Fishpreneurship Development

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2023
Edition

Fisheries College and Research Institute, TNJFU – Thoothukudi

&

National Institute of Agricultural Extension Management (MANAGE) Hyderabad

Fishpreneurship Development

Programme Coordination
TNJFU – Fisheries College and Research Institute, Thoothukudi

Jointly Published By
TNJFU – Fisheries College and Research Institute, Thoothukudi
&
MANAGE, Hyderabad

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Edition: 2023.

ISBN: 978-93-91668-69-3

Citation: Santhakumar.R., Sujathkumar,N.V. Ahilan, B., Shahaji Phand and Sushrirekha Das (2023). Fishpreneurship Development [E-book]. Hyderabad: TNJFU - Fisheries College and Research Institute, Thoothukudi & National Institute of Agricultural Extension Management, Hyderabad, India.

This e-book is a compilation of resource text obtained from various subject experts in Fisheries sector on "Fishpreneurship Development" This e-book is designed to educate extension workers, students, research scholars, academicians related to Fisheries Science about the Fishpreneurship Development. Neither the publisher nor the contributors, authors and editors assume any liability for any damage or injury to persons or property from any use of methods, instructions, or ideas contained in the e-book. No part of this publication may be reproduced or transmitted without prior permission of the publisher/editors/authors. Publisher and editors do not give warranty for any error or omissions regarding the materials in this e-book.

Published for Dr. P. Chandra Shekara, Director General, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, India by Dr. Srinivasacharyulu Attaluri, Program Officer, MANAGE and printed at MANAGE, Hyderabad as e-publication.

MESSAGE

National Institute of Agricultural Extension Management (MANAGE), Hyderabad is an autonomous organization under the Ministry of Agriculture & Farmers Welfare, Government of India. The policies of liberalization and globalization of the economy and the level of agricultural technology becoming more sophisticated and complex, calls for major initiatives towards reorientation and modernization of the agricultural extension system. Effective ways of managing the extension system needed to be evolved and extension organizations enabled to transform the existing set up through professional guidance and training of critical manpower. MANAGE is the response to this imperative need. Agricultural extension to be effective, demands sound technological knowledge to the extension functionaries and therefore MANAGE has focused on training program on technological aspect in collaboration with ICAR institutions and state agriculture/veterinary universities, having expertise and facilities to organize technical training program for extension functionaries of state department.

The fisheries sector plays an important role in the Indian economy. It contributes to the national income, exports, food and nutritional security and in employment generation. This sector is also a principal source of livelihood for a large section of the economically underprivileged population of the country, especially in the coastal areas. India's fisheries sector is on a trajectory of progress. From here, it can only grow higher, generating more income, and employment for people associated with this sector, to support India's blue economy and build a sustainable and profitable future for the industry.

It is a pleasure to note that, TNJFU- Fisheries College and Research Institute, Thoothukudi, Tamil Nadu and MANAGE, Hyderabad, Telangana is organizing a collaborative training program on "Fishpreneurship Development" from 3-5 January, 2023 and coming up with a joint publication as e-book on "Fishpreneurship Development" as immediate outcome of the training program.

I wish the program be very purposeful and meaningful to the participants and also the e-book will be useful for stakeholders across the country. I extend my best wishes for success of the program and also I wish TNJFU- Fisheries College and Research Institute, Thoothukudi, Tamil Nadu many more glorious years in service of Indian agriculture and allied sector ultimately benefitting the farmers. I would like to compliment the efforts of Dr. Shahaji Phand, Center Head-EAAS, MANAGE and Dr. B. Ahilan, Dean, Fisheries College and Research Institute, Thoothukudi for this valuable publication.

Dr. P. Chandra Shekara
Director General, MANAGE

PREFACE

This e-book is an outcome of collaborative online training program on **"Fishpreneurship Development"** conducted from 3-5 January,2023. This e- book is intended is to provide insights to all extension workers, faculties, researchers and students about the Entrepreneurship Development in fisheries sector

Entrepreneurship in fisheries means undertaking a new business venture to make it profitable. It comprises of activities as gathering of information, communication with chain partners, market orientation, strategic decision making, learning etc. Entrepreneurial possibilities in Indian fisheries and aquaculture sectors are yet to be fully exploited. The 'fisheries and aquaculture sector' is the sunshine sector which has immense growth potential. The sector support large number of subsidiary industries and provides livelihood millions of economically backward populations, especially fishermen, of the country. Apart from income and employment generation the sector contributes to food and nutrition security of the country. Entrepreneurial possibilities exist across the value chain in fisheries and aquaculture from see production to value addition and marketing.

This ebook delineates the concepts, issues, related reviews and relevant technologies in the concerned field for developing entrepreneurship in fisheries. I hope this publication will be useful for entrepreneurs, academicians, researchers, scholars, policy-makers and planners as well as developmental experts to formulate strategy on this line. The information will help in developing entrepreneurial skills among youth.

The editors' heart fully record their sincere gratitude and appreciation to the resource persons for sparing their valuable time to develop this resource material. Additional thanks to MANAGE, Hyderabad for providing the financial assistance to conduct the training program. The editors are very much thankful to Dr. G. Sugumar, Honorable Vice-Chancellor, TNJFU, Nagapattinam and Dr. M. Rajakumar, Director of Extension Education, TNJFU, Nagapattinam for the consistent support and encouragement extended for the successful conduct of this training program and e-book creation for the participants. The editors hope that this e-book will help the participants as well as other extension people across the country to gain valuable information on value chain management for inclusive fisheries business.

The valuable suggestions for future improvements are always welcome.

Dr. R.Santhakumar
Dr. N.V. Sujathkumar
Dr. B. Ahilan
Dr. Shahaji Phand
Dr. Sushrirekha Das

CONTENTS

Chapter-1

INTRODUCTION TO FISHPRENEURSHIP DEVELOPMENT

B. Ahilan

TNJFU – Fisheries College and Research Institute, Thoothukudi-08

An entrepreneur is a person who develops a new idea and takes the risk of setting up an enterprise to produce a product or service which satisfies customer needs in the field of fisheries.

Fishpreneurship development aim to enhance the capacity and willingness of business people to develop, organize, and manage their business ventures in the fisheries field. Commercial fish farming, seed production, fish and fish product development and export, ornamental fish breeding and marketing, aquatic plants and their sale are few areas having potential and great demand too. There are several areas in which a fishpreneurship can be started. A fishpreneur should learn and imbibe several qualities required for him to become a successive entrepreneur from fishermen who have some unique qualities. Consistency (though not assured of a catch, fisherman goes for fishing regularly), meticulous utilization of assets and resources (like a fisherman repairing and maintaining his boat and net meticulously), community-oriented activities, teamwork (fishing is essentially a teamwork), and willingness to change are such qualities required for a good fishpreneur.

Basically, entrepreneurship development is basically the process of improving the skill set as well as the knowledge of the entrepreneurs. This can be done through various methods such as classroom sessions or training programmes specially designed to increase the entrepreneurial acumen. Before you get into training the prospective entrepreneurs, it is very important to have a clear objective and plan in mind about what the program is going to encompass.

It is important to select the potential targets who are willing to enhance their skills and who can be identified as the people who have some amount of business acumen. These can be further divided into two categories- the educated target audience and the uneducated target audience. Educated audience refers to the target people who have a decent educational background and want to be entrepreneurs. These people have the motivation to put their education to use by starting a venture and working for themselves.

The process of entrepreneurship development program can be seen as most effective and efficient when it is applied in the local markets and on the local entrepreneurs who know about it. These people understand and absorb the knowledge way more quickly and can apply it in the current scenario because of which the results of the program can be seen more quickly and effectively.

In India unfortunately, these programs can only be launched where support institutions and resources are available, but ideally, these programmes should be planned and launched in the areas where most people are interested and willing to take advantages of these programmes so that this opportunity can be used most effectively and there is no loss of resources.

The population of a country's economy determines its spending potential. A strong, vibrant society has more people with money to spend which increases revenue and production for businesses in the area overall leading them having better times financially as well on average than weak economies where there may be less earning capacity but still many unemployed individuals struggling daily just like underdeveloped countries today that need economic help from abroad if not already receiving such aid themselves primarily because their populations are too small making this necessary assistance difficult or costly without significant outside investment.

Entrepreneurship opportunities in the Fisheries Sector

There are lot of entrepreneurship opportunities in the emerging Aquaculture sector, though in initial stages. However, entrepreneurship development requires a push from the government and other institutions and it is encouraging to see some incubation centers coming up in this sector since the last five years. Though there is provision for technical support from the industry, we need financial support to sustain incubation of startups and help them accelerate and grow. When it comes to handling risks in this sector, if the business becomes sustainable, the risks get mitigated. Unlike what happened to Shrimp Farming in the 1990s with the occurrence of diseases, leading a setback to investments, inland aquaculture has remained sustainable over many decades. Nevertheless, they need insurance coverage since they are prone to losses during natural calamities like floods and cyclones.

Skilling as a catalyst for Blue Revolution

The major aim for skill development in agriculture and allied sectors is to double the farmers' income by doubling the production. In fisheries sector, Government of India has implemented the Blue Revolution Scheme, a flagship programme to increase the fish production to 15 MMT by 2020., out of India's production of 10 million metric tonnes, marine fisheries produce around 3 to 4 million metric tonnes. It cannot be stretched much, as our potential is only 4.5 million metric tonnes by exploiting 80% of the resources. So, doubling the production is not possible

through marine fisheries. It is here that Aquaculture can be potentially used to increase fish production. We have to sustain the livelihood of the fishermen and also maintain the targeted production. For this we need huge infrastructure and skilled workforce.

As per this year's budget, government has provided an outlay of Rs 10,000 crores for National Fisheries and Aquaculture Infrastructure Development Scheme mainly for developing the infrastructure and environment for the sustainable development in this sector with multi-stakeholder involvement. Skill development forms a crucial part of the scheme to take forward the initiatives of increasing the fish production and improving the farmer's income

It is a challenge to convert the mindset of the institutions and capacity building providers to bring them to a skill-based training program. As of now, they indulge only in knowledge—based, theoretical learning with minimum focus on skills. Most of the institutions lack quality trainers, infrastructure and environment for long-term skill-based training. We are planning to take help from the industry and private sector for this purpose. We are in the process of identifying potential training partners, training the trainers, master trainers, curriculum and content development, etc. to speed up skilling programmes in fisheries sector to meet the skilled manpower requirement.

Aquaculture is one of the fastest-growing industries. India offers great fishing chances in both marine and interior waters, with its huge coastline zone. The country's 2.36 million hectares of swamps and tanks, a coastline of 7,500 km, and a brackish water surface of 1,1 million have been placed second in the global aquaculture market, providing a fish farming area. In India, fishing is a livelihood for over 28 million people in the country. Related Projects: Biotechnology, Bio-Technology, Industrial Biotechnology, Biotech Sector, Industry, Biotech Projects, Enzymes Papain, Phytase, Lipase, Enzyme, Food Biotechnology, Industrial Enzymes, Vermiculture, Vermicompost, Biofertilizer, Organic Farming, Biogas

Indian Market Overview

The Report of the Organization for Food and Agriculture (FAO) 2020 stated that Asia is 89% of the worldwide fishery production in the last 20 years.

Due to marine fishing and inland fisheries, world fish production reached the highest level and reached 96,4 million tonnes in 2018. The top seven main producers, which account for approximately 50% of global capture production, were China, Indonesia, Peru, India, Russia, the US, and Vietnam.

India represents 7.58% of world production. In 2019-2020, the country's fish production reached a total of 14,16 million metric tonnes. The sector of fisheries provides 1.24 percent to the GVA and 7.28 percent to the GVA.

Blue Revolution

A seventh five-year strategy to promote the fisheries of the Blue Revolution (between 1985 and 1990) was initiated, to reach the fishing community. The Fisheries, Animal Husbandry, and Dairy Ministry manage the Blue Revolution aims by focusing on how aquaculture and fish yield from both inland and naval sources may be enhanced. The Ministry also promotes the use of work possibilities in economically reversible sectors such as scheduled castes, planned tribes, and women.

GOVERNMENT INITIATIVES

1. Pradhan Mantri Matsya Sampada yojana

This scheme is aimed to fully tap the potential of India's aqua sector. Flagged in May in 2020, the initiative started with an investment of Rs. 20,050 crores for 5 years from 2020-2021 to 2024-2025. This is estimated out to be the highest investment made to date in the fishery sector. It aims to increase fish production, double-up the export earnings, smoothen the value chain, generate employment and boost domestic fish consumption and attract investments in the fisheries sector.The PMMSY system established a fishery vessel insurance cover, which was a first-class move within the sector. By January 2021, proposals worth Rs. 6,567.20 (USD 907.91 million) crore (USD 319.23 million) were received, projects worth Rs. 2309.08 crore (USD 319.23 million) were authorized.

2. Fisheries and Aquaculture Infrastructure Development Fund (FIDF)

This scheme aims for the following benefits in the sector-

- ✓ Enhance fishing infrastructure by establishing fishing harbors, fishing landing centers, fish seed farms, fish feed plants, etc.
- ✓ Sustainable growth in fish production of 8-9 percent and up to 20 million metric tonnes by 2022-23.
- ✓ Creating a total of 9.40 lakh jobs.
- ✓ Attract private sector investment.
- ✓ Adopt modern fishing and aftermarket technology.
- ✓ Strengthening of infrastructure in the cold chain, including ice plants, cold storage, fish transportation, fish processing units, and fish market.

Opportunities and Road Ahead

Advances have already begun to approach new horizons in the aquaculture business. The government aims to convert India into a hot place for production using proper legislation, marketing, and infrastructure support. The industry is transformed by creative solutions from the government to boost the industry. This offers investors a tremendous chance to participate in an industry that has enormous growth potential. Given the advances in technology over the years and

several governments plans to develop aquaculture, and make this industry popular with even more pro-fitness than agriculture. In the previous two decades, Indian aquaculture has risen six times. While India is a strong player in the global aquaculture race, several infrastructure and technological difficulties have yet to be addressed to measure the supply. The extensive coastline of India can reinforce the economy to achieve the Blue Revolution goals.

Chapter-2

AVENUES OF FISHPRENEURSHIP IN FISHERIES SECTOR

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Introduction

Globally, food demand is expected to increase in the range of 59–98% by 2050. To meet this demand, the agriculture and allied sectors will be required to produce almost 50% more food in 2050 than they did in 2012.

At the same time, climate change has been posing challenges to food and nutritional security. At this crucial juncture, fish and aqua products could play a pivotal role in fulfilling the food demand of the growing population, along with providing balanced protein intake across the globe. In 2018, 156 million tons of fish were used for human consumption and non-food usage were 22 million tones. The global average of annual per capita availability of fish is 20.5 kg, which has enhanced at a rate of 2.4% annually in the last six decades.17 Mostly live, fresh or chilled fish is preferred for direct human consumption. Out of the total fish consumption, 44% is live and fresh, 35% is frozen, 11% is prepared and 10% is cured.18 The use of seaweed and aquatic plants is gradually increasing for industrial purposes, especially in medicines, cosmetics, paint, paper and biofuels. The global production of seaweed was 32,386 thousand tonnes in 2018, and it is expected to double by 2025. Currently, China contributes around 56% of the global seaweed production.19 The increasing demand for seaweed has created opportunities for the fishing community to diversify their livelihoods through sustainable practices. Seaweed farming has been initiated in India at a small scale in coastal areas of Tamil Nadu and Andhra Pradesh.

Both fish and meat exports account for approximately 11% of the total food export value each, globally.20 The total annual fish export volume was 67.1 million tonnes in 2018, which is around 38% of the total production value of USD 164 billion.21 Asian countries – China, Vietnam, India, Thailand – and Norway and Chile are the global leaders in fish exports.

A sunrise sectors

The fisheries sector is recognized as a high-potential sector in India, considering its impact on the socioeconomic development of the country. Fish is an inexpensive and nutritious food with high protein content. Moreover, it provides livelihoods to 28 million people in India, including a large economically disadvantaged population.

The fisheries sector has been recognized to contribute elimination of hunger, promote health, reduce poverty by providing food and Nutritional security to the vast majority of the population. Fish contributes substantially to the domestic food security of India which has a per capita consumption of more than 6.00 kg per annum. With freshwater aquaculture being a homestead activity in several parts of the country.

Overview of the Fisheries & Aquaculture Sector of India

India is the world's second-largest aquaculture nation and the third-largest fish producer after China. The Indian Blue Revolution has led to a major improvement the fishing and aquaculture industries. The industries are regarded as sunrise sectors and are anticipated to have a big impact on the Indian economy.

Indian fisheries have recently seen a paradigm shift from inland to marine-dominated fisheries, with the latter becoming a major contributor to fish output, from 36% in the middle of the 1980s to 70% in the recent past. The transition from capture-to culture-based fishing in inland fisheries has opened the way for a stable blue economy. At the primary level, the sector supports the livelihoods of roughly 16 million fishers, fish farmers, and thousands of people along the value chain. While inland fisheries and aquaculture have increased in absolute terms, their potential has not been fully realized. The 191,024 km of rivers and canals, 1.2 million ha of floodplain lakes, 2.36 million ha of ponds and tanks, 3.54 million ha of reservoirs, and 1.24 million ha of brackish water resources vast, underutilized resources offer excellent opportunities for increased production, creation of livelihoods, and emergence of economic prosperity.

Current state of the Fisheries & Aquaculture Sector of India

More than 10% of the world's fish and shellfish species are found in India's rich and diverse fisheries, including deep seas, lakes, ponds and rivers. The country's extensive coastline, exclusive economic zone (EEZ) and sizable continental shelf region are home to marine fisheries resources. The resources for inland fisheries include rivers, canals, floodplain lakes, ponds, tanks, brackish water and regions that influence salty or alkaline conditions. Aquaculture in brackish or saline water has flourished in India. Farmed shrimp production increased from 20 MT in 1970 to 7.47 lakh MT in 2020, adding significantly to the export revenues of fisheries, which has seen tremendous expansion over few decades.

Presently, India produces 7.96% of the world's fish. The estimated total fish output for FY 2020–21 is 14.73 million metric tonnes (MMT), with contributions from the inland and marine sectors at 11.25 MMT and 3.48 MMT, respectively. With India being one of the top seafood exporters worldwide, the fishing industry is crucial to its economy and has historically been a significant source of foreign exchange earnings. Despite the market uncertainties brought by the covid-19 pandemic, exports of marine products were valued at Rs. 43,717.26 crore (US$ 5.37 billion) during FY 2020–21. The US is the largest importers of Indian seafood accounting for 41.15% imports worth US$ 24.05 billion in FY 2020–21.

India's Fisheries Sector

Important Stats

- Fishing Sector in India, with about 7.7% of the global fish production, is the third largest fish producing country and the second largest aquaculture fish producer in the world.
- The country is also home to more than 10% of the global fish biodiversity and is one of the 17-mega biodiversity rich countries.
- Fisheries and aquaculture witnessed manifold rise in its production during past decades, from 5 lakh tons in 1950-51 to 142 lakh tons in FY 2019-20.
- The sector provides livelihood to about 16 million fishers and fish farmers at the primary level and almost twice the number along the value chain, and has enough potential to generate income, employment, growth in subsidiary industries, and earn foreign exchange for the nation.
- The share of fisheries sector in the total GDP (at current prices) increased from 0.40% in 1950-51 to 1.07% of the total GDP in
- The sector has contributed about 1.24% to the country's Gross Value Added (GVA) and over 7.28% to the agricultural GVA.
- Export earnings from the Fisheries sector has been Rs.46,662.85 crores during 2019-20.
- Fisheries sector has been recognized as a 'Sunrise Sector and has demonstrated an outstanding double-digit average annual growth of 10.87% since 2014-15.

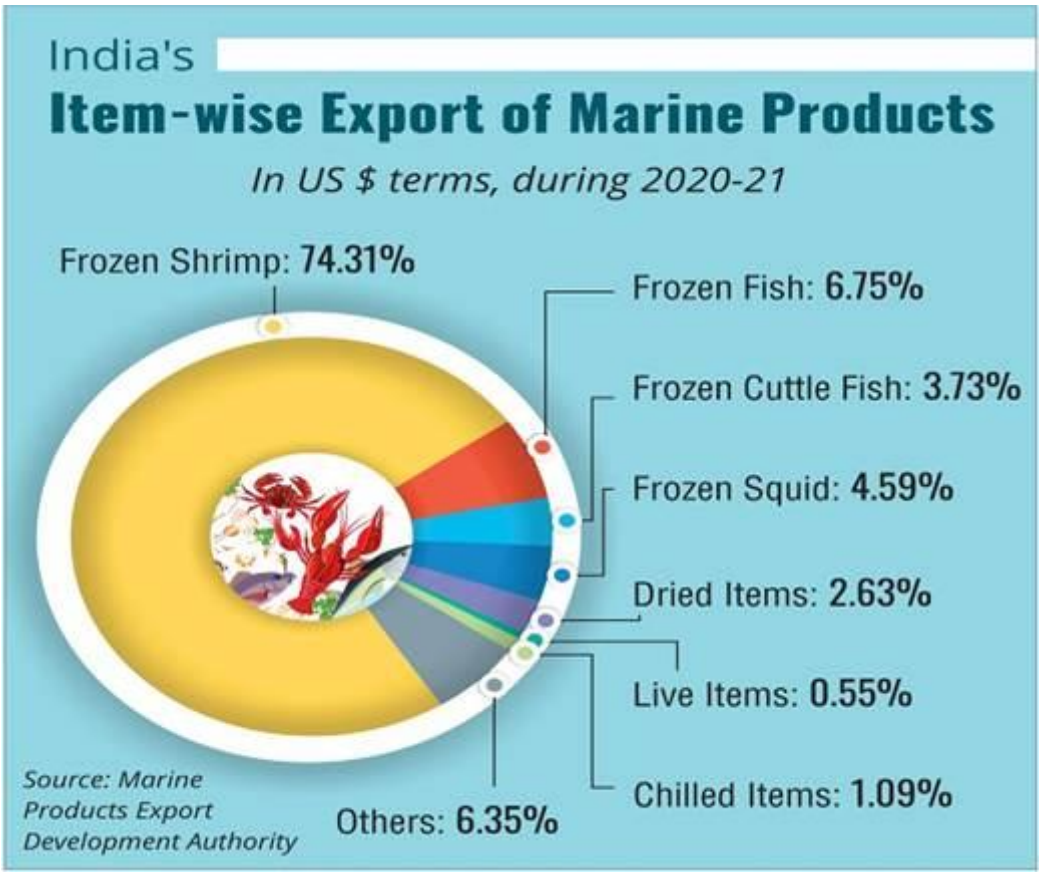
India Specific Key Facts

- ✓ 11.25 MMT Inland Fisheries production during FY 20-21
- ✓ 3.48 MMT Marine Fisheries production in FY 20-21
- ✓ $1.79 mn Export of Ornamental Fisheries in FY 2020
- ✓ Top exporting destination for Ornamental Fisheries: Thailand; UAE; Singapore; Hong Kong; China; Jordan; Taiwan

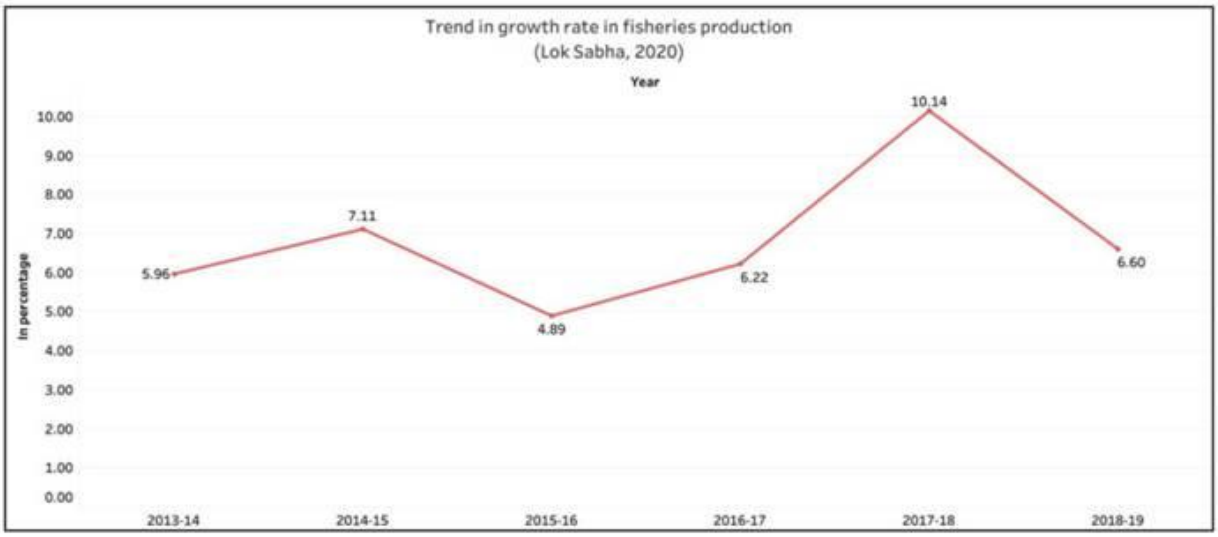
- ✓ States with major breeding units for Ornamental Fisheries: Tamil Nadu; Maharashtra; Kerala; Rajasthan; Madhya Pradesh; Himachal Pradesh; West Bengal
- ✓ 1548 total fish landing centres
- ✓ 671 Cold Storages with 427,713.27 MT of capacity
- ✓ 44 Chilled Storages with 23,640.80 MT of capacity
- ✓ 91 Dry Fish Storages with 38,401.92 MT of capacity
- ✓ Fishing Harbours Under Sagarmala - Ministry has sanctioned 17 fishing harbour projects worth INR 1740.26 Crore under Sagarmala Programme.

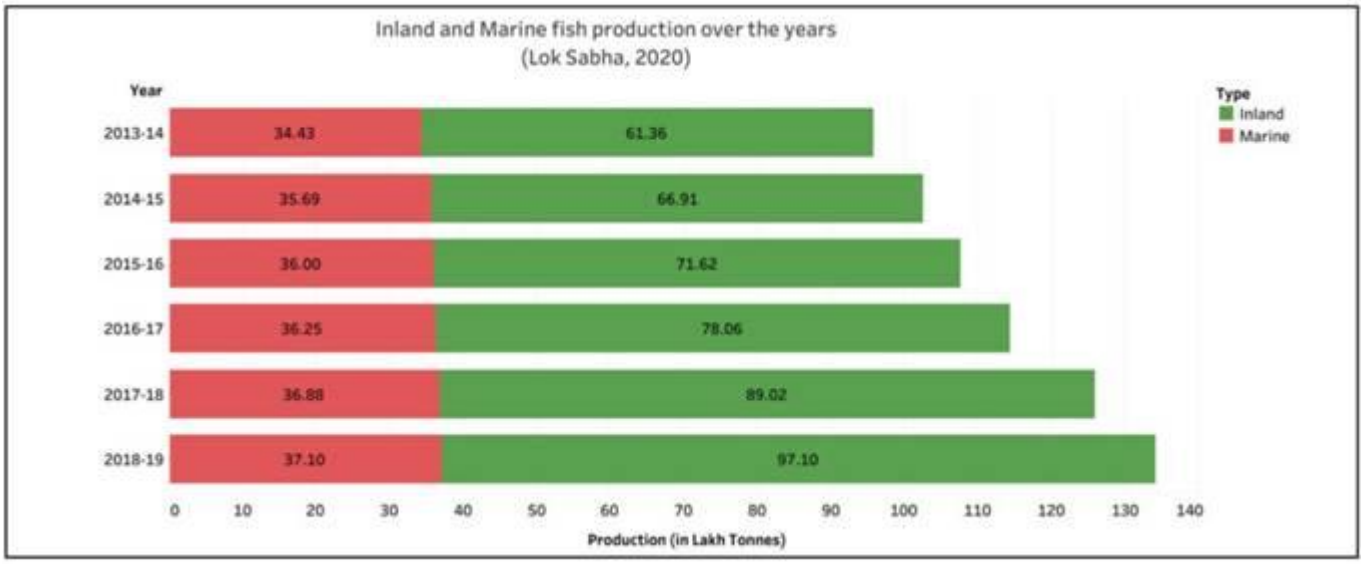
India's marine product exports record an all-time high in FY 2021-22; Grow by over 30% to $7.74 bn

Regional Distribution of Fish



Fish Production has remained uneven across the States depending on the available coastline, infrastructure and entrepreneurship. Southern Region accounted for almost half of the fish production, followed by Eastern Region with one fourth of the total national fish production.





Among the States, Andhra Pradesh (27.4%) and West Bengal (13.8%) together produce about 41% of the country's total fish production.

- Almost every State in India produces inland fish to a certain extent whereas top six States account for about three fourth of the country's total inland fish production.
- Andhra Pradesh, West Bengal and Uttar Pradesh together account for half of the fresh water production in the country.
- Marine fish production has remained limited to nine States and four UTs with coastlines. The West Coast produces 59% and the East Coast produces 41% of total marine fish.
- Gujarat, with 19% of the total marine fish production, is the leading marine fish producing State followed by Andhra Pradesh (16.4%) and Tamil Nadu (13.5%).

Some Schemes and Programs

Blue Revolution

- Blue Revolution, the Neel Kranti Mission has the vision to achieve economic prosperity of the country and the fishers and fish farmers as well as contribute towards food and nutritional security through full potential utilization of water resources for fisheries development in a sustainable manner, keeping in view the bio-security and environmental concerns.
- The Blue Revolution scheme has the following components:
    1. National Fisheries Development Board (NFDB) and its activities
    2. Development of Inland Fisheries and Aquaculture
    3. Development of Marine Fisheries, Infrastructure and Post-Harvest Operations
    4. Strengthening of Database & Geographical Information System of the Fisheries Sector
    5. Institutional Arrangement for Fisheries Sector
    6. Monitoring, Control and Surveillance (MCS) and other need-based Interventions
    7. National Scheme of Welfare of Fishermen

Central Funding pattern: 50% of the project/unit cost for general States, leaving the rest to State agencies; 80% of the project/unit cost for North-Eastern/Hilly States leaving the rest to State agencies; 100% for Union Territories.

Deep Sea Fishing and Tuna Processing

Name of the Activity/Scheme	Unit Cost	Pattern of assistance
Training on Deep Sea Fishing and Tuna Processing	DA @ Rs.150/day/ trainee; Reimbursement of to and fro travel expenses actual/ max Rs. 500/-; Honorarium to resource person @ Rs.500/- per day and TA actual/max @ Rs. 1000/- per programme; to Implementing agency @ Rs. 75/day/trainee	100% financial assistance to Govt. Institutions/ agencies having expertise

Pradhan Mantri Matsya Sampada Yojana (PMMSY)

- Approved in 2020, it is a flagship scheme for focused and sustainable development of fisheries sector in the country with an estimated investment of Rs. 20,050 crores for its

implementation during a period of 5 years from FY 2020-21 to FY 2024-25 in all States/Union Territories, as a part of Aatma Nirbhar Bharat Package.

- The PMMSY is an umbrella scheme with two separate Components namely (a) Central Sector Scheme (CS) and (b) Centrally Sponsored Scheme (CSS).
- The Centrally Sponsored Scheme (CSS) Component is further segregated into non-beneficiary oriented and beneficiary orientated subcomponents/activities under the following three broad heads:
    1. Enhancement of Production and Productivity
    2. Infrastructure and Post-harvest Management
    3. Fisheries Management and Regulatory Framework

Under CSS

- North Eastern & Himalayan States: 90% Central share and 10% State share.
- Other States: 60% Central share and 40% State share.
- Union Territories (with legislature and without legislature): 100% Central share.
- End Implementing Agencies (EIAs)

The PMMSY would be implemented through the following agencies:

- Central Government and its entities including National Fisheries Development Board
- State/UT Governments and their entities
- State Fisheries Development Boards
- Any other End Implementing Agencies as decided by Department of Fisheries

Objectives

- PMMSY is designed to address critical gaps in fish production and productivity, quality, technology, post-harvest infrastructure and management, modernization and strengthening of value chain, traceability, establishing a robust fisheries management framework and fishers' welfare.
- While aiming to consolidate the achievements of Blue Revolution Scheme, PMMSY envisages many new interventions such as
    1. fishing vessel insurance,
    2. support for new/up-gradation of fishing vessels/boats, Bio-toilets,
    3. Aquaculture in saline/alkaline areas, Sagar Mitras, FFPOs/Cs,
    4. Nucleus Breeding Centres,
    5. Fisheries and Aquaculture start-ups,
    6. Incubators,
    7. Integrated Aqua parks,

8. Integrated coastal fishing villages development etc

- PMMSY scheme primarily focuses on adopting 'Cluster or Area based approaches and creation of Fisheries clusters through backward and forward linkages.
- Special focus will be given for employment generation activities such as seaweed and ornamental fish cultivation.
- It emphasizes on interventions for quality brood, seed and feed, special focus on species diversification, critical infrastructure, marketing networks etc.

Implementation of Fisheries and Aquaculture Infrastructure Development Fund (FIDF)

- In order to address the infrastructure requirement for fisheries sector, the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying during 2018-19 has created dedicated fund namely Fisheries and Aquaculture Infrastructure Development Fund (FIDF) with a total funds size of Rs 7522.48 crore.
- FIDF provides concessional finance to the Eligible Entities (EEs), including State Governments/Union Territories and State entities for development of identified fisheries infrastructure facilities through Nodal Loaning Entities (NLEs) namely
  - (i) National Bank for Agriculture and Rural Development (NABARD),
  - (ii) National Cooperatives Development Corporation (NCDC) and
  - (iii) All scheduled Banks.
- Under the FIDF, the Department of Fisheries provides interest subvention up to 3% per annum for providing the concessional finance by the NLEs at the interest rate not lower than 5% per annum.
- Loan lending period under FIDF is five years from 2018-19 to 2022-23 and maximum repayment period of 12 years inclusive of moratorium of 2 years on repayment of principal.

Kisan Credit Card (KCC)

- Launched in 1998, Kisan Credit Card Yojana is a scheme that offers short-term, revolving credit to farmers across India.
- The scheme was further extended for the investment credit requirement of farmers viz. allied and non-farm activities in the year 2004. These include Animal Husbandry, Dairying & Fisheries Sector.

- In this Fish Farmers receive an ATM cum credit card that can be used to withdraw cash from ATMs.
- KCC comes with a 12 monthly repayment period, which offers adequate time to pay off any debt.

Seaweed Park in Tamil Nadu

- This initiative would link and promote Seaweed farming and the seaweed-based industries together to bring out full-fledged expansion of this sector. Further, One Stop Park for entire seaweed value chain will link all the activities, farmers, processors, buyers, exporters, importers, retailers together for arriving at an optimum output and thereby maximizing value addition, minimizing wastage, increasing farmers income and creating employment opportunities.
- This will be developed on a hub and spoke model for which Government would invest about Rs 100 crores for establishing the seaweed park.

Challenges facing the Fisheries Sector in India

Technical Challenges

- The fishing business in the country is reliant on a few fish species – carps, pacu, and pangasius – and increasing this base will boost fish production.
- Overproduction focusing on fewer species results in an overstock of specific fish species, lowering prices and increasing volatility.
- In India, there are no additional aqua feed-consuming species or high-value fish that should be considered when introducing new species. For example, tilapia farming has yet to take off in the country.
- Inadequate hatchery technology for new species introduction, which could include freshwater, brackish, and marine species.
- Diversification of species will assist to keep costs stable while also driving up demand for formulated aquafeeds.
- Classical freshwater fish farming methods – large ponds, no water exchange, no draining, and no bottom sediment removal – are still in use, which can lead to disease-promoting conditions.

In fisheries sector, there are further divisions as fish harvest sector, aquaculture, post-harvest sector and marketing sector wherein fishpreneurship development is possible.

In fish harvest sector, areas wherein fishpreneurship development is possible include; Boat Building Yards, Net Manufacturing Units, Gear Manufacturing Units, Ice Factories, Navigational Equipment's, Communication Equipment's, Craft and Gear Repairing Workshops, etc.

In aquaculture sector, there are ample opportunities for fishpreneurship in Pond Construction, Brood Stock Maintaining Units, Hatcheries and Allied Activities, Feed Manufacturers, Input Industries for treatment of water, chemicals, medicines, pro-biotic, Equipment's ranging from aerators, generators, pumps of various types, etc.

In post-harvest fisheries sector, areas wherein fishpreneurship development is possible include; Pre-processing Units, Ice Plants, peeling sheds, Processing Units, Fish meal and fish oil manufacturers, Fish drying units, Fish curing units, Fish Canning units, Cold Storages, Quality Assessors, etc.

In the marketing sector too, there are diverse opportunities which include; Fish Wholesalers, Middlemen, Fish Retailers, Fish Vendors, Fish transporters, Cold Chain Related Personnel, Buyers from various processing units, etc. Online marketing of fish is also a growing business one can think of. Fishery based enterprises include value added products preparation, preparation of dried fish products, fish processing unit, ready to eat fish product development, ready to cook fish product development, ornamental fish culture enterprise, mussel culture, clam collection, edible oyster culture, pearl culture, mud crab culture, Ferti fish unit, net building, aqua tourism, fish vending/selling, cage farming, fish and shrimp culture, fish feed production and many more. Fish chilling, vacuum packaging, modified atmospheric packaging (MAP), active packaging, freezing, IQF Products manufacture, battered and breaded products manufacture, ready to serve fish products in cans and retort able pouches, ready to eat extruded fish products, fish soup powders, pickled products, Diversified fishing system includes Recreational fishing, fish folklore museum covering models/prototypes on fishing, reservoir/ aquaculture based eco-tourism, Fishing implements caretaking, Fishing gear recycling facility, Fishing bait/ feed making, data centres for fishing boats at sea, square mesh net making unit, net assembling units, etc.

World over in the recent past, research in nutraceuticals has shown continuous growth and the progressive approach is aimed at identifying the potential nutraceutical compounds which are having health benefits in human beings. Awareness among the people is the prime reason for the growing demand for nutraceuticals. Nutraceuticals are food products of natural origin from both terrestrial and marine sources having healthcare importance. Manufacture of nutraceuticals from marine sources include Chitin and chitosan, Glucosamine Hydrochloride, Chondroitin sulphate, Hyaluronic acid (HA), Collagen, gelatin and collagen peptides, Fish lipids, Squalene, Minerals, Calcium powder, functional foods like protein hydrolysates and isolates can be great sources for fishpreneurship development. Challenges for fishpreneurship include knowledge and skill gap, technology gap, market gap and Entrepreneurial gap.

Chapter-3

ENTREPRENEURSHIP DEVELOPMENT THROUGH VALUE ADDITION OF FISH AND FISHERY PRODUCTS - AN ECONOMIC PERSPECTIVE

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Introduction

Fish is a highly perishable food item and cheapest animal protein known to mankind which requires proper handling and preservation for effective maintenance of its quality and nutritional attributes. Indian fisheries are considered as a sunrise sector, with high potential for rural development, food and nutritional security as well as export earnings that can be treated as a rural entrepreneur-led hybrid model for entrepreneurship. Enterprises are the entities or business according to meet out the demand of both domestic and international markets and ultimately satisfying the consumers.

In Indian scenario, export of final consumer food products viz., Ready to Eat (RTE), Ready to Cook (RTC) and Ready to Serve (RTS) has shown significant growth in a last decade. The export of such products under these items had registered 10.4 per cent growth during 2011 to 2020. Since final food products (value added products) are readily available and time saving and also the demand for the value added under the categories of RTE, RTC and RTS has been increasing manifold in recent years due to lifestyle changes. In developing countries, lack of infrastructure facilities and icing lead to deterioration of fish quality and ultimately reduces the economic value. Hence, value addition of fish or fishery products has gained scope towards economic growth and livelihood development of entrepreneurs. Value added fish products may be i) mince or mince-based products ii) battered and breaded or coated products and iii) surimi-based products.

Entrepreneurship Development

The word ‘entrepreneur’ is derived from French word ‘entreprendre’ which means ‘to undertake’. Entrepreneurs are a pivotal and central part of the economy and are contributed significantly to the employment and nation development. India has vast fisheries resources with potential for entrepreneurship by utilising the youth in rural areas.

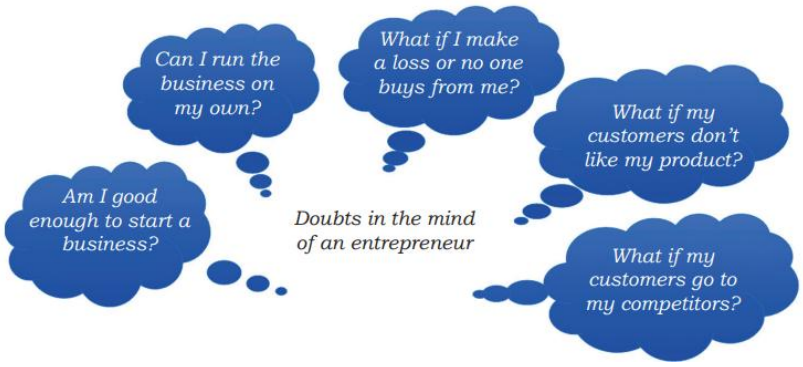


Fig. 1. Basic questions of an entrepreneur

Entrepreneurship is the capacity for innovation, investment and expansion in new markets, products and techniques.

Fig 2. Entrepreneurship process

Entrepreneurship development is a skill of exploring new ideas and learning new skills for developing an enterprise. Entrepreneurship Development is defined as a process of enhancing the skillset and knowledge of entrepreneurs. The concept of enterprise development incorporates the ideas of investing knowledge and time, attracting investment, building linkages, employing more people for an enterprise to compete in the national and international economy. The five stages of the entrepreneurial process are idea development, opportunity appraisal, planning, firm formation/launch, and growth.

Entrepreneurship skills (ES)

Some traits are needed for an entrepreneur to become a successful entrepreneur in long run. The skills that are useful in enriching the entrepreneur's ability are called as entrepreneurship skills. The skills include leadership skills, business management skills, time management skills, creative thinking skills and problem-solving skills.

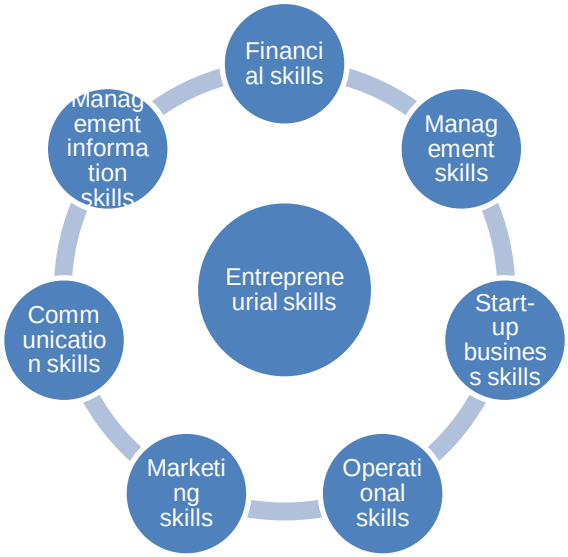


Fig 3. Elements of entrepreneurship skills

According to Mohamad *et al.*, 2014, entrepreneurship skills have various dimensions that are financial skills, management skills, star-up business skills, operational skills, marketing skills, communication and management information skills. For example, entrepreneurs conduct studies to assess the market feasibility of a proposed product to anticipate the problems and assess the quantity, quality, cost and resources of inputs to run the business. ES can be obtained or acquired through entrepreneurship development education and financial literacy. Suparno and Saptono (2018) observed that the combined effect of education and financial literacy influenced on the entrepreneurship skill development.

Entrepreneurship Development Cycle

The entrepreneurial development cycle is the combination of all support activities and assistance that are provided continuously for the development of entrepreneurship. It assists in evolving one's skill in a systematic manner. Generally, there are three types of assistance for the entrepreneurs.

i. Stimulating assistance

ii. Supportive assistance

iii. Sustaining assistance

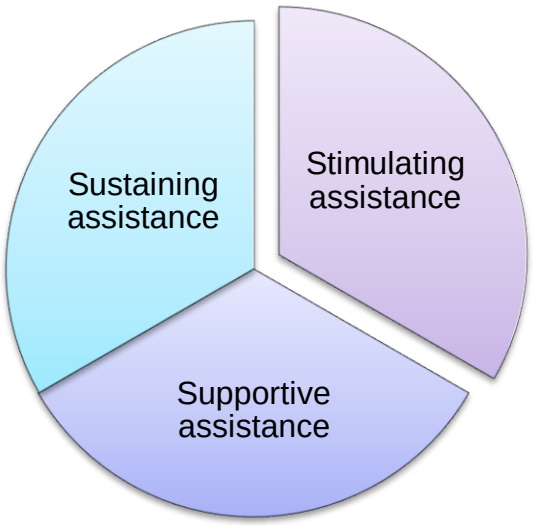


Fig 4. Elements of entrepreneurship development cycle

- Stimulating assistance: Activities and assistance that are encourage the potential entrepreneurs to take initiative. These are called as stimulating assistance. For example: Entrepreneurial education, training and planned publicity and guidance for preparation of project reports etc.

- Supportive assistance: Activities and assistance that make the potential entrepreneurs to conduct their operations. These are called supportive assistance. For example: Arranging finance and other materials, helping in marketing the product etc.
- Sustaining assistance: Activities and assistance that is provided to the existing entrepreneurs to continue their enterprise successfully. For example: Help in modernisation and policy change.

Entrepreneurship development concepts

1. Stakeholders' determination

Stakeholders are the key and vital for the successful execution of the business or enterprise. The feasibility of stakeholders determines the success or failure of the enterprise. Feasibility analysis offers a potential framework for planning and assessing a proposed development including identifying *stakeholders.* Stakeholders' feasibility analysis (SFA) is pivotal for an entrepreneurship development process in which stakeholders are the focal point and their interest and attitude ultimately determine the success and failure of an enterprise. There are three basic types of feasibility analysis that are related to product development. There are technical, economic and market feasibility analysis (Fig. 5.).

Fig. 5. Types of feasibility analysis

Technical Feasibility Analysis: Technical feasibility is a standard practice to conduct feasibility studies before commencing work on a particular project. It is undertaken to assess the practicality and viability of a product or service before launching a product or establishing a business. Technical feasibility evaluates the technical complexity of the expert system.

Economic Feasibility Analysis: Economic feasibility is the most commonly used method for determining the efficiency. It is also called as cost analysis. It helps to identify the profit against investment expected from a project. The two factor which are most essential in this analysis are cost and time.

Market Feasibility Analysis: Market feasibility analysis is considered as the most important analysis. This part of the study helps in describing the current market for the product or service, identifying the market competition, and potential market.

In generally, at the pre-start-up phase, usually an attempt is made to identify the potential stakeholders, which produce often unsatisfactory results due to lack of systematic approach while identifying the stakeholders. The methods used for stakeholders analysis are,

1. Power/ interest grid.
2. Power/ influence grid.
3. Influence/ impact grid.
4. Salience model.

Salience model is a systematic method used for stakeholders' analysis and classifying the stakeholders (Fig. 6.). Salience model is a method used for classifying stakeholders and to decide their contribution based on three attributes viz., power, legitimacy and urgency (Mitchell *et al.*, 1997).

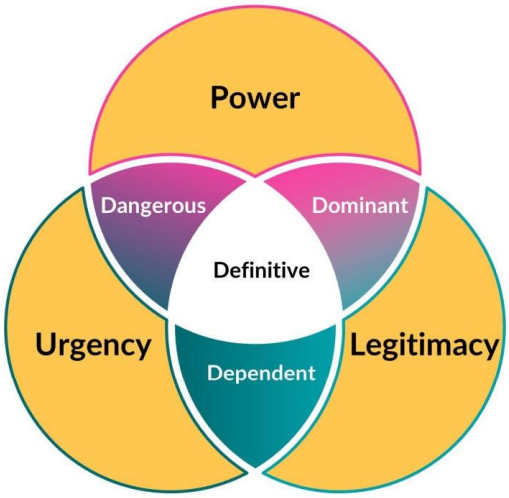


Fig. 6. Salience model for stakeholders' analysis

According to the Salience model, non-stakeholders are those who are not holding any attribute at the particular point of time. The stakeholders holding any one of the attributes are determined as dormant (power only), discretionary (legitimacy only) and demanding (urgency only). There were classified as latent stakeholders.

	POWER	LEGITIMACY	URGENCY	TYPOLOGY
Latent Stakeholders		■		Discretionary stakeholder
			■	Demanding stakeholder
			■	Demanding stakeholder
Expectant Stakeholders	■	■		Dominant stakeholder
	■		■	Dangerous stakeholder
		■	■	Dependent stakeholder
Definitive Stakeholders	■	■	■	Definitive stakeholder
	■	■	■	Definitive stakeholder
	■	■	■	Definitive stakeholder
	■	■	■	Definitive stakeholder

Table 1.Determination of stakeholders using Salience model of feasibility analysis

Similarly, stakeholders holding any two of the attributes were classified as dominant (power and legitimacy), dangerous (power and urgency) and dependent (legitimacy and urgency). These three stakeholders were categorized into broad category called expectant stakeholders. The stakeholders who are holding all the three attributes and influence the business start-up are classified as definitive stakeholders. Those who are not holding any attributes are known as disinterested stakeholders (Table.1).

2. Product development

Any enterprise should be operative when the products are ready for sale. Product development is the integrated step of the business. Product development strategy refers to the methods and actions used to bring new products to a market or modify the existing products to create new business. It comprises several steps from producing an idea till distributing the products

to consumers. Product development strategy is the process of bringing a new innovation to consumers from concept to testing through distribution.

Fig. 7. Stages of product development process

The value addition in fish and fishery products is highly in demand due to its nutritional value both at national and international levels. Value addition means adding extra value to the fish and fishery products based on the market/ consumer requirements. The value addition ranges from live fish to ready-to-serve convenience products. In general, value additions are the activity of adding value to the activity in one or another way.

3. Marketing and Marketing mix

Marketing is the activity which follows the product development. Marketing is part of the product development strategy that refers to the *methods and actions used to bring new products to a market or modify existing products to create new business*. In marketing, it is important to study the marketing mix for the success of the product with fullest consumer satisfaction. The starting point for the decision process is provided by the company's marketing stimuli in terms of product, promotion, price and distribution strategy. In the economic perspective, the basic 4P's are most important factors for the success of fish-entrepreneurship viz., product, price, people and profit.

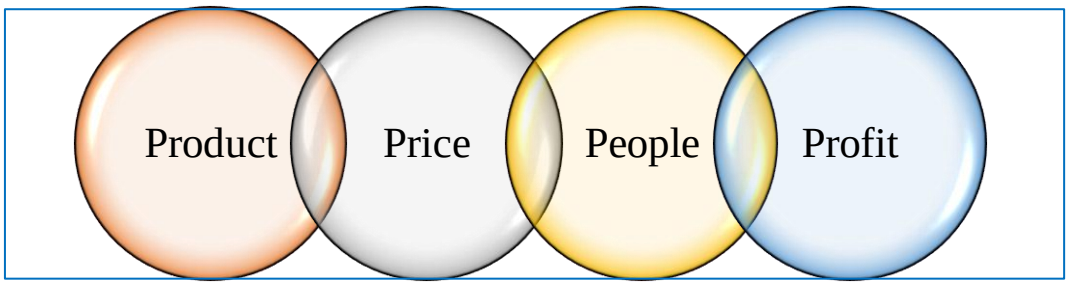


Fig. 8. 4P's of the Marketing

Product is the prime factor of the enterprise and product development on which all the entrepreneurs should ensure the availability of product through out time without breaking the supply chain.

Price is the second important factor but in consumer point of view, it is a crucial factor in deciding the purchase behaviour of consumers.

People are the vital determining factor of the products developed by the entrepreneurs, hence it is prime important to incorporate the likes and dislikes of the customers for the development of the enterprises.

Profit is the viable factor of the enterprise and ultimately determines the success of the products. When the above three factors viz., product, price and people are considered properly, the enterprise will earn profit in long run.

Later, the four components were extended in to seven components of marketing mix which are very essential for an entrepreneur. Besides, the seven P's, the distribution channel of the product i.e., how the product is

Channelized to the consumers in fisheries, the common fish marketing channels are,

(i) Producer – Retailer – consumer,

(ii) Producer - wholesaler – Retailer - consumer

(iii) Producer - commission agent - wholesaler – retailer- consumer

(iv) Producer – wholesaler - commission agent - retailer consumer

(v) Producer – commission agent – wholesaler-commission agent – retailer-consumer.

Fig. 9. Seven P's of Marketing mix

(vi) Producer to consumer (Best Channel)

At present, direct marketing and online marketing are gaining popular as per the consumer requirements. Entrepreneurs should focus on 'ideal' product which is preferred most by the consumers by strategically incorporating the various 'P' elements of marketing mix.

Table 2. Components and features of marketing mix

Components	Aim/ target	Features
Product	What to sell?	Quantity, quality, species, size grades, packaging
Place	Where to sell?	Channels, location and transport
Price	How much to sell?	Market price Margins
Promotion	Product visibility	Promotional agencies
People	Consumers	Consumer satisfaction
Process	Which product to sell?	Value addition
Physical environment	Infrastructure	Icing and cold chain facilities

4. Market competition

Every market has competition. The strategy is to increase the market through mitigate the impact of competition. The ability to reliably measure, track and compare the competitive intensity of a market is extremely valuable to competition authorities and other policymakers to inform decision-making. The fact that competition is a complex notion, and therefore not directly observable, has resulted in the development of numerous methods to capture and measure the degree of competition in markets over the years (OECD, 2021). The way forward to face the market competition is through estimation of marketing efficiency and enhancing the product quality.

4.1. Marketing efficiency

Market efficiency refers to the degree to which market prices reflect all available, relevant information. Market efficiency refers to the ability possessed by markets to include information that offers maximum possible opportunities for traders to buy and sell securities without incurring additional transaction costs. The concept of market efficiency is closely linked to the efficient market hypothesis (EMH). Marketing efficiency is the degree of market performance.

4.2. Estimation of marketing efficiency

Marketing efficiency can be estimated using the following methods.

i. Conventional method

$$Marketing\ efficiency = \frac{(Net\ price\ received\ by\ producers - Consumer's price)}{Marketing\ cost}$$

ii. Shepherd's formula

$$Marketing\ efficiency = \frac{Consumer'sprice}{(Marketing\ cost + Marketing\ Margin)}$$

iii. Acharya's approach

$$Marketing\ efficiency = \frac{Net\ price\ received\ by\ the\ producers}{(Marketing\ cost + Marketing\ margin)}$$

iv. Price spread

Price spread is defined as the difference between the price paid by the consumers and the price received by the producer for an equivalent quantity of produce produced. It is expressed as percentage of consumer's price. It is the common method used to estimate the marketing efficiency.

$$Price\ spread = \frac{(Consumer\ price - Net\ price\ of\ producer)}{Consumer\ price} * 100$$

The linkages in market needs to be explored for the sustainable production and timely delivery of products in long run. Market linkage is the identification of the products and linking the same with commercial buyers through various marketing channels. dentification of the farmer's products and linking them with commercial and institutional buyers.

5. Consumer satisfaction

Consumer is the king and whose wish and preferences makes the product a ideal product. Consumer behaviour is mainly concentrated on three elements viz., product-specific, person-specific and situation.

- **Product specific:** Consumer behaviour depends on the nature of the product.
- **Person specific (individual):** Consumers behave differently due to needs, personalities and values.
- **Situation:** Buying behaviour is dependent on the given situation.

Hence, the success of entrepreneurship will be assessed through consumer satisfaction and repeated purchasing behaviour for the particular product. The consumer preference towards a product depended on various factors/ parameters.

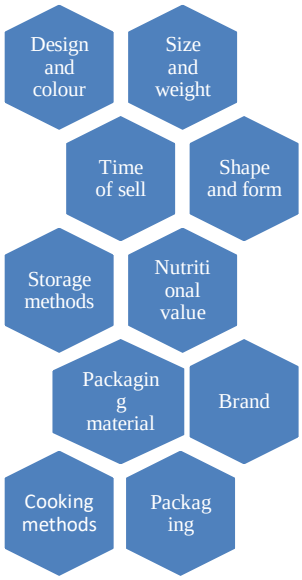


Fig. 10. Factors determining the consumer preference

6. Economics aspects for entrepreneurship development

Economics involves logical solution to the problem. Economic analysis is sales, cost, profit projections of a product proposal. The major purpose of economic analysis is to serve as a basis for a decision as to whether the corporate resources should be committed to the development of new product. The starting point for any economic analysis should be an estimate of total market potential. Besides, the basic aim of economic analysis is revolving around two aspects viz., cost minimisation and yield (revenue) maximisation. Product development involves various factors of production such as land, labour, capital and profit. These factors of products incurred capital formation which requires investment based on the scale of production. Investment is inevitable while considering product development as part of enterprise development.

6.1. Investment

Investment is application of money to earn more money. This process of analyzing financial stability before a business/ entity. The investment should perform in an appreciating way with the following features.

- **Return** – Major benefit expected from investment.
- **Risk** – Loss of principal amount of investment.
- **Safety** – protection of principal amount and expected rate of return.
- **Liquidity** – investment ready to convert into cash position.

6.2. Depreciation

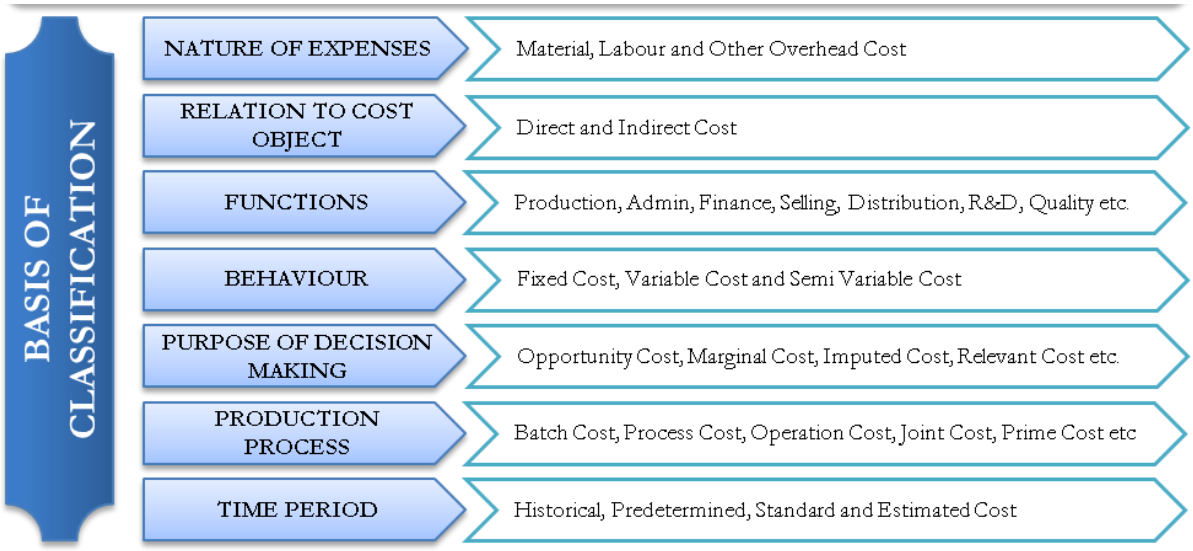
Investment on equipment and machinery shows a kind of utility which is expressed as wear and tear cost, i.e. depreciation. It is a reduction in the value of an asset over time, due in particular to wear and tear on fixed assets. *Depreciation* is an accounting method of allocating the cost of a

tangible asset over its useful life to account for declines in value over time. The simplest and most straight forward method of depreciation is straight-line depreciation. It splits an asset's value equally over multiple years, meaning you pay the same amount for every year of the asset's useful life. It is a good option for small businesses with simple accounting systems or businesses where the business owner prepares and files the tax return

$$Depreciation = \frac{(Cost\ of\ the\ assest - Salvage\ value)}{Estimated\ life\ of\ an\ asset}$$

6.3. Cost estimation

Cost is an expenditure required to produce or sell a product or get an asset ready for normal use.



In other words, it's the amount paid to manufacture a product, purchase inventory, sell merchandise, or get equipment ready to use in a business process. Cost may be either direct or indirect. In terms of product development, the costs include fixed costs, variable costs and total costs. The costs on raw material, labours, equipment and machinery, miscellaneous are the part of variable or operational costs besides fixed costs on assets.

6.4. Revenue estimation

Revenue meaning is the money that is produced by carrying out normal business operations and is calculated by multiplying the average sales price by the number of items sold. It is the total sum of money from which other costs and expenses are subtracted to calculate net income.

$$Total\ revenue = Number\ of\ units\ sold * Unit\ cost$$

6.5. Profitability analysis

Profitability is the degree to which a business or activity yields profit or financial gain. Profitability is measured with income and expenses. Income is money generated from the activities

of the business. Profit and profitability are not same. It has some differences. Profit is an absolute amount, profitability is a relative term. It is the metric used to determine the scope of a profit of an enterprise in relation to the size of the business. Profitability is a measurement of efficiency and also ultimately its success or failure. It is a business's ability to produce a return on an investment based on its resources in comparison with an alternative investment.

6.6. Return on investment (ROI)

Return on Investment (ROI) is a popular profitability metric used to evaluate how well an investment has performed. ROI is expressed as a percentage and is calculated by dividing an investment's net profit (or loss) by its initial cost or outlay. It is most commonly measured as net income divided by the original capital cost of the investment. The higher the ratio, the greater the benefit earned.

$$Return\ on\ Investment\ (ROI) = \frac{Net\ Profit}{Cost\ of\ Investment} * 100$$

6.7 Breakeven point (BEP)

Break-even point is calculated by dividing the fixed costs of production by the price per unit minus the variable costs of production. The break-even point is the level of production at which the costs of production equal the revenues for a product.

Fig.11 Break-even point

6.8. Payback period (PBP)

Payback period can be defined as period of time required to recover its initial cost and expenses and cost of investment done for project to reach at time where there is no loss no profit i.e. breakeven point. It is the difference between initial investment and cash flows. It is the amount of time required to recover the cost of an investment.

$$Payback\ Period = \frac{Estimated\ investment}{Net\ annual\ cash\ flow}$$

6.9. Economies of scale

Economies of scale refers to the phenomenon where the average costs per unit of output decrease with the increase in the scale or magnitude of the output being produced by a firm.

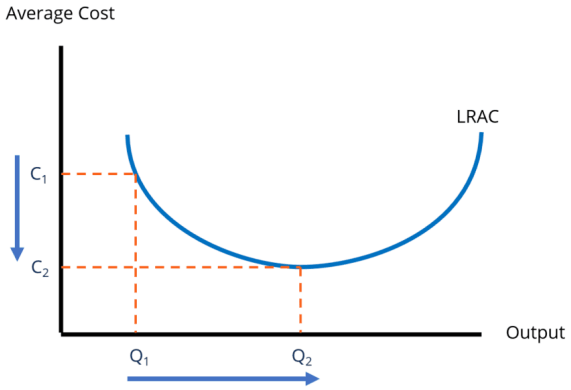


Fig. 12. Economies of scale

6.10. Preparation of detailed project report (DRP)

Detailed Project Report (DRP) is a complete document for investment, decision making, approval and planning. It is the base document for planning and implementing the project. It describes how bankable projects can be helpful in achieving required performance. A good project report should contain the following information towards satisfying the funding sources.

- Brief information about the project.
- Experience and skills of the people involved in the promotion of the project.
- Details and practical results of the industrial concerns of the promoters of the project.
- Project finance and sources of financing.
- Government approvals.
- Raw material requirement.
- Details of the requisite securities to be given to various financial organizations.
- Other important details of the proffered project idea include information about management teams for the project, details about the building, plant, machinery, etc.

6.11. Investment analysis

The practice of evaluating an investment for profitability and risk is known as investment analysis. It aims at researching and evaluating a security, to predict its future performance, to determine its suitability to a specific investor and to involve evaluating or creating an overall financial strategy. The common project evaluation methods to be estimated to justify the worth and viability of the project includes,

1. Net Present Value (NPV)
2. Benefit-Cost Ratio (BCR)
3. Internal Rate of Return (IRR)

6.11.1. Net Present Value (NPV)

NPV stands for Net Present Value. It represents the positive and negative future cash flows throughout a project's life cycle discounted. NPV is calculated by taking the present value of all cash flows over the life of a project. Then, the present value of cash flows is subtracted from the investment's initial investment. If the difference is positive (greater than 0), the project will be profitable.

$$Net\ Present\ Value\ (NPV) = \frac{R_t}{(1+i)^t}$$

Where,

$R_t = net\ cash\ flow\ at\ time\ t.$

I = discount rate

t = time of the cash flow

6.11.2. Benefit-Cost Ratio (BCR)

The benefit-cost ratio (BCR) is an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms.

$$Benefit - Cost\ Ratio = \frac{Present\ value\ of\ benefit\ expected\ from\ the\ project}{Present\ value\ f\ cost\ of\ the\ project}$$

If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors. If a project's BCR is less than 1.0, the project's costs outweigh the benefits, and it should not be considered.

6.11.3. Internal Rate of Return (IRR)

IRR or Internal Rate of Return is a form of metric applicable in capital budgeting. It is used to estimate the profitability of a probable business venture. The metric works as a discounting rate that equates NPV of cash flows to zero. The formula for calculating IRR is,

$$0 = CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \ldots + \frac{CF_n}{(1+IRR)^n}$$

Or

$$0 = NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^n}$$

Where:
CF_0 = Initial Investment / Outlay
$CF_1, CF_2, CF_3 \ldots CF_n$ = Cash flows
n = Each Period
N = Holding Period
NPV = Net Present Value
IRR = Internal Rate of Return

6.12. Pricing of the product

Price is most attractive and decisive factor of consumer purchase of particular commodity.

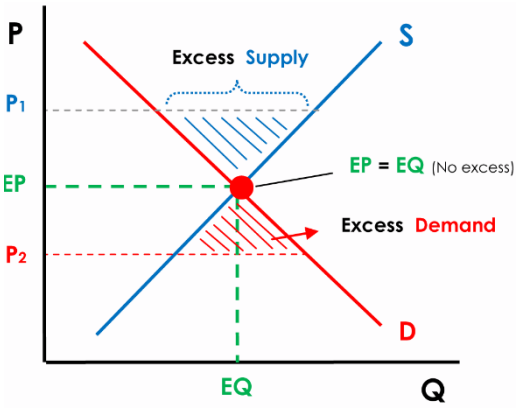


Fig. 13. Price discovery in markets

Price linkages between markets are the important areas of marketing research towards deciding their competitiveness. Market integration is still an important issue for price differentials induced by supply shocks. Price transmission analysis is used to find out the degree of integration of markets. Fundamental law of the one price policy implies that price differential does not exceed the transport and transaction cost. The general pricing policies are based on,

(1) Marketing cost

(2) Profit-Margin Desired

(3) Competitors' Pricing

(4) Government's Policy of Price-Control

It is essential to have a inclusive, participatory and sustainable marketing system for the benefit of both producers and consumers.

7. Risk management

Risk involves uncertainty about the effects/implications of an activity. Risk *implies future uncertainty about deviation from expected earnings or expected outcome.*

Table 3. Risk faced by the entrepreneurs

Technology Risk	**Market Risk**
Not completely understand or predict technology environment Lack of technical capabilities Customer do not fully understand technology brought into new product or service	Customer feels uncertain or fearful product don't meet with needs or expectation Customer changing needs Potential actions of competitor Changing economic and social conditions
Organizational Risk	**Financial Risk**
Competition among companies on resources Human resource availability Supply chain changes Conflict within organization	Access to working capitals Project goes over budget

In terms of product development/ enterprise development, risk can occur at any stage but with strategic techniques can be helpful in managing the risk. There are technology risk, market risk, organisational risk and financial risk. Product development is a crucial stage of an enterprise which requires strategic planning and execution in a systematic and economic way. It is highly critical for product development using fish and fishery products due to its perishability. The economic viability of the product development in an enterprise requires proper economic analysis and marketing strategy throughout the fish supply chain. At the present stage, the green technologies for the sustainable development in product development needs consideration. Entrepreneurship development is a broader term with deeper ideas and techniques that needs strategic planning, execution and follow-up throughout the business viz., pre-, during and post- entrepreneurship phase.

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Chapter-4

MARINE PRODUCTS BUSINESS INCUBATION FORUM

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Introduction

Start-up is a modern entrepreneurship form designed to realize original business ideas, mostly based on new technologies and the Internet. It evolves in the development cycle, which is determined by the business idea development cycle and the financing cycle.

Best business ideas generate high profits and are burdened with low risk. The occurrence of such opportunities is rare, but they can be assessed according to the following criteria, which are derived from entrepreneur aspirations and capabilities and the commercial viability of the idea.

1. Identified market need/gap.
2. Identified customers and marketing strategy.
3. No or few existing competitors.
4. Not easily copied.
5. Growing market.
6. High margins.
7. Low fixed costs.
8. Low funding requirements.
9. Financeable (if not sufficient resources, the project needs to be able to attract finance).
10. Identifiable risks that can be monitored and mitigated.
11. Managerial skills that can be leveraged.
12. Scalability.

Many starting entrepreneurs mistakenly believe that their ground breaking business idea will be equally understood and accepted by customers and that innovation is so superior that it will sell itself. From the idea to its realization and then the acceptance and purchase of the product or service, however, there is a long way to go. Finding a good business idea is not just a matter of chance and fortune. There are also systematic ways to work out the idea. The entrepreneur must have the skills, abilities, and knowledge necessary for the business. Experience with the industry is very valuable. Good business ideas are based on commercial opportunities created by market needs.

Opportunities can be created through radical or incremental product or market innovations, with little or no evidence of market need. Opportunities can also be spotted in finding unsatisfied customer needs. Both approaches are only successful if they are connected with the needs of customers. For people around the world, fisheries play a major role in nutritional security and in food production. Fish is known for its high nutrition as it has various essential micronutrients, minerals, and fatty acids. As India has a vast coastline, it is the second largest producer in the World. There are more than 10 million of people involved in this sector for making their livelihood in nearly 4000 coastal regions (Indian National Fishery Sector Overview). Tamil Nadu contributes 7.32 % to the overall national production. The capacity of the income generation of an individual is directly related to the development of society.

In our institute, EDI-MPBIF is providing many business opportunities for entrepreneurs who are having ideas about start-ups. We are having incubation and mentoring support for some of the following value-added fish and fishery products

- ✓ Extruded products
- ✓ Battered and breaded products
- ✓ Bakery products
- ✓ Pasta products
- ✓ Seaweed products
- ✓ Cured products
- ✓ Canned products
- ✓ Retorted products
- ✓ Analog products
- ✓ Cosmeceutical products

Value addition is the most talked about word in food processing industry, particularly in export-oriented fish processing industry because of the increased realization of valuable foreign exchange. Value can be added to fish and fishery products according to the requirements of different markets. These products range from live fish and shellfish to ready to serve convenience products. As far as fish processing industry is concerned value addition is one of the possible approaches to raise profitability since this industry is becoming highly competitive and increasingly expensive.

There is great demand for seafood/seafood-based products in ready to eat convenience form. A number of such diverse products have already invaded the western markets. One factor responsible for such a situation is more and more women getting educated and taking up employment. Reasonably good expendable income, education, awareness and consciousness

towards hygiene and health, increased emphasis on leisure pursuits, etc. are some of the other reasons.

The marketing of value-added products is completely different from the traditional seafood trade. It is dynamic, sensitive, complex, and very expensive. Market surveys, packaging, and advertising are a few of the very important areas, which ultimately determine the successful movement of a new product. Most of the market channels currently used are not suitable to trade value-added products. A new appropriate channel would be the supermarket chains that want to procure directly from the source of supply. Appearance, packaging, and display are all important factors leading to the successful marketing of any new value-added product. The retail pack must be clean, crisp, and clear and make the contents appear attractive to the consumer. The consumer must be given the confidence to experiment with a new product launched in the market. Packaging requirements change with product form, target group, market area, species used, and so on. The latest packaging must also keep abreast with the latest technology.

Chilled fish

Chilling is an effective way of reducing spoilage by cooling the fish as quickly as possible without freezing. Immediate chilling of fish ensures high quality products.

Chilled fish is another important value-added item of international trade. Chilled fish fetches more price than frozen fish. It is generally accepted that some tropical fish species can keep for longer periods in comparison to fish from temperate or colder waters. Up to 35% yield of high value products can be expected from fish processed within 5 days of storage in ice, after which a progressive decrease in the utility was observed with increase in storage days. Modern packaging techniques viz., vacuum packaging, modified atmospheric packaging and active packaging significantly enhances the shelf life of chilled fish products.

Frozen fish fillets

Freezing and storage of whole fish, gutted fish, fillets etc. are methods for long- term preservation of these species. Many varieties of fresh water fishes like rainbow trout, shell fishes, catla, rohu, tilapia fillets can be frozen for domestic market and export to developed countries in block frozen and IQF forms. In the importing countries these fillets are mainly used for conversion into coated products. Fish fillets can also be used for the production of ready to serve value added products such as fish in sauce and fish salads.

Speciality products

Stretched shrimp (Nobashi)

Increasing the length of peeled and deveined shrimp and minimising its curling by making parallel cuttings at the bottom and applying pressure using simple mechanical devices is a new

technique adopted by the seafood processing industry in recent years. Increasing the length by about 1-2 cms depending on the size of the shrimp is possible by this method. The stretched shrimp will have better appearance compared to conventional PD shrimp and it also fetches higher unit price. The stretched shrimp because of its increased surface area will have more pickup of coating during battering and breading and also good appearance. Shrimp is washed in chilled water containing 5-ppm chlorine, beheaded, deveined, using bamboo stick and pealed keeping the last segment and tail intact. The tail is then trimmed and the shrimp is stretched using a metallic stretcher after making 2-3 parallel cuttings at the bottom side. Stretched shrimps are then packed in thermoformed trays under vacuum and frozen at -40°C.

Barbecue

Shrimp is washed in chilled water containing 5-ppm chlorine, beheaded, deveined, peeled and again washed in chilled water. Bamboo stick is then pierced into the meat from head portion to tail. It is then packed in thermoformed trays under vacuum and frozen at -40°C.

Sushi (Cooked butterfly shrimp)

Shrimp is washed in chilled water containing 5ppm chlorine, beheaded, deveined and again washed in chilled water. Bamboo stick is then pierced between the shell and the meat from head portion to tail and then cooked in 1% brine for two minutes at 100°C. The cooked shrimp is then cooled in chilled water, bamboo stick removed and then peeled completely, including the tail fans. The ventral side is then gently cut down lengthwise completely using a sharp scalpel. The cut surface is then gently opened up to form the butterfly shape, packed in thermoformed trays under vacuum and frozen at - 40°C.

Skewered shrimp

The process is similar to that of barbecue, but piercing is carried out in such a way that 4-5 shrimps are arranged in a skewer in an inverted — U‖ shape. It is then packed in thermoformed trays under vacuum and frozen at -40°C.

Shrimp head-on (centre peeled)

Shrimp is washed in chilled water containing 5 ppm chlorine, pealed at the centre keeping the head and the last two segments intact, deveined, and the tail is trimmed. It is again washed in chilled water packed in thermoformed trays under vacuum and frozen at-40°C.

Shrimp head-on cooked (centre peeled)

Shrimp is washed in chilled water containing 5 ppm chlorine, deveined and then cooked in 1% brine for two minutes at 100°C. It is immediately cooled in chilled water
and pealed keeping the head and the last two segments intact. The tail is trimmed and again washed in chilled water. It is then packed in thermoformed trays under vacuum and frozen at -40°C.

Battered and breaded fish products

Consumers are looking for better alternative for conventional fresh food that offers time-saving preparation. Hence there exists an increased global demand for ready-to-heat frozen foods, especially breaded and battered products with high standards of quality. Battering and breading enhances the consumer satisfaction by improving the nutritional value, organoleptic characteristics and appearance of the products. The most important advantage of coating is value addition as it increases the bulk of the product. Also, this paves way for better utilisation of low cost or underutilised fishes. Coating is referred as the batter and/or breading adhering to a food product. Each ingredient in coating offers unique role in development of functionality and characteristics of the product. Polysaccharides, proteins, fat, seasonings and water are the commonly used ingredients. The method of product development differs with the type of product. Mostly this includes seven major steps.

Portioning / forming

A perfectly portioned product is the right starting point. Mechanically deboned fish meat is formed to different shapes and sizes after mixing with ingredients, if needed.

The product should keep its consistency with proper weight and shape. The key factor in this production step is speed and accuracy of processing the frozen fish block at minimum costs without any compromise to the product quality.

Predusting

Predusting is usually done with very fine raw flour type material or dry batter itself, sprinkled on the surface of food substrate before coating. This helps to reduce the moisture on the surface of the product so that the batter can adhere uniformly. Flavourings such as salt and spices can be added in minimum amounts.

Battering

Batter is defined as the liquid mixture composed of water, flour, starch, and seasonings into which the fish products are dipped prior to breading. Two types of batter are there- adhesive batter and tempura batter. The adhesive batter is a fluid, consisting of flour and water. Tempura batter is the puff-type batter containing raising/leavening agents. This forms a crisp, continuous, uniform layer over the food. The predusted portions are applied with wet batter and excess batter can be blown off by a current of air. The batter mix helps in governing the amount of bread to be picked up and it contributes to flavour of the final product. Specific ingredients are used to aid viscosity, texture and adhesion.

Breading

Breading was defined as the application of a dry mixture of flour starch, and seasonings having a coarse composition to battered food products prior to cooking. Normally the battered fish portions are dropped in to dried bread crumbs and are turned over to ensure complete coating with bread crumbs. A fine layer or coarse layer of bread crumbs will contribute to the structure and tastiness of the product. For soft products, the crumb depth should be fine so as to avoid product damage on further processing.

Pre-frying/ flash frying

Pre-frying is the process of giving a shallow fry so as to coagulate batter over the product and lock the flavour and juices to the product. The time of frying and temperature of oil are crucial factors. This could be done at 180-200°C for 40-60 sec, thus restricting the actual heat transfer to the surface of the product. The term pre-frying is used as frying will be completed only when the consumers fry the product for 4-6 minutes depending on the product size.

Freezing

The fish portions are air cooled before freezing. This helps the coating temperature to drop while the batter can stabilise itself and recover from the frying shock.

Freezing is done at a temperature of -10°C to -20°C in order to preserve freshness and quality of the product over longer storage periods.

Packaging and storage

Proper packaging and storage is essential to prevent/retard desiccation, discoloration and rancidity in coated products. Packaging in thermoformed containers and storage at -20°C are most commonly used for breaded and battered products. The developments in value-added product industry demands packaging that can withstand the higher temperatures of microwave reheating.

Advantages of coated products

- ✓ Enhanced nutritional quality
- ✓ Moisture barrier during frozen storage and reheating
- ✓ Crispy texture and appealing colour and flavour
- ✓ Structural reinforcement of the substrate
- ✓ Prevents loss of natural juices
- ✓ Increased bulk of the substrate and reduced product cost
- ✓ Improved overall acceptability of the product

Battering and breading have contributed significantly to the value addition of fishes, shell fishes and mollusks. The first commercially successful coated fish item was fish fingers. Later several other products like fish cutlets, fish balls, fish nuggets, etc. came into the market. Coated butterfly shrimp,

squid rings, stuffed squid rings etc. are among the fancy items that cater to the luxury markets. Sophisticated equipment like meat bone separators, meat strainers, portioning and forming equipment, preduster, battering and breading machine, fryer, freezers and packaging machineries are in the market for the preparation of a wide variety of coated products.

Fish finger or Fish portion

Fish fingers, or portions or sticks are regular sized portions cut from rectangular frozen blocks of fish flesh. They are normally coated with batter, and then crumbed before being flash fried and frozen. They may be packed in retail or catering - size packs. The typical British fish finger normally weighs about 1 oz. (28 g) of which up to about 50% of the total weight may be batter and crumbs. Food Advisory Committee of the UK government has recommended a minimum fish content of 55% for battered and 60% for fingers coated with breadcrumbs.

Shrimp products

Battered and breaded shrimp can be prepared from wild as well as from farmed shrimp in different styles and forms. The most important among them are butterfly, round tail-on, peeled and deveined (PD), nobashi (stretched shrimp) etc. The products from farmed shrimp have indicated longer shelf life, 16-18 months compared to those from wild variety 12-14 months at –20 oC

Fish fillets

The brined fillets are battered and breaded. Fillets from freshwater fish are also used for the production of coated products. The only problem noticed in this case is the presence of fin bones; its complete removal is still a major hurdle.

Squid products

Squid rings and stuffed squid are the popular coated products processed out of squid. Cleaned squid tubes are cut in the form of rings of uniform size, cooked in boiling brine (3%) for 1-2 minutes followed by cooling, breading and battering. The coated rings are flash-fried, cooled, frozen and packed. Stuffed squid is generally processed out of small size animals. The cleaned tubes are filled with a stuffing mixture prepared using cooked squid tentacles, potato, fried onion, spices etc. It is then battered, breaded and flash-fried.

Clam and other related products

Meat shucked out from depurated live clams after boiling is blanched in boiling brine, cooled, battered, breaded, flash-fried and packed. Other bivalves such as oyster, mussels etc. can also be converted into coated products by the same method.

Fish cutlet

Cooked fish mince is mixed with cooked potato, fried onion, spices and other optional ingredients. This mass is then formed into the desired shape, each weighing

approximately 30g. The formed cutlets are battered and breaded.

Fish balls

Fish balls are generally prepared from mince of low-cost fish. Balls can be prepared by different ways. The simplest method is by mixing the fish mince with starch, salt and spices. This mix is then made into balls, cooked in boiling 1 % brine. The cooked balls are then battered and breaded.

Crab claw balls

Swimming legs of crab may be used for this purpose. Crab claws are severed from the body, washed in chilled portable water and the shell removed using a cracker. The leg meat is then removed and mixed with 2 % starch-based binder. This is then stuffed on the exposed end of the claw. Alternatively, the body meat mixed with the binder also can be used for stuffing. The stuffed claw is then frozen, battered and breaded and flash fried. The coated products are packed in thermoformed containers with built in cavities.

Mince based products

Fish mince separated from skin, bone and fins are comminated and used for preparation of different products. Battered and breaded products like fish fingers, fish balls, cutlet etc. are produced. Fish cutlets fetch good demand in domestic markets while fish fingers are demanded in export market. Fish cutlets with partial replacement of fish meat with soy protein will increase the acceptability and storage stability of fish cutlets. A ready to eat novel battered and breaded snack product, 'Oyster pablano pepper fritter' have a good scope of attraction in value added markets. Fish finger from Bombay duck adds on to the value addition potential of fish in our markets. Fish rolls with good shelf life can be developed from frame meat of fishes, eg: rohu. Fish sausage, cakes and patties are some other mince-based products.

Surimi and surimi-based products

Surimi, term for the mince that are deboned and washed, also act as an intermediary in development of various products. It is one among the most consumed product fish. Low-cost fishes can be conveniently used for the preparation of surimi. Block frozen surimi and surimi-based products are popular. Shell fish analogue products from surimi fetches good demand in both domestic and export markets. The history of surimi in India starts in1990‘s with the first surimi manufacturing plant was set up in 1994. The Indian company Gadre Marine ‘became the third largest manufacturer of surimi, exporting to 24 countries over the world. This shows the potential for production of surimi and surimi-based products in India. The demand of these products is less in domestic markets but is expanding nowadays. These healthy and simple products have great scope in Indian markets as

people are moving towards different alternatives. Shell fish analogue products from surimi fetches good demand in both domestic and export markets.

Ready to serve fish products in retortable pouch

Ready to serve fish products viz. curry products, in retortable pouches are a recent innovation in ready-to-serve fish products for the local market. The most common retortable pouch consists of a 3-ply laminated material. Generally, it is polyester/aluminium/cast polypropylene. These products have a shelf life of more than one year at room temperature. As there is increasing demand in National and International market for ready to serve products the retort pouch technology will have a good future. The technology for retort pouch processing of several varieties of ready to serve fish and fish products has been standardised at CIFT and this technology has been transferred successfully to entrepreneurs.

Extruded products

Fish based extruded products have got very good marketing potential. Formulation of appropriate types of products using fish mince, starches etc., attractive packaging for the products and market studies are needed for the popularization of such products. However, technological studies involving use of indigenously available starches like cassava starch, potato starch, cornstarch and the associated problems need thorough investigation. Such ttproducts can command very high market potential particularly among the urban elites. The technology can be employed for profitable utilization of bycatch and low value fish besides providing ample generation of employment opportunities.

Intermediate moisture products (IMF)

The IMF technology is based on the reduction in water-activity of food to a level in which most bacteria in will no longer grow. Intermediate moisture product from fishes can be made from a combination of different techniques like drying, pH modification etc.

Seaweed products/Seaweed incorporated products

Seaweed incorporation in fish products increases the fibre content and retention of PUFA. ‗Nutradrink ‘and fish soup enriched with seaweed bioactive compounds are novel products developed by CIFT. Sulphated polysaccharides with bioactive properties can be extracted from seaweed. Seaweed incorporated semi-sweet biscuits and extruded snack products will also have good nutritional importance.

Fish caviar substitutes

Polyunsaturated fatty acids and amino acids gives the nutritional importance of fish roe. Besides the commercially available roe from sturgeon, salmon and cod, fish caviar substitute from

fresh water carp roe reconstituted with sodium alginate will have a greater potential as value added fish caviar substitute.

Curing

The traditional methods of processing fish by salting, drying, smoking and pickling are collectively known as curing. Cured fish consumption is more in areas where the availability of fresh fish is comparatively limited, namely interior markets and hilly areas. This is also the cheapest method of preservation, since no expensive technology is used. In India roughly 20 % of the fish caught is preserved by curing. Considerable quantities of cured fish are also exported, mainly to Singapore, Sri Lanka and to the Middle East. Simple sun drying was the widely practised traditional method of fish preservation. By this, preservation was achieved by lowering of water content in the fish, thereby retarding the activity of bacteria and fungi. The heat was able to destroy the bacteria to a certain extent. Later on, a combination of salting and drying or salting, smoking and then drying were developed.

Methods of Drying

There are basically two methods of drying fish. The common one is by utilizing the atmospheric conditions like temperature, humidity and airflow. This is traditional sun drying. The other is dehydration or artificial drying, by using artificial means like mechanical driers for removal of moisture from the fish under controlled conditions. Sun drying depends heavily on the natural weather conditions since the fish is dried by heat from the sun and the air current carries the water away. Here there is no control over the operations and many a time the losses cannot be substantiated. Hence it is necessary that the operations be controlled to get a product, which has an extended shelf life, but at the same time the texture, taste and flavour is maintained. It is here that artificial driers where processing parameters are controlled gain a lot of importance. Such processes are carried out in a controlled chamber or area. Such products have advantages over sun-dried products since they have better keeping quality and longer shelf life. In mechanical driers, removal of water from the fish is achieved by an external input of thermal energy. This is an expensive method since there is need for fuel for heating and maintenance of the temperature. The drying chamber consists of a long tunnel in which the washed and cleaned fish is placed on trays or racks. A blast of hot air is Passed over the material to be dried. After the required degree of drying the product is removed from the drier and packed.

Salting

This is one of the oldest methods of preservation of fish. Salting is usually done as such or in combination with drying or as a pre-treatment to smoking. During salting osmotic transfer of water out of the fish and salt into the fish takes place, which affect fish preservation. It is based on

different factors like diffusion and biochemical changes in various constituents of the fish. Salting amounts to a process of salt penetration into the fish's flesh. Penetration ends when the salt concentration of the fish equals that of the surrounding medium. Loss of water during salting limits bacterial growth and enzyme activity, thus preserving the fish. The high salt content prevents the growth of normal spoilage microflora in the fish; but halophiles, which can survive 12-15% of salt, will survive.

Preparation of some popular products

Pickled products

Fish pickle makes use of the non-fatty variety of low-cost fish having good meat content. Major ingredients are: fish, garlic, green chili, ginger, chili powder, turmeric powder, gingelly oil/ ground nut, salt, vinegar, and sugar. The method of preparation of pickle is simple, the preservative being oil, salt, and vinegar. The traditional packing is in glass bottles. Modern packing materials suitable for packing fish pickles have also been identified. Pouches and stand packs made of 12-micron polyester laminated with 118-micron LD/HD co-extruded film can be used for packing pickles.

Process

Mix the dressed fish with salt at the rate of 3% by weight of fish and dry in the sun /dryer for 2 to 3 hours and then deep fry the fish in oil and keep apart. Then fry mustard, green chilli, ginger and garlic in oil. When frying is adequate add turmeric powder, followed by chilli powder under a low flame and immediately remove from the flame and mixed with fried fish and allowed to cool. Vinegar and salt were added and mixed thoroughly and adjust to a slightly salty taste. Finally, sugar was added and mixed thoroughly. Stored the pickle in a clean container for at least 2 overnights for maturing and fill in glass bottles or acid resistant packets (12 μ polyester with 250-gauge LDHD polythene co-extruded film pouches)

Fish Soup Powder

Fish soup powder can be formulated from any type of fish having very low-fat content. Soup powder prepared from different food materials like vegetables, meat, egg is in use in different parts of the world. These are dry products rich in dietary constituents like protein and minerals. The soup powder prepared out of miscellaneous fish is also a rich source of animal protein and other nutritional factors.

Fish flakes or wafers

Fish wafers are partially deodourized thin flakes of cooked fish meat homogenized with starch and salt. On frying the wafers swell to two to three times of its initial size and become crisp

and delicious. It is an ideal snack. Fish mince and starch are the base material for the preparation of wafers

Fish paste

Fish paste is a high value convenience food popular in South East Asia prepared by mixing fish and salt and allowing it to ferment. This results in the formation of either a paste or a liquid, which is separated from the residue and is used as a flavoring agent Fish paste can also be prepared without fermentation. Frozen fish paste is not relished because during storage, texture and spread ability are adversely affected.

Fish paste is prepared by finely grinding texturized cooked fish meat, gelatinized, starch, sugar, milk powder, colouring matter and flavour. It was packed in flexible pouches made of co-extruded polypropylene; heat processed in air steam pressure in an autoclave and stored at ambient temperature. The shelf life is 36 weeks. It became unacceptable due to changes in texture and spread ability. Microbiological studies showed that the product is bacteriologically safe for human consumption. Studies showed that the fish paste is acceptable as bread spread or similar types of products. The large quantity of low value fish with low fat and white flesh available in India can be used for making good quality fish paste.

Fish Noodles

This is a product similar to ordinary noodles available in the market, but contains 21% protein. Surimi is used as the base for the production of fish noodles Table 7). Cooked surimi is kneaded with salt and maida. The mix is passed through the extruder. Gelatinised noodles is dried under sun or in an electrical drier at 50oC to a moisture level of 8%. The dried noodle is packed in airtight containers or polythene bags. The product has very good rehydration property. The above discussed value-added products have the scope for production and marketing and also can develop viable entrepreneurial opportunities with betterment of the livelihood of the entrepreneurs.

Chapter-5

LIVELIHOOD DEVELOPMENT THROUGH FRESHWATER AQUACULTURE

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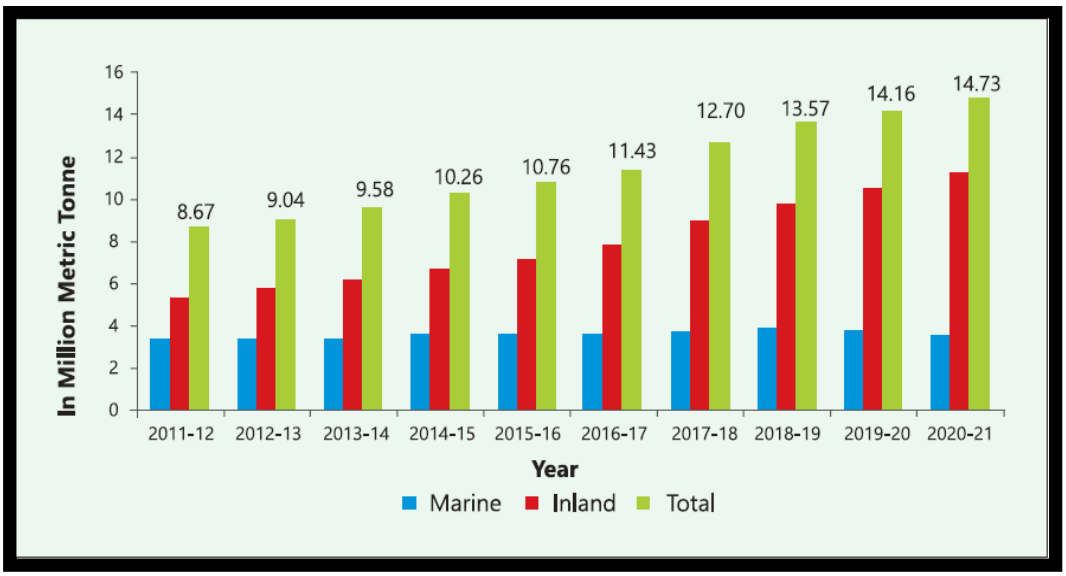
Introduction

Aquaculture as a sunshine sector is providing food, nutritional security and livelihood to more than 14 million people around the world production in last six decades i.e., from 0.75 million tonnes in 1950 - 51 to 14.730 million tonnes in 2020 – 2021 which is account for 19.46 fold increase in 8 decades. The global aquaculture scenario for the year from 1990 to 2020 is given below: The global aquaculture scenario for the year from 1990 to 2020 is given below:

	1990s	2000s	2010s	2018	2019	2020
	Average per year					
	Million tonnes (live weight equivalent)					
Production						
Capture:						
Inland	7.1	9.3	11.3	12.0	12.1	11.5
Marine	81.9	81.6	79.8	84.5	80.1	78.8
Total capture	**88.9**	**90.9**	**91.0**	**96.5**	**92.2**	**90.3**
Aquaculture:						
Inland	12.6	25.6	44.7	**51.6**	**53.3**	**54.4**
Marine	9.2	17.9	26.8	**30.9**	**31.9**	**33.1**
Total aquaculture	**21.8**	**43.4**	**71.5**	**82.5**	**85.2**	**87.5**
Total world fisheries and aquaculture	**110.7**	**134.3**	**162.6**	**178.9**	**177.4**	**177.8**
Utilization[2]						
Human consumption	81.6	109.3	143.2	156.8	158.1	157.4
Non-food uses	29.1	25.0	19.3	22.2	19.3	20.4
Population (billions)[3]	5.7	6.5	7.3	7.6	7.7	7.8
Per capita apparent consumption (kg)	14.3	16.8	19.5	20.5	20.5	20.2
Trade						
Exports – in quantity	39.6	51.6	61.4	66.8	66.6	59.8
Share of exports in total production	*35.8%*	*38.5%*	*37.7%*	*37.3%*	*37.5%*	*33.7%*
Exports – in value (USD 1 billion)	46.6	76.4	141.8	165.3	161.8	150.5

[1] Excluding aquatic mammals, crocodiles, alligators and caimans and algae. Totals may not match due to rounding.
[2] Utilization data for 2018–2020 are provisional estimates.
[3] Source of population figures: United Nations. 2019. 2019 Revision of World Population Prospects. In: *UN*. New York. Cited 22 April 2022. https://population.un.org/wpp
SOURCE: FAO.



In last few decades, aquaculture became the fast-growing food producing sector; however, it still stands inadequate to meet the nutritional demand in the country, particularly in tribal areas. Almost all small-scale fish farmers of the world (98 %) are in developing countries - mostly in rural areas and aquaculture component for rural development has had a poor record in many developing countries.

Aquaculture is one of the most important potential sectors of the national economy. Fish has been a staple food and its demand is increasing due to growing population and awareness on health benefits. Aquaculture is emerging as an important solution and the challenge is to make this growth more inclusive. Given the growing pressure on natural resources and the mounting threat posed by climate change, it is important to make it more sustainable. Aquaculture has the potential to generate income and create jobs, especially to the local youth. Being small and less risky, small-scale aquaculture can be adopted easily by resource poor farmers.

Fish farming in rural areas mainly rely on natural productivity of the pond and can be enhanced by adding animal manure to the water, which increases carrying capacity of the pond. Such systems may not generate substantial financial returns to rural communities but a small increase in food security and nutrition security, particularly in terms of protein, will have a significant effect on the livelihoods of the rural people.

Sustainable livelihood approach (SLA) aims to reduce poverty and vulnerability in communities engaged in small scale aquaculture and fisheries. Through SLA the fish farmers are encouraged to enhance the pond carrying capacity, involve farm family, improve resource utilization, integrate different components in the fish farming and optimally utilize farm areas and farm wastes (Cow manure, vermicompost) to enhance the farm income for the family livelihood and better sustainability.

The Inland Water Resources are huge and the potential resources furnished below:

Rivers & Canals- (2, 52,431.48 km)
Small Reservoir- (13,690 Numbers / 17, 76,991 ha)
Medium & Large Reservoir- (829 Numbers / 22, 54,810 ha)
Tanks & Ponds- (92, 00,327 ha)
Brackishwater- (10, 65,500 ha)
Beels / Oxbow Lakes / Derelict Waters- (4, 81,455.93 ha)
Ponds & Tanks- (2.36 million ha)
Flood Plain Wet Lands- (0.2 million ha)
Up Land Lakes- (0.72 million ha)
Other than Rivers & Canals- (9, 63,189.20)

In India, considering the inland aquatic resources available, the most suited. The livelihood options through small scale enterprises are given below:

1) Composite Carp Farming Indian Major Carps Catla (*Catla catla*) Rohu (*Labeo rohita*) Mrigal (*Cirrhinus mrigala*) Chinese (Exotic) Carps Silver carp (*Hypophthalmichthys molitrix*) Grass carp (*Ctenopharyngodon idella*) Common carp (*Cyprinus carpio)*
2) Production of Major Carps
3) Production of Chinese Carps
Steps involved in culture operation Pond preparation Fertilization Stocking Feeding Water quality management Sampling Harvesting 4) Production of Carp Fry & Fingerlings
5) Production of Cauvery Carp
6) Culture of Common Carp
7) Fish / Cattle Integration

8) Fish / Pig Integration
9) Fish / Chicks Integration
10) Fish / Ducks Integration
11) GIFT Tilapia Fish Farming
12) Scampi Farming
13) Cat Fish Farming
14) Magur (*Clarias batrachus*) Asian Cat Fish
15) Culture of Climbing Perch Fish
16) Freshwater Pearl Culture
17) Culture of Mahseer
18) Culture of Minor Carps & Barbs
19) Murrel Fish Farming
20) Breeding & Rearing of Ornamental Fishes (Live Bearers)
21) Breeding & Rearing of Ornamental Fishes (Egg Layers) Egg Scatter Laying Non Adhesive Eggs Egg Scatter Laying Adhesive Eggs Egg Depositors Egg Burriers Nest Builders
22) Freshwater Ornamental Fish Rearing in Hapas in Earthen Ponds
23) Other than Breeding & Rearing are Natural Collection & Selling Aquatic Plants Propagation Fabrication of Aquarium Tanks Live & Artificial Feeds Preparation Gold Fish / Koi Carp rearing in Earthern Ponds Decoratives Works Maintenance Works on monthly basis
24) Farm Made Fish Feed Preparation
25) LSF Preparation Methods Extracts obtained from Seaweeds known as Seaweed Liquid Fertilizer (SLF)
26) Biofloc Technology

Summary

There are 4 things farmpreneurs need to know about aquaculture are growing demand for fish food, fish farming is greener than livestock, aquaculture is technology -enabled, not risky anymore and creating Livelihood Opportunities in Rural India.

Conclusion

In India, the initiation and expansion of small-scale freshwater aquaculture practices lead to increased production & augment income generation of stake holders in the Country.

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3. https://vikaspedia.in

Chapter-6

NUTRACEUTICALS FROM MARINE ORIGIN AND THEIR IMPORTANCE

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Introduction

Increasing consumer awareness about the relationship between diet, health, and disease prevention has triggered research and development of new functional foods over the last few years. The aging of the population, decrease in quality of life due to stress, and high incidence of lifestyle diseases (cardiovascular disease, obesity, cancer, diabetes, and allergies) represent the driving forces in the search for different foods and diets that promote healthy active aging, improve well-being, and prevent the incidence of many diseases. Food is known to play an important role in the prevention or onset and progression of chronic diseases such as atherosclerosis, obesity, diabetes, hypertension, osteoporosis, cancer, and cardiovascular disease. The marine environment is a huge source of healthy food, including seaweeds with several marine species containing a plethora of chemicals, many of them with biological properties referred to as bioactive compounds. These chemicals can be extracted and incorporated into several food matrices leading to the development of new functional foods

According to Health Canada, functional food is similar to conventional food, which is consumed as part of a usual diet that either provides physiological benefits or reduces the risk of chronic disease beyond its basic nutritional functions. According to the Food Agriculture Organization (FAO), functional foods are those foods similar to conventional food in appearance, intended to be consumed as part of a normal diet containing biologically active compounds that offer the potential for enhanced health or reduced risk of disease. Foods that besides their nutritional effects, have demonstrated that they improve the state of health or well-being, reduce the risk of disease, as well as benefit one or more functions of the human organism are considered functional food. Functionality could be intrinsic to a feature introduced in the food matrix, improving health or reducing any adverse health effect, accomplished, for example, by

i) Elimination or promotion of a chemical change of a harmful ingredient.
ii) Addition of new health-promoting food ingredients or probiotic microorganisms in an effective concentration.
iii) Addition of an existing health-promoting food ingredient, increasing its concentration.

iv) Increasing the bioavailability or stability of the health-promoting food ingredient.

The characteristics of the marine environment such as temperature, salinity, light, pressure, and nutrients are of special importance since due to their broad range of values marine organisms had to evolve some protective mechanisms and metabolites. Crustaceans, macro or microalgae, fish, and fish by-products, as well as bacteria and fungi, are the most representative groups of organisms of potential interest as healthy food or as a source of functional ingredients, which include polysaccharides, chitin, proteins, and peptides, lipids, pigments, vitamins, minerals, and phenolic compounds.

The term "nutraceutical" was first coined by Stephen DeFelice in 1989 and consists of two words nutrient (nurturing element) and pharmaceutical (medicinal component). It had gained importance in recent years with an increase in the field of health-based research. Nutraceuticals are the substances that as a whole or as a part are delivered in the form of dietary supplements/ingredients that are clinically proven to hold health benefits (prevention and treatment of disease). Marine nutraceuticals refer to the compounds derived from the sea. The potential of marine nutraceuticals in human health had already been established

Types of marine nutraceuticals

Marine nutraceuticals can be broadly classified as follows: Marine lipids (animal origin and microalgal origin), Polysaccharides derived from macroalgae, Marine probiotics, Marine natural pigments, Chitin and other related products, Bioactive marine peptides/enzymes and Vitamins.

I. Marine lipids:

a. Lipids of animal origin

Marine lipids are originated either from fish, crustaceans, or other aquatic organisms. Phospholipids, sterols, triacyl glycerols, wax esters, and their metabolic products form the main components of marine lipids. Minor amounts of used lipids like glycerol esters, glycolipids, sulpholipids, and hydrocarbons are also present in marine lipids. Marine lipids are derived mainly from fatty fish flesh, lean fish liver, and the blubber of marine mammals. Fish oils and oils from marine mammals are rich sources of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA). EPA and DHA have anti-inflammatory properties. Shrimp contains 1.8-2.6% lipids based on a wet weight basis. Crustaceans contain much sphingomyelin which is having anti-bacterial and antitumor properties. Lobsters and crabs contain 08-2.0% of lipids. The lipid content of bivalves is below 1.0% but is rich in polyunsaturated fatty acids (PUFA) i.e. 50-64%. Lipids contain interesting health-promoting compounds like sterols and alpha tocopherols. Highly unsaturated fatty acids (HUFA) are found to reduce the effect of environmental change on the nervous system thereby reducing the stress in fish.

b. Lipids of microalgal origin

Lipids derived from marine microalgae have a wide range of applications in the larval nutrition of aquaculture, especially for the enrichment of live feeds. They also exhibit various properties like anti-inflammatory, anti-allergic, anti-viral, and therapeutic. The wide spectrum of the properties is due to the presence of various components like PUFA, HUFA, and other substances. Various microalgal-originated lipid/fatty acids and their activities are given in Table 1.

Table.1 Various microalgal-originated lipid/fatty acids and their activities

Lipid/Fatty acid	**Activity**
Eicosapentaenoic acid (EPA)	Nutraceutical; antimicrobial and anti-inflammatory
alpha-Linolenic acid (GLA)	The integrity of tissue and delay of aging
Arachidonic acid (ARA)	Aggregative and vasoconstrictive platelets
Docosahexaenoic acid (DHA)	Nutraceutical and brain development
Brassicasterol and stigmasterol	Hypercholesterolemic
alpha-amino-butyric acid(GABA)	Neurotransmitter, antioxidant, and anti-inflammatory
Okadaic acid	Antifungal, secretion of nerve growth factor (NGF)
Microcolin-A	Immunosuppressive

II. Polysaccharides derived from macroalgae

Seaweeds contain higher amounts of the polysaccharides like agar, alginates, and carrageenans. These act as food fiber and are collectively called phycocolloids or hydrocolloids. Being rich in fiber, seaweeds exhibit health benefits like reducing the absorption of toxins, and anti-carcinogenic and antioxidant properties. In addition to the phycocolloids, seaweeds are sources of biologically active phytochemicals like carotenoids, phycobilins, fatty acids, vitamins, sterols, tocopherol, phycocyanins, and others. Some of the polysaccharides of the seaweeds and their properties are as follows:

Table. 2 Polysaccharides of the seaweeds and their properties

Polysaccharide	**Property**
Fucoidan	Antioxidant, antiangiogenic and antitumor activities, anticoagulant, immunomodulating and Hypolipidemic, anti-inflammatory
Sphinganine amide and	Antiviral activity

Caulerpa in (green algae)	
Carrageenan	Antibacterial, anti-tumour, antiviral and anti-inflammatory activities
Alginic acid and xyloglucans	Antiviral activity
Hyperoxaluria	Potential blood anticoagulant agent
Sulfated polysaccharides	Antioxidant, antithrombin activity, antitumor, cell recognition, and cell adhesion or regulation of receptor functions.
Alginate	Stimulates the immune system, reduces intestinal absorption, modulates colonic microflora, and elevates colonial barrier function

III. Marine probiotics

The microbial diversity of marine environments is very rich and can be helpful to develop safe and effective probiotics. Novel marine probiotics can be an effective alternative for fighting antibiotic resistance. Lactobacillus and Bifidobacterium are found to possess anti-mutagenic and immunomodulatory activity in host animals. Different strains of marine probiotic bacteria are Lactobacillus (*L. casei, L. acidophilus, L. rhamnosus* GG (ATCC53013), L. johnsonii La-1), Bifidobacterium(*B. bifidum, B. longum, B. infantis, B. breve, B. adolescentis*), Leuconostoc spp. (*Ln. lactis, Ln. mesenteroides* subsp. *Cremoris, Ln. mesenteroides* subsp. *dextranicum*) and Streptococcus spp. (*S. salivarius* subsp. *thermophiles*). The problem posed during the development of new marine probiotics is the isolation and identification of the potential strains. The application of biotechnological and molecular biological tactics is necessary for the development of marine probiotic strains for use in the aquatic industry.

IV. Marine natural pigments

Marine macro and microalgae provide various types of bioactive compounds. The most important and striking feature of marine algae is their natural pigments. The natural pigments of marine algae provide food through photosynthesis and also provide pigmentation. In addition to these, the natural pigments are also found to exhibit health benefits which make them one of the important marine nutraceuticals. The marine natural pigments and their health benefits are given in Table 3.

Table. 3 The marine natural pigments and their health benefits

Natural pigments	Health benefits
Chlorophyll a	Antioxidant and antimutagenic
Pheophytin a	Neuroprotective, Antimutagenic, and anti-inflammatory
Pheophorbide a	Antioxidant
Pyropheophytin a	Antioxidant
Phycoerythrobilin	Antioxidant
Lutein, zeaxanthin, and canthaxanthin	Antimutagenic and antioxidant
alpha-Carotene	Antimutagenic and food additive
Fucoxanthin	Antioxidant, anticancer, anti- inflammatory, antiobesity, anti- angiogenic and Neuroprotective
Siphonaxanthin	Anticancer and anti-angiogenic
Phycocyanin	Anti-inflammatory and antioxidant
Astaxanthin	Strong antioxidant, anti-inflammatory and dietary supplement

V. Chitosan and its derivatives

Chitosan is a natural polymer derived from chitin and it is the second most abundant polysaccharide after cellulose. Chitosan possesses special properties for use in pharmaceutical, biomedical, food industry, health, and agriculture due to its biocompatibility, biodegradability, and nontoxic nature. Through encapsulation, it is being used as a vehicle for nutraceutical compounds and pharmacological compounds.

Antibacterial activity

Chitosan disrupts the barrier properties of the outer membrane of gram-negative bacteria due to ionic interaction between the cationic groups of the chitosan molecules and the anionic groups of the microbial cell membrane, which can rupture the cell membrane. Sulfuryl chitin, phosphoryl chitin, and some chitin derivatives prepared by nitrous acid deamination of DAC, inhibited bacterial growth and increased cytotoxicity of a macrophage cell line. NTM-DAC had higher bacterial inhibition activity than carboxymethyl chitosan.

Antifungal activity

Chitosan can also function as an antifungal agent by forming gas-permeable coats, interfering with fungal growth, and stimulation various defense processes like, the buildup of chitinases, production of proteinase inhibitors, and stimulators of callous synthesis.

Antioxidant activity

This property could be attributed to the ability of chitosan to chelate metals and combine with lipids. Derivatives of chitosan, namely, N, O-carboxymethyl chitosan, N, O- carboxymethyl chitosan lactate, N, O-carboxymethyl chitosan acetate, and N, O- carboxymethyl chitosan pyrrolidine carboxylate had also exhibited the antioxidant activity.

VI. Bioactive marine peptides/enzymes

Peptides refer to specific protein fragments. The bioactive peptides act as sources of biological compounds (nitrogen and amino acids) and also have numerous potential physiological functions within the body. Some of the peptides may exhibit multifunctional properties like opioid, immunomodulatory, antibacterial, antithrombotic, and antihypertensive activity (Kim, 2012). Biofunctional peptides have a size range of 2 to 20 amino acid residues and are encrypted within the sequence of the parent protein and are released during fish processing. They can be formed either by acid or alkaline hydrolysis. The type of bioactive peptides formed is dependent on two factors: (a) the primary sequence of the protein substrate and (b) the specificity of the enzyme(s) used to generate such peptides. The major bioactivities of peptides are as follows: antihypertensive (ACE inhibitory) activity, antioxidant activity, antimicrobial activity, antihypoallergenic activity, cell immunity

Peptide bioactivity	**Marine resources**
ACE inhibitory activity	Big eye tuna (muscle), Alaska pollock, sea bream, yellowfin sole, oyster, shrimp, clam, and sea cucumber
Antioxidant activity	Big eye tuna (muscle), Alaska pollock, yellowfin sole, horse mackerel (skin), croaker (skin), conger eel, Hoki fish (skin), squid, oyster, mussel,
Antimicrobial activity	Oyster, American lobster, shrimp, and sea urchin
Antihypoallergenic activity	Big eye tuna (muscle), seaweed, pipe fish (muscle), and sea cucumber
Cell immunity	Oyster

Proteins isolated from Dunaliella, *Phaeodactylum tricornutum*, and *Arthrospira platensis* are having potent antioxidant and anti-inflammatory activity which can be effectively used in aquaculture practices. Similarly, enzymes (Superoxide dismutase and Carbonic anhydrase) derived from Porphyridium, Anabaena, *I. galbana*, and *Amphidinium carterae* can also play an important role in regulating the metabolite waste (CO2).

VII. Vitamins

Commercially produced cod liver oil is rich in vitamins A and D. Marine microalgae are also known to have a good amount of alpha-carotene. Microalgae like, Arthrospira, *I. galbana*, *P. cruentum* and Tetraselmis are rich in vitamins C, K, A, E, and alpha-carotene which possess strong antioxidant activity. Vitamin A (particularly provitamin A, alpha-carotene) and E (particularly alpha-tocopherol) serve as excellent antioxidants and free radical scavengers that protect cells from damage by oxidants. Research has shown that vitamin E has several extraordinary beneficial effects as a specific antioxidant, acting together with vitamin C and alpha- carotene, in improving antioxidant defences in the body. Fat-soluble vitamin K isolated from Pavlova helps in blood clotting or coagulation. The role of antioxidant vitamins in health and disease control has been well documented. These antioxidants may also be defined as substances that interfere with normal oxidation processes in oils and fats and delay their oxidation.

Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients

Marine sources are known for their phenomenal biodiversity, which offers a strong basis for their use as a natural source of healthy food as well as for many novel functional food ingredients with biological properties. Crustaceans, macroalgae (seaweeds) or microalgae, fish, and fish by-products, as well as bacteria and fungi, are the most representative groups of organisms of potential interest as healthy food or as a source of functional ingredients, which include polysaccharides, chitin, proteins and peptides, lipids, pigments, vitamins, minerals.

1. Seaweeds

Considering their great taxonomic diversity, algae or seaweeds, are a very interesting source of healthy food as well as a natural source of compounds with biological activity that could be used as functional ingredients. There are about 10,000 identified species of algae and about 5% of them are used as food, especially in Asian countries as sea vegetables. Seaweeds when incorporated into diets are low in calories can help in reducing obesity and blood pressure and also are known to help to overcome free radical stress. Seaweeds are rich in polysaccharides, minerals, vitamins, proteins, steroids, and dietary fibers in addition to possessing several biological properties such as antibacterial, antioxidant, anti-inflammatory, anticoagulant, antiviral, and/or apoptotic activities. The presence of pigments such as carotenoids, phycobilins, chlorophylls, and phenolic compounds

make them strongly antioxidant in nature. Some algae thrive in complex habitats exposed to extreme conditions. To adapt and survive, they produce a wide variety of biologically active secondary metabolites like acetogenins, terpenes, derivatives of amino acids, phenols, and polyphenols, which are often halogenated. Algae are generally classified as brown macroalgae (phylum Ochrophyta), red macroalgae (phylum Rhodophyta), or green macroalgae
(Phylum Chlorophyta). Brown algae owe their color to the presence of the carotenoid fucoxanthin. Food reserves of brown algae are characteristically complex polysaccharides including laminarins, fucans, and cellulose, as well as higher alcohols; many bioactive metabolites with different pharmacological activities such as antioxidant, anti-inflammatory, antitumor, cytotoxic antifungal, and nematocidal activities, have been isolated from these algae. Green algae owe their color to the dominant presence of chlorophylls a and b, and the main polysaccharides present are normally vans. In turn, red algae, which are also considered an important source of many biologically active metabolites possess phycoerythrin and phycocyanin as the main pigments, and the primary polysaccharides are agars and carrageenans.

2. Microalgae

Microalgae or phytoplankton are microscopic marine organisms that can be found in benthic and littoral habitats in the ocean comprising blue–green algae (phylum Cyanobacteria, class Cyanophyceae), diatoms (phylum Ochrophyta class Bacillariophyceae), dinoflagellates (phylum Myzozoa, class Dinophyceae), as well as green and yellow–brown flagellates (Chlorophyta, prasinophytes, prymnesiophyta, cryptophyta, and others). Microalgae play a key role in the productivity of oceans, constituting the basis of the marine food chain, and are considered important producers of some highly bioactive compounds. Microalgae have an abundance of PUFAs and pigments such as carotenoids and chlorophylls -chlorophyll a, phycocyanins, and phycoerythrin (phycobilins) are the pigments of interest found in blue–green algae. These compounds exhibit biological properties such as anticancer, antifungal, antibacterial, and immuno- suppressive properties. Diatoms are photosynthetic organisms that dominate the phytoplankton of cold and nutrient-rich waters. They produce PUFAs such as eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and other omega-3 FAs, antioxidants fucoxanthin, and chlorophyll. Dinoflagellates' eukaryotic primary producers are rich in chlorophyll and carotenoids as well as PUFAs.

3. Fish and Fish By-Products

Several million tons of fish and fish by-products are discarded as waste, representing a large environmental problem. However, fish and fish by-products are known sources of potential bioactive ingredients such as fish oils rich in PUFAs from fish livers, calcium from fish bones, protein hydrolysates of high biological value, peptides with biological properties such as

antihypertensive activity, amino acids such as taurine, which have antioxidant activity and positive effects on the cardiovascular system, as well as vitamins and minerals. Fish heads, viscera, skin tails, blood, and seafood shells possess a plethora of compounds with the potential to be used as functional food ingredients. Bioactive compounds from marine processing by-products can be obtained by extraction and purification procedures enabling the isolation of bioactive peptides, oligosaccharides, as well as FAs suitable for biotechnological applications

4. Crustaceans

Chitin is extractable from crustaceans' shells, being the second most abundant natural polymer. Chitosan is a biodegradable and biocompatible polymer chitin derivative. Its ability to absorb fat is exploited in applications as an anticholesterol agent. Chitosan and Chito oligosaccharides are reported to have several biological activities (antioxidant, antitumor, anticancer, hypocholesterolemic, immunity-enhancing, antimicrobial) and hence find application in food and health industries.

5. Marine Fungi and Bacteria

Marine bacteria and fungi have drawn increasing attention from researchers from all over the world since they are considered sources of new marine natural compounds. Marine extremophilic bacteria, for example, are of particular interest since they have metabolic pathways adapted to various extreme marine environments. Many microbial enzymes and exopolysaccharides from extremophiles have unique properties. Bacteria derived from intestinal tracts of marine organisms such as fish have also been researched with interest, since these strains may be new probiotics or have additional functions such as antibacterial activity. For example, it was observed that *Lactococcus lactis* isolates from the intestinal tract of freshwater fish possess different phenotypic properties, suggesting additional functions in comparison to those derived from a cheese starter. Much interest has also been focused on marine fungi, which have been studied for their metabolites. A unicellular marine fungus with a high concentration of γ-amino-butyric acid (GABA), which is a promising functional and healthy food ingredient. In addition, marine fungi are a promising source of novel bioactive compounds with anticancer, antibacterial, antiplasmodial, anti-inflammatory, and antiviral properties.

Functional Foods Incorporating Marine-Derived Ingredients

Marine resources are a source of high-value-added compounds with biological properties to be used as functional food ingredients. Several types of polysaccharides, such as sulfated polysaccharides, chitin or chitosan, proteins and protein hydrolysates, peptides, amino acids such as taurine, omega-3 oils, carotenoids, and other bioactive compounds are examples of compounds that can be added at different stages, from processing to storage, of the food production process. Since

dairy products are widely accepted by consumers, the use of this type of product to deliver bioactive compounds has received attention from the food industry in the last few years. Functional foods and natural health products are an emerging field in food science due to their increasing popularity with health-conscious consumers and are a source of new opportunities for the agri-food sector. Food products containing marine-derived chitin, and chitosan, as well as oils rich in omega-3 fatty acids, are some food products that are being commercialized in several markets around the world including Japan, the USA, and some European countries.

The consumption of functional foods can provide various nutritional/health benefits, with diet controls and modulating many functions of the body, maintaining good health and homeostasis. Enhancement of immunity and antioxidant effect is the most studied health benefits. Nowadays, marine-derived functional ingredients such as fish oils, fish proteins, and seaweeds themselves have found application in bakery, dairy, confectionery, and pasta products. They are added as fortificants and nutritional enrichments in food, to form functional foods. More concerted efforts in research and design of novel marine ingredients-based functional foods are needed to contribute to the reduction of health problems through diet. Despite the scientific progress in the use of marine-derived food ingredients, there still are various challenges ahead that have to be overcome:

i) Efficient extraction methods and purification steps, to obtain food-grade validated extracts or purified compounds with biological properties (antioxidant, antibacterial, prebiotic, and others). Isolated functional ingredients should rely upon food methods compatible with economically viable yields. Hence, different extraction methods must be applied to maximize the extraction efficiency of functional ingredients with biological properties.

ii) To design functional foods based on the incorporation of marine-derived functional ingredients upon biological validation. Consumers are more inclined to buy functional foods with physiological health claims.

iii) Foods should have good sensorial characteristics to be accepted by the consumer. In general, consumers do not compromise their taste for health. This is one of the most important challenges to overcome in the use of some marine compounds, for example, fish oil.

Conclusions

In the present scenario, people are very health cautious and prefer to consume organic foodstuff which is free from antibiotics, pesticides, hormones, and other contaminants. The ban on the usage of antibiotics, pesticides, and hormones in the aquaculture industry improved the farmed fish quality but still, it needs certain value addition to enhance the health benefits of consumers. Similarly, to mitigate the stress in culture conditions (present intensive farming practices), in addition, to feeding, certain compounds are desired by cultured fish. Now, the industry is looking for alternative products

which are derived from nature (organic) and have nutritional and health benefits. Marine nutraceuticals are naturally available organic substances which are having greater health-promoting factors and are derived from seaweeds, marine microalgae, marine lipids, etc. So, directly or indirectly, marine nutraceuticals help shortly, to gratify everyone's (fish farmers and consumers) necessity for the aquaculture industry and overall enhance aquaculture production.

Chapter-7

BUSINESS OPPORTUNITIES IN PREPARATION OF FISHERY BY-PRODUCTS

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Introduction

Fish is a versatile food commodity. The expansion of fish processing industry results in the generation of large quantities of wastes, which are estimated to be reach up to 75% of the total volume. Fins, heads, skin and viscera of fish are discarded as “fish wastes”. The discard from the world fisheries exceeds 20 million tons every year, which is equivalent to 25% of the total fish production, including “non-target” fish, fish processing wastes and by-products. Fish waste generation has become a global problem that causes significant economic loss. Therefore, it has been proposed to use fish waste as a potential resource for many by-products. In some countries, the use of fish by-products has developed into an important industry, with a growing focus on their handling in a controlled, safe and hygienic way.

Co- Product vs By-Product

In processing of fish wastes into useful products, two terms, *viz* ‘Co-products’ and By-products’ are used. The term "co-product" means products derived from fish along with the final product, ultimately intended for human consumption without subsequent processing (eg. fish cheeks in fillet operation). The term “by- products” represent the remains of fish resulting after processing, which are not valued as human food but required to be further processed into usable products.

Therefore, no part of the fish is a waste and each part can be processed into valuable products, as shown in the picture depicted below (Fig 1.1). In a finfish, head constitutes 9-20%, backbone 9-15%, trimmings 8-17%, viscera 12-18% and skin 1-3%. Yield of fully developed eggs (roe) shall vary from 8-27% depending on the species and the stage of maturity.

The total yield of edible portion of finfish accounts for 27 to 40% while that of crustaceans is 25% for shrimp and 45% for crabs. Molluscan shellfish such as clams and oysters have a low meat yield of about 10%. The remaining non-edible portion of seafood serves as good sources for the preparation of several industrial products.

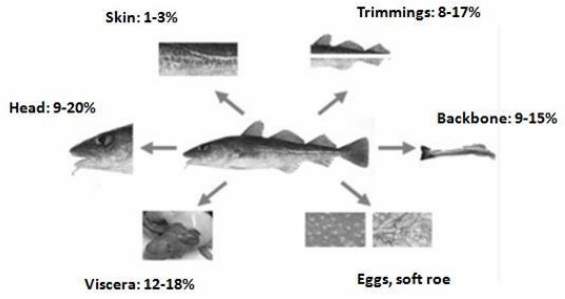

Fig 1.1 Waste generated from fin fish Source: Dumay, J. (2006)

By-products produced from fish and fishery wastes

Fish by-products are marketed after further processing to meet the consumer preferences and sanitary regulations. Traditionally, fish by-products are used in the production of fishmeal, fish oil, fish protein concentrate, fish hydrolysate, fish silage, fish soluble, fish maws, Ising glass, etc. Heads, frames and fillet cut-offs and skin can be processed into gelatin, sauces, collagen and other products for human consumption. Some by-products, in particular viscera, are highly perishable and therefore be processed while fresh to produce enzymes like pepsin, trypsin, chymotrypsin, and collagenase.

Fish bones are good sources of collagen and gelatin, calcium and other minerals such as phosphorus, which are used in food, feed or food supplements. Calcium phosphate present in fish bone, such as hydroxyapatite, helps to hasten bone repair after major trauma or surgery. Fish skin from larger fish provides gelatin as well as leather for use in clothing, shoes, handbags, wallets, belts and other items. Carp and redfish scales when treated using acid/alkali produce collagen peptides.

Fish scales are treated with suitable solvents to produce pearl essence, a suspension of guanine crystals. When guanine particles are deposited on the inside surface of solid beads, an optical effect similar to that of real pearl is obtained. Fish roes are mature ovaries and caviar is the processed fish roe. Fish roes are nutritionally important as they possess lipid rich in essential fatty acids and protein rich in essential amino acids.

Shark fins are used to make a traditional shark fin soup in the Chinese culture and it is one of the most valuable fish products in the world. Only the fine collagenous fibers called “needles” that support the fin margin, are used in soup preparation. Shagreen is an untanned shark skin, with the rough denticles attached. It is used as sandpaper in woodwork and other industries. It is also used to cover sword hilts (providing a slip-free grip) and as a striking surface for matches. Shark skin is largely used in leather preparation. Shark skin is tanned in a similar way as that of skins of other

animals. Shark leather is used to make a variety of products including furniture, bookbinding, shoes and handbags. Shark liver is also eaten as food in China and the Solomon Islands. The liver is cooked fresh or salted prior to product preparation. Shark liver is rich in various hydrocarbons. Oils extracted from shark livers are used in the farming and textile industries as lubricants, in cosmetics, as lamp fuel, as a wood preservative on boat hulls and in the pharmaceutical industry. Shark teeth are used in handicrafts.

Squalene is a highly unsaturated aliphatic hydrocarbon found in the liver of deep-sea dogfishes (Order: Squaliformes). Squalene is used as a fine lubricant because it is stable over a wide temperature range (-75ºC to 330ºC). It is widely used in skin creams to soften skin, as moisturizer to speed up wound healing and as a bactericide.

Production and processing of crustaceans and bivalves generate huge quantities of shell wastes. The efficient use of shell wastes is important not only to maximize financial return but also to address waste disposal problems. The degradation of shell wastes is a slow natural process. Chitin and chitosan are produced from shrimp and crab shells and it has a wide range of applications. Chitin and chitosan have the ability to form polyoxysalts and films and to chelate metals. Their optical structure characteristics make them attractive compounds for utilization in medical, pharmaceutical, food and cosmetic industries, nutraceuticals, bioremediation, gene therapy and cosmetics. Crustacean shell wastes also yield pigments (carotenoids and astaxanthin) for use in pharmaceutical industry.

Mussel shells provide calcium carbonate for industrial use. In some countries, oyster shells are used as a raw material in building construction and in the production of quicklime (calcium oxide). Shells can also be processed into pearl powder. Scallop and mussel shells are used in handicrafts and jewelers and also for making buttons. Different kinds of fish byproducts and their uses are given in the Table 1.1

Table 1.1. Fish by-products and their uses

Fish parts	By-product	Uses
Fish liver	Fish liver oil, Vitamin A	Pharmaceutical
Fish body	Fish body oil	Pharmaceutical
Fish protein & trimming	Fish protein concentrate	Human consumption
	Fish meal, Fish silage, Fish soluble	Animal feed
	Fish manure, Fish guano	Agriculture
	Fish albumin	Human consumption
Fish skin & Fish bone	Collagen, Gelatin, Fish leather	Industrial
Fish scales	Animal charcoal, guanine, Shagreen	Industrial
Fish eggs	Fish roe (Cavier)	Human consumption
Fish viscera	Enzymes, Hormones	Pharmaceutical, Industrial

Fish swim bladder	Isinglass	Industrial
Shark fins	Shark fin rays	Human consumption
Shark liver	Shark liver oil, Squalene	Human consumption
Shrimp shell	Chitin, Chitosan, Pigments	Industrial, Pharmaceutical
Mussel shell	Calcium carbonate, pearl powder, handicrafts, jewels	Industrial

Though many products could be prepared from fish waste, two products viz. fish silage and chitin are discussed below.

FISH SILAGE

Fish silage is a liquid product wherein whole fish or parts of fish are preserved by addition of acid or by anaerobic production of lactic acid by bacteria. The necessity of preserving fish by ensilation arose only with the need to preserve large quantities of pelagic fish catches or fish processing wastes such as viscera, head, fins, filleting wastes, etc. Fish silage is preserved against microbial spoilage mainly by lowering pH, which is accomplished by the addition of acid or *in-situ* production of acid. The native endogenous enzymes present in fish gut break down proteins into smaller soluble units, and the acid helps to speed up their activity and prevents bacterial spoilage.

Methods of production

Fish silage are commercially produced by two methods.

Acid preserved silage (External addition of acids):

Acid preserved silage is produced by the addition of inorganic or organic acids (Fig. 5.1.) Inorganic mineral acids such as hydrochloric or sulphuric acid are more preferred, as they are reasonably cheap and produce a lower pH than some organic acids such as formic, citric, benzoic and lactic acids. Organic acids are regarded as "Generally regarded as safe, GRAS" by FDA. The use of mineral acids causes greater corrosion problems, and hence, the silage has to be neutralized before use.

- Fish is ground to particle size of not more than 10 mm in diameter.
- Ground fish is mixed well with 3.5% (w/w) of 85% formic acid using a mechanical mixer.
- The acidity of the mixture must be adjusted to pH 4 or lower to prevent bacterial action.
- The mixture is allowed to liquefy for two days at 20^{o}C or 5-10 days at 10^{o}C or much longer at lower temperature.

Fermentation is faster at slightly high temperature. The warmer the mixture, the faster is the process. Therefore, in cold area, it would be necessary to heat the mixture initially; or to keep it in a warm area until it becomes a liquid. Fish silage made with sulphuric acid can be neutralized with calcium hydroxide [$Ca(OH)_2$].

Fermented silage (*In situ* production of acid by bacterial fermentation)

In fermented silage, fish is mixed with fermentable carbohydrate such as molasses and lactic acid bacteria (LAB). The lactic acid bacteria produce lactic acid by fermentation and lower the pH. They also produce bacteriocins, which together with the acid suppresses the growth of spoilage bacteria and preserves the silage (Fig 5.2).

- Ground fish is made into slurry by mixing with 10% molasses and 30% water by weight.
- The mixture is cooked at 100^{o}C for 10 min and cooled to room temperature.
- Young culture (18-22 h culture) of lactic acid bacterium, *Lactobacillus plantarum* is introduced into the slurry, mixed well and allowed to ferment for 72 h.

Commercial enzymes like bromelain (0.7 - 0.9% w/w) is also used in fermented silage production to accelerate the liquefaction process along with lactic acid bacteria. Liquefaction of the silage takes about 3 to 7 days, depending on the temperature and nature of raw material. Addition of 15% molasses increases the proteolysis rate and reduces the liquefaction time to 12h. The silage separates into 3 or 4 layers. The oily layer floats at the top. The middle aqueous layer forms most of the silage. The bottom layer consists of sediment or sludge with undigested protein, scales and bones. The shelf life of the product is not more than 6 months. The loss of tryptophan amino acid is reported during prolonged storage. The biochemical composition of white flesh fish silage is 80% water, 15% protein, 4-5% ash and 0.5% fat.

Advantages of fish silage

1. Low capital investment
2. No requirement for skilled labours
3. No smell in silage making process

Disadvantages of fish silage

1. Transportation cost is high due to bulkiness
2. Low marketability
3. Excess oil taints the fish flesh, if fatty fish is used.

Use of fish silage

Fish silage is a nutrient product similar to fish meal and hence, ideal as an animal feed and a fertilizer. It has high digestibility because of the hydrolyzed proteins. The presence of organic acid has antibacterial property in the intestine of the animals. Acid preserved and fermented silages are principally used in animal / cattle feeds as protein supplement. Fish silage is fed directly as part of the daily feed for pigs, which gives higher growth rates, improved health, and reduced mortality. In feeding farmed fish, fish silage processed from same fish should not be used. Fish silage can be mixed with other feed ingredients such as grains (rice bran) and fed to livestock. Fish silage can be

used in extruded feeds by replacing part of fish meal (10-15%), which makes stronger pellets. Fish silage as a fertilizer is a good source of nitrogen, phosphorus, potassium, calcium, magnesium and trace elements for plants. Fish silage is applied in irrigation water i.e. 2-5% liquid silage to the water to increase the growth of plants.

Chitin and Chitosan

Chitin is widely distributed in nature and is the second most abundant polysaccharide after cellulose. The name 'chitin' is derived from the Greek word 'chiton', meaning a "covering" or "coat". The use of chitin was first described by the French chemist, Henri Braconnot in 1811. Chitin occurs as crystalline microfibrils in exoskeletons of crustacean such as crabs, shrimps, squilla, cuttlefish and squid pens, and cell walls of fungi. The major source of chitin is exoskeletons of crustacean such as shrimps, crabs and lobsters. The shell of crustacean consists of 30-40% skeletal protein, 30-50% ash (calcium carbonate and calcium phosphate) and 20-30% chitin (Fig 6.1). Shrimp shell is considered to be the major source of chitin production since it contains more chitin than crab shell.

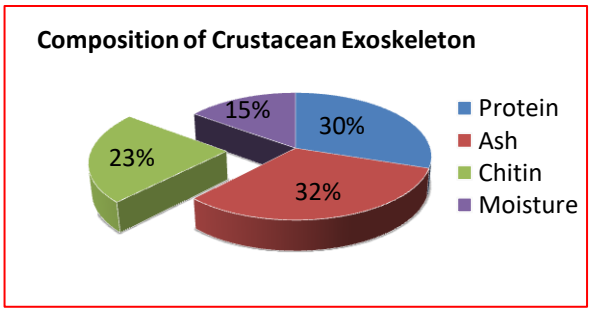

Fig 6.1 Composition of crustacean shell waste

Chitosan is an important derivative of chitin and is soluble in acidic solution. The conversion of chitin to chitosan is possible either by enzymatic or chemical hydrolysis. Chitin and chitosan are bio-compatible, bio-degradable and non-toxic biopolymers.

Chemical structure - Chitin

Chitin ($C_8H_{13}O_5N$) is composed of N-acetyl -D-glucosamine (GlcNAc) residues attached by β (1-4) glycosidic linkage. In native chitin, one out of six GlcNAc residues remains deacetylated. The crab chitin contains 5000 to 8000 GlcNAc residues. Chitin is characterized into α, β and γ chitin on the basis of the H bond arrangement. In α chitin, the chains are arranged parallel to each other to offer more stability and is present in arthropods and crustaceans. In β chitin, chains are arranged anti-parallel and it is found in marine diatoms and squid pens. In γ chitin, chain arrangement is complicated (Fig. 6.3.)

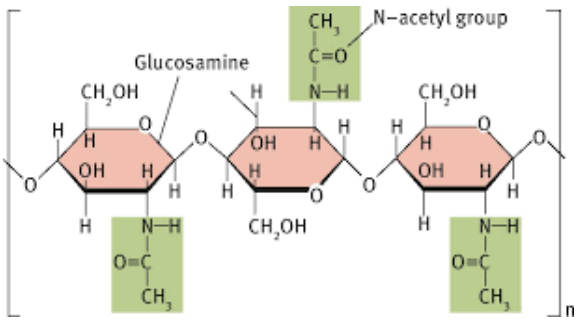

Fig. 6.3 Chemical structure of chitin

Chemical structure - Chitosan

Chitosan is the most important derivative of chitin obtained by deacetylation of chitin. It is a linear polysaccharide composed of randomly distributed D-glucosamine (non-acetylated) and N-acetyl glucosamine (acetylated) attached by β (1-4) glycosidic linkage. Chitosan carries a net positive charge from amino groups (Fig. 6.4).

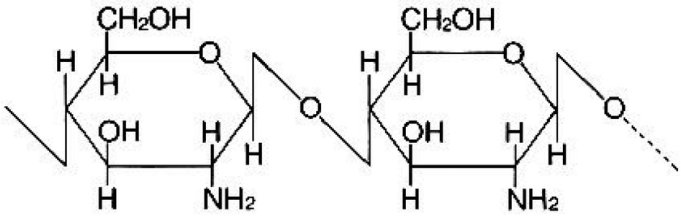

Fig 6.4 Chemical structure of chitosan

Production of chitin and chitosan from shrimp shell wastes by chemical method

- **Pre-processing step:** Shrimp shell wastes are washed in tap water to remove foreign particles in the shell
- **Deproteinization step: S**hrimp shells are deproteinized with 4% NaOH at solid to solvent ratio of 1:5 (w/v) for 1 h at 80^{o}C. The alkali is drained and shells are washed repeatedly in running tap water to a neutral pH.
- **Demineralization step**: Shrimp shells are then treated with 3% HCl for 1 h at solid to solvent ratio of 1:5 (w/v). The acid is drained out and shells are washed repeatedly in running tap water to a neutral pH.
- **Decolorization step:** Shells are bleached with 1% potassium permanganate for 30 min and again with 1% oxalic acid for 30 min. The purified chitin is then dried at 65^{o}C for 1 h, until it becomes crispy.
- **Deacetylation step:** The chitin is treated with 40% NaOH at solid to solvent ratio of 1:10 (w/v) at 80-100^{o}C for 2 h. The alkali is washed out and the residue is washed repeatedly in

running tap water until neutral pH. The resultant **chitosan** is dried in a drier for 4 h at 65^{o}C. (Fig. 6.5)

Chitin **Chitosan**

Fig 6.5. Chitin and chitosan

Yield of chitin and chitosan

Wastes (Dry weight basis)	Chitin	Chitosan
Shrimp waste	14-27%	20%
Crab waste	13-15%	12%.

Biological method for chitin production

Chitin can also be produced by biological method, which is a green technology with the application of enzymes and microorganisms. It offers high reproducibility in shorter time, simple manipulation, less solvent consumption and low energy input. The biological methods use proteolytic enzymes to digest the proteins and the fermentation process use microorganism to digest both protein and minerals.

Enzymatic method for chitin production

Chitin extraction requires proteases of plant, animal or microbial origin. Many proteases like pepsin, papain, pancreatin, alcalase, devolvase, and trypsin remove proteins from crustacean shells. This is done after or before demineralization. Purified or crude proteases can also be used. Crude proteases derived from bacteria and fish viscera are cheaper and more common. Crude alkaline proteases of *Bacillus cereus*, *Bacillus subtilis,* and *Bacillus majovensis* are used to achieve 88% deproteinization. Alkaline proteases of marine fish and invertebrates are also used. The residual protein content in shell after deproteinization varies from 6-10%.

Packaging of Chitin / Chitosan

Chitin and chitosan are packaged is a high-density polythene woven gusseted bag laminated with 100-gauge low density polythene. It is also available as creams, capsules etc. Chitosan available as powder in 100g and 250g poly jars.

Potential applications of Chitin and Chitosan

Chitin and chitosan find applications in various fields such as water treatment, biomedical and pharmaceutical industries, food and beverages, cosmetics, agrochemicals and biotechnology.

Chapter-8

TRAITS OF FISH ENTREPRENEUR

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Entrepreneur

"An entrepreneur is one who organizes and manages a business undertaking, assuming the risk, for the sake of profit. The entrepreneur evaluates perceived opportunities and strives to make the decisions that will enable the firm to realize sustained growth. "An entrepreneur is a person having specific skill, ability, knowledge, awareness and self-confidence who bears the risk of operating a business in the face of uncertainty about the future conditions. The term "entrepreneurship" comes from the French verb "entreprendre" and the German word "undernehmen", both", means to "undertake". Fish-preneurship means undertaking a new business venture in fisheries to make it profitable. It comprises of activities as gathering of information, communication with chain partners, market orientation, strategic decision making, learning etc. Entrepreneurship involves a lot of 'special' skills of the farmer, communication and risk management, and competencies like leadership, initiative, openness to signals from society, vision, creativity, self-reflection etc.

Challenges for fishpreneurship

1) Knowledge and skill gap 2) Technology gap 3) Market gap 4) Entrepreneurial gap

1.Knowledge and skill gap

In spite of large numbers of available entrepreneurial fishery technologies, there is weak linkage of professionals with stakeholders with respect to acquisition of knowledge, capacity building and interface for instant solutions of field problems. Therefore, frontline extension should be rightfully utilized to awaken and sensitize the stakeholders about the scopes and opportunities that are available for entrepreneurship development in fisheries

2.Technology gap

Today the main concern is lack of technology transfer and dissemination to the right people at right time. Without using the appropriate technology, our products are getting low valued with poor quality that fails to fetch the market. This indifference to technology is proving to be very

expensive. Hence, disruptive extension system needs to be adhered to bring sustainable development through effective technology dissemination.

3.Market gap

Growers and producers have no access to market or lack proper understanding of market network as a result middlemen siphon away the profits Marketing expertise ought to be utilized for such a scenario

4.Entrepreneurial gap

Mostly the Indian farmers lack the basic entrepreneurial instinct to venture for start-up business. That may be due to lack of entrepreneurial motivation, social responsibility, achievement planning, risk taking ability, poor market linkage above all proper business plan, which needs to be addressed through various capacity building programmes.

Five Core Elements of Entrepreneurship

1. Key part of entrepreneurship is to identify opportunities that no one has earlier noticed. Such opportunities need not be large; these can even be small ones. Creativity and innovation from the core of entrepreneurship that enables the entrepreneur to think entirely new ways of working. Creative people are receptive to new ideas generated by other.

2. The entrepreneurs have an ability to apply the creativity to business problems. They understand the people and environment around them. They can effectively materially resource for the same. It is not enough to think creatively to think creatively, successful entrepreneurship demands that thoughts be translated into action and result. They need an ability of getting thing done.

3. Entrepreneur always takes rise. Their main task is evaluating rise for cutting across accepted boundaries, breaking rules and doing things in a different manner.

4. Entrepreneur focus on creating value by doing things in a cheaper, better and faster manner.

5. They have a sound belief in their ability to change the status quo- the way the things are being done presently. With their drive and passion to achieve success they change the way things are being performed

Characteristics of successful fishpreneur

- ✓ High achievement motivation
- ✓ Readiness for challenge
- ✓ Problem solving attitude
- ✓ An overpowering need to achieve
- ✓ Visionary and goal setting
- ✓ Positive mental attitude
- ✓ Dealing with failure

- ✓ Objectivity
- ✓ Risk taking propensity
- ✓ Respect attitude towards money
- ✓ Tendency to anticipate developments
- ✓ Resourcefulness
- ✓ Communication abilities
- ✓ Technical expertise
- ✓ Spirit of innovation
- ✓ Self-initiative and personal responsibility
- ✓ Competing against self-imposed standards
- ✓ Regularity and dedication to work
- ✓ Confidence in self-capability
- ✓ Time management

Thus, entrepreneurship can be defined as "creating of value by people working together toimplement an idea through the application of drive and a willingness to take risk.

Successful entrepreneur

1. **Need to achieve:** Entrepreneurs have got strong desire to achieve higher goals. Their inner self motivates their behaviour towards high achievement: most of the people dream of success but do not take any action towards achieving these dreams. Entrepreneurs with high n-Ach factor act continuously to achieve the goal and make their dreams come true. For them, winning is achievement

2. **Independence:** Most of the entrepreneurs start on their own because they dislike to work for others. They prefer to be their own boss and want to be responsible for their own decisions

3. **Risk-bearing:** Entrepreneurs are the persons who take decisions under uncertainty and thus they are willing to take risk, but they never gamble with the results. They choose moderate risk rather than play wild gamble. They, therefore, undertake calculated risk which is high enough to be exciting, but with a fairly reasonable chance to win

4. **Locus of control:** According to Rotter's locus of control theory, an individual perceives the outcome of an event as being either within or beyond his personal control. Entrepreneurs believe in their own ability to control the consequences of their endeavor by influencing their socioeconomic environment rather than leave everything to luck.

5. **Perseverance:** Entrepreneur has got the quality of sticking to job he decides to undertake. Once committed to a specific goal and course of action, entrepreneurs become absorbed to it. They

personally solve the problems that come across their way while setting up the project. They also work sincerely until the whole project is successfully implemented

6. **Positive self-concept:** Entrepreneurs are always positive in their action. Being an achiever, he directs his fantasies and dreams towards achievement of worthwhile goals and sets extraordinary standard of excellence in what he is doing. This is based upon his awareness of SWOT analysis, i.e. his strengths, weaknesses, opportunities and threats. He utilizes his positive knowledge to support his thinking. He never exhibits any negative attitude.

7. **Ability to find and explore opportunities:** Entrepreneurs are always alert to opportunities. They are very much quick to see and grab opportunities. They exhibit an innovative turn of mind and convert the problems into viable opportunities. They plan intellectually and anticipate carefully how to achieve their goals in realizing an opportunity.

8. **Flexibility:** Most of the successful entrepreneurs measure the pros and cons of a decision and tend to change if the situation demands. They never feel reluctant to revise their decisions. They are the persons with open mind without rigidity.

9. **Sense of efficacy:** Entrepreneurs are always oriented towards action for accomplishment of their goals. Being confident of their abilities, they find themselves as problem solvers rather than problem avoiders. They chalk out their goals for future and make planning to achieve them.

10. **Openness to feedback and learning from experience:** Successful entrepreneurs like to have immediate feedback of their performance. They modify their plans on the basis of the feedback they receive from the environment around them. They learn from their experience and never get discouraged having received unfavorable information. On the contrary, they are stimulated by unfavorable information to involve themselves sincerely in their own tasks to reach their desired goals.

11. **Confronting uncertainty:** Successful entrepreneurs are always optimistic and take every odd as the opportunity. They maneuver their environment in such a way that the works get accomplished rationally. Thus, they win by the application of their extraordinary insight and skill.

12. **Interpersonal skills:** Entrepreneurs are always comfortable while dealing with people at all levels. They interact with raw material suppliers, customers, bankers, etc... for different activities. As successful entrepreneurs, they should be persons who like working with others possessing the much-needed quality of interpersonal skill to deal with people.

13. **Need to influence others:** Once the entrepreneurs set their goals, they have to play the roles of manager too. For influencing others (n Power), a low need to establish emotional relationship (low n Affiliation), and a high need to discipline one's own self (to inhibit over expression of their personality) are essential

14. **Time orientation:** Entrepreneurs anticipate future trends basing upon their past experience and exposure. They stick to the time pragmatically while doing their jobs.

15. **Innovators:** Successful entrepreneurs are innovators. They constantly put their efforts in introducing new products, new method of production, opening new markets and recognizing the enterprise.

16. **Business communication skill:** In order to motivate others in the business entrepreneurs must possess good communication skill. Both written and oral communication skills are necessary for the entrepreneurs for running enterprise efficiently.

17. **Telescopic faculty:** Successful entrepreneurs always tend to think ahead. They have got telescopic faculties which make them think for the future. Future orientation makes them quite alert to the changing conditions of the time and they tend to produce goods and commodities as per the changing demands.

18. **Leadership:** Entrepreneurs should possess the quality of leadership. Leadership is the ability to exert interpersonal influence by means of communication towards the achievement of goals. Entrepreneurs as the leaders should provide the necessary spark to motivation by guiding, inspiring, assisting and directing the members of the group for achievement of unity of action, efforts and purpose. Hence, entrepreneurs by their own leadership styles and behaviour reduce the problems by proper handling of situations. Good administrative work depends upon effective leadership of the entrepreneur.

19. **Business planning:** Planning implies deciding in advance what, when and how to do a thing. Entrepreneurs should be equipped with skill and knowledge to prepare their business plan. A successful entrepreneur always follows the principles of management while planning for his business. The planning can act as a bridge between the present position and expected future shape of the enterprise. It provides a sense of vision to the entrepreneurs to cope with risky and uncertain situation.

20. **Decision making:** Decision-making skill is a fundamental characteristic of an entrepreneur. This implies the function of choosing a particular course of action at every stage of creation of an enterprise out of several alternative courses for the purpose of achieving specified goals. Hence, decision making is necessary at all times and mostly at conditions of uncertainty and risk.

21. **Ability to mobilize resources:** Entrepreneurs must have the ability to marshal all the inputs to obtain the end product. They have to mobilize 6Ms, i.e. Man, Money, Material, Machinery, Market and Method effectively to realize the final product as entrepreneurship is a function of gap filling and input completing

22. **Self-confidence:** Entrepreneurs must have self-confidence to accomplish the task effectively and efficiently. They must take decisions on their own in uncertain and risky situation and should stick to it confidently even if there occur initial setbacks

23. **Stress takers:** Entrepreneurs are capable of working for long hours and solving different complexities at the same time. As the captain of an industry or an enterprise, an entrepreneur faces a number of problems and in right moment he takes right Decisions which may involve physical as well as mental stress. He can face these challenges if he has the capability to work for long hours and keep himself cool under monotony

24. **Hope of success:** Hope of success is a significant quality of entrepreneurial personality. Entrepreneurs set their goals with a hope of success rather than fear of failure. This is because they set their goals on the basis of facts and their ability to maneuver them to their advantage.

SWOT analysis

SWOT is an acronym for Strength, Weakness, Opportunity and Threat

SWOT Analysis refers to identifying the strengths, weaknesses, opportunities and threats of an entrepreneur, person, company or organization. To innovate, an entrepreneur has to make a diagnosis of the current situation. The diagnosis of the current situation is done by conducting an Internal Analysis and External Analysis. Analysis of Internal and External Environment together is called SWOT Analysis. The Internal Analysis will cover the different functional areas like production, finance, marketing, R & Distribution and so on. More specifically, this may look into sales volume, market share, profitability and so on. This will reveal its strength and weakness The External Analysis will do the necessary scanning of the business environment to identify any threat and opportunities posed on the enterprise, its products or services. More specifically, this will include the industry performance, competitive activity and a review of the growth and decline of the user industries

STRENGTH is the positive internal factor and basic asset that would provide competitive advantage for the growth and development.

Some of the strengths are:

(i) Availability of necessary infrastructure.

(ii) Adequate production capacity.

(iii) Skilled manpower.

(iv) Good manufacturing control.

(v) Low cost of manufacture.

(vi) Good location.

(vii) Wide distribution network.

(viii) Motivated staff.

(ix) Efficient management

WEAKNESS is negative internal factor and the liability that can create disadvantage for growth and development:

Some of the weaknesses are:

i) Rising cost of operations.

(ii) Low level of motivation of staff.

(iii) Non-availability of raw materials.

(iv) Scarcity of capital.

(v) Outdated technology.

(vi) Inadequate infrastructure.

(vii) Shortage of trained technicians.

(viii) Lack of effective coordination.

(ix) Inadequate training in skills.

OPPORTUNITY is positive external factor and the ability to grow and achieve objectives in a given situation.

Some of the opportunities are:

1) Increase in disposable income.

2) Availability of appropriate technology.

3) Favourable government policies.

4) Availability of different task environment like market information, distribution outlets and media.

5) Presence of favourable cultural environment

THREAT is negative external factor that blocks the abilities to grow and develop for reaching ultimate goal Some of the threats are:

1) Shortage of power, water, fuel.

2) Rejection of product in the market.

3) Tough competition.

4) Fiscal policy resulting into increased taxes, duties, imports reservations, licensing

5) Obsolete technology

6) Resource crunch.

7) Changing customer tastes and preferences.

8) Prolonged economic depressions.

Skills in marketing of fish products. The skills that could be adopted by farmers in marketing of fish products successfully include the following. Survey the market to determine the size of fish products that buyers pay best price. Sort fish products using sizes, colour, species and level of processing. Package sorted fish in bags, paper cartoons or any other material of one's choice. Grade packaged fish products using quantity and quality of fish products. Label the packages appropriately to give clear instruction to the buyers or consumers. Fix prices for each packaged fish products based on market survey or demand. Transport packaged fish products to market or showcase them for sale at better price. Advertise the fish products locally and internationally through media or middlemen to attract buyers. Sell fish products to effective buyers at an agreed price with evidence such as receipt. Keep appropriate records of sales of fish products for sustainability, expansion and future references.

Challenges to marketing of fish Products

Challenges here are situations facing marketing of fish products which need great mental or physical effort of the agents in order to carry out the operations successfully. These situations test the abilities of all the marketing agents of fish products in one way or the other. The challenges include the following. Perishability of fish products: Naturally, fish products are high perishable and can easily get spoiled within a very short time if not handled properly. This condition forces the farmers and other marketing agents to sell of their products as soon as possible. Inadequate and poor processing facilities: Some of the facilities needed to process the products to a form that will enable the marketing agents to store it safely within a short time are not readily available and not adequate where available.

Poor quality fish products: The ability of fish products to store for a long time depends on the quality of processing. Some of the products supplied to the market by the farmers are contaminated and not well processed because they hasten to remove the products from their hand before they get damaged. Poor quality fish products spoil during marketing as the products move from one agent to another.

Inadequate storage facilities: Fish products especially captured fish take some time to be supplied by farmers which makes its supply seasonal.

This means that fish products have to be stored to make it available all the period of the year. But storage facilities that could be used for fish products are inadequate among the marketing agents. This puts the agents under pressure to buy fish in a manageable quantity that can be disposed of before it gets spoiled. Inadequate transportation system: This involves road and vehicles used for transporting fish products. The poor road networks and scarcity of haulage vehicles in most

countries in the tropics make it difficult to move fish products from the area of production to the area of consumption, abundance to scarcity. Poor road system increases the cost of buying and selling fish products, reduces payments to farmers and increases prices to consumers. It also results in loss of fish products along the marketing chain. Small quantity supply: Most of the producers of fish (farmers) are peasants and engage in small scale of production, as a result, they only supply small quantity to the market. This forces the marketing agents to buy fish in small quantity irrespective of their capital, hence increase the cost of transporting the fish products each time of purchase.

Poor capital: Some marketing agents started with very little capital which makes it difficult for them to purchase large quantity of fish products, store and transport the products. Poor capital makes it difficult for wholesalers to buy large fish products of farmers who may want them to pay for their fish before they get matured for sale. It also hinders retailers from buying enough and selling their goods to the consumers on credit to keep them. Inadequate marketing infrastructure: Most markets especially in the village lack infrastructure such as pipe born water, cold rooms, electricity, telephone services that are necessary for processing and preservation of fish products to avoid spoilage.

Inadequate marketing information: Most farmers and other marketing agents do not normally get adequate information on the current market prices of fish products in their store, as such, they sale of their products or goods with little or no gain. Some lack marketing facilities like telephone, internet gadgets that could enable them to buy and sell their fish products without actually travelling to the market or having contact with the customer.

Instability of market prices: The prices of fish products are unstable and have never remained same for one full year without any fluctuation. The worst of it is that the fluctuation is hardly forecast or determined by the marketing agents beforehand. The instability of the prices is advantageous and disadvantageous depending on the fish products and the agents involved. For instance, decrease in fish products may discourage farmers from increasing the scale of their production which will affect the quantity of their supply later. In the same vein, decrease in price will encourage other marketing agents such as wholesalers to buy more fish products from the farmers and the retailers from the wholesalers but will discourage supply by all the agents including farmers unless otherwise forced by other unforeseen factors.

Lack of uniform measurement: There is no uniform measure or standard for determining the size, quantity or amount of fish products to be sold at what prize. The prices are decided by each agent depending on market situations such as availability of the product, season of the year, location of the

market among others. This is why the prices of fish products differ widely among countries in the tropics and states or cities within a particular country.

Policy in marketing of fish products: Marketing of fish products needs to be carried out within a supportive policy, legal, institutional, macro-economic, infrastructural and bureaucratic environment. The marketing agents and others cannot make investments in a climate of arbitrary government policy changes, such as those that restrict imports, exports and internal produce movement. The marketers find it difficult to function if their trading activities are hampered by excessive bureaucracy.

Inappropriate law can interfere and reduce the efficiency of the market, increase the costs of running business and retard the development of a competitive private sector. Weak support institutions, such as agricultural extension services, municipalities that operate markets inefficiently and export promotion bodies, can be particularly destructive. In addition, the ever-present challenge of corruption can seriously influence marketing of fish products efficiency in many countries in the tropics by increasing the transaction costs faced by agents in the marketing chain.

Presence of marketing agents: The agents in marketing of fish products are the auctioneer, wholesaler, retailer and the vendor. These agents have great impact on the sources of marketing, costs such as transport, commission charges and market margins received by the intermediaries such as trader, commission agent, wholesaler and retailer. They decide the price to be paid by the consumer and share of it received by the farmer/producer. An agent or a channel is considered good or efficient if it makes the produce available to the consumer at the cheapest price and also ensures the highest share to the producer. The cost of fish products is directly proportional to the number of the agents involved in the market chain as each agent involved will increase the cost to make profit. So, the smaller the number of agents involved in a chain, the lower the cost of the fish products. The stronger the marketing agencies, the better for the marketers and consumers. The agents involved in marketing of different fish products are summarized thus

- ✓ Producer (fish farmer) – fishermen cooperative society – wholesaler – retailer – consumer.
- ✓ Producer (fish farmer) – fishermen cooperative society/wholesaler – processing industries – wholesalers – retailer – consumer
- ✓ Producer (fish farmer) – fishermen cooperative society – retailer – consumer
- ✓ Producer (fish farmer) – wholesaler – retailer – vendor – consumer
- ✓ Producer (fish farmer) – wholesaler – retailer – consumer
- ✓ Producer (fish farmer) – retailer – consumer
- ✓ Producer (fish farmer) – consumer

Chapter-9

PROSPECTS OF CRAB AND LOBSTER FATTENING FOR LIVELIHOOD SUPPORT

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PROSPECTS OF CRAB FATTENING

The mud crabs inhabit marine as well as brackish water environments. Mud crabs of genus *Scylla*, also known as green crabs or mangrove crabs constitute an important secondary crop in the traditional prawn or fish culture systems in the Asian countries. In India the mud crabs have come into prominence since early eighties with the commencement of live crab export to the South East Asian countries which has created a renewed interest in the exploitation as well as in the production of mud crabs through aquaculture. Crab is exported in the form of live mud crab, frozen whole crab, pasteurized crab meat, frozen stuffed crab, frozen cut crab without claw, and Frozen cut crab with claw. The importance of live mud crabs as an export commodity has opened up great opportunities for crab farming. It has high demand and price in the export market. Culturing of the mud crab is not economical and hence the mud crab fattening being profitable is practiced. Fattening mud crab is being undertaken in the states of Andhra Pradesh, Tamil Nadu, Karnataka, Odisha and West Bengal.

Prospects of mud crab fattening

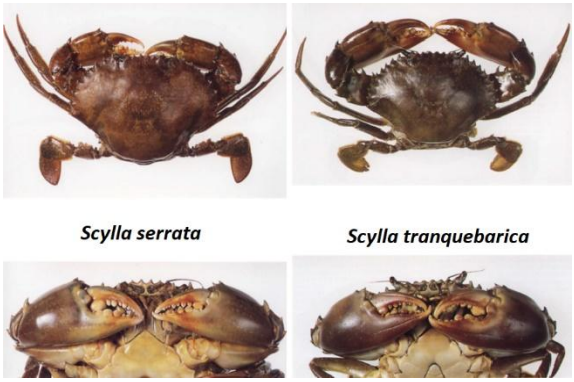
Mud crab fattening has been considered as most profitable venture and as a method for small-scale aquaculture as the

- Extensive potential shallow coastal waters, lagoons, brackish waters lakes, estuaries and intertidal swampy areas are available along the east and west coasts in the country.
- Fattening of crab is profitable, because of the fast turnover, relatively short period between investment and returns low operating cost, high survival rate due to control of cannibalism and short rearing period and good market demand for finish product.
- Crab fattening, could be carried out on part time avocation and needs relatively low capital. Viable technology is available for this small-scale operation and the scope for development is promising.
- Fattened crabs can be stocked at higher densities (15 crabs/sq m) compared to grow-out systems (1 crab/sq m) as no moulting occurs and therefore losses due to cannibalism are reduced to a great extent and

- Short production time reducing the risk of losing crabs to disease and thus rendering a higher survival rate for fattening (>90%) compared to grow-out systems (40%).

Crab Species for Fattening

Two species of mud crabs namely *Scylla serrata* and *S. tranquebarica,* are found in the inshore sea, estuaries, backwaters, coastal lakes and mangroove swamps of all maritime states on the main land and the creeks and bays of Andaman and Nicobar Islands. Both the species co-exist in the inshore sea as well as in the inland brackish waters preferring muddy or sandy bottom. These two species are used for fattening activity as they are relatively abundant in the coastal area in the inshore sea, estuaries, backwaters, coastal lakes and mangrove swamps. *Scylla serrata* is locally called 'giant mud crab'. The colour is greenish with white polygonal markings on the swimming and walking legs, chelipeds, carapace and with orange claws. It has deep serration and pointed frontal spines. The spines at the dorsoposterior side of the merus are more prominent. *Scylla tranquebarica* has almost similar features with the *serrata* species except that the colour of the chelipeds is purple and polygonal markings are only prominent at the cheliped and swimming legs and gradually fade towards the anterior walking legs. It has shallow serrated and blunt frontal spines and the spines at the dorso-posterior side of the merus are not as prominent as the *Scylla serrata*. This difference could not be identified at the juvenile stage. Only when their size is reached sub adult (or) >90 g, *Scylla serrata* can be differentiated from the *Scylla tranquebarica*. The sex of the crab can be identified even at the juvenile stage.



Biology of Mud Crabs

Mud crabs grow to a very large size of about 22 cm in carapace and about 2 kg in weight. The crabs belonging to the species *S. tranquebarica* is free living and grows to a large size with carapace width of 22 cm and those of species *S. serrata* have borrowing habit and grow to about 12.7 cm in carapace width. Mud crabs are omnivorous and they feed on a wide variety of food items such as shrimps, crabs, bivalve molluscs and fish. The females reach sexual maturity at a size of

about 12 cm in *S. tranquebarica* and 8.5 cm in *S. serrata* in the brackish water. Both the species are continuous breeders with peak breeding seasons which vary from place to place. The peak seasons of seed abundance is May to October along the southwest coast, December to May in Madras coast and March to June in the Chilka Lake. Each crab spawns once in two months. The number of eggs carried by *S. tranquebarica* are about 1.1 to 7.0 million and by *S. serrata* are 0.5 to 0.9 million. The berried females migrate from estuarine areas to the inshore sea. The eggs hatch out in the sea and undergo metamorphosis and then they migrate to brackish water areas and spread to different parts of the estuarine systems.

Crab Fattening

Crab fattening is essentially stocking of soft-shelled crabs or water crabs that are held in smaller impoundments for 20 – 30 days till the shells are hardened and they 'flesh out'. Crab fattening can be carried out in ponds, cages or pens. The peak season when the crabs are available for fattening is between July to November every year. The availability of the water crab in this region has been posing a problem especially during the lean season.

I. Crab Fattening in Ponds

Small ponds ranging from 0.1 to 0.5 ha in size with a water depth of 1.5 m are generally selected for the purpose. The pond should preferably have a sandy bottom. Bunds should have a minimum of 1.0 m width at the top to prevent crabs from escaping by borrowing through the bunds. Crabs are capable of climbing over the bunds, which is prevented by fixing overhanging fences on dykes. Fencing of height between 0.5 to 1.0 m over the dyke is done with materials like bamboo sticks, bamboo poles and knotless nets, asbestos sheets, fibreglass panels, etc. As the crabs are highly cannibalistic especially on freshly moulted animals, 'refugee cages' made out of hollow bamboo pieces, cement pipes or stones are placed inside the pond to minimise mortality.

(i) Water Supply and Drainage

Water exchange is through tidal water. Sluice gates may be used to regulate the inflow and outflow of the tidal water. The sluice gates are fitted with bamboo screens to prevent the escape of crabs. In regions where tidal influence is less, sea water is pumped in.

(ii) Pond Management

The pond is prepared by draining out the water. The pond is then allowed to dry in sunlight before the liming is done. The water is let in during the high tide or sea water is pumped in to a height of 1.5 m.

(iii) Stocking

Soft-shelled crabs of size 8 cm Carapace Width and above or crabs of more than 550 gm are stocked in the density of 1 crab/m^2. The stocking density is normally 1 crab/1 to 3 m^2.

(iv) Water Quality Management

Monitoring of water quality parameters such as temperature, salinity, dissolved oxygen concentration, pH, water colour and daily transparency is important for the maintenance of good water conditions. Mud crabs are highly tolerant to varying salinity conditions, so brackish water would be ideal for crab fattening operation within a temperature of 23 – 30º C. Optimum range for water quality parameters are as follows: Water temperature: 25 to 35 º C; salinity: 10 to 35 ppt; Dissolved oxygen: 4 ppm; pH: 8.0 to 8.5; Water depth: 80 – 100 cm; Transparency: 30 to 40 cm.

(v) Feeding

Mud crabs are omnivorous and they feed on a wide variety of food items. They feed preferably on molluscs by crushing them with their claws. They also feed on small crabs, slow moving animals, small fish and shrimps which they catch as they lie camouflage in the muddy bottom of their natural habitat. Feed comprises 40% of the total cost of production. If brown mussel meat is available and cheap, a mixed diet of 75% brown mussel meat and 25% trash fish is recommended. The crabs are fed 10% of the crab biomass per day twice daily when the mean carapace length is < 6 cm and 5% when > 6 cm with 40% of the daily feed ration given at around 7.30 am and 60% given at around 5 pm.

(v) Harvesting

The crabs are harvested after the shell becomes sufficiently hardened and before next moulting. The harvesting is done by draining the pond and using scoop nets and ring nets with baits. Harvesting should be done in the early morning hours or evening to prevent mortality of crabs due to overheating of water at noon time. In a year 9 to 10 cycles of fattening can be taken from a pond.

II. Crab Fattening in FRP Cages

The FRP cage of size 3’ x 3’ x 1.5’ consist of nine chambers. The cages are kept immersed in water and tied with bamboo poles for support. The cage should be kept in running water and some coconut leaves are to bespread over cage.

(i) Stocking in Cages

Mud crabs are acclimated before releasing into cages to prevent thermal and salinity shock that lead to death. Stocking of mud crabs in the early morning or late afternoon when water temperature is low is preferable. Mud crab juveniles are stocked individually in each chamber.

(ii) Feeding

The crabs are fed with clam, mussel and trash fishes at 5 - 10% of the crab biomass per day twice daily.

(iii) Cage Maintenance

Crabs and cage need to be cleaned once in a week. Settlement of Oyster and plankton on carapace need to be cleaned.

(iii) Duration of Fattening

The fattening duration is about 20 -30 days. The cages are checked from the 10th day of stocking for the hard crabs. If hard crabs are found, they need to be harvested from 10th day onwards and up to 30 days. The survival rate of the crabs is 90%.

(iv) Harvesting

Selective harvesting is the removal of harvestable size and fat mud crabs several times during the culture period in the range of 500 to 750 gm and above by hand picking method. The average increase in weight after fattening is around 40 – 50 gm, crabs may be harvested totally at the end of 20 to 30 days culture by hand picking method. Harvested crabs are immediately placed in a moist and shady, cool place. Mangrove fronds should be placed in the harvest container. Cool water is poured frequently on the crabs. The crabs should not be exposed to heat nor should they be bunched and hanged, as this would reduce the turgidity of the crab mussels. If algal and barnacle fouling are found on the carapace, they should be removed by brushing.

(v) Packing

The first pair of largest legs with pincers / chelate legs of each crab should be firmly tied up to the body by jute/nylon thread to avoid fighting among them. A stick should be firmly placed on the carapace for instant arrest of its movement and the thread needs to be placed in between the frontal portion of the body and chelate legs. After keeping the chelate legs in folding posture, the thread should be coiled around their fingers (chelae) and both the ends of thread need to be put into a double knot at the posterior end of the crab. Wet cloth is kept in between the packed layers of crabs to enhance moist and cool condition during transport from place to place. The tied-up crabs are washed with fresh seawater and packed either

baskets or in perforated thermocol boxes or in wet baskets.


Packing Mudcrabs

Different forms of crabs for export

Prospects of Lobster Fattening

Marine resources of India constitute a coastline of 8118 km, Exclusive Economic Zone (EEZ) of 2.02 million sq. mt., and a continental shelf area of 0.53 sq. mt. India is the third-largest fish and aquaculture-producing country, accounting for 7.96% of the total global fish production. India is one among the top five fish exporting countries in the world. About 17% of India's agricultural exports are fish and fish products. In 2021-22, the country exported marine products of 1.36 million MT, worth of US$ 7.76 billion. In addition to shrimps, India exports varieties of fish, squid, cuttlefish, octopus, crabs, lobsters, clams, mussels etc. Lobsters are one of the most valuable and highly priced marine crustaceans in India, as well as an important export commodity either in live condition or in frozen form.

Lobster Diversity in India

Lobsters are decapod crustaceans belonging to four families: Nephropidae (clawed / true Lobsters), Palinuridae (Spiny / rock lobsters), Scyllaridae (Sand / slipper lobsters) and Synaxidae (Coral lobsters). Commercially exploited lobsters in India belong to the families, Palinuridae and Scyllaridae. Among the 38 species constituting the lobster fauna of India, only four species of palinurids [*Panulirus polyphagus* (mud spiny lobster), *P. homarus homarus* (Scalloped spiny lobster), *P. ornatus* (Ornate spiny lobster), *Puerulus sewelli* (Whip lobster)] and one species of

scyllarid, *Thenus unimaculatus* (Flathead lobster / Sand lobster)] significantly contribute to the fishery.

Lobster Fishery in India

Lobsters are one of the highly esteemed seafood delicacies and currently fetch the highest unit value among commercially exploited marine resources. Although lobster constitutes only 0.05% of the annual marine fish catch of India (2010–2015), export fetches an average Rs. 196 crores (USD 32 million) in foreign exchange annually. The multispecies resource is intensively exploited by both artisanal and mechanised sectors, with the latter contributing around 67% of the total catch. Though lobsters are distributed almost throughout the Indian coast, major fisheries are located on the northwest, northeast and the southern Indian region. The two north-western states Gujarat and Maharashtra and the northeast state of West Bengal together contribute an average 65% of the total annual country catch (2007–2014). *P. polyphagus* forms 61% of the total annual catch and is the dominant species along the northwest and northeast coasts. This species is found in muddy substrates and often near river mouths in depths, less than 40 m. The fishery is dominated by sizes ranging from 15 - 20 cm in total length. *P. homarus homarus*, *P. ornatus* and *T. unimaculatus* are the major species constituting the fishery along the southern region. The scalloped spiny lobster, *P. homarus homarus* is mainly distributed along the South West and South East Coast and are caught by traps, bottom set gill nets and occasionally in trawls. This species inhabits shallow waters mostly between 1 and 5 m in rocky areas and their size in the fishery ranges from 15 - 20 cm. The ornate spiny lobster, *P. ornatus* mainly forms a fishery on the South East coast of India in the Gulf of Mannar. This is one of the largest of the *Panulirus* species and is caught in gill nets, as well as in trawls. The fishery is dominated by sizes ranging from 25 - 35 cm. The major share of the lobster landing in India is held by the trawlers, forming 67% of the total annual catch. The share of the state of Gujarat to the total annual lobster landing is 28%, followed by Maharashtra, 27%; Tamil Nadu, 15%; Kerala, 13%; West Bengal, 10%; and Andhra Pradesh, 5% (2007–2014). The deep-sea lobster fishery is centred around the southern region with meagre landing in recent years.

Prospects of Lobster Fattening

India is one of the prominent countries in lobster production with the annual catch fluctuating between 2000 - 3000 tonnes. Fishery trend showed that lobster catch increased from an annual average of 1562 t during the period 2003 -2014 to 2466 t during 2015 - 2019. Lobsters, especially live ones have a prominent place in the sea food export market in terms of both demand and price from countries such as Japan, Korea, China, Taiwan, Europe and United States of America. The main lobster landing centers in India are Veraval, Mumbai, Kozhikode, Colachel, Mandapam, Thoothukudi and Chennai. The ever-increasing demand for Indian spiny lobsters in the

world sea food market and high price have led to over exploitation of the lobster resources in the seas around India. Unlike the American lobster, which has a relatively short larval life (several weeks), the rock (spiny) lobster has a larval life of about six or seven months. The technical difficulties presented by the fragile, demanding requirements of the early life stages discount the use of traditional hatchery methods. The advantage of lobster fattening is that it skips that difficult stage of larval life, allowing the capture of juvenile lobster for commercial cultivation. The best way of utilizing the juveniles is to fatten them to bigger sizes for value addition. Fattening can be used for value addition of bigger lobsters and for growing lobsters in late or early moult stages, which do not survive transportation. This has led to the need for farming the lobsters, utilizing vast resource of juveniles that are caught and underutilized. Live lobsters of *P. ornatus* weighing 500 g 1000 g are in great demand in the South East Asian market. Medium sized *P. homarus* and *P. potyphagus* are exported as whole cooked and frozen to Japan and other European countries. *P. ornatus* is the most promising species as it grows faster in captivity. Since they attain maturity only at a larger size (700 - 800 g weight), juveniles of this species are most suited for fattening to the target size of 500 g, which could be achieved in 3-4 months. Fattening of larger sizes (300 - 350 g) to the prime size might be possible in three months. Lobster fattening can be carried out in indoor (Cement tanks) and outdoor systems (Sea cages).

P. polyphagus

P. homarus homarus

Juvenile Lobsters

P. versicolor

P. ornatus

Fattening in Indoor Systems

The indoor system required for fattening comprise of rectangular cement tanks of about 5 tonne capacity (4 m x 2.5 m x 0.75 m). Aeration pipes need to be fixed along the bottom of the tank to ensure a uniform water circulation. Materials such as PVC pipes, hollow cement blocks or boulders, tiles etc., should be provided as hide-outs. About ten lobsters can be stocked per square metre. All species of lobsters can be held together for the fattening purpose. The major steps involved in fattening are collection and transport of juveniles to the fattening site, acclimatization and stocking, feed management, water quality and disease management, sampling and harvesting.

Lobsters weighing around 90 g can be used for fattening as the growth rate is high (35 g/month) in this size range. Careful handling is essential for transportation of live lobster. Animals have to be acclimatized for two weeks before stocking in fattening tanks. Prior to acclimatization, animals should be quarantined and fed with the proposed feed (bivalves) for fattening. Stocking can be done based on the size, ranging from 6 – 30 Nos./m^2 for lobsters of size range of 50 – 150 g. Approximate initial weight of each lobster should be determined so as to know the quantity of feed that has to be provided to attain target growth of the animals at the end of the fattening period. Before stocking, newly collected lobsters should be maintained in well-aerated clean seawater tanks. Natural food items such as mussels, clams, squids, trash fish etc. could be used as fattening diets. Artificial diets could be used as supplementary diet for fattening. Initially, 4 - 5 % of body weight has to be fed to the lobsters and subsequently the feed quantity is increased or decreased depending upon their consumption. Feeding has to be done only once daily during the evening hours between 4 .00 - 5.00 p.m.

In lobster fattening, the main input is the feed. Although the feed given is live, chances for the increase in the organic load is still high only. Thus, the water quality management methods such as aeration, water circulation, and water exchange must be done regularly to maintain optimum culture conditions for lobsters. Although some general ideas about water quality in tanks can be obtained from visual observations, a much better picture can be obtained from chemical and physical measurements such as salinity, temperature, pH, dissolved oxygen, ammonia and nitrate. 80 - 90 % water exchange should be done every morning. The optimal range of physico–chemical parameters of the culture water to be maintained during fattening period are as follows: Salinity: 30 - 3 5ppt; Temperature: 26 - 33°C; pH: 7.5 - 8.5; Dissolved oxygen: > 4.5 mg/L; Total ammonia: < 1 ppm; Free ammonia: < 0.25 ppm; Nitrate: < 0.25 ppm.

Growth of the lobsters can be assessed by sampling the animals once in every thirty days. Growth in lobsters occurs through the moulting phenomenon. The frequency of moulting depends on the size of the animal. Small sized animals have increased moulting frequency than the bigger

sized ones. Ten days before the date of harvesting the lobsters should be given a quarantine treatment using 0.5 ppm malachite green for a period of one hour in order to remove the algal deposits if any in the carapace of lobsters. On the day of harvesting, water level should be decreased to 0.5 m and lobsters can be harvested using a hand net without damaging the antennae or other part of the body.

Fattening in Outdoor Systems

The steps involved in outdoor lobster fattening are site selection, cage deployment, stocking, feeding, sampling, cage maintenance and harvesting.

(a) Iron Cages

Iron cage designed by NIOT has a main frame of 2.5-inch GI pipe with steel woven mesh (2 m x 2 m x 1.2 m) and accommodates four inner cages (0.75 m x 0.75 m x 1. 1 m) with two layers of nylon mesh with sizes 15 mm x 15 mm (inner) and 5 mm x 5 mm (outer). The volume of each inner cage is 0.65 m^3. A lifting arrangement with pulleys is provided for handling these inner cages at site. The frame has four buoyancy 'modules made of polyethylene containers of 200 L each filled with PUF foam and sealed properly.

Site selection determines the potential yield and cost of shed construction for the fattening activity. The cages can be deployed about 1.5 km from the shore and juvenile lobsters can be stocked at a density of 1 5-20/m^2. They can be fed with the feeds available near the site like clams, trash fishes and mussels. Growth performance of the animals can be assessed at an interval of every thirty days. Periodical cleaning of the cages should be done to remove any adhering organisms. The animals also should be monitored regularly to check for the presence of any infestations or epibionts colonizing on them. Depending upon the effort taken by beneficiary the profit will vary.

(b) FRP Cages

FRP cages with following specifications can be used for Lobster Fattening.

- Top (5'×5') Neck (4'×4')
- Main Hold: Top: 1.5 m x 1.5 m; Bottom: 1.35 m x 1.35 m; Height: 1 m; Door size (mouth) – 1.5 x 1.5 feet; with all side holes

This cage needs to be placed appropriately using weights in shallow coastal water which is free of pollution. Short PVC pipes need be provided as hide-outs inside. The major steps involved in fattening are collection and transport of juveniles to the fattening site, acclimatization and stocking, feed management, sampling and harvesting as mentioned earlier.

Fattened Lobsters Ready for harvesting

Harvested Fattened Lobsters

Conclusion

Crab fattening can be undertaken as an alternative livelihood option for the fishermen / fisherwomen. This has proved to be a great success not only in terms of generating extra income to the family but also in creating an awareness among fisherfolk about the value of marine resources and the need for conservation and sustainable utilization.

Like crab fattening, lobster fattening can also be undertaken as an alternative livelihood option by the fishermen / fisherwomen. This has also proved to be a great success not only in terms of generating extra income to the family but also in creating an awareness among fisherfolk about the value of marine resources and the need for conservation and sustainable utilization. Meanwhile, lobster fishing should be done responsibly. Catching juvenile and berried lobsters selectively should be avoided.

Chapter-10

PREPARATION OF BANKABLE PROJECTS/DETAILED PROJECT REPORT IN FISHERIES

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Introduction

Detailed Project Report (DPR) is an essential component of the project and hence to be prepared carefully. Once the planning and the designing part of a project are completed, a DPR is prepared. A DPR is a very extensive and elaborative outline (360 degree view) of a project which includes essential information on resources and tasks to be carried out. It is the final blueprint/practical view point of a project after which the implementation and operational process can occur. Also, the roles and responsibilities are highlighted along with the safety measures so that execution can be carried out hassle-free.

Why DPR?

DPR is a vital document which is mandatory while applying for any project finance. The financing institute inspects the project report thoroughly to ascertain the various prospects of the project. The document has the vital data which has been used to appraise any project and fund that covers data and stats from every aspect of the business *e.g.*, financial, technical, economic, manufacturing or service-related aspects. To make the financing organisations' task easy and get quick loan approval, it's essential to have a precise, up to the mark & pitch-perfect DPR.

Content of a DPR

A DPR should contain the information related to

- Location
- Land to be used
- Product to be manufactured
- Manufacturing process
- Annual manufacturing capacity
- Pricing of the machinery used for production
- Raw material to be used, necessary electricity, water, number of work force, advertising and marketing expenses, any other financial aspects

- Importantly, the economic viability of the project

Objectives of a DPR

Objectives of a DPR include i) feasibility analysis of any project and ii) to help the financers to get an in-depth insight into the project on various aspects *viz.*, financial, social, economic, technology and design.

a) Financial aspect

DPR helps the analysts to get an in-depth understanding of how a business will perform in the future financially since it contains a projected profit and loss account, estimated sales account, production cost, estimated revenue, gross profit and net profit. Also, explains the projected cash flow statements and fund flow statements in the upcoming period of 3 years.

b) Social aspect

Analyzing the relationship between the proposed project and the society is critical as the project depends on the society for its employment, infrastructure, consumption, profit, marketing and every other factor that can influence the business. So, it's vital to understand how the proposed project will impact on the society and vice-versa. As a business that depends solely on society, it's important how it will be following its Social Responsibility. The DPR must have a detailed dissection of how the project intends to give back to the Society once the production commences.

c) Economic aspect

Every business needs a continuous flow of capital for smooth operations and hence essential to mention the primary source of funding for the proposed project in the DPR. Apart from funding from external sources, the information about the owner's financial status and the details of borrowed funds should also be mentioned in the DPR. Helps the lender to understand the economic aspects of the proposed project and how it will operate once they lend money. The estimated cost of the entire project must be broken down into the following parts:

- Expenses towards the purchasing or leasing of Land
- Construction of infrastructure
- Machinery & equipment
- Preliminary expenses
- Preoperative expenses
- Working Capital

Also helps understand the analysts about expected financial sources along with the norms related to equity financing and debt financing.

d) Technology and design aspect

Helps the analysts to understand whether the proposed business will be able to cope with the rapidly changing technologies and consumer demands. Now the technologies are changing at a rapid pace. Any business with outdated technology or even technology that is working fine right now but can't withstand the onslaught of rapidly changing customer needs cannot survive for too long. So the lender will be keen to know about the technology that the proposed business will be utilizing to stay on the top in the future.

Preparation of DPR

The process of preparing a DPR for any financial firm needs a lot of attention and precision. There is no fixed format for the DPR, but all the financial institution accepts a generalized form.

General format of a DPR

a) Introduction page

   Should contain the potential of the business, its needs, finance & fund required.

b) Scope of the proposed project

   Should contain detailed information on the performing activities once the business commence.

c) Details of products and services

   Should contain detailed information on the products and services the business is producing.

d) Location of proposed project

   Should contain the detailed information about the exact location where the business will be conducted.

e) Raw material

   Must mention the details about the raw material necessary for the project.

f) Equipment and machinery description

   Details of all the machinery and equipment required for the project must be mentioned.

g) Details of promoters

   Qualification and experience details about the promoters along with their financial status should be mentioned.

h) Details of employees

   Mention the education details and their experience in the relevant industry.

i) Market potential of our product or services

   Mention how well the product or service can perform in the market and what is the future potential for the same.

j) Marketing tactics

Mention what marketing routes to advertise the product or services.

k) Estimated project cost

Disclose what the whole project will cost.

l) Utilisation of funds

Explain how the allotted fund will be utilized.

m) Source of financing

Mention of all financial sources.

n) Financial statements

A detailed insight into the previous Balance Sheet, Profit and Loss Statements for the previous three years and Cash flow statement have to be provided.

o) Profitability ratios and Break-even evaluation

p) Conclusion

Content of DPR

The DPR should include a specific detail about the company consisting of the business structure, how long the company has been in the relevant industry and other information. Should also have details about the promoters of the company, their experience and qualification. The information about the product or the services that are provided is also needed. The DPR must contain the Market analysis performed before deciding to move ahead with the project. Should include brief information on the following factors:

- Target Customer Base
- Potential growth
- Nature of Market
- Objectives of sales
- Marketing expenses
- Proposed Market share of the project
- The demand for the product or services at multiple levels
- Distribution channels

The project report must have complete detail on the total capital requirement of the project. It must have detailed information on the sources of finance too. Apart from this, the information about the owner's fund and the borrowed funds must also be included in the DPR. A brief on how the proposed project will generate employment in the locality and the information related to the necessary skilled and unskilled labour should be included. Additionally, the plan on how to market and advertise about the product or services and the plan to carve a niche in the market and any after-sales services have to be included.

The DPR should have precise information about when each phase of the project will start functioning. The timetable of various proposed activities should be prepared systematically. This helps the analysts and financial institutes to understand at what stage and what interval finance is needed.

SWOT analysis for a project is vital for a DPR. It helps the financial institutes to understand how the business can grow in a highly competitive market. Shows how in-depth market research has been performed while planning the proposed project. Including a well-planned SWOT analysis in the DPR can prompt the financial institutes to lend the necessary funds quickly. No financial institution is interested in investing money in the project unless a detailed feasibility report is included in DPR. Also, helps the investor understand how feasible the project is and what is its strength.

Benefits of DPR

- Helps in Cost Benefit Analysis
- Helps in identifying the risk
- Helps in identifying the ROI
- Assure performance for reliable quality
- Assess business weakness and strength
- Helps in getting funding/investment
- Helps in restructuring decisions
- Determines the payback period
- Compares Budgeted Vs Actual figures

Feasibility Study

A feasibility study is an in-depth examination of a project's potential for success and the goal is to determine whether the project is even possible with the resources the company has, generate sufficient cash flow to justify its cost, remain viable for the long term and good fit with the company's mission and other activities

Challenges

Setting clear goals and objectives, Impractical deadlines / Time, Project scope and Budget are some of the challenges in DPR preparation which need to be taken care and addressed accordingly to get the financial support from the funding agency to take up any economic activity.

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