commerce is a suggested forum. A chamber of commerce (or board of trade) is a form of business network, whose goal is to further the interests of businesses (Chamber of Commerce, 2019). It may provide low-cost means of business promotion through establishing start-ups, providing awards, creating advertising opportunities, developing business-to-business network, assisting in solving business problems, and promoting economic and social welfare of business communities (Lacho and Brockmann, 2011). Moreover, the ACC needs to incorporate aquaculture and fisheries extension that is largely meant for common pool fisheries resources. It requires building strategies in four directions—production, marketing, conservation, and climate resilience—all of which require expertise from different fields for which an expert network needs to be created (Ojha, 2019). Workshops conducted by experts also need to be organized for conservation of common property resources by assessing the implementation fidelity of the welfare programmes, need-based alternative livelihood programmes, augmenting conservation awareness, and developing action plans through participatory approaches. Augmenting production in the deep seas, marine aquaculture, inland aquaculture, and ornamental fisheries also necessitates the participation of public, private, and community organizations. As such, the development of ACC needs to be guided by the following principles.

Principles of Private Fisheries and Aquaculture Extension

1. **Fish Production Extension:** There is a need for strengthening convergence for transfer of technology between international, national, and local fisheries development organizations for bringing additional area under aquaculture; integrating agriculture, livestock, and aquaculture; integrated multi-trophic aquaculture; integrating water harvesting with aquaculture; integrating groundwater recharge and aquaculture; facilitating aquaponics; and promoting aquaculture in the commons. Strengthening convergence for transfer of technology may also address the issues related to the major disease outbreaks in aquaculture.

2. **Fish Marketing Extension:** To promote aquapreneurship there is a need to address the accelerated shift of consumer preferences, establish fish market information systems, and expand the use of fish-processing waste in fishmeal and fish oil production. Under marketing extension, the scope of input-driven aquaculture private extension is manifesting to promote input delivery systems for commercial and subsistence fisheries/aquaculture. Therefore, there is a need to strengthen the input-credit-market-consultant interface by developing public-private-community partnership.
3. **Fisheries Extension for Conservation, Sustainability and Livelihood:** Improvement in culture-based capture fisheries and co-management are important to conserve fisheries resources and sustain the livelihoods of fishers. Moreover, overfishing and increasing population necessitates inclusive and pluralistic fisheries, and aquaculture extension. This may include livelihood and business-related issues that are addressing small-scale fisheries incorporating the gender lens. This may be promoted by facilitating convergence for pluralism, enabling convergence for inclusiveness, and by integrating the development strategies with subsidy driven schemes.
4. **Climate-Smart Fisheries Extension:** This is needed for better climate adaptation and disaster preparedness. Promoting blue economy and blue growth initiatives may address such cross-cutting issues. Climate-smart fisheries is key for sustainability of aquaculture and fisheries systems. Water conservation, integrated farming systems that integrate crops and livestock with aquaculture, and intercropping also need to be promoted as part of the private extension programs.

Organizing Aqua-Entrepreneurship along the Fish Value Chain

Agriculture and allied activities deal with living beings that breathe, feed, grow, and reproduce at definite intervals. This requires round-the-clock close supervision. Fixed waged labour and working for a fixed time of eight hours sometimes fail to provide the supervision required and the crop may die because of any negligence. The farmers, therefore, share their produce/profit with the tenants through a sharecropping system which may make the farmers and tenants innovative and responsible for profit, if managed properly. The tenant farmers are also screened on the basis of their entrepreneurial abilities (Singh, 2000). The labourers, likewise, sometimes get the share of the produce in kind--ensuring their food and nutritional security.

In India, Haque (2000) observed that large farmers tended to lease-in more than small farmers – until they get better opportunities in the non-farm (or allied) sector supported by good infrastructural and institutional facilities. He further reported that in contract farming, the partner companies needed to provide all kinds of inputs and credit to ensure the partnership of small farmers. For labour, he observed that, contract labour based on piece-based wage rate was more productive than wage labour; and there was a need to moderate the rural power structure (maybe in favour of poor and sustainable income). This can be further improvised, if the ‘input-consultant-market entrepreneurs’ encourage entrepreneurship of innovative land-owners, tenants and labours. However, agricultural scientists focus on output per hectare, whereas, from a welfare perspective, output per worker is more relevant to measure agricultural productivity (Timmer, 2017). The transformation in agriculture is suggested to graduate through stages, like, subsistence-farming, linking farm-nonfarm income, rural-urban associations, and modern agriculture (Timmer, 2005). In order to bring such transformation, the agricultural extension had transformed accordingly.

In Netherlands, by 1990 one-half of the public extension service was brought under the farmer associations as private extension, whereas, in France, the chambers of agriculture that were supported by public funds and private companies were already involved in providing extension services. India has established the Indian Chamber of Food and Agriculture to address agricultural and animal husbandry service activities under the Indian Council of Food and Agriculture. Many other countries had contract arrangements with farmers (Swanson, 2006). Therefore, private extension may be part of contract farming, input-agencies, producer co-operatives, and private consultancy services.

Aquaculture and fisheries production primarily comes from common property resources where social and ecological issues are a joint responsibility along with economic development. This can be addressed by social entrepreneurs who identify social problems and create self-sustaining organizations (Dona, 2019). In aquaculture such innovative farmers, tenant-farmers, and labourers may be called as ‘primary-aqua-(social)-entrepreneurs.’ Modern aquaculture that is dependent on commercially produced seed, fertilizer and other inputs provided by the organized sector has given space for ‘secondary-aqua-(social) entrepreneurs.’ The marketing and value addition also have added another group of ‘secondary-aqua-(social) entrepreneurs’. Moreover, the private aqua-advisory services are also emerging as aquaculture is becoming more knowledge intensive. These knowledge providers may be labelled as ‘tertiary-aqua-(social)entrepreneurs.’ For a proper management through partnership of the primary, secondary and tertiary (social) entrepreneurs, the aquaculture and fisheries sector has to be organized to sustainably improve the business-volume and income of each partner or actor (Figure 2).

Figure 2: Organizing Aqua-Entrepreneurship along the Fish Value Chain



Source: Authors’ compilation

Proposed Actors and Actions of the ACC

Private extension in fisheries and aquaculture is emerging through coordinated efforts of private organizations, consultants, fish farmers, and fishers. Such coordinated efforts may be effective when the private actors are organized under a chamber of commerce that can also address the issues related to common pool fisheries resources. Therefore, there is a need for an ACC to promote aqua-entrepreneurship and economic integration to lower the prices for distributors and consumers while increasing productivity, welfare, and profit. Accordingly, the actors of ACC may involve multinational agencies/companies, local entrepreneurs, fish farmers, and fishers (Figure 3).

Figure 3. Aqua Chamber of Commerce Framework: Actors and Actions in India



Source: Authors' compilation

The actors of the chamber will take up three types of actions to strengthen aquapreneurship. They include: 1) facilitating business ecosystem and strategies (first outer circle from the core), 2) advocating major policy and program reforms (second outer circle from the core), and 3) intensification of extension to augment the volume of business (final outer circle from the core). These actions are elaborated in the next section in the context of establishing a ACC.

Specific Strategic Actions for Establishing an Aqua Chamber of Commerce

In this section, using the above conceptual framework, (Figure 3), we identify specific actions that are needed for developing the ACC.

Action 1: Facilitating the Business Ecosystem

To enhance fish production by 2025, there is an urgent need to initiate systematic action on different components of the aquaculture value chains, such as facilitating international and national collaborations with private organizations, promoting entrepreneur-led extension, and implementing data-based field extension monitoring system (Table 1 and 2).

Table 1: Prospective Collaboration with Private International Organization

S. No.	Name of the organization	INPUT TYPE							
		Seed	Feed	Aerators	Sanitizers/ disinfectants/ adsorbant/ deodorisers	Probiotics/ feed additives/ nutritional ingredients and solutions	Fish stimulants/ fish hormones/ immunostimulants	Aquaculture technology setup / tanks/ Aquaculture equipment/ aqualab	Aquaculture chemicals/ medicines
1.	Biostadt India Ltd.	✓		✓	✓	✓	✓		
2.	AquaMaof							✓	
3.	ADM Animal Nutrition					✓			
4.	BioMar Group		✓						
5.	Cargill		✓						
6.	Charoen Pokphand Foods (CPF) Public Company Limited		✓						
7.	Alltech Company					✓			
8.	Skretting		✓						
9.	Aller Aqua		✓						
10.	Nutreco					✓			
11.	Agrovet Animal Health Austria					✓			
12.	Blue Planet					✓			
13.	Netilion							✓	
14.	QB Labs					✓			✓

Source: Authors' compilation.

Table 2 : Prospective Collaboration with Private National Organizations

S. No.	Name of the organization	INPUT TYPE							
		Seed	Feed	Aerators	Sanitizers/ disinfectants/ adsorbant/ deodorisers	Probiotics/ feed additives/ nutritional and solutions	Fish stimulants/ fish hormones/ immuno-stimulants	Aquaculture technology setup/ tanks/ Aquaculture equipment/ aqua lab	Aquaculture chemicals/ medicines
1.	Avanti Feeds Limited		✓						
2.	Waterbase Ltd.		✓						
3.	Shantanu Sheorey Aqua Ltd.	✓		✓				✓	✓
4.	Utekar Fisheries			✓				✓	✓
5.	Kwality Feeds Ltd		✓						

S. No.	Name of the organization	INPUT TYPE							
		Seed	Feed	Aerators	Sanitizers/ disinfectants/ adsorbant/ deodorisers	Probiotics/ feed additives/ nutritional and solutions	Fish stimulants/ fish hormones/ immuno- stimulants	Aquaculture technology setup/ tanks/ Aquaculture equipment/ aqua lab	Aquaculture chemicals/ medicines
6.	Growel feeds pvt. Ltd.		✓					✓	
7.	Advanced aqua biotechnologies India Private Limited.		✓						
8.	Grobest Feeds Corporation (India) Private Limited		✓						
9.	Godrej agrovet Ltd.		✓						
10.	Anmol feeds pvt. ltd.		✓						
11.	Syon Fishing	✓							
12.	Chand Fish Seed Company	✓							
13.	Global Fish Seed Farm	✓						✓	
14.	Aahil Fisheries	✓	✓					✓	
15.	Jack Sparrow Fisheries	✓	✓						
16.	Bihar Fish Seed Center	✓	✓						
17.	Nabotuas Enterprise	✓							
18.	Bharat Aquaculture Technology	✓	✓						
19.	Bengal Associates	✓							
20.	Pawar Fisheries	✓							
21.	Capital Nets	✓	✓						✓
22.	Umesh Umang International	✓	✓						
23.	Ahire Fisheries Products	✓						✓	
24.	Bareilly Hatchery (OPC) Private Limited	✓							
25.	Kartik Fisheries	✓							
26.	Maa Lakshmi Fisheries Private Limited	✓							
27.	Anand Marcom Private Limited	✓							
28.	Jaman Fish & Seed Suppliers	✓							

S. No.	Name of the organization	INPUT TYPE							
		Seed	Feed	Aerators	Sanitizers/ disinfectants/ adsorbant/ deodorisers	Probiotics/ feed additives/ nutritional and solutions	Fish stimulants/ fish hormones/ immuno- stimulants	Aquaculture technology setup/ tanks/ Aquaculture equipment/ aqua lab	Aquaculture chemicals/ medicines
29.	Dastgir Saheb Fish and Prawns Company	✓						✓	
30.	Sapna Feeds Inc		✓						
31.	Nature Nerve					✓			
32.	Universal Fish Feed		✓					✓	
33.	JV Marine shrimps	✓	✓						
34.	Santhas Aquaculture Consultancy Services	✓		✓					
35.	M/s Saha Enterprise	✓							
36.	Fishery	✓	✓						
37.	Amulya Enterprises	✓							
38.	Aarush Fish Seeds Supply	✓							
39.	King Fisheries	✓							
40.	Mahavir Enterprise	✓							
41.	Kolleru Fish Seed Supplier	✓	✓			✓			
42.	Laxmi Aaditya Fisheries		✓						
43.	AgroFisher	✓	✓						
44.	Nabaloke Aquaculture	✓							
45.	Falguni Fishery	✓							
46.	Arjun Aqua Culture	✓	✓						
47.	Bengal Fishery	✓							
48.	Royal Hatcheries	✓							
49.	Rajanagri	✓							
50.	Mumbai Fish Seed	✓							
51.	Bangla Krishi Khamar	✓							

Source: Authors' compilation.

A. International and National Collaborations for Private Extension Services

Fisheries and aquaculture are water-based and are not restricted by territorial boundaries. Moreover, there is also a need to bring economic integration to lower the prices for distributors and consumers while increasing productivity, welfare, and profit. Research, extension and private/non-government

organizations across the countries need to collaborate and address the issues of blue revolution and food security. There is also a need to strengthen partnerships and collaborations among the private organizations in fisheries. Table 1 and Table 2 depict a selected set of key private international and national organizations that may collaborate for their mutual benefit. This can also help in leveraging limited public resources to guide collaboration and coordination at various stages of the aquaculture value chains.

B. Entrepreneur-led Extension

Nurturing aquaculture and fisheries farmers as entrepreneurs and building on their enterprising abilities for extension services can be a progressive way of addressing the shortage of manpower in the aquaculture and fisheries extension sector. Aqua-input industry, fish marketing agents, and fish processing units may also be used for extension activities to enlarge the volume of production and aquaculture business. This approach is being explored at Motipur Centre (Bihar) of ICAR-Central Institute of Fisheries Education (ICAR-CIFE), Mumbai, to foster entrepreneurship-led extension. In this model, the entrepreneurs who produce seed and feed and are engaged in fish marketing are enrolled to create a “Value Chain Cluster” for the mutual benefit of their marketing and extension activities.

C. Data-Based Extension Management System:

Data-driven entrepreneurship is taking an extraordinary shape in several subsectors of agriculture and food systems. Data-based management systems (DBMS) helps in handling complex data and analytics to organize them for regulating the present status and to predict the future strategies. In order to track the doubling of fish production in fisheries and aquaculture by 2025 and thereby augmenting the business volume, we propose a Data-Based Extension Management Systems(DBEMS) with following steps.

Step 1: Identification of Potentiality of a district

This step begins with mapping the opportunity for development of aquaculture in a selected district. Every district in India has some water bodies that are not effectively used. These water bodies could be mapped and recorded by the ACC in terms of their acreage. These can be recorded under the present capacities of a given district for a given year. Again, these water bodies must be getting services from secondary and tertiary entrepreneurs in the district. The present capacities of each of these entrepreneurs, for a given year, may also be defined in the beginning of the production cycle. Average output and productivity of each water body and the entrepreneurial activities practiced in the district may also be recorded. Some water bodies or aqua-enterprises must be practising a package of practices that are recommended for maximizing profit, minimizing risks, and addressing sustainability. Thereafter, the experienced and technical experts, through key informant interviews (KII), can also identify the future possibilities for each of the water bodies and enterprises that may be environmentally, economically, and employment friendly. For example, in the large water bodies, a given district is only able to practice capture fisheries from a given area of water body in a given year. Each of such water bodies, then, will be given a target in terms of amount of yield/productivity/output in that year through a given package of practices. The teams of technical experts may further explore new (aquaculture conservation) possibilities and develop better package of practices. These technologies could include pen culture, cage culture, aquaponics, sea weed culture, etc. The technical experts may also meet the entrepreneurs to finetune their technologies and business plans. Some of such entrepreneurs, who want to work for the development of fishers and fish farmers may also be identified as -- Sagar/Matsya Mitra – friends of the sea or fisher’s/fish farmer’s friends.

Therefore, to summarize, the first step should incorporate the following point:

- Identification of new possibilities through KIIs or Sagar/Matsya Mitra as depicted in the Table 3.

Table 3: Schedule for identification of potential village/s through Key Informants Interviews (KII)

District (Name)	Water Bodies	Present Capacities (yr)	Average Output/ Productivity (yr.....)	Existing Fisheries and Aquaculture Practices Identified (Descriptions) (Y/N)	Future Possibilities & Interventions Identified (that are environmentally, economically and employment friendly in nature) (Descriptions) (Y/N)
Fisheries and aquaculture resources & entrepreneurship information in the districts	Resources in the potential villages				
	Sea (Km)				
	River (s) (Km)				
	Reservoir(s) (Ha)				
	Tank(s) (Ha)				
	Community Pond(s) (Ha)				
	Individual Pond(s) (Ha)				
	Basic secondary and tertiary entrepreneurship information of the district				
	Production and maintenance of fisheries equipment (Types and nos/yr)				
	Seed production (No. of fry/fingerlings/ yr)				
	Feed production (Kg/ yr)				
	Fish sale in the Market(s)(Kg sold/ yr)				
	Fisheries and Aquaculture Advisory/Consultancy Services(Nos. of farmers/fishers covered)			No s of Subject Matters Covered	
	Any other (specify)				
*					

Source: Authors' Compilation

Step 2: Prioritizing the Potential Villages

The second step is the identification of potential villages. This may be possible when the local aqua-entrepreneurs prioritize the villages on the basis of potential, farmers'/fishers' innovativeness, and their accessibility to markets. Many entrepreneurs may get involved in this activity to increase their sale or procurement volume. Accordingly, they may document the existing and expected practices for production, credit, procurement, and marketing. Finally, the entrepreneurs may develop a consensus about the interventions that can be introduced in a given village. Therefore, at this stage the entrepreneurs may work on the following actions:

- Prioritizing the potential villages on the basis of potentiality, innovativeness of the fishers/farmers, farmers' accessibility to extension agencies, and assigned targets.
- Documenting the existing and expected practices for production, credit (grants, loans, crowd funding, and venture capital etc.) procurement, and marketing.
- Identifying the interventions specific to the villages.

Step 3: Estimating enhanced productivity and employment opportunities

This third step is important for identifying opportunities for increasing the productivity of aquaculture and fisheries systems and their potential for enhanced employment opportunities. In this step, the identified entrepreneurs will focus on increasing the productivity of the fish farmers and the fishers. This will in turn increase procurement and sale of the inputs supplied by the entrepreneurs and result in new employment opportunities in the aquaculture and fisheries sector. The new employment opportunities created will not only increase the sustainability of the entrepreneur-led extension system, but it will also contribute towards food and nutritional security of the newly employed rural households by augmenting their purchasing power. However, to make this private extension system further sustainable, there is a need to focus on environmentally and economically sustainable technologies. As part of this step, Rapid Rural Appraisal (RRA) methods will be used for collecting and analyzing the opportunities for enhanced productivity and employment opportunities, as mentioned below.

Conducting RRA in the prioritized villages could include survey questions on water area used under aquaculture, productivity levels of aqua-enterprise, productivity targets, and number of additional skilled persons required to meet future production and productivity targets.

Step 4: Identification of Potential Adopters

This step focuses on human resources. If the potential adopters of the new technology are not carefully identified on the basis of their innovativeness, commitment, and their skills, the system may not be sustainable. Therefore, once it is known through RRA that the improvement, refinement and adoption of new technologies can increase the number of jobs in a given village, the ACC representatives may approach the local leaders of the village to explain to them about the new schemes that may provide employment opportunities to a given number of youths in the village. Once the local leaders agree to implement the programme in their village, ACC representatives may appeal to the local leaders to prepare a list of the potential adopters who may be innovative and committed to this program. After the list is made, an inception meeting needs to be called to educate the new farmers about the project. If the fish farmers and fishers agree to the new idea, they should be educated on the specific conditions under which the program will operate. For example, such initial interaction will make it clear that the project is not intended for distributing subsidies. In this program, if subsidies are made available, they will be used as rewards to successful fish farmers and fishers who could complete an assigned task. Once they agree to the basic set of conditions, they may be enrolled in the system.

To summarize, this step may ensure the implementation of the following action.

- Meeting with the village leaders and ACC representatives to identify the names of additional persons to be trained and employed.

Step 5: Developing Training and Visit Module

Under Step 1, the future possibilities for a given district were identified. In Step 2, the business models were developed. Now in Step 5, all possibilities and models need to be discussed and refined in the training programmes. Practical sessions for demonstrating specific technologies could be organized through Field Schools. A follow-up visit schedule of ACC representatives will be prepared to handhold the participants. Once the new units start operating, the ACC may develop a monitoring plan that incorporates the recording of data related to production, marketing, jobs created, and other indicators of success. Some of the participants may be encouraged to take up extension and marketing work. Those participants who are successful in taking up extension and marketing work can also be enrolled as Sagar/Matsya Mitra in the newly announced program of the federal government.

Therefore this step includes the following two steps.

- Developing the training and visit plans
- Developing the monitoring and mentoring plan

Step 6: Scaling-Up Strategies

The last step is dedicated to scaling up the model to many villages and districts. At this stage, the para-extension services developed through the earlier steps need to be further strengthened by developing scaling up strategies. Information and communications technology (ICT) tools will be used to mobilize more fish farmers and fishers in the system, enlarging the markets, and using modern human resource management tools. All these will have to be consolidated in the form of a producer organization.

Therefore, this step can be summarized as:

- Developing the scaling-up strategies of proven practices by engaging participation and partnership through ICT-led para-extension services and development of producer organizations.

Action 2: Advocacy for Major Policy and Program Reforms

Development and implementation of state-level ACCs will require certain policy reforms, some of which are discussed below.

A. Promoting blue economy and blue growth policy initiative: At the macro level, there is a need to move towards promoting blue economy and blue growth. Like the 'green economy', the blue economy model proposes development of human well-being, social equity, and ecological security through better stewardship of the water bodies. Blue economy is a means to drive economic growth and job creation through addressing disaster prevention, pollution governance, industrial support, and ecological restoration of water resources (Wenhai et al., 2019). Blue growth policies should also take into consideration potential for growth in traditional sectors and cooperative fishing. Aquaculture and tourism too have to be a part of this process at a much earlier pre-planning stage (Schultz-Zehden et al., 2019). In the context of development of private extension in the aquaculture and fisheries sector, blue economy activities provide new opportunities for including sustainable fisheries development, need-based-alternative livelihood options, ecosystem health, climate resilience, and pollution prevention. In the Indian context, development of coastal communities through marine-sector-related activities like fisheries, aquaculture and cold chain development, fishing harbor development, deep-sea fishing, fish processing centers, maritime tourism, and corresponding skill development are an essential part of the Sagarmala Programme, which can benefit from close collaboration with ACCs.

ACCs could work for public sector programs that promote policies related to blue economy and blue growth, including cooperative fishing, fish transportation, and aquatourism, to increase the business and employment opportunities for fish farmers and aquaculture producers.

B. Strengthening convergence for transfer of technology in aquaculture and fisheries sector: Since India's independence in 1947, the aquaculture and fisheries sector has come under planned development process of five-year plans with a focus on spread of innovative technologies, based on scientific research supported by a wide range of services, public policies, and increased supply of inputs. Proper coordination of research-based technologies were promoted through the advent of ICAR's All India Coordinated Research Project (AICRP) in 1971 (Sinha, 2016). The extension programmes of ICAR included National Demonstrations (ND), Lab-to-Land programmes (LLP), Operational Research Projects (ORP), National Agricultural Technology Project (NATP), National Agricultural Innovation Project (NAIP), and more recently beginning in 2018, the National Agricultural Higher Education

Project (NAHEP). The district level Farm Science Centres (locally called Krishi Vigyan Kendras or KVKs) were established in 1974 to facilitate the Front Line Demonstration Programmes (ND, ORP, and LLP) so that the generators of innovations could directly interact with the adopters. Moreover, the Fisheries Research Institutes under ICAR (ICAR-FRIs) and Colleges of Fisheries (CoFs) have been playing an important role in developing technologies and human resources for fisheries development. Since early 1950s, many short-term schemes were funded in fisheries to promote seed production; stocking of reservoirs; modernization of fishing vessels, fishing harbours, markets, and storage facilities; and setting-up of fisheries cooperatives under the “Grow more Food” campaign program (Chopra, 1951). All such schemes are currently grouped under the Centrally Sponsored Scheme (CSS) on “Blue Revolution” and are implemented by the Department of Fisheries (DoFs). However, with the rising demand for fisheries and aquaculture products, there is a need to involve the private sector in the promotion of the technology transfer process. International organizations and national systems need to work together to meet local technological needs and to cater to international standards in fish processing, marketing, and trade.

ACCs are well-placed to promote such technology convergence. To further strengthen the public sector approach in fisheries and aquaculture extension, ACCs need to advocate for All India Coordinated Fisheries Research and Extension Programmes (AIC-FR-EP) to bridge the gap between ‘Laboratories of Excellence’, Prototype Developer, FAO, CGIAR, ICAR-FRIs, CoFs, KVKs, and DoFs. ACCs will play an important role in facilitating the ‘Laboratories of Excellence’ and promoting ‘Prototype Developers’ at the state level with adequate policy support at the national and state levels.

- C. *Strengthening input-market-credit-consultant interface*: Initial efforts of the public sector extension system in the 1950s helped trigger a range of entrepreneurship in the fisheries and aquaculture sector (Kumar, 2016). In addition, over the past 30 years, NGOs have also played an important role in sustaining the livelihood of fishers and fish farmers. Many of the dealers of commercially produced aqua-feed developed long-term relationships with their clients, often providing extension services to the farmers (Hasan and Arthur, 2015). ACCs could develop business models to commercialize innovative technologies by collecting and coordinating information on target market, credit, input-supply, and output marketing. Specifically, the Ministry of Micro, Small and Medium Enterprises (MSME) in collaboration with ACCs may assist in further mapping of the possibilities for expanding aquaculture entrepreneurs in various districts. In this context, the Pradhan Mantri Matsya Sampada Yojana (PMMSY), also called the Prime Minister Fish Wealth Programme, launched in the year 2019, by the Government of India will further facilitate the infrastructure needed in the aquaculture and fisheries sector. ACCs can help in developing public-private partnerships with PMMSY.

To further promote a private sector approach in fisheries and aquaculture extension, there is a need to coordinate and facilitate the efforts of input suppliers, credit agencies, marketing agents, and consultancy services to develop appropriate business models at the district level. The ACCs would be well-placed to deliver on such coordination.

- D. *Promoting public-private-community partnership*: Out of 25 public private partnership (PPP) projects initiated in the past decade in developing countries in the aquaculture and fisheries sector, about 59 percent of them were on supply chain management in the form of organic certification, product handling, food safety, and marketing (Weirowski and Liese, 2009). In case of small-scale fisheries it was observed that public authorities emphasized environmental and livelihood issues. The private sector showed interest in profit-oriented activities during the partnership. PPPs were observed mostly with cooperatives, communities, and associations of small-scale farmers. PPPs were also observed in supply chains, marketing partnership, capacity building, technology and environmental management, and research (Weirowski and Liese, 2010). PPP have also been helpful for harnessing the benefits of common property resources for the benefit of the landless, and poor rural households. Poor villagers

were dependent on gathering and hunting fish from the common resources. Over the years, the multiuse common property water bodies in villages have been leased out to outside contractors, which deprived poor people of using these common pool resources. PPPs can help the poor by organizing them into self-help groups (SHGs) through which they can benefit from common property village ponds. However, this arrangement cannot increase production unless these SHGs are linked with suppliers and marketing agents through the PPP model. ACCs can help with translating PPP models into public-private-community-partnerships (PPCP) at the community level. ACCs could be a platform for developing PPCP governance in a context-specific approach to address challenges such as active participation of local communities, financial transparency, procurement competitiveness, credit agreement, cooperation between the governments, sharing authority between the private sector and communities, improving cost effectiveness of operation, and revenue sharing. (Adnyana et al., 2015).

To strengthen the present arrangement, PPCP governance structure needs to be recommended where ACCs can play a key role in streamlining the process.

- E. Facilitating convergence for pluralism in extension services:* Considering the rising influence of voluntary, private and community organizations in extension services, the extension services need to take a lead role in converging all the extension efforts on behalf of the communities. This will ensure livelihood and environmental security through relevant commodity-based management, integrated farming, and a farming system approach. Within the pluralistic extension system, NGOs and private commodity extension organizations play an important role in supporting smallholder farmers (Zhou and Babu, 2015; Gemo et al., 2013). Convergence of pluralistic extension, therefore, is characterized by the coexistence of multiple public, private, and mixed extension systems and approaches; multiple providers and types of services; diverse funding streams; and multiple sources of information—all of which benefit from some degree of coordination and regulation that facilitates interaction and learning (World Bank, 2012). In the Indian fisheries context, it was observed that in Kerala, all the fish farmers were aware of resource persons whom they could approach in times of need through the Agricultural Technology Management Agency (ATMA) – a pluralistic extension model in India (Joshua et al., 2015). The community-level resource person in pluralistic extension model of ATMA, is also called the ‘Farmers’ Friend’, can work as a para-extension agent on behalf of all the extension agencies covered under the model. Farm Science Centers (Krishi Vigyan Kendras, KVK), have been claimed as one of the major institutional innovations of the National Agricultural Research System (NARS) in India, demonstrating the institutional convergence to enhance innovation and impact (Ananth et al., 2019).

Therefore, ACCs will advocate for developing linkage with Farm Science Center (KVKs) to integrate aquaculture with agriculture and livestock systems. ACCs will also take up fisheries-based alternative livelihood options and even provide ‘value chain support activities’ to the fishers. Private enterprises can likewise take up a pluralistic approach through a business-to-business model as per the needs of the local clients and conditions to further lower down their administrative cost and increase their efficiency. In this sense, ACCs will function as ATMA, a structure currently implemented through public sector departments.

- F. Enabling convergence for inclusiveness:* Several decades of public and private investments and charities have been found to be insufficient for creating an inclusive environment for the rising number of poor and hungry people, particularly women. The inclusive approach to development has been extended with greater commitment in the Twelfth Five-Year Plan (2012-17) and the need for a specific policy (for including women, social, religious and economic groups) was felt (Thorat and Dubey, 2012). Promoting social entrepreneurship is a viable option to bring convergence in the public and private efforts to develop business models for including the poor so that they can generate their own income and can address social issues of hunger, nutrition, health, and education (Azmat et al., 2015). The

factors contributing to social entrepreneurship are identified as business planning skills, entrepreneurship orientation, leadership, networking, innovative financing, triple bottom-line planning, social entrepreneurship marketing, community engagement, human capital, organizational culture, social impact evaluation, economic innovation, and government support (Satar and John, 2016). To facilitate this, the Government of India in its National Policy on Skill Development and Entrepreneurship 2015 stated that the academia will be encouraged to launch courses on social entrepreneurship. It is observed that shrimp farming in Odisha has increased the gap between the rich and the poor, and thus better policies are needed to minimize its adverse impact on small-scale farmers and on the local environment (Dora and Kara, 2015). Small-scale producers require both institutional and technical innovation to reduce transaction costs and risks through better linking to, and greater equity within, value chains (Little et al., 2012).

Inclusive fisheries extension programmes may depend upon the ability of the ACCs to organize input agents, smallholder farmers, and marketing agents along value chains with a focus on low-cost technology for getting quality fish produced by small-scale fish producers that may be sold through ACC's organized outlets. Social entrepreneurship models and approaches need to be promoted as part of the implementation of private extension for ensuing inclusiveness of various socio-economic groups, including women, through ACCs.

- G. *Integrating with subsidy-driven schemes:* The vision of the blue revolution strategies in India revolves around creating an enabling environment for integrated development of the full potential of the aquaculture and fisheries sector of the country, along with substantial improvement in the income status of fishers and fish farmers keeping in view the sustainability, bio-security and environmental concerns. The mission is a formulation of a Neel Kranti Mission Plan (Blue Revolution Mission Plan - BRMP), that ensures doubling of income of fishers and fish farmers of the country and addresses environmental concerns for enabling sustainability of the fishing industry. The nodal agency for planning and implementation of BRMP is the state-level Departments of Fisheries. However, in order to ensure implementation of the scheme on a fast-track and in a result-oriented manner, the state governments may identify any existing agency or create a new agency as the state implementing agency (SIA) for channeling funds, administrative and financial convenience, and ease of implementation. Even where such an SIA is created or notified, the entire responsibility of ensuring planning and implementation of the scheme lies with the state's Department of Fisheries in convergence with the Sagarmala Project, MGNREGA, RKVY, NRLM, and other ongoing schemes in the agriculture sector. ACCs can provide a platform for these schemes to converge in the context of the BRMP. Up to 5 percent of the allocated budget in each component of the central government schemes shall be earmarked for ACCs for administering the schemes through the PPCP mode of implementation.

National schemes in agriculture and aquaculture and fisheries sectors could converge and be implemented through participatory programs and diffusion of innovation approaches to enhance their implementation fidelity. ACCs may facilitate such subsidy driven programmes to promote fish business through inclusive development.

Action 3: Extension Intensification Approaches

In addition to the above policy reform and pragmatic actions, developing private sector aquaculture and fisheries extension also needs intensification in terms of the ratio of extension professionals to fish farmers to increase the quantities of fish produced at the farm level. To improve the extension density (fisher/farmer: extension professional ratio), the tools and strategies like ICT, Internet of things, machine learning and artificial intelligence (AI), GIS, para-extension, NGOs, CBFM, and social entrepreneurship need to be effectively used along with increasing the number of extension personnel through ACCs. We elaborate on these tools and strategies below.

- A. *ICT-led extension approach*: ICT-led agricultural extension plays a significant role in improving the livelihood of farmers through facilitating the adoption of new technologies (Aker, 2011). Despite the evident benefits of ICT integration into traditional extension services, the farmers suffer from some basic problem like lack of connectivity, lack of awareness of technologies, and skill required in handling ICTs, training, and practical exposure to ICTs. Furthermore, the knowledge of ICT is limited to media such as mobile phones, television, and radio. For an enhanced scope of ICT use as well as raising the interest of farmers in using ICT, there is a need to look closely at factors that impede the use of ICT in extension as well as the constraints the farmers currently face with use of ICT. Besides this, the major pitfall of ICT interventions are that they don't continue after any project that introduces them is over due to lack of financial support. In order to address these sustainability challenges, ACCs need to devise revenue-based ICT models (Aker, 2011).
- B. *GIS & AI-led extension approach*: GIS mapping of resources and landscapes has become an integral part of the planning and program development in the areas of rural and urban development, agriculture, and forestry. Aquaculture development in order to meet the increased demand for fish need to develop such mapping for facilitate interventions including allocation of resources towards private extension. It is also imperative that the stakeholders should have a say in the policymaking and programing of interventions. GIS mapping and the use of such maps in the ACCs planning at the district and community levels can significantly improve the participation of stakeholders in the implementation process. For example, participatory GIS (PGIS) initiatives shall focus on generic issues such as empowerment for site selection, market identification, and potential fishing zones. Through AI-powered apps, farmers could be targeted and receive customized responses from extension professionals or the ACCs central portals.
- C. *Para-extension approach*: Selected fish farmers could serve as para-extension workers. Through participatory approaches, the para-extension workers (chosen from the pool of fish farmers/fishers and called "Fishers Friend"/Sagar Putra), can increase the extension intensity. Such approaches have improved interpersonal communication between the farmers and the para-extension workers. They have been useful in the effective use of mass media through ICT intervention. The para-extension professionals need to be further trained and graduated to social entrepreneur levels before enrolling them as part of the private extension programs of the ACCs.
- D. *NGO and CBFM-led social entrepreneurship approach*: Social entrepreneurship and community-based fisheries management (CBFM) may become a significant tool to promote environment and sustainable profit to the fishers. For example, Dona et al., (2019) reported that in the Vembanad Lake of Kerala, five SHGs were formed by Ashoka Trust for Research in Ecology and the Environment (ATREE), each SHG comprising 10 fishermen members. SHGs were mobilized for social entrepreneurship on fish aggregating devices (FADs) ventures under the change agency (NGO). Thus, CBFM needs to be driven by initiatives that are indigenous to local fishing communities and could be promoted for developing social entrepreneurship with the help of ACC.

III. GAPS IN THE EXISTING POLICY SYSTEM FOR PROMOTING AQUA-ENTREPRENEURSHIP IN INDIA

In order to meet the increasing demand for fish in India in the next 10-15 years, several national programs are in operation to support the development of the aquaculture and fisheries sector. Yet, progress has been limited due to limited capacity for translating the policies and programs into action on the ground. While this paper develops a road map for promoting a private-sector-led extension system for fisheries and aquaculture development, sustaining such efforts requires development of policies, and institutional, technical, and human capacities for entrepreneurial development in the aquaculture and fisheries sectors.

In this section, we identify four such factors that facilitate rural entrepreneurship. They are: 1) policy environment and regulatory system, 2) institutions and intermediary organizations, 3) technological options and business infrastructure, and 4) individual capacity and skills (Babu and Blom, 2014; Babu and Shisodia, 2018). The above four factors elaborate and capture the contextual factors and drivers of rural entrepreneurship development and are discussed in detail below.

- 1) To enable a policy environment and regulatory system for aquapreneurship, India has established a new department called Department of Fisheries out of the former Department of Animal Husbandry, Dairying and Fisheries. It has also launched a new scheme called Pradhan Mantri Matsya Sampada Yojana (Prime Minister Fish Wealth Programme) with the aim of fostering infrastructure creation and value addition across value chains. The Sagarmala (Port-led Prosperity) Programme has also been put in place to fund capacity building, infrastructure, and social development projects related to value addition in fisheries, aquaculture, and cold chain development. Moreover, for better access to credit and facilitating the handholding services for the entrepreneurs, the government has created Micro Units Development and Refinance Agency (MUDRA) Bank and Rashtriya Krishi Vikas Yojana–Remunerative Approaches for Agriculture and Allied Sectors Rejuvenation (RKVY-RAFTAAR) programme respectively. The National Fisheries Policy (NFP) 2020 has proposed establishment of a National Marine Fisheries Authority (NMFA) to regulate the standards and norms prescribed for sustainable fisheries development. It also recommends development of a National Fisheries Development Council (NFDC) to formulate policies and guidelines for fisheries and aquaculture development in the country.
- 2) Fisheries institutions and intermediary organizations need to be developed to support the above policy and program initiatives. On this front, to develop and support skilled entrepreneurs, the Government of India has launched the Start-up Village Entrepreneurship Programme (SVEP), which will help entrepreneurs in rural areas in setting up local enterprises. An Aqua-Clinic and Aquapreneurship Development Programme (AC&ADP) has also been launched to establish Aqua One Centres (AOC) that will cater to the needs of the fish farmers and provide consultancy for aquapreneurship development. NFP 2020 suggests the development of special institutional development programs such as Fish Producer Organizations, National Data Acquisition Plans, Promotion of Cluster Farming, and Entrepreneurship Development Approaches. The Government of India has also recently announced the Sagar Mitra (Friends of the Sea) program for the development of fisheries, which is aimed at improving opportunities for the young people who depend on fishing and fisheries. The guidelines to implement the scheme are being prepared. The National Marine Fisheries (Regulation and Management) Bill, 2019 is under consideration. It focusses on fishing beyond territorial seas and within the Exclusive Economic Zone (12 to 200 nautical miles from the coast), which is within the control of India). This area needs to be regulated for foreign and Indian vessels. The bill also proposes “Entrepreneurship development, private investment, Public Private Partnership (PPP) and better leveraging of institutional finance for marine fisheries sector. Besides, modalities will be worked out for integration of sea food processing and export sector with the deep-sea fishing industry for holistic development of the sector.” All these institutional development plans have to be integrated with the strategies of ACCs in the context of private extension development.
- 3) The existing technological options and business infrastructure development facilitating aquapreneurship in India are promoted by ICAR-FRI, CoFs, KVK, DoFs, etc. The ICAR-FRIs are conducting various entrepreneurship awareness programmes and are developing the Agri-business Incubation (ABIs) centres for providing holistic and all-around services to the entrepreneurs related to technology, marketing, and financing. Technological options in aquapreneurship development are also available through fisheries mobile apps, private Youtube channels, and other social media pages. They share information and procedural needs of the potential entrepreneurs for accessing a variety of fisheries-related information. The ICAR-FRIs are developing mobile apps pertinent to the fish farmers

and to meet the information needs of the sectors. The National Fisheries Development Board (NFDB), Marine Products Exports Development Authority (MPEDA), and others are working on the business infrastructure development for fisheries development at the state levels. NFP 2020 emphasises introduction of globally best technologies for production enhancement and better resource utilization through technology-based interventions and equitable distribution of benefits to all stakeholders. AI technologies will be used through suitable platforms and apps to improve efficiency and sustainability of aquaculture and fisheries sector. The public extension system addresses sustainability in the aquaculture and fisheries sector by banning fishing during breeding seasons, destructive fishing equipments, etc. Private extension will address this issue by introducing business models on alternative livelihood options so that the fishers' livelihood is also addressed while complying with such bans. This will also increase the volume of business and share of stakeholders involved.

- 4) Public sector capacity in the fisheries extension continues to be weak. To address this capacity gap, individual capacity development in the institutions such as ICAR-ABIs, AC&ADP, and SVEP need to be strengthened. NFP 2020 also plans to develop the “capacity of planners and managers at different levels” through regular interaction with Knowledge Centers and the Department of Fisheries will develop linkages for effective convergence with other agencies to upscale skills of fishery personnel and workers in the context of emerging technologies, fisheries management and national and international developments.” Since private extension will enroll farmers/fishers to augment the total fish business and its share to individual stakeholders, it will train its new members on business and organization development skills in addition to technical skills.

However, against the backdrop of the concept of ACC depicted in Figure 2, there are some gaps in the policy ecosystem for promoting aquapreneurship in India. In the context of developing private extension through social entrepreneurship, they include: lack of harmonized policy system for enabling PPP (at the district level), limited effort for facilitating the input-market-credit-consultant interface (for development of business models). The aquapreneurship policy ecosystem also needs to follow a pluralistic and inclusive approach involving all the public, private, NGO, and community stakeholders of the sector who can aid in enhancing the volume of business. In order to fulfill the required needs and cater to the demands of the entrepreneurs, ACCs will be an ideal platform. ACCs will help in fostering a holistic aquapreneurship policy environment, thereby addressing the existing policy and programming gaps present in the aquaculture and fisheries sector.

IV. CONCLUDING REMARKS

The aquaculture and fisheries sector is expected to expand and intensify for the next 40 years to meet the demand for fish for the growing Indian population. Hence, it needs prioritized attention. The Indian government is paying concentrated attention to the sector through establishment of a separate ministry as well as a special Fisheries and Aquaculture Infrastructure Development Fund (FIDF). Besides this, there is a need to revisit the goal for doubling the fish production by 2025, as the existing scenario reveals that from 2020-2025 the total fish production of India will increase from 13.74 million MT to 16.59 million MT. To achieve the goal of doubling production, radical revamping in the aquaculture and fisheries extension systems is needed. Along with public sector extension, a well-functioning private extension system needs to be established for fostering better business opportunities in the aquaculture and fisheries sector.

It is also essential to reduce the dependency on government in such efforts. Therefore, it is critical to develop an extension system that is driven more by (social) entrepreneurs than government schemes only. This demands institutional reform in the current extension system. A private extension system in aquaculture and fisheries sector, discussed in this paper, is a formal setup empowered by the fishers, farmers, and entrepreneurs as a bottom-up system under the leadership of a platform called ACC. This effort will focus

on the overall increase in fish business and the share of individual stakeholders in it by increasing productivity of the resources through the introduction of environmentally, economically, and employment-friendly technologies. The job-driven technology options will also ensure food security by improving the purchasing power of the employees. ACC will also acknowledge three types of entrepreneurs who need to be enrolled in the overall production system. These are the primary aqua-entrepreneurs who are the innovative aquaculture farmers, fishers, tenants, and workers, the secondary aqua-entrepreneurs who are made up of input, processing, and marketing agents, and the tertiary entrepreneurs who are the service providers--mainly the advisory services or the consultants.

Since fish and related products are marketed globally and locally, the sector's actors will include multinational and national companies working with local fish farmers and fishers. The international and national actors may facilitate technology transfer and promote organizational development of the fishers and the fish farmers to make the system bottom-up through participative approaches. These actors need to engage in actions that will help develop a business ecosystem, facilitating policy reforms and initiating intensive extension strategies to further increase the business volume and the share of the stakeholders in it. Developing an ACC as proposed in this paper could be the right platform for fostering the development of business networks and providing all its stakeholders a voice in aquaculture and fisheries policymaking.

REFERENCES

- Adnyana, I.B.P., Anwar, N., Soemitro, R.A. and Utomo, C., 2015. Critical Success Factors of Public-Private-Community Partnership in Bali Tourism Infrastructure Development. *Journal of Sustainable Development*, 8(6), pp.208-215.
- Aker, Jenny C. 2011. "Dial A for Agriculture: A review of ICTs for Agricultural Extension in Developing countries." *Agricultural Economics*. 42(6):631-47.
- Alexandratos, N. and Bruinsma, J. (2012). World Agriculture towards 2030/2050, the 2012 Revision, ESA Working Paper No. 12-03, June 2012, Agricultural Development Economics Division, Food and Agriculture Organization of the United Nations. www.fao.org/economic/esa.
- Ananth, P.N., Barik, N.K., Babu, S.C., Dash, A.K. and Sundaray, J.K., 2019. Can institutional convergence force agricultural development in pluralistic extension systems: a case of Krishi Vigyan Kendra (the farm science center) in India. *Agricultural Extension Reforms in South Asia: Status, Challenges, and Policy Options*, p.141.
- Azmat, F., Ferdous, A.S. and Couchman, P., 2015. Understanding the Dynamics Between Social Entrepreneurship and Inclusive Growth in Subsistence Marketplaces. *Journal of Public Policy & Marketing*, 34(2), pp.252-271.
- Babu, S.C. and Blom, S., 2014. Building capacity for resilient food systems. *Resilience for food and nutrition security*, p.119.
- Babu, S.C. and Shishodia, M., 2018. Measuring Agribusiness Competitiveness: An Application to African Countries. In *Africa's Competitiveness in the Global Economy* (pp. 169-193). Palgrave Macmillan, Cham.
- Chandra Gowda, M.J., 2001. Micro level Opportunities and Challenges for Privatization of Agricultural Extension. Seminar Book. National Seminar on Private Extension, MANAGE, Hyderabad, pp. 18-25.
- Chandra Sekhara, P., 2001. Private Extension in India: Myths, Realities, Apprehensions and Approaches. Seminar Book. National Seminar on Private Extension, MANAGE, Hyderabad, pp. 1-17.
- Chopra, B. N. 1951. Handbook of Indian Fisheries, Ministry of Agriculture, Government of India
- Claire, J., Glendenning, S.B. and Kwadwo, A., 2010. Review of Agricultural Extension in India, Are Farmers' Information Needs Being Met. *IFRPI. Eastern and Southern Africa regional zone, South Africa*.
- Dona, P., Nair, V.R., Ojha, S.N., Vipinkumar, V.P., Nalini, R.K. and Salas, S., 2019. Change Agency Facilitated Social Entrepreneurship towards Community-based Fisheries Management (CBFM) in Vembanad Lake, Kerala. *Multilogic in Science*, 9(30), pp.1-7.
- Dora, BB and Kara, PK 2015 impact of shrimp culture in Chilika area, east-coast of India: a study of Krushnaprasad block of Puri district, Odisha, *PARIPEX - Indian Journal of Research*, vol.4. no.10,
- Edwards, P., 2015. Aquaculture environment interactions: past, present and likely future trends. *Aquaculture*, 447, pp.2-14.
- FAO. 2017. Aquaculture, the Sustainable Development Goals (SDGs)/ Agenda 2030 and FAO's Common Vision for Sustainable Food and Agriculture. COFI Sub-Committee on Aquaculture Ninth Session, 24-27 October, 2017. COFI:AQ/IX/2017/5. Rome.
- FAO. 2018. The State of World Fisheries and Aquaculture 2018. Rome, FAO
- FAO, IFAD, UNICEF, WFP and WHO. 2019. The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns. Rome, FAO
- Gemo, Helder R.; Stevens, J. B.; Chilonda, Pius. 2013. The role of a pluralistic extension system in enhancing agriculture productivity in Mozambique. *South African Journal of Agricultural Extension*, 41(1):59-75. <https://cgspace.cgiar.org/handle/10568/58360>
- Grafton, R.Q., Daugbjerg, C. and Qureshi, M.E., 2015. Towards food security by 2050. *Food Security*, 7(2), pp.179-183.

- Hambrey, J. 2017. The 2030 Agenda and the sustainable development goals: the challenge for aquaculture development and management . FAO Fisheries and Aquaculture Circular No. 1141. Rome, FAO.
- Haque, T., 2000. Contractual arrangements in land and labour markets in rural India. *Indian Journal of Agricultural Economics*, 55(3), p.233..
- Hasan, MR. and Arthur, JR. 2015. Fisheries seed and feed production and management in Bangladesh. - Status, issues and constraints, FAO Rome. <http://www.fao.org/3/a-i4945e.pdf>
- International Food Policy Research Institute (IFPRI). 2019. IMPACT Projections of Food Production, Consumption, and Hunger to 2050, With and Without Climate Change: Extended Country-level Results for 2019 GFPR Annex Table 5. Washington, DC: IFPRI [dataset].
- Joshua, NE, Ojha, SN, Immanuel, S & Salim, SS 2015, 'Fisheries extension among farmers: Policy implications,' *Eco. Env. & Cons*, vol. 21, no. 4, pp. 1925-1932.
- Kumar, D. 2016, Fisheries and social entrepreneurship. In Souvenir of PAF3 Congress on Social Entrepreneurship in Fisheries, ICAR-Central Institute of Fisheries Education, pp – 31-43.
- Lacho, K.J. and Brockmann, E.N., 2011. Promoting a small business through the services of a chamber of commerce: One chamber's story. *The Entrepreneurial Executive*, 16, p.1
- Little, D.C., Barman, B.K., Belton, B., Beveridge, M.C., Bush, S.J., Dabaddie, L., Demaine, H., Edwards, P., Haque, M.M., Kibria, G., Morales, E., Murray, F.J., Leschen, W.A., Nandeesh, M.C., & Sukadi, F. 2012. Alleviating poverty through fisheries: progress, opportunities and improvements, In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, eds. *Farming the Waters for People and Food*. Proceedings of the Global Conference on Fisheries 2010, Phuket, Thailand. 22–25 September 2010. pp. 719–783. FAO, Rome and NACA, Bangkok. http://pubs.iclarm.net/resource_centre/WF_3150.pdf
- Msangi, S., Kobayashi, M., Batka, M., Vannuccini, S., Dey, M.M. and Anderson, J.L., 2013. Fish to 2030: prospects for fisheries and aquaculture. *World Bank Report*, 83177(1), p.102.
- Mukherjee, A. and Maity, A., 2015. Public–private partnership for convergence of extension services in Indian agriculture. *Current Science*, pp.1557-1563.
- NFDB, 2019. Indian Fisheries. Available on - <http://nfdb.gov.in/about-indian-fisheries.htm> (Accessed on 11.12.19)
- NFP, 2020. National Fisheries Policy 2020. Available at - http://nfdb.gov.in/PDF/National_Fisheries_Policy_2020.pdf
- Ojha, S.N. (2019). Ontological Design of Aqua-Chambers of Commerce Framework: A Private Fisheries and Aquaculture Extension Strategy. *MEDC Economic Digest*. Vol 2(1), pp24-27.
- Ojha, S.N. and Dey, S., 2019. Revamping Fisheries and Aquaculture Extension Strategies: Doubling the Fish Production by 2025 in India. Souvenir book. Fourth PAF Congress on Increasing Aquaculture Production in India through Synergistic Approach between Multinational Industries, Domestic Entrepreneurs and Aquaculturists, ICAR- CIFA, Bhubaneswar, Odisha, India, pp.14-27.
- Roy, A.K., 2019. Investment Opportunities in Fisheries and Aquaculture Sector in PPP Mode to Harness the Blue Economy Potential of India. Souvenir Book. Fourth PAF Congress on Increasing Aquaculture Production in India through Synergistic Approach between Multinational Industries, Domestic Entrepreneurs and Aquaculturists, ICAR- CIFA, Bhubaneswar, Odisha, India, pp.77-115.
- Saravanan, R., 2001. Privatization of Agricultural Extension. Seminar Book. National Seminar on Private Extension, MANAGE, Hyderabad, pp. 1-17
- Satar, MS and John, S (2016) "A conceptual model of critical success factors for Indian social enterprises", *World Journal of Entrepreneurship, Management and Sustainable Development*, Vol. 12 Iss: 2, pp.113 - 138
- Satpathy, C and Mangaraj, A.K., 2001. Privatization of Extension – An answer to rural poverty. Seminar Book. National Seminar on Private Extension, MANAGE, Hyderabad, pp. 1-17.

- Schultz-Zehden, A., Weig, B. and Lukic, I., 2019. Maritime Spatial Planning and the EU's Blue Growth Policy: Past, Present and Future Perspectives. In *Maritime Spatial Planning* (pp. 121-149). Palgrave Macmillan, Cham.
- Singh, N., 2000. Theories of sharecropping. *Readings in Development Microeconomics*, 2, pp.19-71.
- Sinha, V.R.P., 2016. Fisheries and social entrepreneurship. In *Souvenir of PAF3 Congress on Social Entrepreneurship in Fisheries*, ICAR-Central Institute of Fisheries Education, pp – 1-12.
- Swanson, B., 2006. *Improving agricultural extension*. Daya Books. <https://www.betuco.be/voorlichting/Improving%20agricultural%20Extension-%20a%20reference%20Manual.pdf>
- Syngenta Foundation for Sustainable Agriculture, 2019. Rural Entrepreneurship and Youth Empowerment. Available at: <https://www.syngentafoundation.org/rural-entrepreneurship-and-youth-empowerment> (Accessed on 08.12.2019).
- Tacon, A.G. and Metian, M., 2018. Food matters: fish, income, and food supply—a comparative analysis. *Reviews in Fisheries Science & Aquaculture*, 26(1), pp.15-28.
- Thorat, S. and Dubey, A., 2012. Has growth been socially inclusive during 1993–94–2009–10. *Economic and Political Weekly*, 47(10), pp.43-53
- Timmer, C.P., 2017. Food security, structural transformation, markets and government policy. *Asia & the Pacific Policy Studies*, 4(1), pp.4-19.
- Timmer, P., 2005. Agriculture and pro-poor growth: an Asian perspective. Available at SSRN 1114155.
- Weirowski, F., Liese, A. 2009. Public-Private Partnerships in Fisheries and Fisheries in Developing Countries in Asia and Africa – a Review. WorldFish Center Report, 2009. http://pubs.iclarm.net/resource_centre/WF_1068.pdf
- Weirowski, F., Liese, A. 2010. The WorldFish Center, 2010. Public-private partnerships in small-scale fisheries and fisheries. Policy brief no. 2135. The WorldFish Center, Penang, Malaysia. 8 pp. http://pubs.iclarm.net/resource_centre/PPP.PDF
- Wenhai, L., Cusack, C., Baker, M., Tao, W., Mingbao, C., Paige, K., Xiaofan, Z., Levin, L., Escobar, E., Amon, D. and Yue, Y., 2019. Successful blue economy examples with an emphasis on international perspectives. *Frontiers in Marine Science*, 6.
- World Bank, 2012. Agricultural Innovation Systems : An Investment Sourcebook. Agricultural and Rural Development. World Bank. © World Bank. <https://openknowledge.worldbank.org/handle/10986/2247> License: CC BY 3.0 IGO.
- Zhou, Y. and Babu, S. eds., 2015. Knowledge driven development: Private extension and global lessons. Academic Press. <https://www.elsevier.com/books/knowledge-driven-development/zhou/978-0-12-802231-3>

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