MPEDA Newsletter

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INDIA INTERNATIONAL SEAFOOD SHOW – 2018 SPECIAL ISSUE

WELCOME to GOA

21st INDIA INTERNATIONAL SEAFOOD SHOW 2018

27 – 29 January, 2018

Open Sports Complex Ground, Fatorda, Margao, Goa

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COVER IMAGE : Fishing activity in Goan village Beach
PHOTO : Jakob Alvares

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Dr. A. JAYATHILAK IAS
Chairman

Dear friends,

Season's greetings to all of you! I wish that 2018 may bring all the prosperity in your business and earn more production and export benefits to the country. The India International Seafood Show is visiting the West Coast after 10 years, since the 2008 edition in Kochi. The show is coming back to Goa, which is known for its beaches and seafood delicacies, after 15 years. MPEDA is sure that this edition of seafood show will give a lot of impetus to the seafood production and trade in the West Coast, which is yet to tap its aquaculture potential adequately.

Recently, we got an information that the U.S. authorities have decided not to be rigid on the data supports required under Seafood Import Monitoring Programme (SIMP) till a time the technical system is compliant to the programme requirements and to avoid potential disruption to the trade. A lot more is to be done on the technical and structural issues related to the programme, it is also likely that the inclusion of shrimp in the programme may also be done by treading a safe path.

MPEDA is glad to announce the commissioning of its new Quality Control Laboratory at Nayapalli in Bhubaneswar for the testing of Chloramphenicol and Nitrofuran metabolites in fish and fishery products with state-of-the-art facilities. The laboratory has recently got the accreditation from National Accreditation Board for Testing and Calibration Laboratories (NABL) and approval from the Export Inspection Council of India (EIC). This lab intends to accept commercial samples too.

I would like to congratulate the scientists of the Central Institute of Fisheries Technology (CIFT) for developing a rapid detection kit that can be used conveniently by individual buyers to determine formalin and ammonia contamination in fish. This provides access to the common man to detect the presence of these two contaminants at the purchase point or in their kitchen. I am sure that this small step will move a long way in increasing the consumer awareness and alertness about the purity of their purchase, indirectly forcing those handlers to cleanse the system.

Another heartening news was the withdrawal of the notification issued on November 30 by the Environment Ministry under the Prevention of Cruelty to Animals (Aquarium and Fish Tank Animal Shop) Rules, 2017 which stipulated certain hard conditions that were potentially affecting the aquarium business, both domestic and international. MPEDA along with other stakeholders and departments had taken up the issue with the concerned Ministry and cited the flaws in the notification that harm the trade.

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Though our exports to Thailand predominantly consist of frozen fish, the recent temporary ban imposed by Thailand on the import of shrimps to prevent the spreading of Infectious Myonecrosis Virus (IMNV) from India may affect our share of US$ 14 million consuming close to 100 containers. MPEDA has already taken up the matter with the Ministry of Commerce and Industry and also with the Indian Embassy in Bangkok. Citing biosecurity issues are becoming common for import countries to restrict the trade.

The move by the Andhra Pradesh Government to have aqua zones and closure of unauthorized shrimp hatcheries will be helpful in declaring contaminant/disease free zones and to curb the spread of pathogens. In the international trade, such measures could assist the export of shrimps addressing contamination and biosecurity issues.

Thank you

21st India International Seafood Show 2018

A Curtain raiser

Welcome delegates!

Boosting India's marine products to achieve export target of US$10 billion by 2022; safe and quality seafood from India to the European Union (EU), implications of GST for the seafood sector, and recent advances in global aquaculture will dominate the proceedings of the 21st India International Seafood Show (IISS), a showpiece event of Asia's marine sector, being held in Goa's commercial capital Margao from January 27-29.

'Safe & Sustainable Seafood from India' is the focal theme of the three-day biennial exposition, being jointly organised by the Marine Products Export Development Authority (MPEDA), and the Seafood Export Association of India (SEAI).

The inaugural function will be held at 10 am on January 27 in the Pai Tiatrist JAF auditorium, adjacent to the Open Sports Complex Ground, Fatorda, Margao, where the IISS-2018 exhibition is being organized. IISS 2018 will have 300 stalls spread over 7,000 sq m, showcasing a wide range of products, production and harvest technologies, machinery and accessories in the export-oriented aquaculture sector. The delegates would include farmers, entrepreneurs, hatchery operators, feed manufacturers, input suppliers, manufacturers and suppliers of various aquaculture implements from around the world.

"A basic objective of the event is to highlight the country's commitment towards sustainability in the entire value chain of seafood products such as primary production, processing and transportation," according to MPEDA Chairman Dr. A. Jayathilak. Internationally acclaimed experts from India and abroad will address technical sessions on topics of current interest such as GST and its implications for Seafood Sector, Food Safety requirements in major markets, Safe & Quality Seafood from India to the EU, Seafood Certification, and price influencing factors in the demand and supply of seafood. Around 3,000 delegates and more than 2,000 visitors from India and abroad, including the US, the UK, Spain, Japan, Australia, China, Vietnam, South Korea, Thailand, Malaysia and the Middle East, are expected to participate in the mega event.

SPECIAL ARTICLE

Eco-labelling as a tool for sustainable aquaculture

T. N. VENUGOPALAN*

An eco-label is a mark, logo, a label or a product endorsement affixed to a seafood product at the point of sale that implies to a purchaser that the product has been produced through ecologically sustainable procedures, and is from a source that is well managed

INTRODUCTION

Aquaculture is world's fastest growing food production system. During the past two decades, aquaculture production has increased by 10 percent per annum. This sector is rapidly gaining importance as a result of dwindling catches of fish from natural water bodies and increasing global demand for seafood. However, the tremendous growth in aquaculture sector is accompanied by a number of environmental and social problems that could undermine the future development of this sector unless suitable remedial measures are taken.

In order to address the negative impact of aquaculture development on the environment, a number of management measures have been taken. Eco-labelling is one such management measure which is a market based economic instrument that seeks to direct consumers' purchasing behaviour so that they consider product attributes other than price. Such attributes can relate to environmental, social and economic objectives.

Market-based approaches have become a prominent strategy of environmental movement organisations. Using such market-based approaches, sustainable seafood organisations contribute to sustainable aquaculture and fisheries. However, there is a view that such market-based approaches lead to capitalist accumulation which is counter-productive to environmental sustainability.

There has been growing realisation among national governments and multinational institutions that economic development and environmental issues are inseparable; many forms of development erode the environmental resource upon which they must be based and environmental degradation can undermine economic development.

SUSTAINABLE DEVELOPMENT

The United Nations Sustainable Development Goals (SDGs) are grounded in a sound evidence-based approach that takes into account three dimensions of sustainability such as economic, social and environmental.

The term 'sustainable development' has a different connotation and is defined variously by different organisations. However, there is no single agreed definition. In 1980 FAO defined sustainable development as "the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in agriculture, forestry, fisheries sectors) conserves land, water, plant and animal resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable."

The most well-known definition of sustainability was coined by the 1987 Brundtland Commission of the UN; which was constituted to study the impact of development on the society, the economy and the environment. The commission defined sustainable development as "development that meets the need of the present without compromising the ability of future generation to meet their own needs" (WCED, 1987). In recent years the concept of sustainable development has been widely discussed in many national and international forums and as a result, a vast literature on the topic emerged.

SUSTAINABLE AQUACULTURE

All fisheries and aquaculture activities generate some kind

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of impact on the environment. The concept of sustainable aquaculture is based on the extraction of resources in such a manner as to minimise the environmental impacts to an acceptable level. It may be defined as aquaculture systems which are environmentally sound, economically profitable and productive and maintain the social fabric of the rural community.

The sustainability of fisheries and aquaculture production is vital for the livelihood, food security and nutritional requirements of billions of people.

IMPORTANCE OF AQUACULTURE

Aquaculture is one of the fastest growing food production systems, and presently this sector contributes around 13 percent of world animal protein supply. With the world's capture fisheries in deep crisis and their restoration in many cases appears to be difficult or impossible, aquaculture has emerged as a viable alternative for many countries for increasing and sustaining their fish supply.

The world aquaculture production increased significantly from 49.9 million tons in 2007 to 66.6 million tons in 2012 and 73.8 million tons in 2014 (State of World Fisheries and Aquaculture, SOFIA 2016). During the same period, the global capture fishery production was 90.8 million tons , 91.3 million tons and 93.4 million tons respectively (SOFIA, 2016). However, the rapid growth of the aquaculture has caused a wide range of concerns about the harmful environmental and social impact of the culture system. These include biodiversity, critical habitats like mangroves and ecosystems, genetic diversity including GMOs, endangered species, exotic species, alien and migratory species, natural fish stocks and species and the associated ecosystems, water, soil and air quality.

Other environmental and social concerns of aquaculture arise from the unscientific use of banned antibiotics and veterinary drugs for prophylactic and therapeutic purposes, use of fishmeal as feed and restricting traditional access to local inhabitants.

Many investigators have questioned the merits of farming high priced carnivorous species such as shrimp, salmon, tilapia and pangasius fed on fish meal and oil. These species consume a huge amount of fish meal and oil derived from the output of wild fisheries, thereby putting more pressure on the already overexploited wild fish socks. This is a major issue of concern as fishmeal and oil are mostly derived from small pelagic species that are highly fecund, fast growing, short-lived and occupy low trophic level in the food chains. It is expected that fish meal and oil consumption in aquaculture feeds will actually decline in the long term because of high prices; there will be better substitutes with plant-derived protein and lipid sources and consumer resistance to eating farmed fish fed on other fish.

ENVIRONMENTAL LABELLING

The 1992 Earth Summit endorsed environmental labelling as a legitimate environmental management tool. Since then it had been seriously debated in a number of international fora, including the United Nations Environment Programme (UNEP), United Nations Industrial Development Organisation (UNIDO), Food and Agriculture Organisation of the United Nations (FAO), United Nations Conference on Trade and Development (UNCTAD), Codex Alimentarius Commission (CAC) and ISO besides a number of regional and national bodies.

AQUACULTURE CERTIFICATION SCHEMES

In the past two decades, the concept of eco-labelling and certification schemes for aquaculture has gained significant importance in the global trade and marketing of fish and fish products. The demand for eco-labelling and certification for both aquaculture and capture fishery are driven by large-scale retailers and food business operators (FBOs) with focus on food safety, environmental sustainability and social criteria. The label enables the retailers and brand owners to meet the growing consumer demand for products which originate from sustainably managed fisheries and aquaculture systems. Retailers use eco-labels as a tool to express their Corporate Social Responsibility (CSR) and thereby promote the sale of such labelled products.

In 1996 FAO Committee on Fisheries (COFI) discussed the possible role of eco-labelling as a tool for sustainable fisheries management. However, several members were apprehensive about the possible use of eco-labelling schemes as non-tariff barriers to trade.

In 1991 Organisation for Economic Co-operation and Development (OECD) defined environmental labelling as "the voluntary granting of labels by a private or public body in order to inform consumers and thereby promote consumer products which are determined to be environmentally friendlier than other functionally and competitively similar products."

Eco-labelling schemes entitle a fishery product to bear a distinctive logo or statement which certifies that the fish has been harvested in compliance with conservation and sustainability standards. The logo or statement is intended to make provision for informed decisions of purchasers whose choice can be relied upon to promote and stimulate the sustainable use of fishery resources. Eco-labels are defined as marks on products that are "deemed to have fewer impacts on the environment than functionally or competitively similar products." Global Eco-labelling Network (GEN) defines an eco-label as "a label which identifies the overall environmental performance of a product (i.e. goods or service) within a product category based on lifecycle considerations."

An eco-label is a mark, logo, a label or a product endorsement affixed to a seafood product at the point of sale that implies to a purchaser that the product has been produced through ecologically sustainable procedures, and is from a source that is well managed.

Eco-labels are normally applied as labels or tags, such as a recognisable logo to a seafood product as a product endorsement at the point of retail sale. Where individual products are small or where they are marketed in a combined or processed pack (such as a canned product), the label may be applied to the pack rather than the individual product itself.

The consumer-facing label is an assurance that the product they purchase is produced in a manner which has less impact on the environment in comparison to an unlabelled product. Thus the message that the eco-labelled product is more environmentally sustainable is conveyed to the consumer.

International Organisation for Standardisation (ISO) states that the overall goal of these labels and declarations is "through communication of verifiable and accurate information that is not misleading, on environmental aspects of products and services, to encourage the demand for and supply of those products and services that cause less stress on environment, thereby stimulating the potential for market-driven continuous environmental improvement."

There is a difference between 'Environmental labels' and 'Eco-labels.' The term environmental labelling is rather broad and imprecise, whereas the term eco-label refers to a special group of environmental labels. There are many labels and declarations on environmental performance which are categorised as 'environmental labels' while eco-labels are a sub-group and they are based on special criteria which are comprehensive, self-determining and traceable. In 2005, FAO developed Guidelines for Eco-labelling of Fish and Fishery Products from Marine Capture Fisheries (Marine Guidelines) and in 2011, developed Guidelines on Aquaculture Certification (Aquaculture Guidelines).

These guidelines provide guidance for the development, organisation and implementation of credible aquaculture certification schemes. The criteria address (1) animal health and welfare, (2) food safety, (3) environmental integrity and (4) socio-economic aspects.

The aquaculture guidelines are applicable to voluntary certification schemes and are to be applied and interpreted in tune with their objectives also considering existing national laws and regulations and international agreements.

The aquaculture guidelines are rooted in the fact that sustainable development of aquaculture is closely linked to social, economic and environmental aspects of aquaculture including issues like aquatic animal disease control, food safety and biodiversity conservation.

OBJECTIVES OF ECO-LABELLING AND CERTIFICATION SCHEMES

The important objectives of labelling and certification schemes are to communicate verifiable and accurate information, encourage demand and supply of eco-friendly products and services, reduce ecosystem degradation and stimulate market-driven continuous environmental improvement.

Technical guidelines on aquaculture certification

FAO in collaboration with the Network of Aquaculture Centres in Asia-Pacific (NACA) developed guidelines for the development and implementation of credible aquaculture certification scheme.

The guidelines cover four broad ranges of issues which are considered relevant for certification. Aquaculture certification schemes may cover one or all of these issues.

1. Animal health and welfare

Aquaculture activities should be conducted in a manner that assures the health and welfare of farmed aquatic animals, by optimising health, minimising stress, reducing phases of the production cycle.

2. Food safety and quality

Aquaculture activities should be conducted in a manner that ensures food safety and quality by implementing appropriate standards and regulations as defined by FAO/WHO, Codex Alimentarius and in related codes of practice and guidelines developed within the context of the Codex Alimentarius Commission and any other relevant organisation.

3. Environmental integrity

Aquaculture should be planned and practised in an environmentally responsible manner in accordance with appropriate national and international rules and regulations.

4. Social responsibility

Aquaculture should be conducted in a socially responsible manner, within national rules and regulations, to benefit aquaculture workers, local communities, investors and the country.

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Aquaculture should contribute effectively to rural development, poverty alleviation and food security and deliver benefits to the local community and surrounding resource users.

TYPES OF ECO-LABELS

Eco-labels are classified into three main groups.

1. First party labelling schemes: These are established by individual companies based on their product standards. Also called self-declarations; they address specific environmental issues which are known to the consumers, involve development of standard and criteria within a company, with compliance assessment procedures carried out internally (such as company-appointed assesses). Such internal standards concentrate on specific sustainability issues that could be complied by the organisation. Since such self-declarations are not subjected to either peer review or public critique, they are not recognised as a sound system of certification for achieving ecological sustainability. They serve the main purpose of reducing the gap between the 'best' and 'worst' performing products/ventures in terms of sustainability.

2. Second party labelling schemes: These are labelling schemes established by industry associations for the product of their members. These schemes adopt an industry-wide standard and criteria with assessment procedures that may be either internal or independent. The owner of the standard (typically an industrial association, a group of companies or sometimes a government) will determine the standard and criteria that rely on an independent assessment. These assessments are seldom made public, though the standard and criteria may be publicly available. As in first party labelling, here also the standard and criteria may be set in such a manner that majority of the group members will comply with them.

3. Third party labelling schemes: They are normally established by a private initiator independent from the producers, distributors and sellers for labelled products ('standard makers'). A third party eco-label implies that a particular product was produced in an 'environmentally friendly' fashion. Standards and criteria are established after extensive stakeholder consultation. Assessment is carried out by independent third party certifiers.

Certification also involves Chain-of-Custody (CoC) assessment process to ensure that there is no mixing of certified product with the non-certified product along the supply chain or in the market.

Broad range of eco-labelling schemes in aquaculture

A number of stakeholders are involved in aquaculture certification and labelling and a broad range of issues are covered. Most issues are of common interest for stakeholders whereas others are of more specific interest to fewer or single stakeholders. Based on stakeholder interest and participation, aquaculture labelling can be classified as follows:

1. Scheme promoted by retailers

Responding to the requirements of consumers and NGOs and also as an expression of their Corporate Social Responsibility (CSR) policy, the procurement policies of many retailers are influenced by various NGOs through media campaign or boycotts announcing the most ethical supermarkets. A number of retailers have begun developing standards aimed at sustainable production. In most cases, retailers have joined together in formulating the labelling and certification standards as this will reduce the cost of auditing and certification. Many retailers and brand owners are on the bandwagon of sustainable seafood movement and are actually driving the demand for ethical products. Currently, only a limited number of retailer-promoted labelling schemes are available for aquaculture products. Examples are GLOBALGAP, Safe Quality Food and Carrefour.

2. Schemes promoted by aquaculture industry

The aquaculture industry has an interest in promoting sustainable aquaculture products in general; better-performing practices can serve as a good example for the industry. It is the most organised group of producers who can agree on and establish industry-led labelling schemes. Examples are Global Aquaculture Alliance (GAA), Aquaculture Certification Council (ACC), Shrimp Seal of Quality (SSOQ), Siges-SalmonChile, Scottish Salmon Producers Organisation (SSPO).

3. Schemes promoted by Governments

Governments in exporting countries have a clear interest in promoting a sustainable aquaculture industry and promoting it among buyers in both national and international markets. In order to mitigate the adverse impact of aquaculture on environment, many governments have adopted eco-labelling as a means of ensuring sustainable aquaculture. Examples are Thai Quality Shrimp, Vietnam GAP, Hong Kong Accredited Fish Farm Scheme.

4. Schemes promoted by NGOs

Non-Governmental Organisations with interest in conservation, environment, fair-trade etc play a key role in developing labelling schemes for the aquaculture industry. Many environmental NGOs like WWF have developed eco-labelling schemes for aquaculture. It is often mentioned that NGO-established schemes are 'truly' third party schemes as there is often less conflict of interest. Examples are Aquaculture Stewardship Council (ASC), Aquaculture Certification Council

(ACC), Marine Aquarium Council (MAC) and International Organisation for Standardisation (ISO).

Eco-labelling was first recognised internationally at the 1992 United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro. Eco-labelling in the context of fisheries and aquaculture is designed to incentivise environmentally sustainable fish production methods and to influence the procurement policies of large retailers and brand owners as well as purchasing decisions of consumers. In the fisheries and aquaculture sector, the eco-labelling schemes are promoted by governments, retailers, the industry and environmental NGOs. Currently, more than 30 labelling schemes are available for aquaculture. The proliferation of labelling schemes created confusion among retailers, processors, farmers and distributors resulting in 'eco-label clutter.'

Selected eco-labelling schemes in aquaculture

A number of certification schemes are available for aquaculture products. The most important aquaculture certification schemes are discussed below:

1. Global Aquaculture Alliance (GAA)

It is a non-governmental body established to certify social, environmental and food safety standards at aquaculture facilities throughout the world. GAA has been formed by the aquaculture industry; particularly by the shrimp farmers to promote sustainable aquaculture throughout the world.

GAA developed first voluntary Best Aquaculture Practices (BAP) standards in a certification system and aligned with Aquaculture Certification Council (ACC). Certified producers are entitled to use 'BAP' certification logo for products from certified fish farms. BAP standards cover a wide range of issues such as food safety, traceability, animal welfare, community and social welfare and environmental sustainability.

BAP certification can be obtained for both farms and processing. The BAP certification mark is a trademark of the GAA that is licensed to ACC for the use by facilities certified by ACC. The BAP logo can be used on retail packaging only if it contains aquaculture product farmed and/or processed in accordance with Best Aquaculture Practices standards.

Compliance with BAP standard is assured through site inspection and auditing procedures implemented by ACC. The BAP mark reflects process certification only. In other words, the ACC is mainly a business-to-business tool but the ACC label is visible and promoted on finished product packaging.

The GAA standards for shrimp farming include the following:

• Community: Property right and regulatory compliance, community relations and worker safety and employee relations.

• Environment: Mangrove conservation and biodiversity protection, effluent management, sediment management, soil/water conservation, post-larvae sources and storage and disposal of farm supplies.

• Food safety: drug and chemical management, microbial safety, harvest and transport.

2. GLOBAL GAP

It was established in 1997 by Euro-Retailer Producers Working Group (EUREP). In 2007, it became GLOBAL GAP with an international focus. Efforts were led by British retailers and supermarkets in continental Europe and were aimed at addressing consumer concerns toward food safety, environmental sustainability and labour welfare, in addition to reducing costs for producers by providing a single set of standards accepted by a wide range of retailers. EUREP developed harmonised standards and procedures following Good Agricultural Practices (GAP). GLOBAL GAP is implemented by Food PLUS, a non-profit limited company based in Germany, which is responsible for facilitating GLOBAL GAP activities, serving as the legal owner of the normative documents and hosting the GLOBAL GAP secretariat.

GLOBAL GAP certification can be issued to individual farms or to a group of farmers who must fulfil a set of requirements including conducting regular internal inspections. GLOBAL GAP is also developing guidance documents for smallholders to assist the process of group certification.

GLOBAL GAP standards allow other schemes to be benchmarked against it, through which standards from other certification schemes can be recognised as equivalent to the GLOBAL GAP standards. Several countries have benchmarked their standards with GLOBAL GAP giving


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origin to China GAP, Mexico GAP and others.

GLOBAL GAP standards are process (and not product) standards and address food chain operators only, and hence GLOBAL GAP labels are not visible on the packaging of the product itself, although GLOBAL GAP products are sometimes sold in separate recognisable areas within supermarkets.

In 2003, for aquaculture certification, GLOBAL GAP constituted Integrated Aquaculture Assurance (IAA). IAA members include major retailers like Royal Ahold, Tesco, Metro Group, Mc Donald's Europe, Wal-Mart (UK) and others.

GLOBAL GAP is a private sector body that sets voluntary standards for certification of production processes of aquaculture and agricultural products. It is a business-to-business (B2B) scheme; there is no label visible to the consumer, covering the entire production chain ranging from the brood stock, seedlings and feed suppliers, to the farming, harvesting and processing stages.

GLOBAL GAP standards cover aspects like site management, reproduction, chemical usage, occupational health and safety of workers, fish welfare, management and husbandry, harvesting, feed management, environmental and biodiversity management, water usage and disposal and post-harvest-mass balance and traceability.

3. Aquaculture Stewardship Council (ASC)

ASC was co-founded by World Wildlife Fund (WWF) and Dutch Sustainable Trade Initiative (IDH) in 2009. This initiative is the result of a series of roundtables called 'Aquaculture Dialogues,' between WWF and various stakeholders (farmers, NGOs, retailers, experts) which led to the definition of standards for responsible aquaculture and the creation of a new organisation, ASC.

The ASC standards address the following seven principles:

- 1 Legal compliance (obeying the law, the legal right to operate)
- 2 Preservation of natural environment and biodiversity
- 3 Preservation of water resources
- 4 Preservation of diversity of species and wild populations (eg. preventing escapes which could pose a threat to wild fish)
- 5 Responsible uses of animal feed and other resources
- 6 Ensuring good animal health (eg. no unnecessary use of antibiotics and chemicals)
- 7 Ensuring social responsibility (eg. no child labour, health and safety of workers, freedom of assembly, community relations)

ASC will be working with independent, third party entities to certify farms which are in compliance with its standards.

Dutch Retailer Association announced that they will sell only ASC certified farmed seafood. So far ASC has finalised standards for 11 species of fishes such as salmon, shrimps, tilapia, pangasius, albacore, clams, trout, oysters, scallop, seriola and cobia as these species have the highest impact on the environment and highest market value. Currently, ASC has certified more than 200 farms spread across 37 countries and there are over 1120 products carrying ASC label.

According to WWF, ASC certification is more credible than other such similar schemes as it is based on seven principles which are: science-based, performance-based, metrics based, created by a diverse and balanced group of stakeholders, focused on minimising or eliminating the key environmental and social impact of aquaculture, not a laundry list of impacts.

4. Friend of the Sea (FoS)

FoS is a Italy-based fisheries and aquaculture certification scheme promoted by the Earth Island Institute, an international, independent, non-profit environmental organisation. FoS standards are available for both wild fisheries and aquaculture.

FoS Sustainable Aquaculture criteria require:

No impact on critical habitats (eg. mangroves, wastelands etc.)

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5. Naturland (Germany)

It is a German based organisation in the field of organic agriculture and is one of the pioneering standard organisations in the field of organic aquaculture development. Naturland developed the first species-specific standards in 1995, starting with carp, followed by salmonids, bivalve molluscs and shrimps. Naturland certified products are marketed internationally and are well accepted by major market players. To date, Naturland has certified more than 30 farms and aquaculture projects.

6. Thai Quality Shrimp (TQS)

Thai Quality Shrimp programme (TQS) has been developed by the Thai Department of Fisheries (DoF) with the support of various international organisations like World Bank. The DoF has been introducing several programmes and activities to ensure food safety and sustainability of Thai shrimp.

The Good Aquaculture Practices (GAP) programme and the Code of Conduct for responsible shrimp farming (CoC) provide the support for the TQS programme.

The GAP programme mainly focuses on food safety and implements good practices at the hatchery and farm level to ensure that products are fresh and do not contain residues of chemicals and antibiotics or microbial contaminants.

The Code of Conduct for responsible aquaculture (CoC) encompasses guidelines for the entire production chain including feed mills, hatcheries, farms and processors.

The Thai CoC programme is based on the Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries (CCRF) and International Principles for Responsible Shrimp Farming (WWF, 2007). The CoC guideline is divided into two sections for hatcheries and farms, each containing 111 criteria that need to be met by hatcheries and farms applying for certification. The criteria include site selection, farm management, stocking densities, feed, health, medication, effluents, proper harvesting and transportation, farmers' organisation, data collection as well as social responsibilities.

Both the GAP and the CoC programme are operatively managed, inspected and certified by the Thai Department of Fisheries (DoF). TQS has so far certified 97 farms and 28 hatcheries.

7. BioSuisse (Switzerland)

Bio Suisse is the Association of Swiss Organic Farmers' Guidelines for organic aquaculture was developed in 2000 and the first product (trout) has been certified in 2001. Bio Suisse certified products are mainly marketed in Switzerland where the label is well received by consumers and retailers.

Bio Suisse requires that aquaculture operation should not disturb ecological balance, the natural population should not be threatened and the basic principles of sustainability are to be adhered to.

Only native fish species adapted to regional conditions are to be raised. Use of genetically modified or triploid fish is prohibited. Parent and young stock must not be fed with antibiotics, growth promoters or hormones.

For salmonids and other carnivorous species, the addition of fish meal and oil is permitted provided the same is

derived from residues from fish processing or from provably sustainable fishing.

The entire fish farm must be engaged in organic fish production. Parallel production of organic and non-organic fish is not permitted.

8. Debio (Norway)

Debio is a membership-based Norwegian organic organisation. Debio performs auditing and certification assignments of organic production. Debio has certified 3 aquaculture operations; salmon, trout and cod. The main markets for these products are Norway, Sweden, the UK and Germany.

Conclusion

Eco-labelling and certification are non-state market-driven initiatives which can be employed as powerful tools for the development of sustainable aquaculture systems across the globe. A number of large corporations like Walmart, Tesco, Findus Group and Whole Foods have committed to source aquaculture products only from certified sources. However, the proliferation of labelling and certification schemes applicable to aquaculture has created 'label clutter' and resultant 'label fatigue.' There are labelling schemes promoted by retailers, those promoted by the aquaculture industry, those promoted by Governments and those promoted by NGOs. In the coming years, the importance of eco-labelling will gain further momentum as a market-driven initiative to promote sustainable aquaculture and give a fillip to our Blue Growth Initiative.

SPECIAL ARTICLE

Brackishwater aquaculture for food, employment and prosperity

Dr. K. K. VIJAYAN*

World population has continuously been in an increasing trend and progressing at a rapid pace. With the current trend, the figure is expected to touch 10 billion by 2050. At the same time, the natural resources remain the same. Moreover, the availability of these natural resources for food production has plateaued and at a decreasing trend because of the unsustainable exploitation. Supplying adequate quality food to the growing population will be a major challenge in the near future. Additionally, severe challenges are there to generate sufficient employment for the increasing population. As expectation from agriculture sector has almost reached saturation in terms of farming area and productivity, the main focus is now on fisheries sector.

GLOBAL AQUACULTURE SECTOR HAS SHOWN A TREMENDOUS GROWTH DURING THE PAST TWO DECADES WITH PRODUCTION REACHING AS HIGH AS 73.8 MILLION TONS

Fish has been popularly accepted as a cheap protein source across all the sections. Capture fisheries from natural water bodies are already overexploited and the focus has turned to farming in water or aquaculture. Presently aquaculture production has crossed halfway mark of the capture fisheries.

Global aquaculture sector has shown a tremendous growth during the past two decades with production reaching as high as 73.8 million tons (SOFIA, 2014). As only a part of the aquatic resources are presently used, there is immense potential for aquaculture growth and expansion. For countries like India whose population expected to cross 1.5 billion marks by 2050, food safety issues are serious, where aquaculture provides a great hope. In addition to providing quality protein, this sector can generate employment, provide opportunities for economic improvement and societal development.

All the three water bodies, fresh, brackish and marine, are equally suitable for culture of various aquatic organisms. However, for valid reasons, the brackishwater resources deserves special attention.

BRACKISHWATER - A UNIQUE ECOSYSTEM FOR AQUACULTURE PRACTICE

Though the availability of brackishwater resources is recorded to be 1.2 million hectares, its utilization has been very poor, say around 14%. This fact exposes the immense potential of this natural resource for judicious utilization of aquatic food production. On the scientific basis, it has been projected that the expected growth is exponential. Being in the buffering zone of both fresh and marine ecosystem, this provides a productive zone for farming the candidate finfish and shellfishes. Water from this ecosystem is otherwise unsuitable for drinking, agriculture or other purposes such as construction. Therefore, there is no competition for the brackishwater resource and can be completely utilized for aquaculture without compromising with human or animal needs. This unique characteristic makes the brackishwater aquaculture a zero water footprint resource and adds to the production of high-value seafood such as shrimps and finfishes.

On the contrast, fresh water ecosystem competes with human needs such as drinking and irrigation purpose and the land can as well be used for the agricultural activities. Though the marine ecosystem is vast, considering the challenging environment and huge infrastructural requirement, mariculture expansion requires time, novel technologies and investments. Therefore, when all the ecosystems are compared, brackishwater aquaculture industry has visible advantageous and more promising than any other sectors.

Added to the brackishwater resources, there are inland saline areas in different states which can also be utilized for the culture of brackishwater species. The productivity of the shrimp farming sector has always attracted the attention of the policymakers. In the beginning of the shrimp farming industry in the country, the productivity levels were at 2-3 tons /ha/yr. which now stands at 8-10 tons /ha/yr, which translates handsome income to the tune of one to few lakhs per a crop in a period of 120 days, while on the contrary in the agriculture sector the income per crop is far lesser than the brackishwater aquaculture. At the national level, when the focus is on the doubling of farmers income in the agriculture sector, this can be achievable in brackishwater aquaculture, as witnessed in the shrimp farming sector during the 2010 to 2016 period.

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BRACKISHWATER AQUACULTURE FOOD PRODUCTION

Vannamei

The second major contributor to the Indian aquaculture production is the brackishwater aquaculture which is at present dominated by the shrimp farming. Around 4,87,470 tons of shrimp was produced from the shrimp farming sector during 2015-16. The finfish culture is yet to be developed and practiced only in few pockets. Fishes like seabass, milkfish, mullet etc. are regularly being consumed and have high consumer preference. Similarly, crab culture also has a great potential and many of the stakeholders are expressing their interest. Many of the brackishwater molluscs have good potential for the culture practice. Seaweed is another potential commodity to be utilized. With the vast brackishwater area available in the country, there is a wide scope for this sector to expand using suitable brackishwater species and serve as food for the growing population.

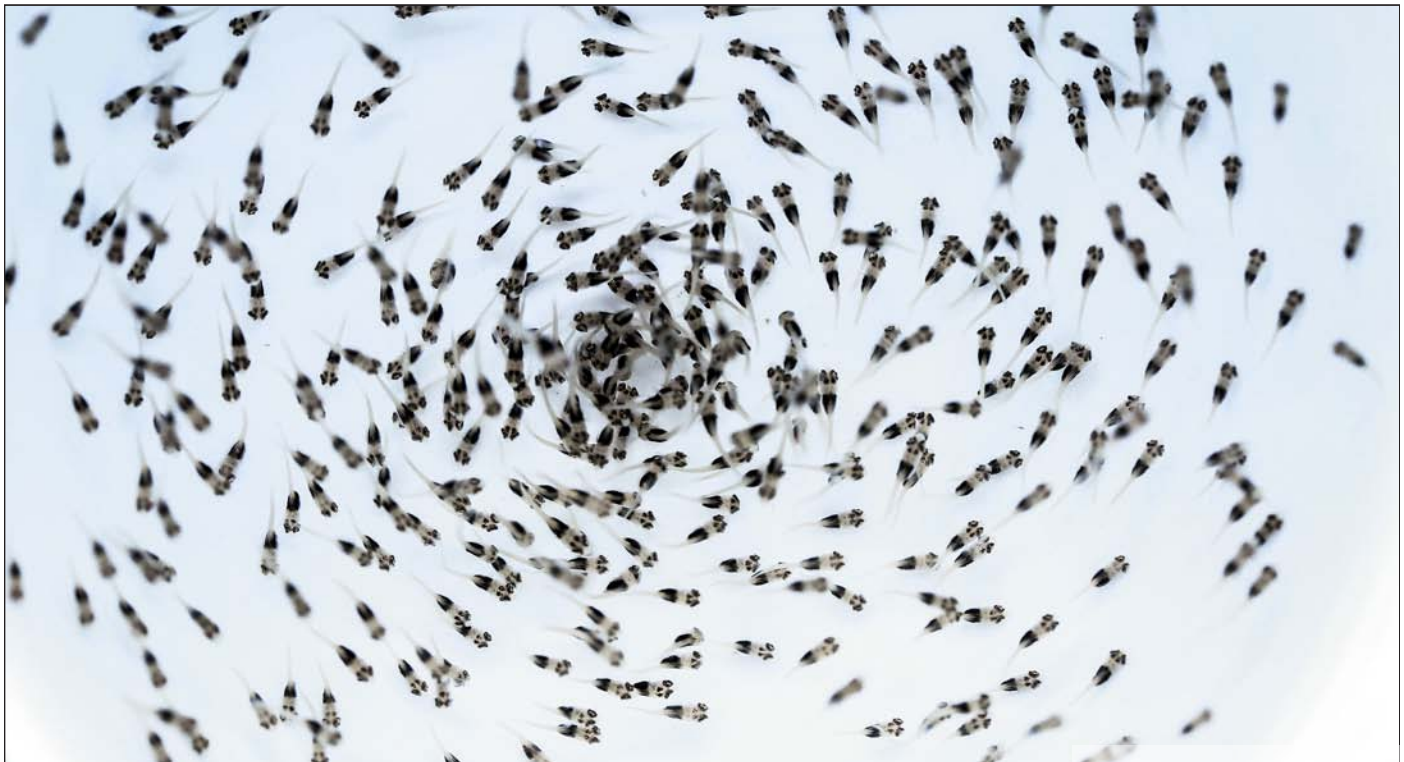
BRACKISHWATER FARMING FOR LIVELIHOOD ENHANCEMENT

Brackishwater aquaculture in India is synonymous to shrimp farming and over the years, a drive for the diversification in this sector has not been seen till date. From the past experiences, it is becoming increasingly clear that diversification is the key for the success and sustainability of any industry. CIBA's recent breakthrough in the breeding and seed production of the major brackishwater finfishes such as Milk fish, Pearl spot and Sea bass is a milestone towards diversification. Even though the shrimp farming sector of the country provides delighting production, wide disparity can be seen in the shrimp production among the Indian states. The states like Andhra Pradesh, Gujarat, etc. outperform the traditional aquafarming states like Kerala, Goa, Karnataka and West Bengal, despite having a huge potential area for development. Adoption of location specific farming using suitable species is the way forward for these states, on a sustainable mode, considering the geography, climatic conditions and infrastructure. It is highly advised that the brackishwater aquaculture should move to a sustainable model in these states with appropriate space for diversification.

The farming of Asian sea bass is a suitable model for development of finfish farming since the seed production, formulated feed and culture technology is already available with CIBA. The brackishwater cage culture (BCU) of Seabass is a promising venture for enhancing the livelihood of the coastal poor, and brackishwater open water bodies can be utilized for this purpose. Recently ICAR-CIBA has successfully demonstrated low volume cage (2 m x 2 m x 2 m) culture in open brackishwater body with a productivity of 19.8 kg/m3 with a net profit of 85000/- with in a period of about 8 to 10 months. Here the labour required is only one hour each in the morning and evening, hence the activity can be taken up as an alternative livelihood venture for additional income generation. The recent breakthrough in induced breeding of Milk fish (*Chanos chanos*) under captivity for the first time in India has got the attention of the stakeholders. Milk fish is an important candidate species suitable for brackishwater aquaculture. Milk fish already have a ready market with a selling price of Rs. 150-200/Kg in states like Kerala, West Bengal and Odisha, where the production cost is only in the range of Rs. 80-90/kg. Milk fish can be compared to carps in freshwater farming because of their ability of utilizing the natural food present in the habitat. Milk fish farming can be done with minimum inputs and shrimp farmers already practice stocking of milkfish in shrimp ponds considering the beneficial effects of milk fish in keeping the pond health and plankton stability etc., with additional income.

Seabass harvested from brackishwater cage units (BCU) installed in brackishwater

Brackishwater finfishes adapt to monoculture or polyculture model with different levels of intensification. One such species is Pearl spot (*Etroplus suratensis*), which is the state fish of Kerala. It is the most sought after fish in restaurants and also used aquarium fish. Complex parental care and low fecundity were the major constraints in the seed production of this species. ICAR-CIBA has developed a modular hatchery technology for breeding and larval rearing of this species. A fry yield of 4000 to 6000/pair/annum can be realised from this technology and can be easily



Pearl spot, a brackishwater species

adopted by the homestead, SHG's and farming families due to lower input cost. Formulated feed are also developed and available for broodstock, larval rearing and growout. Combined effort and support from the state and central government authorities are inevitable for the development of this important sector, ultimately lead to the development of better culture technologies which are economically viable, socially acceptable and environmentally stable.

Apart from the food fishes, the brackishwater ornamental fish rearing or aquariculture can be a new and promising venture. The brackishwater ornamental fish rearing is an unexplored area with better future prospects. CIBA has identified and standardized the seed production technology for several ornamental candidate in brackishwater that can be used for the development of the sector. The candidate species include Green chromide, Orange chromide, Spotted scat, Silver moony, Crescent perch and brackishwater shrimps. The brackishwater ornamental fish rearing can be adopted as a homestead production units involving women entrepreneurs. The technologies packages with seed production formulated feed, and modular rearing technologies are available with CIBA for propagation.

BRACKISHWATER AQUACULTURE FOR EMPLOYMENT

Shrimp aquaculture in brackishwater system has emerged as a lucrative industry. The sector provides attractive production volumes with an impressive profit within a minimum time period or 3 to 4 months, where two crops/year can be realized. Due to the visible advantageous and attractive profits, the shrimp farming sector has grown in size and volume, with hatchery, culture unit, feed production units, water and pond management inputs and processing units etc. involving a very large number of employees. Other than direct workers for the industry, allied sector also provide opportunities for employment including rural women and fisher folks.

INLAND SALINE SHRIMP FARMING: A NEW AVENUE

According to Central Soil Salinity Research Institute (CSSRI) around 6.7 million hectares of salt-affected soils and 1.9 lakh sq.km of saline groundwater area is present in India. They are present in states like Haryana, Punjab, parts of Rajasthan and Western Uttar Pradesh. Saline aquifers are formed as a result of salt-bearing rocks in the deeper layers or as a result of anthropogenic interventions like excessive irrigation and deforestation. Interestingly, most soils overlying these saline aquifers are also saline. The inland saline areas have long been considered as a hindrance for economic development as the land could not be used for agriculture, animal husbandry, and other industrial applications. Saline groundwater, however, may be used to rear brackishwater shrimp and fish after the necessary ionic amendment of the saline water. Saline groundwater has an ionic profile different from that of seawater diluted to the same salinity and the ionic levels of calcium, magnesium, and potassium are highly variable. Inland saline groundwater around the world is deficient in potassium and has an excess of calcium and magnesium. Commercial shrimp farming using saline groundwater is therefore possible by suitable ionic amendment of the medium using agriculture grade Muriate of potash (KCl) and Magnesium chloride flakes ($MgCl_2 6H_2O$). Shrimp farming in amended inland saline groundwater is already in vogue in the states like Haryana and Punjab, however, the expansion needs to be regulated considering the possibility of salination affecting the freshwater resources. Concerned state government needs to develop a roadmap for the potential sector considering unique nature of the resource, where ICAR-CIBA would be able to provide required location specific technological backstopping for sustainable aquaculture with suitable shrimp and fishes.

CONCLUSION

A nation like India, with an ever-growing population racing to become the most populous country in the world, food, employment and economic development are the three major challenges to be met. Here, brackishwater aquaculture provides means to provide all the three challenges, and slogan 'brackishwater aquaculture for food, employment, and prosperity' is the right slogan, to take the sector forward, and also to meet the national objectives such as doubling the farmer's income. While the focus on research and development on novel technologies to support the major components of aquaculture such as species diversification and production of quality seeds, feed biotechnologies, fish health management and genetics and stock improvement, need to be continued. A close link between farmers, stakeholders, researchers, and governments need to be in place for technically feasible, economically viable, environmentally safe and socially acceptable brackishwater aquaculture.

Sea cage culture

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Role of freshwater aquaculture in food security of India

RAMESH RATHOD, JITENDRA KUMAR SUNDARAY*, I. SIVARAMAN

ABSTRACT

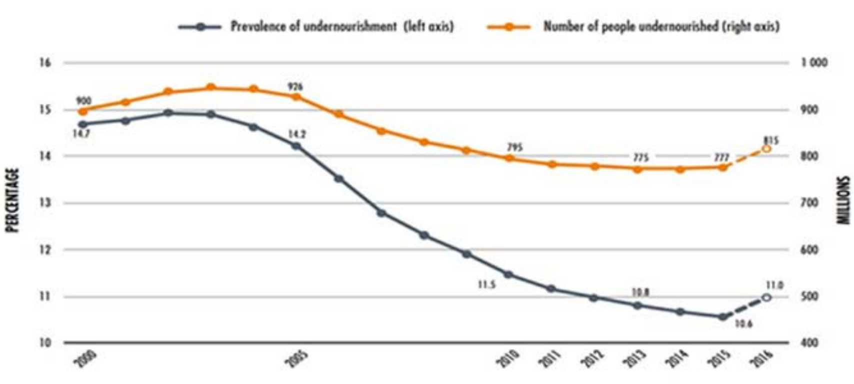
The projected doubling of global food demand by 2050 might be met through interventions to boost aquatic agricultural production. A large section of Indian population is dependent on the animal source of protein like milk, meat, fish and egg. Among them, fish played a significant role in the life of one-quarter of the population who depends directly and indirectly on fish in India and growing recognition of its nutritional and health-promoting qualities. Fish and fishery products represent a valuable source of animal protein, as a portion of 150 g of fish provides about 50-60% of the daily protein requirements for an adult. Apart from that, it is rich in omega 3 fatty acids and micronutrients. Though there is a drastic reduction in the availability of capture fisheries, the country has huge resources to develop inland aquaculture production in the country. The expansion of freshwater aquaculture would contribute significantly to meet the future demand of nutrition and food security.

INTRODUCTION

Food security refers to access to quality food for everyone at every time. The nutritional dimension is integral to the concept of food security. The Food and Agricultural Organization (FAO) states that food security emerges when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security has three important and closely related components, which are the availability of food, access to food, and absorption of food.

Attaining food security is a matter of prime importance for India, where more than a third of its population is estimated to be absolutely in poor, and as many as one-half of its children have suffered from malnourishment over the last three decades. Thus, the issue of food security needs to be closely studied and mitigated.

Food security is thus a multi-dimensional concept and extends beyond the production availability, and demand for food. There has been a definite and significant paradigm shift in the concept of food security from mere macro level availability and stability to micro level household food insecurity, and also from an assessment of energy intake to measures and indicators of malnutrition.



NOTE: Prevalence and number of undernourished people in the world, 2000–2016. Figures for 2016 are projected estimates.
SOURCE: FAO.

Fig.1 Prevalence and comparison of undernourished people

The number of undernourished people has been on the rise since 2014, reaching an estimated 815 million in 2016 (Fig. 1). The per capita dietary energy supply increased significantly from 2370 kcal/day in the early 1990s to about 2440 kcal/day in 2001-03 and to 2550 kcal/day in 2006-08.

The prevalence of undernourishment in the total population also decreased from 25 to 20 percent during the period of 1990 to 2000, and as many as 58 million individuals were estimated to have come out of the poverty trap (Table 1).

The absolute number of poor persons came down from 317 million to 259 million with other livelihood indicators such as the literacy rate and longevity increasing substantially. The life expectancy at birth for males and females respectively, in 2005-06 was 63 and 66 years respectively as compared to that in 1986-91, which was as low as 58 and 59 years for males and females, respectively (Agricultural Statistics at a Glance; 2007).

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Table 1. Per capita dietary energy supply and prevalence of under nutrition in total population

Year	Dietary energy supply (kcal/day)	Undernourishment in the total population (%)
1990-1992	2370	25
1995-1997	2450	21
2002-2004	2470	20
2006-2008	2550	20

Source: FAO, RAP, 2007/15 and FAO Year Book 2012

The green revolution initiated in the late 1960s was a historic watershed that transformed the food security situation in India. It tripled food grain production over the next three or four decades and consequently reduced by over 50 percent both the levels of food insecurity and poverty in the country, this was achieved in spite of the increase in population during the period, which almost doubled. The country succeeded in the laudable task of becoming a food self-sufficient nation, at least at the macro level.

Notwithstanding the achievement of macro-level food security and the discernable improvement in per capita consumption, the country is still home to a fifth of the world's undernourished population. This given situation has been ascribed to high and increasing population pressure with nearly 16 million people being added annually to the already large population exceeding 1.2 billion. This situation of hunger and malnutrition is also equally on account of serious problems related to the distribution and economic access to food, which adversely affect household and individual level food insecurities.

A wide range of food commodities is required to fulfill nutritional security need of the people. The trends in nutritional intake, provided by National Sample Survey signify the importance of consumption diversification into high-value nutrient-rich food items. The average calorie and protein intake at all India level have declined, and the share of cereals in total calorie and protein intake has also fallen. In India, the daily per capita protein intake has declined from 60.2 g to 55.0 g in the rural households and from 57.2 g to 53.5 g in the urban counterparts between 1993-94 and 2009-10 (NSS 66th Round).

The dietary protein requirement consists of metabolic demands that satisfy those needs in the context of the efficiency of utilization to meet the need (WHO, 2002). Cereals and pulses alone cannot be relied upon to meet

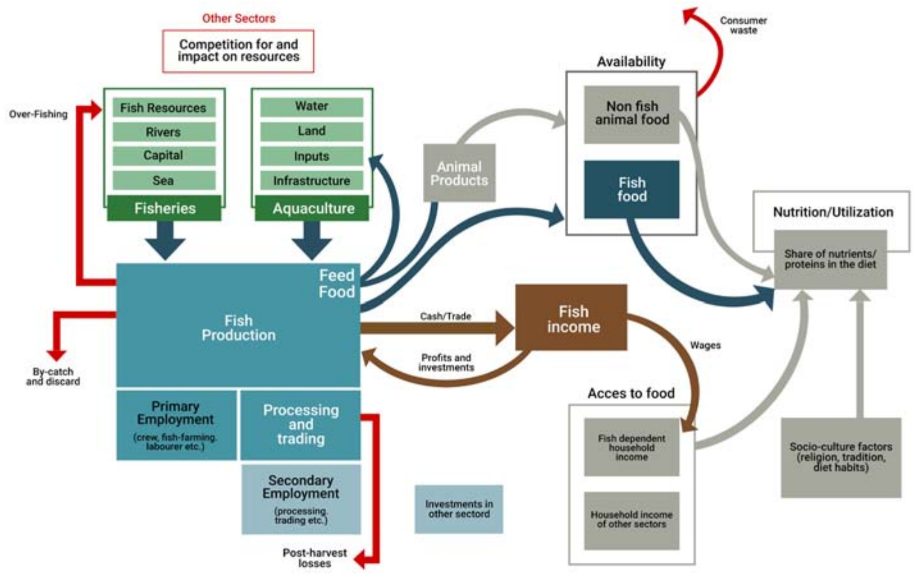

Fig. 2 shows the different pathways by which fish contributes to food security and nutrition. Fish contributes to food security and nutrition directly through the availability of nutrient-rich food both at the household and at local, provincial, and national market levels. Indirect pathways involve the trade of fish and generation of revenues, at household level or at higher (national) levels, including through income for crew-members and for those involved in fish-related activities such as fish processing factory workers. Income allows access to other food commodities (including other cheaper fish products (HLPE, 2014)

the dietary protein requirement for the rising population. Area expansion to increase the production of cereals and pulses may also not benefit India.

The policymakers are hoping for a second green revolution to increase the food grain production to the level which can support the population surge. Animal proteins which include milk, fish, meat, and egg are essentially required for nutritionally balanced diets which are available from diverse food commodities. Thus, it is the right time to evaluate that the potential of livestock and fisheries to meet our dietary protein demand and other nutrient requirements. This paper discusses the importance of freshwater aquaculture in the country and its role in food security.

IMPORTANCE OF FISH IN FOOD SECURITY

Fish plays an important role in food security and nutrition by providing food and income. However, fisheries and aquaculture are often kept on the side of debates relating to food security and nutrition. To a certain extent, the fisheries community is mainly focused on the fish and related resources, and the food security community, despite the widening of the definition of food security to include dietary patterns and their influence on nutrition, is still geared mainly towards food access and availability with a focus on staple foods. Three fundamental aspects stand out to ground the importance of fish for food security and nutrition:

a) The protein and nutrient content of fish as food

b) The role of fisheries and aquaculture activities as a source of income and livelihoods

c) The relative efficiency of fish to produce/transform proteins.

The relationships between fish and food security and nutrition involve many different 'pathways,' direct and indirect, operating at different levels from households to macro, global level, each having its own dynamic. Some pathways combine their effects towards food security and nutrition as, for example, in poor communities where fish is at the same time a source of nutrition and a source of income. The different pathways from fish to food security and nutrition along the four dimensions of food security are,

1. Food availability, in terms of the production and use of fish as human food but also for feed, especially in the context of a growing demand for fish.

2. Access to food, through the fact that fish and all related economic activities in the 'fish chain' represent an important means to generate jobs, income and wealth, with positive effects from the household level to broader economic scales.

3. The contribution of fish to good nutrition - the 'utilization' dimension of food security.

4. Combination of availability and access at macro level which itself is a function of the sustainability of the sector and access, availability and utilization at the micro/household level.

FISH AND HUMAN HEALTH BENEFITS

Fish is 'nature's super food,' an important source of proteins and healthy fats and a unique source of essential nutrients, including long-chain omega 3 fatty acids, iodine, vitamin D and calcium. It is especially crucial for women during pregnancy and lactation which promotes a child's proper physical and mental development. The nutrients in fish promote optimal brain development and regulate the immune system.

In addition to animal protein, fish contributes significantly to the overall protein intake of people, because the digestibility of protein from fish is approximately 5-15% higher than that from plant sources (WHO, 1985). Animal-source foods, including fish, contain several of the essential amino acids, especially lysine and methionine, facilitating a balanced intake of essential amino acids from the diet (Tacon and Metian, 2013). Including fish in the diet improves total protein intake as fish can compensate for the shortage of these amino acids in other elements of the diet.

Table 2. Nutritional value of fish and different meat products

Component	Unit	Salmon, farmed	Salmon, wild	Carp	Tilapia	Chicken	Beef
Protein	g/100g	20	20	18	20	19	21
Lipids	g/100g	13	6.3	5.6	1.7	15	12
Water	g/100g	65	69	76	78	66	65
Ash	g/100g	1.1	2.5	1.5	0.9	0.8	1.0
DHA + EPA (ω-3)	mg/100g	1966	1436	350	91	40	3

USDA National Nutrient Database (USDA, 2012) and ICAR CIFA- 2016, 2017

The lipid composition of fish is unique, having long-chain poly-unsaturated fatty acids (LC-PUFAs) in the form of Arachidonic Acid (ARA), Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA), with many potential beneficial effects for adult health and child development (Thilsted, Roos and Hassan, 1997). Among fish species that are cheaper and often traded in developing countries, small pelagic fish such as anchovy and sardine are perhaps some of the richest sources of LC-PUFAs (USDA, 2011). In contrast, the amount of LC-PUFAs in 'large' freshwater fish such as carp and tilapia is lower, while that of many smaller indigenous species is yet to be determined.

Fish compared to other foods is known to be an important source of essential micronutrients -vitamins D and B, and minerals such as calcium, phosphorus, iodine, zinc, iron and selenium (Roos, Islam, and Thilsted, 2003; Roos et al., 2007a; Bonham et al., 2009). Lipid-rich fish also contain vitamin A. Recent researchers suggests that fish species that are consumed whole with bones, heads, and viscera (usually small fish) play a critical role in micronutrient intakes as these parts are where most micronutrients are concentrated. For instance, zinc is especially abundant in fish eaten whole. The potential contribution that fish (even in small quantity) can offer to address multiple micronutrient deficiencies, such as phosphorous deficiency in LIFDCs or B-vitamins deficiency, is now being increasingly recognized (Roos et al., 2007b; Kawarazuka and Béné, 2011; Thilsted, 2012). Different fish have different nutritional qualities and these may also vary for aquaculture fish that are cultured differently, in particular, those that received different types/levels of feeds. Therefore caution has to be exerted when extrapolating the nutritional value of fish from one species to another, or from one region to another.

PER CAPITA AVAILABILITY OF FISH AND FISHERY PRODUCTS

Globally, capture fisheries and aquaculture provide 3 billion people with almost 20 percent of their average per capita intake of animal protein, and a further 1.3 billion people with about 15 percent of their per capita intake. The freshwater fishes production has grown rapidly at the rate of 5 percent in last five decades -which is next to poultry sector-

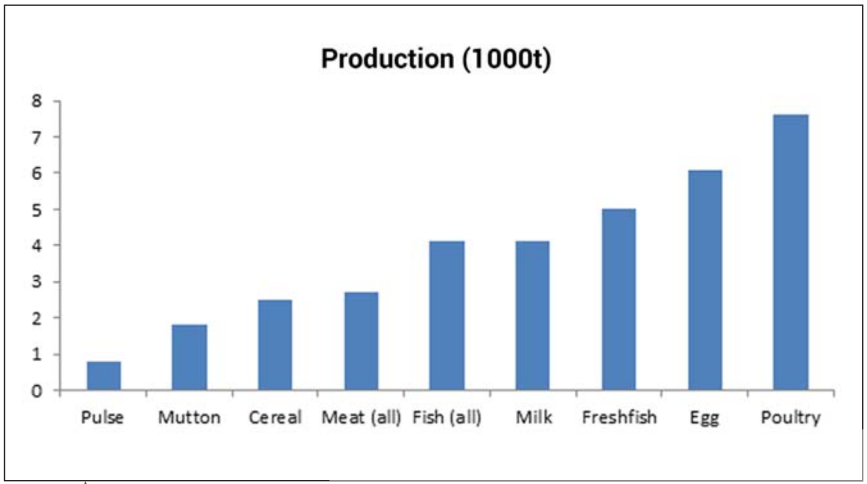

Fig. 3 Annual growth rates in production of protein sources (FAO data: 1961-2013)

has tremendous potential to further increase its share to the net animal proteins and proteins availability in the country. Many developing and developed countries consume fish in much higher quantity than India. The net consumption of fish for the consuming population is 12.6 kg/capita/year, which is far less as per global standards. National Nutrition Committee recommends that an amount 31 kg fish/capita/year as advisable to maintain good health (Srivastava, 1988).

In contrast to that, the national average annual consumption of fish and fish products in 2010 was 2.85 kg/capita. However, there are regional variations in the consumption of fish as states like Kerala and islands states consume a much higher quantity than other states. The consumption of fish in southern India has been found to be more than double of central India. For example, in the coastal state of Kerala, fish is consumed the most, with 22.7 kg/per capita and in the mountainous state of Himachal Pradesh consumption is with 0.03 kg/capita relatively low (RVO, 2017).

The apparent fish consumption per capita per year in the country has increased primarily due to increase in freshwater fish availability from 0.7 kg/cap/year in 1961 to 3.48 kg/cap/year in 2013, enabling an increase in the overall fish availability from 1.9 to 5.04 kg/cap/year during this period. Fish contributed only 0.5 g/cap/day of protein which has increased to 1.53 g/cap/day in 2013 (Barik, 2017). At present fish contributes 12.8% of animal protein which has increased from 8.2% (1961). With the exclusion of milk, fish is the largest contributors of non-vegetarian protein among the Indians.

DECLINE IN CAPTURE FISHERIES PRODUCTION

India's marine fisheries sub-sector (Approximately one-third production) is now performing with a downward trend with 60% of Exclusive Economic Zone (EEZ) stocks over-exploited and the rest fully exploited. The marine fishery potential in the Indian waters has been estimated at 4.41 MMT constituting more than 47% demersal, 48% pelagic and 5% oceanic groups. The dwindling trend in marine capture fisheries limits the scope of further augmentation in harvest capture as out of 1,368 species available, 200 commercially important species also require attention for their survival due to their complex food chain and interdependent existence.

Food and Agriculture Organization (FAO) categorizes fish stocks as underexploited, moderately exploited, fully exploited, overexploited, depleted or recovering. Analyses of world marine stocks show an increase in the percentage of overexploited and depleted stocks over time, while the number of underexploited or moderately exploited stocks decreases (FAO, 2014). The volume of fish discards varies greatly between fisheries and within fisheries, with discard rates ranging from negligible in some small-scale coastal fisheries, to 70-90 percent for some demersal trawl fisheries.

As a consequence, global fishing capacity is still very high and the required adjustments in fishing capacities have not yet happened. In India, many fishery resources are severely depleted and subsidies (often in the form of subsidized fuel) continue. Detailed attributed amounts of these subsidies are not systematically made public everywhere.

When the environment, production ecosystems and/or the resources bases (fish stocks) are degraded or overexploited, the capacities of the sector to deliver its food security and nutrition functions are limited or reduced. The sustainability of fisheries in their environmental and natural resource dimensions is therefore recognized to be a sine qua non condition for food security and nutrition. In addition, food security and nutrition outcomes of fisheries would not depend only on stock recovery but also on access and distribution of the harvest.

The impacts of activities such as oil drilling, energy installations, coastal development and construction of ports and other coastal infrastructures, dams and water flow management (especially for inland fisheries), etc. have tremendous impacts on aquatic productivity, on habitats that sustain resources (eg. erosion and pollution), or on the livelihoods of fishing communities. Climate change also is one of the threats to capture fishery due to ocean acidification, severe cyclones and Inland fisheries and aquaculture may face higher mortality due to heat waves, water scarcity and competition for water.

FRESHWATER AQUACULTURE: SUCCESS KEY TO THE FOOD SECURITY IN INDIA

Globally, in the last three decades, farmed fish production has increased 12 times at an average annual growth of over 8% (FAO, 2016), making it the fastest growing food production sector. It is now widely agreed that the foreseen future increase in demand for fish will have to be satisfied through aquaculture production.

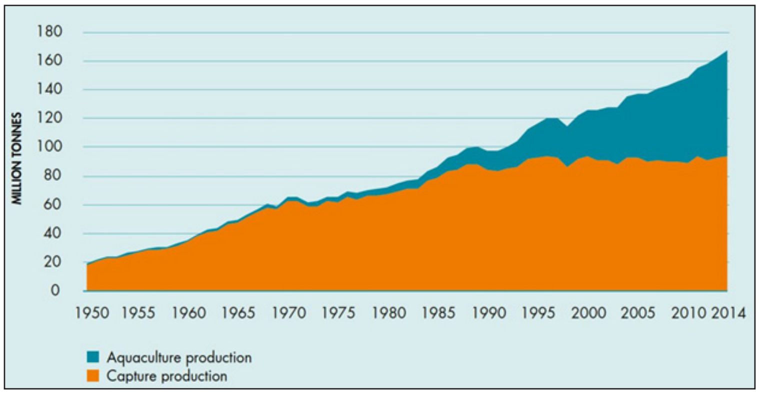

Fig. 4 World capture and aquaculture production (FAO, 2016)

India is the second largest producer of fish in the world, contributing 5.68% of global fish production by aquaculture. The historical scenario of Indian fisheries reveals a paradigm shift from marine dominated fisheries to a scenario where inland fisheries have emerged as a major contributor to the overall fish production in the country. An inland fishery presently has a share of 66.81% in the total fish production of the country (Fig. 5). Within inland fisheries, there is a shift from capture fisheries to aquaculture during the last two and a half decade. Freshwater aquaculture with a share of 34% in inland fisheries in the mid-1980s has increased to about 80% in recent years (DADF, 2016). It has emerged as a major fish producing system in India as a result of initiatives taken by the Government. Freshwater aquaculture showed an overwhelming 12-fold growth of 0.37 million tons in 1980 to 6.58 million tons in 2015; with a mean annual growth rate of over 6%. The quantity produced is almost fully consumed on the domestic market, except for shrimps and freshwater prawns, which are mainly exported.

FISH PRODUCTION POTENTIAL IN THE COUNTRY

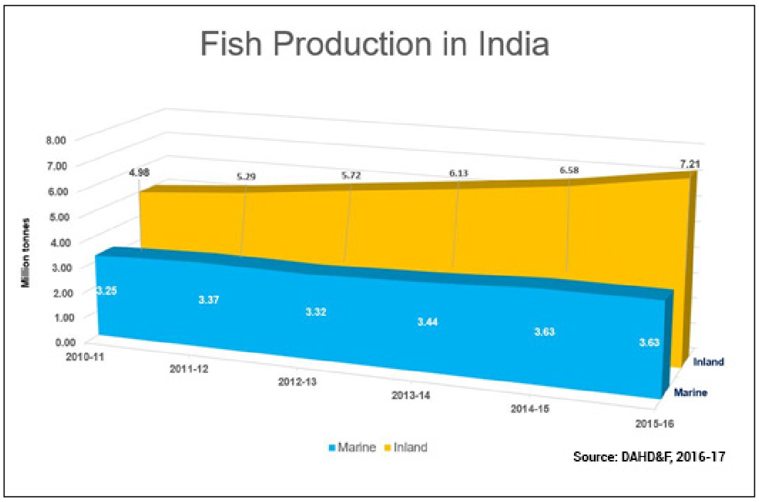

Fig. 4 World capture and aquaculture production (DADF, 2016)

The demand for fish is growing rapidly from an average consumption of 9 kg per capita in 1961 to over 20 kg per capita (FAO, 2016). The demand is expected to rise with the increase in population. Capture fisheries alone cannot meet this increasing demand. The paradigm shift in the fish production has been observed in the country since 1980 that expanded from inundated land to the mainland in all the states. Andhra Pradesh, Odisha and West Bengal are making a good trade in fish production at the national and international level. Improved production efficiency and distribution channels enabled the supply of fish to all over the country. Over the last two decades, aquaculture has experienced spectacular growth and now, for the first time ever, aquaculture makes up over 50% of the fish destined for human consumption.

There was a strong positive relationship between fish consumption and inland fish production. The inland fish production included aquaculture from small ponds and tanks as well as inland capture fisheries from rivers, reservoirs, and wetlands.Traditionally, inland capture fisheries were the predominant source of fish for the non-coastal regions, but over a period of time, aquaculture has improved considerably. Moreover, the major technological transformations were occurring in aquaculture; therefore, increase in the inland fisheries production was primarily due to growth in aquaculture. The ponds and tanks were the major resources available for increasing fish production in future.

The natural capture fisheries in inland waters are multiple purposes large water bodies where the fisheries productivity is dependent on environmental management and productivity can be increased through management options like stock enhancement, species enhancements, etc. At present, the wetlands produce fish in the range of 200-500 kg/ha and reservoirs 20-50 kg/ha (Sugunan and Sinha, 2001). However, there is a huge potential of increasing fish production from small water bodies like ponds and tanks through scientific management of aquaculture.

In specific cases, the productivity of 40-50 tons/ha is also reported (Gopal Rao, 2010). In 2013-14, the average productivity was reported to be 6.1 tons/ha in Punjab and 4.4 tons/ha in West Bengal and Haryana. It is not unusual to report as high as 8-10 tons/ha by some enterprising farmers. Therefore, the average productivity of 6 tons/ha for all aquaculture ponds is attainable across the country in near future (at present 2.64 tons/ha).

It would be more than double of the present level of productions of aquaculture and almost double of the total fish production for India. The past four decades have witnessed a steady expansion of aquaculture and more so in the eastern and southern parts of the country. In future, the other regions would contribute significantly to the fish production through the use of the available small water resources and scientific management practices. Therefore, there is considerable potential for increasing fish production in the country.

The major resource for freshwater aquaculture in the country is 2.41 million ha of ponds and tanks. The other resources where fish farming can be undertaken include floodplain wetlands, lakes, reservoirs, irrigation canals and paddy fields. The inland fisheries resources provide full-time vocation to 1.24 million fishers and contribute approximately 6 mmt to annual fish production in India. In inland capture fish production, India occupies the third position after China and Bangladesh. It provides nutritional and livelihood security to the rural people through fishing and ancillary activities like fish processing, value addition, and fish marketing. However, reports say that only about 40% of the available ponds are utilized for freshwater fish culture activities. The rapid growth in the inland fish production since 1984-85 clearly depicts its scope to serve the cheapest protein source to growing population of our nation in future.

Reservoir fishery in India has enormous potential for further development with the incorporation of suitable management techniques. The total area of the reservoirs is estimated at

> RESERVOIR FISHERY IN INDIA HAS ENORMOUS POTENTIAL FOR FURTHER DEVELOPMENT WITH THE INCORPORATION OF SUITABLE MANAGEMENT TECHNIQUES.

3.15 million ha out of which large and medium reservoirs comprise 1.6 million ha. The total and partial utilization of this resource potential under reservoirs will generate about 0.98 mmt and 0.24 mmt of fish respectively with an average productivity of 0.25 tons /ha. Another important resource is the floodplain wetlands which hold a potential for 0.3 mmt of fish and an area of 0.35 million ha with an average productivity of 0.85 tons/ha.

Aquaculture, along with crop production and dairy and livestock farming, has an important role to play in promoting a balanced nutrition. After implementation of Code of Conduct for Responsible Fisheries, the aquaculture sector has changed tremendously and more than half of what we consume comes from aquaculture.

Now, much more attention is being paid to developing aquaculture in a manner that does not impact negatively the vulnerable populations and their environment. However, land scarcity is also an issue when it comes to aquaculture, not only for inland aquaculture sites but also for coastlines for maritime aquaculture. The solution is aquaculture intensification and better aquaculture zone planning and management.

Freshwater aquaculture over recent years has not only led to substantial socio-economic benefits such as increased nutritional levels, income, employment and foreign exchange but has also brought vast un-utilized and under-utilized land and water resources under culture (Table 3). With freshwater aquaculture being compatible with other farming systems, it is largely environment friendly and provides for recycling and utilization of several types of organic wastes. Over the years, however, culture practices have undergone considerable intensification and with the possibility of obtaining high productivity levels, there has been a state of flux between the different farming practices.

Freshwater aquaculture production is mainly of a low quality which requires low levels of inputs. More intensive high-quality aquaculture has received more attention in recent years. However, Freshwater aquaculture in Eastern India mainly consists of ponds and tanks of less than one hectare. In Western India, aquaculture is operated on a larger scale, with watersheds of 15-25 ha. In Northern India, more use is made of open waters for aquaculture and in the South, ponds for crop irrigation are used in aquaculture.

Table 3 Potential area for freshwater aquaculture in different states of India

S. No	State	Area (lakh ha)
1	Andhra Pradesh	8.11
2	Arunachal Pradesh	3.18
3	Assam	1.35
4	Bihar	1.60
5	Chhattisgarh	1.47
6	Goa	0.06
7	Gujarat	4.26
8	Haryana	0.20
9	Himachal Pradesh	0.43
10	Jammu & Kashmir	0.30
11	Jharkhand	1.23
12	Karnataka	7.40
13	Kerala	5.43
14	Madhya Pradesh	2.87
15	Maharashtra	3.83
16	Manipur	0.10
17	Meghalaya	0.10
18	Mizoram	0.02
19	Nagaland	0.67
20	Odisha	9.89
21	Punjab	0.07
22	Rajasthan	3.00
23	Sikkim	0.03
24	Tamil Nadu	6.93
25	Tripura	0.18
26	Uttarakhand	0.21
27	Uttar Pradesh	4.32
28	West Bengal	5.45
29	A and N Islands	0.34
30	Chandigarh	0.00
31	Dadra and Nagar Haveli	0.05
32	Daman and Diu	0.00
33	Delhi	0.04
34	Lakshadweep	0.00
35	Puducherry	0.01
	Total	73.12

THE ROLE OF CIFA IN DEVELOPMENT OF FRESHWATER AQUACULTURE IN THE COUNTRY

1. Carps

Earlier, India regarded as carp country; more than 75% of the aquaculture production is being contributed by carps (Indian Major Carps (IMC), exotic carps and medium carps). Different species of Indian carps catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) contribute between 70% and 75% of the total freshwater fish production, while silver carp, grass carp, common carp and catfish make up 25% to 30% of the production. Availability of seed from the hatcheries is the main reason for these production levels. However, broodstock management in these hatcheries is poor, and inbreeding has become a problem, which has deteriorated the quality of carp seed over time. The hatcheries located across the country are having difficulties in producing quality seed due to a lack of scientific broodstock management programmes in place as well as continued use of broodstock of deteriorated genetic quality. Although many hatcheries try to improve their broodstock by introducing wild broodstock, the process has been very irregular and disorganized due to high cost and poor organization and has low yield or no impacts.

ICAR-CIFA has developed technologies for hatcheries to enhance the seed production techniques, methods of carp broodstock management, and maintenance namely Jayanti rohu, FRP carp hatchery, CIFABrood. The better quality seed would lead to increased production at the farmer level without additional cost.

SPECIAL ARTICLE

2. Fiberglass Reinforced Plastic (FRP) carp hatchery

FRP Hatchery

- Fiberglass Reinforced Plastic (FRP) carp hatchery effective tool in providing quality carp seed production.
- It can be transported, installed and operated in remote places to ensure easy and timely availability of seeds - Hatchery on wheels.
- Suitable for fish breeding in field conditions for 10-12 kg of carps in one operation – 1-1.5 million spawn.
- Portable magur hatchery a simple device comprising a stand on which are placed a row of plastic tubs (12 cm dia, 6 cm high) for egg incubation and hatching.
- High hatching percentage and maximum 50,000 eggs can be incubated at a time.
- Both marketed by M/s M. R. Aquatech, Bhubaneswar, Odisha

3. CIFABROOD

CIFABROOD

- CIFABROOD, an exclusive carp broodstock diet, rich in adequate nutrients
- Ensures quality of the carp seed, and advances gonad growth and maturation and facilitates early spawning
- Suitable for multiple/repeated breeding in carp and ensures better survival of seed and rapid growth during nursery rearing
- Validated through repeated field trials
- Marketed by M/s Aishrya Aquaculture Private Limited, Naihati, West Bengal
- The firm flooded with demands for the product, substantial economic gain right in the first year of commercialization

4. Genetic improvement programme of carps

CIFA has developed an improved rohu variety called Jayanti rohu through the selective breeding programme with great importance on the use of improved quality fish seed to achieve a target fish production by 2020. Initially, Jayanti rohu was targeted for improvement in growth by genetic selection and realization was achieved 17% higher growth than normal rohu. By implementing such programmes in the sector, it is expected that faster-growing fish will lead to higher production for farmers and increase fish availability and accessibility. Researches were going on to develop new strains of other two species such as catla and mrigal which were widely used in polyculture systems.

5. Improved rohu, Jayanti

- Jayanti rohu developed through selective breeding of Labeo rohita from different

Jayanti Rohu

- founder populations of North Indian rivers
- Improved Jayanti rohu the first genetically improved fish in India and trialed under field
- conditions in different states
- Genetic gain of 17 % per generation for growth trait
- Dissemination of improved rohu to different parts of India under progress. Annually
- About 5 crores of seed of this improved variety are supplied presently to the sector.
- Multiplier hatcheries and the recently formed National

Desi Magur (Catfish)

Murrel Seeds

Freshwater fish Brood bank

- Facility (NFFBB) in Odisha for wider dissemination
- A.hydrophila – resistant rohu ready and undergoing farm trials

6. Catfishes and Murrels

Catfish (***Clarius*** sp. and ***Pangasius*** sp.) offers a huge potential and the diversification of cultivation practices has been identified as a national priority by the government of India. Catfish Pangasius species has become popular among aqua farmers and interestingly, India is now the third largest producer of this species after Vietnam and Thailand.

Currently production reaches 10 tons per ha, but the government aims for, through diversification, 15 to 20 tons per ha. Average yields have already increased in the past decades. Catfish in the aquaculture sector is mainly produced in Eastern and North-Eastern India.

Prawns farming in freshwater

7. Freshwater Prawns

The farming of freshwater prawn primarily the giant freshwater prawn, ***Macrobrachium rosenbergii*** (the largest and fastest growing species), is another area for generation of fishery resources in which the culture can be practiced as monoculture or polyculture with major carps.

Annually, about 30,000 tons of fresh water prawn is produced from an area of 43,433 ha with an average productivity of 990 kg/ha/year. Seed production has been adequately addressed through hatcheries in coastal states and demonstrations in inland states using artificial seawater or ground saline water.

8. Self sufficient in seed production

Production of quality fish seed is vital for the development of aquaculture and culture-based fisheries in inland fishery resources. Out of total fish seed production from the country, West Bengal contributes 84% and 50% respectively to fingerling and fry production of our country. Hence, there should be rigorous initiatives from other states to augment the seed production and ensure the year-round supply. In this regard, reservoirs can be utilized as a good resource for the production of fish fingerlings through cage culture technique. Considering the infrastructure facilities for seed production, the production and collection centres should be located near to the farming sites in order to reduce the cost of logistics, transportation, and seed mortality.

9. Production techniques

Freshwater aquaculture in the past ten years has witnessed both horizontal and vertical expansion with conventional farming practices using carp, as well as an increased emphasis on a diversified culture of catfish, pangasius, murrles, pacu, tilapia and freshwater prawns are important areas of growth in the freshwater aquaculture sector. Greater adoption of modern farming techniques like zero point culture and multi stocking cum multi harvest and assured higher profit margins in carp culture over most other agricultural enterprises has attracted farmers to fish farming in states like Andhra Pradesh. Freshwater aquaculture has further witnessed diversification through the incorporation of high valued species like vannamei culture in freshwater and has increased its production from 455 tons in 1992 to over 1.2 lakh metric tons in 2015.

> FOCUS ON THE PRODUCTION OF TILAPIA WILL HELP TO SATIATE THE GROWING MARKET FOR CHEAP PROTEIN SOURCES.

The progress in pond aquaculture production was highly satisfied in the Andhra Pradesh, Odisha and West Bengal where average fish production would be 8-10 tons per ha. Also, Tilapia and Pangasius offer opportunities to enhance the production in the country up to 10-15 tons per ha. Focus on the production of Tilapia will help to satiate the growing market for cheap protein sources. India requires here a development of production techniques. Although one should take into account environmental sustainability issues with this technique, CIFA expertise can be deployed in the enhancement of production of Tilapia and Catfish (magur and pangus) culture.

In addition, the introduction of Recirculation Aquaculture Systems (RAS), Integrated Pond Aquaculture Technology (IPAT), Integrated Multi Tropic Aquaculture (IMTA) are fairly new to India. These systems can be beneficial in reducing soil and water-related environmental problems. These systems can also be installed closer to consumer centres and thus avoiding transportation costs and difficulties. Moreover, RAS may become more attractive due to increasing land prices. The development of RAS in India is nevertheless very slow. The lack of practical demonstration opportunities to farmers is a hindrance and also government agencies have not yet taken up the development of RAS. Aside from these innovations, West Bengal is active on the use of wastewater in aquaculture production. Almost 80% of existing primary-treated wastewater fertilizer aquaculture units are located within this state and about 5,700 ha is currently used to produce over 7,000 tons of carps per year.

There are several other non-conventional practices of aquaculture including the sewage fed fish culture in Bheries of West Bengal, which is an example of efficient waste management. Cage cultures for ***Etroplus*** and mullets have also been tried in these regions other than the conventional carp culture. Region-specific models have been developed in order to improve the management of aquaculture in different regions. The manipulations are associated with species, size, stocking density, biology and the seed availability. Integrated farming practices are coming up with the synergistic systems in which fish will be integrated with cattle, rice, horticulture crops, duck, pig and in various combinations.

10. Inputs

Feed is provided through farm produced oil cakes and rice bran, basically, 90% of feed was supplemented by these two major ingredients. When looking at specific states, Andhra Pradesh, followed by West Bengal and Uttar Pradesh are the main producers of freshwater aquaculture. For feed, however, producers depend on these agricultural by-products. The production of feed specifically for freshwater aquaculture experienced a growth in 2010's. Additional feed is imported from Thailand, Chile, Peru, Myanmar and Taiwan.

It is estimated that the demand for feed from the freshwater aquaculture sector by the end of the twelfth Five Year Plan would be approximately 10 mmt. If we improve the water stability of the prepared feed in 50% of the aquaculture farms, the Feed Conversion Ratio (FCR) can be reduced from 4 to 1.5, which will significantly reduce the feed ingredient requirement. Considering the infrastructure facilities, the development of fish feed mills and scaling up of production from the existing feed mills is the need of the hour. 60-70% of the production cost is for fish feed. Aquaculture industry requires quality fish feed that help in growth stimulation and thus increase in margins for farmers. Sustainability issues are furthermore a concern with farmers that lack expertise and stock too much fish in a tank to achieve a high output. Farmers are therefore in need of better management practices aimed to reduce diseases. In order to overcome these hurdles, several collaborative projects/ research programmes to be conducted by public and private sectors for the benefit of the farming community.

11. Health management

The intensification of aquaculture and introduction of exotic species, the disease outbreaks are frequent in the culture systems in the country. This possesses a serious hindrance to the development of aquaculture and disease outbreaks will result in a considerable economic loss in aquaculture, reduction of income for farmers and finally reduced fish supplies. Basically, the awareness level of aquaculture farmers on the aquatic animal health management is poor. Further, the farmer's knowledge of infrastructure facilities for disease surveillance, early warnings, diagnostics, and field level treatments is also inadequate.

Therefore, there is an urgent requirement of an effective programme to improve the health and hygiene in aquaculture through setting up of quarantine facilities, steady surveillance, epidemiological studies and early warning systems, disease diagnostic laboratories and hands-on training of field level staff to assist the farmers in early diagnosis of the problem. Further, networking amongst national level institutions and laboratories on scientific investigations, the establishment of standard protocols for diagnosis, risk assessments and contingency planning in the event of disease outbreaks would also be essential.

12. Species diversification

India is a country where carp aquaculture (IMC. exotic and medium carps) provides major share (approximately 75%) of the cultured fish production both in terms of quantity and area of farming. The remaining aquaculture production comes from Pangasius sp., other catfishes and air-breathing fishes. Therefore, species diversification in aquaculture is another vital aspect of freshwater aquaculture.
The diversification of fish species in Indian aquaculture is limited just to 15 species in comparison with 29 species in China. The diversification of fish species in aquaculture will help to supply many fish resources pertaining to regional preferences. Besides, this will contribute to the conservation of species diversity in long run. Hence, there should be pragmatic efforts to encourage the utilization of the locally available and marketable species in aquaculture operations.

There are many cultivable species with local demand viz. ***Labeo calbasu, L. fimbriatus, L. gonius, L. dussumieri, L. bata, Cirrhinus reba, Systomus sarana*** and ***Puntius jerdoni*** etc. Therefore, presently there is concerted effort for mass scale breeding and seed production to ensure the seed supply of these species and their inclusion as a part of carp polyculture on the basis of local demand. Moreover, experimental culture trials are also carried out for several species such as murrels, pabda, other air-breathing fishes and mahseers in the freshwater. Besides, sustainable and eco-friendly culture operations can be performed with the eco-friendly exotic species with rigorous monitoring to improve the production.

13. Water resource management

Water is turning into a scarce resource since there are heavy demand and competition for this resource among various sectors and users. This situation addresses the need for harvesting the rainwater and optimizing its usage in aquaculture. The emergence of a re-circulatory system in aquaculture is a good initiative to cope-up with the increasing demand for water resources.

Thus, modern engineering techniques have to be applied for the efficient utilization of water in aquaculture. In this line, technologies are required for enhancing water use efficiency which may include systems for removal of metabolites and microbial load, maintenance of higher oxygen regime, minimizing water loss through seepage and percolation etc. Apart from this, conservation of existing water resources is also very important for increasing the availability of water in future.

14. Ornamental fish culture

Ornamental fish farming holds a good scope in the future since India is blessed with a rich diversity of marine and freshwater ornamental fishes. The export potential of ornamental is about $30 billion which is not fully utilized. At present, the export is restricted to a few species of indigenous fishes from north-eastern states and some exotic species and thus share of the country in Asia's ornamental fish exports is just 2%. However, the trade from the country is expanding at an annual rate of 20% though it amounts only 15 crores presently.

Around 350 species of attractive indigenous and endemic freshwater ornamental fishes are available in India, especially in the biodiversity-rich Western Ghats and the North Eastern Hills (e.g. loaches, barbs, etc). 95% of our ornamental fish export is based on the wild collection. Development of culture technologies is the answer to a long-term sustainable trade of ornamental fish, which reduces the insistence on wild populations. Intense efforts are being carried out by Central Institute of Freshwater Aquaculture (CIFA) for standardization and commercialization of the seed production techniques.

The initial experimental results are encouraging and a great future is ahead for ornamental fish culture in the country.

CIFA technologies for ornamental fish culture

CIFA has successfully bred and standardized the successful rearing of 16 indigenous ornamental species from NEH, Eastern and Southern Western Ghat region comprising barbs, danios, rasboras, catfish and chameleon fish. The recent achievement of the captive breeding technology of an endangered fish *Dawkinfia tambraparniei* has been successful at CIFA leading to commercial production. Development of 'shining barb' through selection process is one of the major achievement and in ornamental fish industry, now under field trial with a private company at Udaipur, Rajasthan. CIFA is playing a major role for conducting research and training programmes on freshwater ornamental fish breeding and culture in the country by conducting several national level training programmes both in and off-campus comprising more than 2000 participants from all over the country.

In addition to that many farmers also visit CIFA regularly for exposure to this area. Development of 'ornamental fish village' through community participation is also another area of success. CIFA scientists regularly facilitate the new entrepreneurs in the development of viable business plans to establish ornamental units. There are several governmental incentives and subsidies to start ornamental fish farming. NFDB provides 50% subsidy for establishing ornamental fish breeding and culture farms. Hence a farmer can prosper more in this direction by availing the supports laid by the Government.

Rosy barb selected for bright shining yellow colour in females and orange in males Commercialized and to be marketed by M/s Tropical Aquaculture & Farming Systems (India), Udaipur, Rajasthan

Climate resilient aquaculture

Aside from the challenges and opportunities mentioned above, there are other multidimensional challenges which can hamper the development of the aquaculture sector.

The Indian climate can interfere with production, also as a consequence of climate change. Monsoon rains reduce the salinity of coastal waters every year, which requires shrimp species that can handle salinity changes. Additionally, poaching and cyclones causing destruction through high waves constitute other impediments. Simultaneously the production costs for aquaculture are increasing worldwide due to increasing feed prices.

Moreover, in India, there is a lack of awareness about long-term sustainability with regard to fisheries and aquaculture. In certain areas fish catch already declined. Other areas suffer from an inadequate water supply due to depleting water sources, mainly caused by irrigation for agriculture and the contamination of water resources used.

New cage-based aquaculture may involve major environmental sustainability risks. The expansion of fresh and brackish water aquaculture production can have major environmental consequences. The location of new aquaculture production can have consequences for water quality through the use of antibiotics, quality and quantity of feed, but also long-term consequences with regard to water flows or reduction of forests or agriculture land. Antibiotics are a concern, mainly because of a lack of awareness amongst farmers. In the extensive aquaculture, antibiotics are not regularly used, because of the size of the ponds and the price of antibiotics.

Fish as livelihood

Shining barb A variant of Rosy barb developed at CIFA

Earlier days, fish said to be a poor man's food but now demand of fish have been raised all over the country, importantly in urban areas where health and living standard of the people significantly increased which enabled the boost in fish production. Fish and fish-related products provide income and livelihoods for numerous communities across the world. It is estimated that more than 120 million people in the world depend directly on fisheries-related activities (fishing, processing, trading), a vast majority of them living in developing and emergent countries. Small-scale fisheries account for 90% of the fisherfolk of India. Small-scale fisheries, as compared to larger scale fisheries, generally make broader direct and indirect contributions to food security; they make affordable fish available and accessible to poor populations and play a key role in sustainable livelihoods of marginalized and vulnerable populations in the country.

The importance of small-scale fisheries (including inland fisheries) in terms of overall production and contribution to food security and nutrition is often underestimated or ignored. Whereas, larger-scale industrial fisheries can also contribute to the food security and nutrition of the poor in developing countries, especially when they favour the wide commercialization of cheap, easily stored and transported (e.g. canned) nutritious pelagic fish such as sardine, pilchard, herring, anchovy or even tuna.

For aquaculture, whether the scale of operation is neutral or not with respect to food security and nutrition outcomes is less clear. The medium-scale enterprises are more effective at addressing poverty reduction and food security, the fact remains that 70-80% of aquaculture production has come so far from small-scale fish farming.

Gender disparity in the sector

Blue revolution in the sector has given more emphasis on social and economic aspects of the people who engaged in the sector. According to experts, "If you give a man a fish, you feed him for a day. If you teach a woman to farm fish, you feed a family for a lifetime." These sectors have enormous potential to strengthen and nurture women as they have a big stake in fish processing and marketing.

The FAO is trying to strengthen the role of women in both the domains. Food insecurity and malnutrition arise from inequalities, including those related to gender. In the fisheries literature, 'gender' and 'gender and development' papers focus mainly on women, ignoring. They comprise 20% of all primary fishing activities and 90% of post-harvest work. Women role in fisheries sector was often 'invisible' and unidentified. They are generally not considered an integral part of the workforce, often lacking the access to credit, training and technology.

In fish processing factories surveyed in India, 60% of workers were women. Women face discrimination in the fish processing sector. In India, they were found to be paid less than men in the seafood export industry and were away from their homes for longer periods which made it difficult for them to balance work and home.

Administration and management of the sector

1. At research level

Research should focus on health control and food safety, improved feedstocks that do not directly compete with human foods, domestication and genetic improvement of key traits contributing to the various dimensions of food security and nutrition, integration of aquaculture in agro-ecological models of production at the farm and landscape levels, and improved linkages with food chain, with due consideration to ecosystems' integrity. However, at national level, so far only limited attention is paid to fisheries sector which is a key element in food security and nutrition strategies. May be most of the researchers concentrated their activity towards production efficiencies and sustainability rather than developing some livelihood programmes to support rural communities or towards malnutrition and hunger of below poverty line.

Important technologies developed by the different research institutes have undergone multi-site testing in different agro-climatic conditions in the country. Certification programmes like Best Aquaculture Practices (BAP) to be developed in the country for encompassing the entire aquaculture production chain and all key components to fish farming responsibly - environmental responsibility, social responsibility, food safety, animal health and welfare and traceability. Electronic media like radio and television must play a major role in the dissemination of the emerging technologies through specific programmes at regular intervals.

2 At policy level

The central and state government should support the aquaculture production sector with an adequate policy framework. Preliminary steps have been made with the establishment of a National Fisheries Development Board (NFDB), a Marine Products Export Development Authority (MPEDA), a National Cooperative Development Corporation (NCDC) and a National Federation of Fishermen's Cooperatives Ltd. (FISHCOPFED).

The 2017 national budget allocated however relatively few funds to the fisheries and aquaculture sector and does not foresee in necessary legislative revisions.

However, fisheries and aquaculture are a state matter and therefore mainly addressed at the state level. The government currently tries to stimulate the sector through providing feed free of cost to farmers. This consumes 60% of the Fisheries budget and farmers do not use the feed in the most efficient way. Another sector to which the government attaches importance is the development of ornamental fish culture. The market for ornamental fish is big within the country and abroad.

ANOTHER SECTOR TO WHICH THE GOVERNMENT ATTACHES IMPORTANCE IS THE DEVELOPMENT OF ORNAMENTAL FISH CULTURE. THE MARKET FOR ORNAMENTAL FISH IS BIG WITHIN THE COUNTRY AND ABROAD.

The strategies can be increased area utilization, improved status of feed, seed and supplements, Institutional strengthening, demand-based production, disease control and surveillance, species diversification, efficient utilization of water resource, generation of database on cultivable areas and species, creation of demand for domestic and export markets, diversification of the culture practices, utilization under-utilized areas like inland saline waters, proper policy options for the management and the initiation of public-private partnerships. The future demand can be met sustainably if the aquaculture will go hand in hand with the environment. The focus for the future should be producing more per drop of water and within the spatial limits.

In the last 20 years, practices have changed and efforts have been made in environmental and conservations. International cooperation and strong regional fisheries management organizations are vital for sound fisheries management policies.

The contribution of fisheries and aquaculture to food security and nutrition, present scenario and in the future it may be driven by many interactions between several environmental, development, policy and governance issues. Although, there are several key laws and regulations may be relevant to aquaculture and they must be read in conjunction with one another to gain a full picture of the rules that are applicable to aquaculture.

INTERNATIONAL COOPERATION AND STRONG REGIONAL FISHERIES MANAGEMENT ORGANIZATIONS ARE VITAL FOR SOUND FISHERIES MANAGEMENT POLICIES.

Make fish an integral element in inter-sectoral national food security and nutrition policies and programmes with special regard to promoting small-scale production and local arrangements and other policy tools, including nutrition education.

Conclusion

Increased demand for food grains and protein will cause a price hike in a country like India, where the population is quite high. Aquaculture can undoubtedly serve as a cheap protein source of fish in the future to feed 1.5 billion people.

The different sectors of aquaculture have to be strengthened in demand based manner to approach the target levels of production. India can play a major role in the production and distribution of the farmed fish around the world.

The appropriate policy and institutional framework are essential to realize such huge potential in the country which would contribute to the national nutritional security significantly.

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SPECIAL ARTICLE

Strengthening and scaling fisheries co-operative based approach to

Fish production and post-harvest technology for nutritional food security

B. K. MISHRA*

INTRODUCTION

Fish is one of the most important sources of animal protein. It plays a great role in the nutrition and human health care. Fish helps maintain ecosystem and provides livelihood to a huge population of the country. A large number of fish farmers are involved in the fishery sector through fishery cooperative societies. There are women fishery cooperative societies too. For the benefit of this huge population who are mostly landless and marginal fish farmers, the diversification of fishery activities and strengthening and scaling of fishery co-operatives sector should be a priority to cope with unemployment, hunger and poverty of rural India and nutritional food security of all including semi-urban and urban areas. Recent advances in aquaculture like RAS technology and post-harvest technology has also open doors for entrepreneurs in the sector.

The umbrella body of fishery co-operatives in India is the National Federation of Fishers Co-operatives Ltd. (FISHCOPFED) which is an apex and national level cooperative organization for the development of fishery co-operatives movement in India. Registered in 1980, the federation started its operation in the year 1982. FISHCOPFED has 101 member institutions all over the country including Ministry of Agriculture and Farmers Welfare, Government of India and National Cooperative Development Corporation (NCDC).

FISHCOPFED provides social security through insurance schemes and training extensions to the poor fishers to train their skills on various aspects of fisheries. FISHCOPFED is the best service delivery system in the country in fisheries sector focusing on economic empowerment of poor fishers. FISHCOPFED is a member of the International Co-operative Alliance (ICA) and also a member of the International Co-operative Fisheries Organization (ICFO) and Network for Development of Agricultural Co-operatives in Asia and the Pacific (NEDAC). FISHCOPFED is engaged in a number of activities of fish marketing in several states as retailer and wholesaler for the ease of the primary fishery cooperative societies to provide them hurdle free marketing channels and give them a better price for their produce.

In order to demonstrate fish culture in inland water, FISHCOPFED has five water bodies in the state of Odisha and one water body each in Assam and Bihar. FISHCOPFED also manages and operates a hatchery at Bhimpur in the state of Rajasthan to supply quality fish seeds to fish farmers of

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SPECIAL ARTICLE

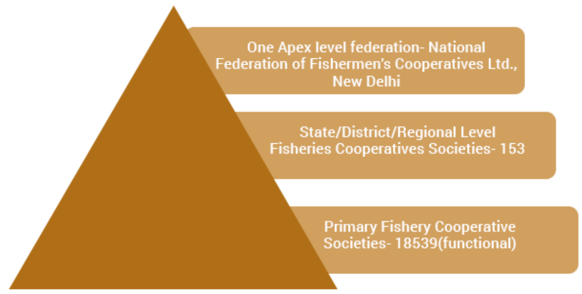
Rajasthan and supply fingerlings for reservoirs in the state.

Nowadays FISHCOPFED is also focusing more on Sustainable Development Goals (SDGs) adopted by world leaders in September 2015 at a historic UN Summit which officially came into force with effect from January 1, 2016. Accordingly at present it is providing technical know-how to the members of fishery cooperative societies to enhance their production through scientific aquaculture practices, introducing high-yield fish species, providing infrastructural support and promoting cooperative fish marketing in order to maximize the profit of the poor fish farmers/members of PFCS, minimize the pre and post-harvest loss of fish from farm to freeze and trying to ascertain that the fish which is highly perishable item reaches the end consumer in fresh and wholesome condition. Fish is very rich in quality protein and have free amino acids and omega-3 fatty acids which are known for the overall wellness of body and heart in particular of the human beings. Efforts of FISHCOPFED are to reduce poverty, malnutrition, and hunger through fishery cooperative societies which have vast untapped potential in the country.

The centrally sponsored Group Accident Insurance Scheme implemented by FISHCOPFED has been converted to Pradhan Mantri Suraksha Bima Yojna (PMSBY) which provide insurance cover to 42.14 lakhs fishers in 23 states and 5 Union Territories. The premium is Rs. 12 per insured and is shared on 50:50 basis between the central government and state government. It is shared on 80:20 basis between the central government and state government for the North-Eastern States and the Hill States. There is 100% central share of Union Territories covered under the scheme. The cover is of Rs. 2 lakh for death or permanent disability and Rs. 1 lakh on partial but permanent disability due to an accident.

CURRENT STRUCTURE OF FISHERIES CO-OPERATIVES IN INDIA

CURRENT STRUCTURE OF FISHERIES CO-OPERATIVES IN INDIA



INDIAN FISHERIES

Global position	3rd in Fisheries and 2nd in Aquaculture
Contribution of Fisheries to GDP (%)	1.07
Contribution to Agril. GDP (%)	5.4
Per capita fish availability (Kg.)	9.0
Employment in sector (million)	14.0

Current structure of fishery co-operatives in india

Name of the State / UT	Number of societies (level)				No. of members
	State level	Regional level	District level	Primary level	
Andhra Pradesh	1		13	2,275	2,52,174
Arunachal Pradesh				11	230
Assam	1			272	43,845
Bihar	2			510	4,10,007
Chhattisgarh	1		3	765	26,154
Goa				20	1,503
Gujarat	1		2	263	26,045
Haryana			1		11
Himachal Pradesh				45	5,837
Jammu Kashmir				1	18
Jharkhand	1			384	22,853
Karnataka	1		2	420	2,04,689
Kerala	1			386	3,48,466
M.P.	1		1	596	25,496

Maharashtra	1	2	39	3,315	3,32,636
Manipur	1		3	240	18,433
Meghalaya				18	611
Mizoram	1			47	1,656
Nagaland				267	9,234
Odisha	1	1	2	657	1,38,143
Punjab		1		1	8
Rajasthan			1	34	4,130
Sikkim				8	230
Tamil Nadu (TN)	1	11		1,353	6,01,620
Telangana	1	10		3,933	2,52,202
Tripura	1			142	22,967
UP	1	19		1,011	54,521
Uttarakhand				13	634
West Bengal	1	20		1,433	92,759
Andaman Nicobar Islands	1			41	1,361
Daman and Diu				7	3,136
Lakshadweep				6	2,910
Puducherry	1	1		64	58,522
Total	***21***	***3***	***129***	***18,539***	***29,63,051***

ROLE OF PFCS IN HARNESSING OPTIMUM POTENTIAL

PFCS can play a very vital role in the supply of quality fish seed (Tilapia, Pangasius, IMC and Exotic Carps etc.) and set up fish seed rearing farms to supply fingerlings of various fish species. It can also supply broodstock to hatcheries besides setting up fish feed mills. Technological advancement has also open doors for cage culture and doors for the marketing of value-added fish and fishery products in supermarkets.

A.Potential for fisheries co-operatives in culture and capture fisheries

Inland water resources of India

Area under reservoirs	3.15 million ha
Area under ponds and tanks	2.36 million ha
Area under brackish water	1.24 million ha
Length of rivers and canals	0.19 million ha

Marine water resources of India

Length of the coast line	8,118 km
Exclusive economic zone	2.02 million sq.km
Continental shelf - 0.53 million sq.km	0.53 million sq.km

Number of fisheries centres - 1537	1537
Number of fishing village - 3432	3432

Target set by Govt. Of India

Fish production in 1950-51	0.75 MMT
Fish production in 2015-16	10.79 MMT
Target by 2020-21	15.08 MMT

INCREASING PRODUCTION OF AIR-BREATHING FISH SPECIES

There are many air-breathing fishes which are commercially very important. Some of them are Singhi (***Heteropneustes fossilis***), Magur (***Clarias batrachus***), Sol (***Channa striatus & Channa marulius***), Climbing perch/Koi (***Anabas testudineus***), Pabda (***Ompok pabda***) and species of Pangasius to increase the production of fish farmers and fishery co-operatives in water bodies with low oxygen level. These fishes have high consumer preference and fetch good prices to farmers. The culture of some fishes can be done with carp fishes also under polyculture system of fishes. The catfishes can be easily cultured in an intensive culture system and hence gives more production from per unit volume or area of water. The high yield culture system of air-breathing fishes with low input has proved to be of low risk and required simple management well suited to rural development.

INCREASING PRODUCTION OF GENETICALLY IMPROVED FISH SPECIES (GIFS)

Genetically improved fish species like GIFT strain of Nile tilapia, Jayanti rohu and improved catla etc. have considerably increased the production of some fish farmers. Awareness level among the farmers is still very low and there is need of setting of nursery and marketing units of these species across the country.

INTRODUCTION OF GOOD MANAGEMENT PRACTICES

Effluents from factories, sewage from municipal drainage, fertilizers and pesticides from agricultural wash offs happen to defile our aqua farms and equate resources. There are large scale fish kills and disease due to water pollution in one form or the other. Under such circumstances, a centrally sponsored fish crop insurance policy should come into effect through FISHCOPFED.

B. Potential for fisheries co-operatives in post-harvest operations

1) CO-OPERATIVE FISH MARKETING FROM FARM TO WHOLESALE MARKETS

Fish is a very highly perishable item and its nutritive value has to be maintained by means of fish preservation immediately after harvesting and until it reaches the end consumer. Hence, marketing of fish to far distant states has emerged as an issue of great concern for individual fish farmers and fishery cooperative societies because of lack of infrastructure with them, their exploitation at various level of trading by middlemen, uncertainty of market demand and lack of other infrastructure like cold storage and insulated/refrigerated trucks for transportation etc. Keeping all these things in view, FISHCOPFED is passionate to create marketing infrastructure (Cold Chain Development) with stable supply chain management in some metropolitan cities for fisheries sector. This can be feasible with the support of government and involvement of fishery cooperative societies under the supervision of FISHCOPFED. Development of fish preservation infrastructure and minimization of post-harvest loss can contribute a lot to SDGs.

The database of all the fishery cooperative societies including the details of their activities, infrastructure, production, water bodies in the country is with FISHCOPFED together with their potential, needs and problems etc. In India, there are 18,539 functional primary fishery cooperative societies with a membership of 29,63,051 fishers both in marine and inland sector. Most of these societies are engaged mainly in culture and capture fisheries and very few are engaged in processing and marketing. About 70% of fish production is coming from these cooperative societies only.

FISHCOPFED is making efforts to strengthen the cooperative fish marketing societies in the country by providing infrastructural support to some of the identified fishery co-operative societies with funding support of Govt. of India and aims at facilitating the marketing needs of thousands of fishery cooperative societies in the country. The whole and semi-processed fish can be brought from distant areas by FISHCOPFED at the minimum transportation cost in insulated/refrigerated trucks from these co-operatives and sold to the wholesalers in other distant markets through the organized marketing network with the help of local fishery co-operative societies, wholesalers and further forming management committees. In the days, the demand for hygienic fish and fishery products shall be high because of the consciousness of the people towards the hygienic handling of finfish and shellfish and as well as the nutritious value of it. FISHCOPFED can ensure the regular supply of varieties of fish from coastal states/fish producing states in a good nourishing condition through its supply chain management supported by the cold chain to fish deficient states.

It would not be feasible for the Government to establish ice plants, cold storage etc. without the support of fishery cooperative societies in Inland states which are producing large quantities of fish. The Government of India should consider establishing at least 100 fish collection centres with ice plants and chilled stores near the big reservoirs in inland states and other fish production areas being managed by fishery co-operative societies. From nearby fish farms too, the fishes can be brought to these centres and collected from there having all those facilities for washing, grading, loading/unloading, icing and transportation etc. It can be done very easily with the involvement of FISHCOPFED and its member fishery co-operatives in various states with the funding support of government very easily in a sustainable manner.

i) Fish collection centers

Govt. of India should consider constructing at least 100 fish collection centres under the supervision of FISHCOPFED with procurement shed of 20 x 20 feet size with tiles flooring and tin roofing, fish washing facility, drainage, weighing balance, plastic crates, submersible pumps, overhead tanks, insulated plastic boxes etc. As soon as fish is harvested, it should be stored with ice after washing to avoid its spoilage. The collection centres should provide facilities for sorting, grading, washing, icing, packing in tubs/insulated boxes etc. Therefore it is necessary to have ice making plant at every fish collection centre. Tube ice is used for short distance transportation of fish while cube ice is used for long-distance transportation of fish.

ii) Refrigerated-insulated trucks of 20 tons carrying capacity

The refrigerated and insulated body of the vehicle help maintains the temperature of the fish below 4^{0}C from farms/landing centres to point of sale and help maintain the nutritive value of fish. At least 100 trucks of 20 tons capacity each are required to strengthen the co-operative fish marketing of the country.

2) Co-operative fish marketing from wholesale markets to doorsteps

FISHCOPFED also aims at the marketing of whole fish, semi-processed fish (ready to cook fish fillets etc.), and ready to eat fishery products in the retail markets and directly to end users of nonmaritime states like Delhi and National Capital Region (NCR) at their doorstep. There is a vast demand for fish in Delhi and NCR but due to the outlying location of retail/wholesale markets in Delhi, the people are deprived of this healthy food. The vendors and retailers do not cover sufficient parts of Delhi and NCR. People from government and private institutions, residential complexes, apartments, hostels and hotels etc. generally approach FISHCOPFED for delivery of fish and fish products.

The whole fish could be easily supplied through mobile vans from the fleet of 20 tons capacity refrigerated trucks reaching Delhi or from the wholesale market but for semi-processed/processed fishery products, a processing plant (or a big kitchen) should be set up in NCR with 5 tons capacity tube ice plant and cold storage and other processing and cooking facilities. The cold storage is used to store and preserve whole fish and processed fishery products in separate chambers with a proper arrangement to check the cross contamination. From this centralized kitchen, at least 50 mobile fish parlours can be run in Delhi and NCR to supply semi-processed, ready to cook and ready to eat fishery products.

Infrastructure requirements for marketing of fish directly to consumers

Fish processing centre (a big kitchen) with facilities of filleting machines, cold storage and other processing equipments have to be set up to run at least 50 mobile fish parlours (fish on wheels) in Delhi and NCR. The fish brought in iced and refrigerated condition from fish farmers/members of PFCS to the processing plant shall be processed as per the demand of the customer. Pre-processing like sorting (species-wise) and grading etc. can be done manually. Then it is de-scaled, beheaded, filleted, and finally packed in polythene pouch for marketing. Further, cooking faculties are used to prepare ready to eat products.

The processing facility (centralized kitchen) requires following machineries/equipments

a) Processing tables
a) Weighing Machine
b) De-scaling Machine
c) Beheading Machine
d) Filleting Machine.
e) Washing, cutting and finishing equipments (20 plastic trays, knives etc.)
f) Polythene pouch sealing machine.
g) Tunnel Trolley Freezer
h) Label printing machine.
i) Cold storage of 4 x 4 m size (-50°C temp.) made of PUF panel and allied machineries.
j) Waste collection and waste water treatment system
k) Fly catching machines
l) Tube ice plant etc.

The above plant and machinery can be set up anywhere in fish deficient states. FISHCOPFED proposes it to be established in Delhi/NCR on a pilot project basis and then it can be rolled out to the whole country. The design of the plant should be as per the guidelines needed to establish HACCP system. The Mobile fish selling units should have provisions for selling whole fish, fish fillet pouches and as

well as ready to eat products.

3) Hygienic fish retail outlets

FISHCOPFED has two fish retail outlets in Delhi and some retail outlets in other cities of different states of the country. There is a need to open up more fish retail outlets in Mother Dairy pattern. It can be possible only if government support is there in terms of leasing shops to fishery co-operatives in shopping complexes, markets etc. There is also need of policy to remove hurdles in getting a license from several authorities to sell fish in town and cities.

Nutritional food security through fisheries and fisheries co-operatives

Fisheries, being a major sector providing cheapest protein source without any significant carbon-footprint (as seen in meat, wheat, rice production etc.) has a great potential wealth of food fishes, for which culture and breeding techniques are steady developing. A vast wealth is waiting in the wilderness, the fish culture of indigenous species will not only offer additional food source, it will help in conserving the species in the long run while augmenting livelihood and offering more protein source. The meat of some catfishes is highly recommended for some ailments and physical weakness of human beings. There will be the following benefits to food value chain through fishery cooperatives.

1) Fishery co-operatives are a group of fish farmers who band their resources and mechanize their farms to enhance production. They have larger water bodies and can ensure regular supply of fish. While the individual fish farmer lacks infrastructure, knowledge and skill required at the various level of aquaculture, capture and marketing of fish etc.
2) Cooperative fish marketing system can ascertain supply of wholesome fish from farm gate/landing centers to freeze/customers of distant states through cold chain development.
3) Producer cooperatives/fish farmers can get better prices for their produce through cooperative fish marketing by elimination of middlemen viz transporters, multi-level traders etc.
4) Employment generation, cold chain, food security, enhanced per capita fish consumption, removal malnutrition, and popularity of fish and fishery product, strengthened marketing networks can be achieved through fishery cooperatives.

CONCLUSION

Around 3 million people are being benefited economically through primary fishery co-operatives in India. By strengthening these co-operatives through cooperative fish marketing with sufficient infrastructure and organized marketing channels, FISHCOPFED can, to a large extent strengthen 3 million people of these societies and can play a good role to keep the pace of production and supply to the tune of increasing population, its food demand and nutritional food security in the country. FISHCOPFED with its mobile vans can be able to provide fish to the people at their doorsteps and increase the graph of the popularity of fish in the market.

There is an urgent need of setting up of a small processing plant in each city of the country on PPP model for semi-processed fishery products like fish fillets, ready to cook and ready to eat products etc. for local marketing through mobile vans. With the results of the nationwide fishery co-operatives survey, FISHCOPFED has also speeded up its work to promote these co-operative societies in a sustainable manner through various means like marketing, processing, insurance, training and technology transfer etc. With increased demand for fish in various forms, production of fish will also come up making fisheries more profitable venture for these cooperatives. Hence, the role of fishery co-operatives has to be considered at every level in the changed economic scenario and it should be supported with funds to develop infrastructure for sustainability.

SPECIAL ARTICLE

Smart Packaging: the future for seafood packaging industry

C. O. MOHAN*, C. N. RAVISHANKAR**

INTRODUCTION

There has been an increasing demand for good quality food products with better shelf life. Over the years, packaging has brought out a revolution in marketing and distribution of food products including fish. Among the food categories, seafood ranks the third position with respect to consumption which explains the importance of fish. Fish is a vital source of food for people. It is the most important single source of high-quality protein that provides approximately 16% of the animal protein consumed by the world's population (Food and Agriculture Organisation (FAO), United Nations, 1997). By any measure, fishes are among the world's most important natural resources. Annual exploitation of wild populations exceeds 90 million tons , and total annual trade exceeds US$ 55 billion. Additionally, with over 25,000 known species, the biodiversity and ecological roles of fish are being increasingly recognized in aquatic conservation, ecosystem management, restoration and aquatic environmental regulation.

Like any other food commodities, fish is one of the highly perishable items which undergo spoilage if sufficient care is not taken. Various preservation methods have been in place to overcome the spoilage of fish. Chilling and refrigeration is the most preferred preservation method as it helps in preserving fresh like quality. Chilling or icing reduces the temperature of fish so as to prolong the lag phase of bacteria and help in reducing the spoilage rate. Fish being one of the most perishable foods, its freshness is rapidly lost even when stored under chilled conditions. Further, consumers demand to have fish as fresh as possible, so that the characteristics flavours are retained. Bulk transportation of fresh fish in ice has several limitations like limited extension of shelf life, unnecessary expenditure on freight due to ice, difficulty in handling and maintaining hygienic conditions due to leaching of ice melt water with leaching losses of soluble nutrients and flavouring compounds.

Proper packaging will help in improving the keeping quality of fish. Packaging is an important aspect of improving the shelf life and marketability. Packaging enhances consumer acceptability and hence saleability of the product. Traditionally, food packaging is meant for protection, communication, convenience and containment. The package is used to protect the product from the deteriorative effects of the external environmental conditions like heat, light, presence or absence of moisture, pressure, microorganisms, and gaseous emissions and so on. Packaging is an integral part of food processing and plays an important role in preventing or reducing the generation of waste in the supply of food. Packaging assists the preservation of the world's resources through the prevention of product spoilage and wastage, and by protecting products until they have performed their function.

Basic requirements of a package are good marketing properties, reasonable price, technical feasibility, a utility for food contact, low environmental stress, and suitability for recycling. Simply packing fish enhance the shelf life of chilled and refrigerated fish for 7 to 15 days depending on fish species. However, the spoilage process will be accelerated due to the presence of O_2 in the normal air packing. Alteration in the package atmosphere will help in overcoming the problem of shelf life, which can be achieved by vacuum packaging or modified atmosphere packaging.

VACUUM PACKAGING

Important properties by which consumers judge fish and shellfish products are appearance, texture, and flavour. Appearance, specifically colour, is an important quality attribute influencing the consumer's decision to purchase. In fresh red meat fishes, myoglobin can exist in one of three chemical forms. Deoxymyoglobin, which is purple, is rapidly oxygenated to cherry red oxymyoglobin on exposure to air. Over time, oxymyoglobin is oxidized to metmyoglobin which results in a brown discolouration associated with a lack of freshness. Low oxygen concentrations favour oxidation of oxymyoglobin to metmyoglobin. Therefore, in order to minimize metmyoglobin formation in fresh red meats, oxygen must be excluded from the packaging environment to below 0.05% or present at saturating levels.

Lipid oxidation is another major quality deteriorative process in mussle foods resulting in a variety of breakdown products

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which produce undesirable off-odours and flavours. Hence O_2 may cause off-flavours (e.g. rancidity as a result of lipid oxidation), colour changes (e.g. discolouration of pigments such as carotenoids, oxidation), nutrient losses (e.g. oxidation of vitamin E, ß-carotene, ascorbic acid) and accelerates microbial spoilage thereby causing a significant reduction in the shelf life of foods. Therefore, control of

Typical vacuum packaging machine

oxygen levels in food package is important to limit the rate of such deteriorative and spoilage reactions in foods. Oxygen level in the package can be controlled by using the vacuum packaging technique in which, the air present in the pack is completely evacuated by applying vacuum and then the package is sealed.

Vacuum packaging, which is also referred to as skin packaging involves removal of air inside the pack completely and maintaining food material under vacuum conditions so that oxygen available for the growth of microbes and oxidation will be limited. This will help in doubling the shelf life of fish under chilled conditions. This technique is particularly useful in fatty fishes, where the development of undesirable odour due to the oxidation of fat is the major problem. Vacuum packaging for chilled and refrigerated fishes doubles the shelf life compared to normal air packaging. Application of this to frozen fishes is also commonly followed as it helps in reducing the problem of freezer burn. This technique can be applied to fresh meat and fishes, processed meat and fishes, cheese, coffee, cut vegetables etc. One of the important aspects of the vacuum packaging is the use of packaging material with good barrier properties. Normally polyester-polyethylene or nylon-polyethylene laminates are used. Polyester and nylon provides good strength and acts as a good barrier to oxygen. Polyethylene proves good heat sealing property and is resistant to water transmission.

ADVANTAGES OF VACUUM PACKAGING

- Reduces fat oxidation
- Reduces growth of aerobic microorganisms
- Reduces evaporation
- Reduces weight loss
- Reduces dryness of product
- Reduces freezer burn
- Reduces volume for bulk packs. Eg. tea powder, dry leaves etc
- Extends the shelf life
- Easy to use and maintain the equipment

Vacuum packed fish

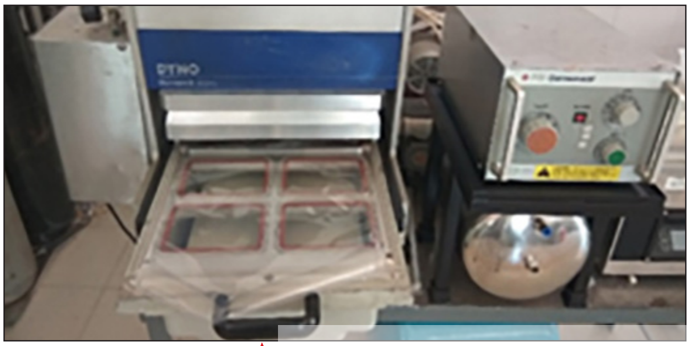
DISADVANTAGES OF VACUUM PACKAGING

- Cannot be used for crispy products and those with sharp edges
- Requires high barrier packaging material to maintain vacuum
- Creates anaerobic condition, which may trigger the growth and toxin production of Clostridium botulinum and the growth of Listeria monocytogenes. Additional barriers/hurdles are needed to control these microorganisms
- Capital intensive

An alternative to vacuum packaging, the reduced oxygen level in the package can be achieved by using active packaging system like oxygen scavenger. Use of oxygen scavenger is very effective in reducing the oxygen level to <0.01% within 24 hours, which helps in preserving the quality of food. This is not capital intensive and can be applied to any products including crispy and products with sharp edges.

MODIFIED ATMOSPHERE PACKAGING (MAP)

Marketing of modified atmosphere packaged foods has increased, as food manufacturers have attempted to meet consumer demands for fresh, refrigerated foods with extended shelf-life. It is also used widely, as a supplement to ice or refrigeration to delay spoilage and extend the shelf



Modified Atmosphere packaging equipment

Gas composition analyser

life of fresh fishery products while maintaining a high-quality end product. A modified atmosphere can be defined as one that is created by altering the normal composition of air (78% Nitrogen, 21% Oxygen, 0.03% Carbon Dioxide and traces of noble gases) to provide an optimum atmosphere for increasing the storage length and quality of food/produce.

Oxygen, CO_2, and N_2 are most often used in the MAP. Other gases such as nitrous and Nitric Oxides, Sulphur Dioxide, Ethylene, Chlorine, as well as Ozone and Propylene Oxide have been suggested for a variety of products and investigated experimentally. However, due to safety, regulatory and cost considerations, they have not been applied commercially. These gases are combined in three ways for use in modified atmospheres: inert blanketing using N_2, semi-reactive blanketing using CO_2:N_2 or O_2:CO_2:N_2 or fully reactive blanketing using CO_2 or CO_2:O_2.

DEVELOPMENT OF MODIFIED ATMOSPHERE PACKAGING

Kolbe was the first to investigate and discover the preservative effect of Carbon Dioxide on meat in 18th century and Coyne was the first to apply modified atmospheres to fishery products as early as 1930s. Modified atmosphere packaging (MAP) is the removal and/or replacement of the atmosphere surrounding the product before sealing in vapour-barrier materials. While technically different many forms of the MAP are also case-ready packaging, where meat is cut and packaged at a centralized location for transport to and display at a retail store. Most of the shelf life properties of meat are extended by use of MAP, but anoxic forms of the MAP without Carbon Monoxide do not provide bloomed red meat colour and MAP without Oxygen may promote oxidation of lipids and pigments.

Advances in plastic materials and equipment have propelled advances in the MAP, but other technological and logistical considerations are needed for successful MAP systems for raw chilled fresh meat.The growth inhibition of microorganisms in MA is determined by the concentration of dissolved CO_2 in the product. The preservation effect of the MAP is due to the drop in surface pH in MA products because of the acidic effect of dissolved CO_2, but this could not entirely explain all of CO_2's bacteriostatic effect. The possibility of intracellular accumulation of CO_2 would upset the normal physiological equilibrium by slowing down enzymatic processes. Thus, the effect of CO_2 on bacterial growth is complex and four mechanisms of CO_2 on micro-organisms have been identified:

1. Alteration of cell membrane functions including effects on nutrient uptake and absorption
2. Direct inhibition of enzymes or decrease in the rate of enzyme reactions
3. Penetration of bacterial membranes, leading to intracellular pH changes
4. Direct changes in the physicochemical properties of proteins.

Probably a combination of all these activities accounts for the bacteriostatic effect. A certain amount (depending on the foodstuff) of CO_2 has to dissolve into the product to inhibit bacterial growth. The ratio between the volume of gas and volume of food product (G/P ratio) should be usually 2:1 or 3:1 (gas:food product). This high G/P ratio is also necessary to prevent package collapse because of the CO_2 solubility in wet foods. The CO_2 solubility could also alter the food-water holding capacity and thus increase drip.

The major function of Carbon Dioxide in the MAP is to inhibit the growth of spoilage microbes. Carbon Dioxide (CO_2) is soluble in both water and lipid and it has bacteriostatic and fungistatic properties. Carbon Dioxide lowers the intra and extracellular pH of tissue including that of microorganisms. It affects the membrane potential and influences the equilibrium of decarboxylating enzymes of microorganisms.

CO_2 increases the lag phase and a slower rate of growth of microbes during the logarithmic phase. This bacteriostatic effect is influenced by the concentration of CO_2, the partial pressure of CO_2, volume of headspace gas, the type of microorganism, the age and load of the initial bacterial population, the microbial growth phase, the growth medium used, the storage temperature, acidity, water activity, and the type of the product being packaged. Pathogens like ***Clostridium perfringens*** and C. ***botulinum*** are not affected by the presence of Carbon Dioxide and their growth is encouraged by anaerobic conditions. In general, Carbon Dioxide is most effective in foods where the normal spoilage organisms consist of aerobic, gram-negative psychrotrophic bacteria.

The CO_2 is flushed into the modified atmosphere package by evacuating the air and flushing the appropriate gas mixture into the package prior to sealing. Another method to create a modified atmosphere for a product is either to generate the CO_2 and/or remove O_2 inside the package after packaging or to dissolve the CO_2 into the product prior to packaging. Both methods can give appropriate packages with smaller gas/product ratio to the package. The solubility of CO_2 decreases with increasing temperature, hence MAP products should be stored at lower temperatures to get the maximum antimicrobial effect. Also, the temperature fluctuations will usually eliminate the beneficial effects of CO_2. The rate of absorption of CO_2 depends on the moisture and fat content of the product. If product absorbs excess CO_2, the total volume inside the package will be reduced, giving a vacuum package look known as 'pack collapse.' Excess CO_2 absorption along with 'pack collapse' results in the reduction of water holding capacity and further drip loss to the products.

The major function of oxygen is to avoid anaerobic condition which favours the growth and toxin production of *C. botulinum* and growth of *L.monocytogenes*. Oxygen in the MAP is also useful to maintain the muscle pigment myoglobin in its oxygenated form, oxymyoglobin. In fresh red meats, myoglobin can exist in one of three chemical forms. Deoxymyoglobin, which is purple, is rapidly oxygenated to cherry red oxymyoglobin on exposure to air. Over time, oxymyoglobin is oxidised to metmyoglobin which results in a brown discolouration associated with a lack of freshness. Low oxygen concentrations favour oxidation of oxymyoglobin to metmyoglobin. Therefore, in order to minimize metmyoglobin formation in fresh red meats, oxygen must be excluded from the packaging environment to below 0.05% or present at saturating levels. High oxygen levels within MAP also promote oxidation of muscle lipids over time with a deleterious effect on fresh meat colour. O_2 in MA-packages of fresh fish will also inhibit reduction of TMAO to TMA.

Nitrogen (N_2) is an inert and tasteless gas and is mostly used as a filler gas in the MAP, either to reduce the proportions of the other gases or to maintain pack shape by preventing packaging collapse due to the dissolution of CO_2 into the product. Nitrogen is used to prevent package collapse because of its low solubility in water and fat. Nitrogen is used to replace O_2 in packages to delay oxidative rancidity and to inhibit the growth of aerobic microorganisms. The exact combination to be used depends on many factors such as the type of the product, packaging materials and storage temperature. The gas ratios normally used are 60% CO_2 and 40% N_2, for fatty fishes and 40% CO_2, 30% O_2 and 30% N_2 for lean variety fishes. The helf life of different fishes packed under vacuum and MAP at different storage conditions are given in Table 1.

ADVANTAGES OF MAP

- The natural colour of the product is preserved
- The product retains its form and texture
- Reduces the growth of micro-organisms
- Product retains its vitamins, taste and reduces fat oxidation
- The need to use preserving agents is reduced
- Helps in marketing products to distant locations
- Improved presentation-clear view of product
- Hygienic stackable pack, sealed and free from product drip
- Longer durability of perishable food/decrease of spoilage
- Extends the shelf life of fish in chilled/refrigerated storage by 2-3 times
- Helps in reducing post-harvest loss

DISADVANTAGES OF MAP

- Capital intensive due to the high cost of machinery
- Cost of gases and packaging materials
- Additional cost of gas analyser to ensure adequate gas composition
- No control over the gas composition after packing
- Increase of pack volume which will adversely affect transportation cost and retail display space
- Benefits of MAP are lost once the pack is opened or leaks
- High concentration of CO_2 may favour anaerobiosis
- Strict maintenance of temperature has to be ensured to avoid the risks of C. *botulinum* and *L. monocytogenes.*

SMART PACKAGING TECHNOLOGIES

Traditional packaging concepts are limited in their ability to prolong the shelf life of fish products. This can be overcome by adopting vacuum and modified atmosphere packaging technologies. However, these require capital investment apart from the requirement of fresh food grade gas in case of the MAP. This prompted the researchers to develop new and improved methods for maintaining food quality and for extending shelf life. Active and intelligent packagings, which are regarded as smart packaging technologies, is one such advanced packaging technique which is finding its way in the preservation of various food systems including fish and shellfish. The market for active and intelligent packaging systems are fast growing and their demand is projected to reach $10.5 billion by 2021, fuelled by the development of new generations of products and more cost competitive prices, which will spur greater market acceptance for many product types.

BASIS OF SMART PACKAGING

Source: AWA Alexander Watson Associates

Packaging has four basic functions, viz., containment, convenience, protection and communication. Conventional packaging systems offer limited protection and communicate only through the labelling. It will not provide any information about the quality and safety of the product. Active and intelligent packaging enhances the protection and communication functions, respectively. The following graphics explain how this enhanced functionality works.

ACTIVE PACKAGING

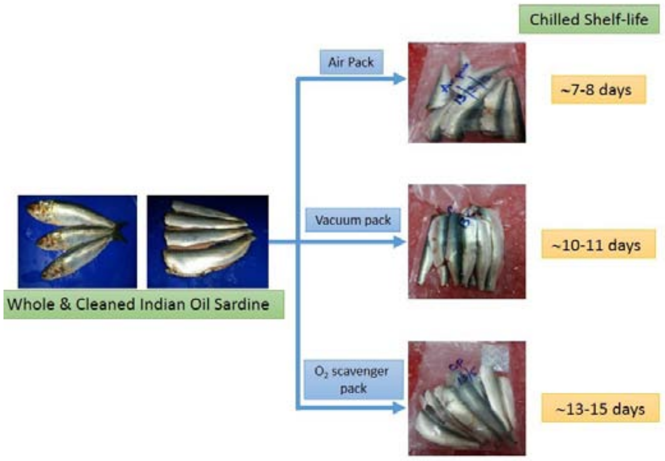
Active Packaging (AP) is an innovative concept that can be defined as 'a type of packaging that changes the condition of the packaging and maintains these conditions throughout the storage period to extend shelf life or to improve safety or sensory properties while maintaining the quality of packaged food.' Active packaging performs some desired role other than providing an inert barrier between the product and external conditions and combines advances in food technology, biotechnology, packaging and material science, in an effort to comply with consumer demands for 'fresh like' products. This involves incorporation of certain additives into the packaging film or within packaging containers with the aim of maintaining and extending product shelf life. Active packaging technique is either scavenging or emitting systems added to emit (eg., N_2, CO_2, ethanol, antimicrobials, antioxidants) and/or to remove (eg., O_2, CO_2, odour, ethylene) gases during packaging, storage and distribution.

In case of a gas-scavenging or emitting system, reactive compounds are either contained in individual sachets or stickers associated to the packaging material or, more recently, directly incorporated into the packaging material. Major active packaging techniques are concerned with substances that absorb Oxygen, Ethylene, moisture, Carbon Dioxide, flavours/odours and those which release Carbon Dioxide, antimicrobial agents, antioxidants and flavours. The most important active packaging concepts for fishery products include O_2 scavenging, CO_2 emitters, moisture regulators, antimicrobial packaging concepts, antioxidant release are discussed here.

O_2 SCAVENGER

Oxygen scavenging sachet, film and bottle closure

Fish products are highly susceptible to oxygen as it leads to the growth of aerobic microorganisms and oxidation which causes undesirable colour changes (eg. discolouration of pigments such as myoglobin, carotenoids), off-odours and flavours (eg. rancidity as a result of lipid oxidation) and leads to loss of nutrients (eg. oxidation of vitamin E, β-carotene, ascorbic acid) which adversely affects the quality. Therefore, control of oxygen levels in food package is important to limit the rate of such deteriorative and



Schematic representation of Influence of active packaging on the shelf life of Indian Oil sardine spoilage reactions in foods. Although O_2 sensitive foods can be packed appropriately using Modified Atmosphere Packaging (MAP) or vacuum packaging, these technologies do not always remove O_2 completely. Moreover, the O_2 that permeates through the packaging film cannot be removed by these techniques. By use of an O_2 scavenger, which absorbs the residual O_2 after packaging, quality changes of O_2 sensitive foods associated with low residual oxygen levels can be minimized.

O_2 scavengers were first commercialized in the late 1970s by Japan's Mitsubishi Gas Chemical Company (Ageless). O_2 scavengers are able to eliminate oxygen contained in the packaging headspace and in the product or permeating through the packaging material during storage. O_2 scavengers are efficient in preventing discolouration of fresh and cured fish, rancidity problems, mould spoilage of intermediate, and high moisture products or oxidative flavour changes. O_2 scavenging concepts are mainly based on iron powder oxidation, ascorbic acid oxidation, photosensitive dye oxidation, enzymatic oxidation (eg. glucose oxidase and alcohol oxidase), unsaturated fatty acids (eg. oleic or linolenic acid), rice extract or immobilized yeast on a solid substrate. Structurally, the oxygen scavenging component of a package can take the form of a sachet, label or film (incorporation of scavenging agent into the packaging film, which avoids the accidental consumption of sachet), card, closure liner or concentrate.

CO_2 EMITTER

The method of preserving food products using Carbon Dioxide is not new. Modified atmosphere packaging which mainly employs the gases like CO_2, N_2 and O_2 has been in use for extending the freshness of fish products since many

Seer fish packed with CO_2 emitter to enhance the shelf life under chilled storage

decades. The high CO_2 levels (10-80%) are desirable for moist food products like fish, shell fish and meat products which inhibit surface microbial growth and thereby extend shelf life. The overall effect of CO_2 is to increase both the lag phase and the generation time of spoilage microorganisms. Over the years this has been achieved by modified atmosphere packaging, in which a package is flushed with a mixture of gases including carbon dioxide at sufficient levels. However the concentration of CO_2 within the package will change due to the partial dissolution of CO_2 in to the product and permeability through the packaging film.

Normally, the permeability of carbon dioxide is 3-5 times higher than that of oxygen in most plastic films, so it must be continuously produced to maintain the desired concentration within the package. A Carbon Dioxide generating system

Fish with moisture absorbing pad

can be viewed as a technique complimentary to MAP to overcome the drawbacks. The potential of CO_2 in MAP and more recently generation of CO_2 inside the packaging system have been explored in relation to a number of commodities for their successful preservation. Such systems are based on sodium bicarbonate, ferrous carbonate, ascorbate, citric acid, etc. Sodium bicarbonate, when used together with ascorbic acid or citric acid in the presence of sufficient moisture generates CO_2. This technique is very simple and economical as it does not require any costly equipment and pure gases.

MOISTURE REGULATOR

Wet food has a high vapour pressure, and hence the humidity in the food package increases. Apart from this a certain amount of moisture will be trapped in the packaging due to temperature fluctuations in high equilibrium relative humidity food packages or the drip of tissue fluid from cut fish and fish products. If it is not removed, this moisture will be absorbed by the product or condense on the surface, which cause microbial spoilage and/or low consumer appeal. An excessive level of water causes softening of dry crispy products.

On the other hand, excessive water evaporation through the packaging material might result in desiccation of the packed foodstuffs. It may also favour rancidity of lipids. The controlling of this excess moisture in food package is important to lower the water activity of the product, thereby suppressing microbial growth and preventing foggy film formation. Apart from this, removal of drip from chilled fish and melting water from frozen fish and shellfish makes the package more attractive to the consumer.

An effective way of controlling excess water accumulation in a food package is the use of high barrier film material with the appropriate water vapour permeability and use of moisture scavenger, such as silica gel, molecular sieves, natural clays, calcium oxide, calcium chloride and modified starch, etc. Among these, silica gel is the most widely used desiccant because it is not toxic and non-corrosive. Drip-absorbent sheets for liquid water control in high aw foods such as fresh fish and shellfish basically consist of a super-absorbent polymer in between two layers. Large sheets are also used for absorption of melted ice in packages of seafood during air transportation. The preferred polymers for absorbing water are polyacrylate salts and graft copolymers of starch. For dried fish applications, desiccants such as silica gel, molecular sieves, CaO and natural clays (e.g. montmorillonite) packed in sachets can be used.

Biodegradable chitosan based antimicrobial packaging film developed by ICAR-CIFT

ANTIMICROBIAL PACKAGING

Major part of the fish spoilage is attributed to the microbial contamination and subsequent growth which reduces the shelf life of foods and increases the risk of food borne illness. Traditional methods of preserving fish from the effect of microbial growth include thermal processing, drying, freezing, refrigeration, irradiation, MAP and addition of antimicrobial agents or salts. However, some of these techniques cannot be applied to fresh fish products as they alter its fresh nature. Antimicrobial packaging is a fast developing active packaging especially for fish and meat products. Since microbial contamination of these products occurs primarily at the surface, due to post-processing handling, the use of antimicrobials either by spray or dip treatment and more recently using antimicrobial packaging can be advantageous to improve safety and to delay spoilage. The principle action of antimicrobial films is based on the release of antimicrobial entities into the food which extends the lag phase and reduces the growth phase of microorganisms in order to prolong shelf life and to maintain product quality and safety. To confer antimicrobial activity, antimicrobial agents may be coated, incorporated, immobilised or surface modified onto package materials.

Promising active packaging systems are based on the incorporation of antimicrobial substances in food packaging materials in order to control the undesirable growth of microorganisms on the surface of the food. The antimicrobial compound embedded in the polymer acts by two different kinds of mechanisms. In the first method, the preservative is covalently immobilized into the polymer matrix and acts directly from the film when the food is brought in contact with the active material. Regarding the latter, the preservative is embedded into the matrix in the dry state. When the active material is brought in contact with a moist food or a liquid-like food, the preservative is released from the material and acts directly. In both cases, the aim of the system is to extend the shelf life of the packaged foodstuff, inhibiting the microbial growth and preserving its properties.

Biodegradable antioxidant packaging film developed by ICAR-CIFT incorporating Rosemary essential oil

The classes of antimicrobials range from acid anhydride, alcohol, bacteriocins, chelators, enzymes, organic acids and polysaccharides. Apart from these, various plant derivatives and derivatives from fishery waste like chitosan can be incorporated into the packaging system as antimicrobials.

ANTIOXIDANT RELEASE

Antioxidants are widely used as food additives to improve oxidation stability of lipids and to prolong shelf life, mainly for dried products and O_2-sensitive foods such as fishes as they contain highly unsaturated fatty acids. Antioxidants can also be incorporated into plastic films for polymer stabilization in order to protect the films from degradation. Incorporation of butylated hydroxytoluene (BHT) into the packaging film as an antioxidant is widely practiced. However, there has been some concern regarding the physiological effects of consuming BHT due to its tendency to accumulate in human adipose tissue. Hence, the use of synthetic antioxidants in contact with foods is decreasing. It is therefore desirable to use natural and harmless antioxidants. Vitamins E and C are the common natural antioxidants, and their incorporation in polymer films to exert antioxidative effects is still at the experimental stage. Vitamin E is stable under processing conditions and has an excellent solubility in polyolefins. Apart from these, natural antioxidants extracted from plant and animal substances and their use as antioxidant packaging is under experimental stages.

ACTIVE PACKAGING SYSTEMS WITH DUAL FUNCTIONALITY

A more sophisticated way of extending the shelf life of packaged foods with active packaging systems is to use multiple function active systems. For example, the combination of oxygen scavengers with carbon dioxide and/or antimicrobial/antioxidant releasing systems significantly improves the storage stability of packaged foods. In the packages with O_2 scavenger alone, the removal of oxygen from the package creates a partial vacuum, which may result in the collapse of flexible packaging. Also, when a package is flushed with a mixture of gases including carbon dioxide, the carbon dioxide dissolves in the product creating a partial vacuum and certain amount of CO_2 permeates through the packaging film. But relatively high CO_2 levels are necessary in order to inhibit surface microbial growth and to extend the shelf life. In such cases, the self-working systems, which absorb O_2 and generate sufficient volume of CO_2 will be promising in extending the shelf life of foods particularly fishery products. ICAR-CIFT has developed the technologies for these active packaging systems to be adopted in different food systems to enhance the shelf-life.

INTELLIGENT PACKAGING

Intelligent packaging senses some properties of the food it encloses or the environment in which it is kept and informs the manufacturer, retailer and consumer of the state of these properties. Although it is distinctly different from the active packaging concept, features of intelligent packaging can be used to check the effectiveness and integrity of active packaging systems. Intelligent packaging has been defined as ***'packaging systems which monitor the condition of packaged foods to provide information about the quality of the packaged food during transport and storage.'*** Smart packaging devices, which may be an integral component or inherent property of a foodstuff's packaging, can be used to monitor a plethora of food pack attributes. A variety of indicators such as temperature, time-temperature, pack integrity, microbial growth, product authenticity and freshness are of interest to the fish packaging industry.

TIME-TEMPERATURE INDICATORS

The basic idea behind this indicator is that the quality of food deteriorates more rapidly at higher temperature due to biochemical and microbial reactions. Operation of time-temperature indicator or integrator (TTI) is based on mechanical, chemical, electrochemical, enzymatic or microbiological change usually expressed as a visible response in the form of a mechanical deformation, colour development or colour movement. The visible response thus gives a cumulative indication of the storage temperature to which the TTI has been exposed. Essentially TTIs are small tags or labels that keep track of time-temperature histories to which a perishable product like fish is exposed from the point of production/manufacture to the retail outlet or end-consumer. Their use in fish and shellfish products offers enormous potential where monitoring of the cold distribution chain, microbial safety and quality are of paramount importance. Hence, a TTI may be defined as a small measuring device that shows a time and temperature dependent, easily, accurately and precisely measurable irreversible change that reflects the full or partial temperature history of a food product to which it is attached.

LEAKAGE INDICATOR

The development of improved methods to determine food quality such as freshness, microbial spoilage, oxidative rancidity or oxygen and/or heat induced deterioration is extremely important to food manufacturers. In order to maximise the quality and safety of foodstuffs, prediction of shelf-life, based on standard quality control procedures is normally undertaken. Replacement of such time-consuming and expensive quality measurements with rapid, reliable and inexpensive alternatives has lead to greater efforts being made to identify and measure chemical or physical indicators of food quality. Determination of indicator headspace gases provides a means by which the quality of a fish and meat product and the integrity of the packaging in which it is held can be established rapidly and inexpensively. One means of doing so is through the intelligent packaging incorporating gas sensor technology for sensing the oxygen and CO_2, as these two are the most commonly used gases. The monitoring of these gases in the package helps in establishing the food quality.

The profiles of oxygen and carbon dioxide can change over time and are influenced by product type, respiration, packaging material, pack size, volume ratios, storage conditions, package integrity etc. A number of analytical techniques are available to monitor gas phases in MAP products. Instrumental techniques such as GC and GC/MS require breakage of package integrity and are time-consuming and expensive. Portable headspace oxygen and/or carbon dioxide gas analysers use 'minimally destructive' techniques (packages can be re-sealed) but tend not to be applicable to real-time, on-line control of packaging processes or large scale usage. An optical sensor approach offers a realistic alternative to such conventional methods. They can be used as a leak indicator or to verify the efficiency of O_2 scavenger, CO_2 emitter or MAP systems. Most of these indicators assume a colour change as a result of a chemical or enzymatic reaction. The most common redox dye used for leak indicators is methylene blue.

FRESHNESS INDICATORS

An ideal indicator for the quality control of packaged food products should indicate the spoilage or lack of freshness of the product, in addition to temperature abuse or package leak. The information provided by intelligent packaging systems on the quality of food products may be either indirect (e.g deviation from storage temperature and changes in packaging O_2/CO_2 concentration may imply quality deterioration through established correlation) or direct. These freshness indicators are based on the detection of volatile metabolites produced during ageing of foods, such as CO_2, diacetyl, amines, ammonia and hydrogen sulphide. Freshness indicators provide direct product quality information resulting from microbial growth or chemical changes within a food product. Microbiological quality may be determined through reactions between indicators included within the package and microbial growth metabolites. The chemical detection of spoilage of fish and the chemical changes in fish during storage provide the basis for which freshness indicators may be developed based on target metabolites. Total volatile nitrogenous compounds and biogenic amines such as histamine, putrescine, tyramine and cadaverine have been implicated as indicators of fish product decomposition. As the biogenic amines are toxic compounds and they cannot be detected by means of the senses, the development of effective amine indicators would be beneficial.

Hydrogen sulphide, a breakdown product of cysteine, with intense off-flavours and low threshold levels is produced during the spoilage of fish and shellfish by a number of bacterial species. It forms a green pigment, sulphmyocin, when bound to myoglobin and this pigment can be used as a basis for the development of a freshness indicator in red meat fishes. Normally, the freshness indicators are incorporated into the packaging film, which reacts with volatile amines and other indicating agents produced during the storage of fish and other seafoods, and the freshness is indicated by a colour change.

FUTURE PROSPECTS

Smart packaging systems contribute to the improvement of food safety and extend the shelf-life of the packaged foods. However, these are evolving technologies in the seafood area and many of these systems are in the developmental stage. Continued innovations in active and intelligent packaging are expected to lead to further improvements in food quality, safety and stability.

MARKETING NEWS

Russia: A seafood market India shall reckon

ANJU*, C. S. SHINE KUMAR** AND M. K. RAM MOHAN***

Fish production in Russia

Although the Russian fishery sector is on the rise, the sector faces many challenges that slow down its continuous development. Russia's wild catch in 2016 was 4.67 million metric tons and recorded an increase of 5.6% compared to 2015.

Russia's aquaculture accounts for only 4% of the total fish production of the country. Though there was an increase of 11% in the production in 2016 compared to 2015, the sector still lags behind its full potential. Russia's share of world aquaculture production is meagre at 0.2%. Freshwater aquaculture accounts for almost 85% of the seafood industry whereas mariculture contributes the remaining 15%. Major species farmed in freshwater are carps, sturgeon, and salmon. Mariculture production consists of salmon (75%), molluscs (12%) and aquatic plants (9%).

Experts estimate that 100,000 MT of fish is harvested annually from freshwater basins, but this is less than half of the normal freshwater fish consumption recommended by the Russia Ministry of Health. Russia needs 320,000 MT of freshwater fish annually to reach the recommended level. Current annual fish consumption is 1.7 kg per capita. The most consumed types of fish include herring, saury, salmon, and pollock. The most popular fish product is frozen fish that accounts for 62% of the total fish produced, followed by fresh or chilled fish, canned fish, and other preserves.

Russia's newly released National Fishery Development Strategy includes a strong emphasis on increasing production and exports of the country's renowned black caviar. The plan, which outlines the nation's strategy for the development of its fisheries through the next decade and beyond, forecasts an increase in black caviar production to 185 MT per annum by 2030 and its global market share to 15 percent. The main buyers of Russian black caviar are the United Arab Emirates, Canada, the United States, China, Singapore, and Japan.

Russia is also trying to increase its fish exports and decrease the share of imports. The composition of countries where Russia has sourced its fish and seafood has changed considerably over the last 3 years. Currently, Russia's major

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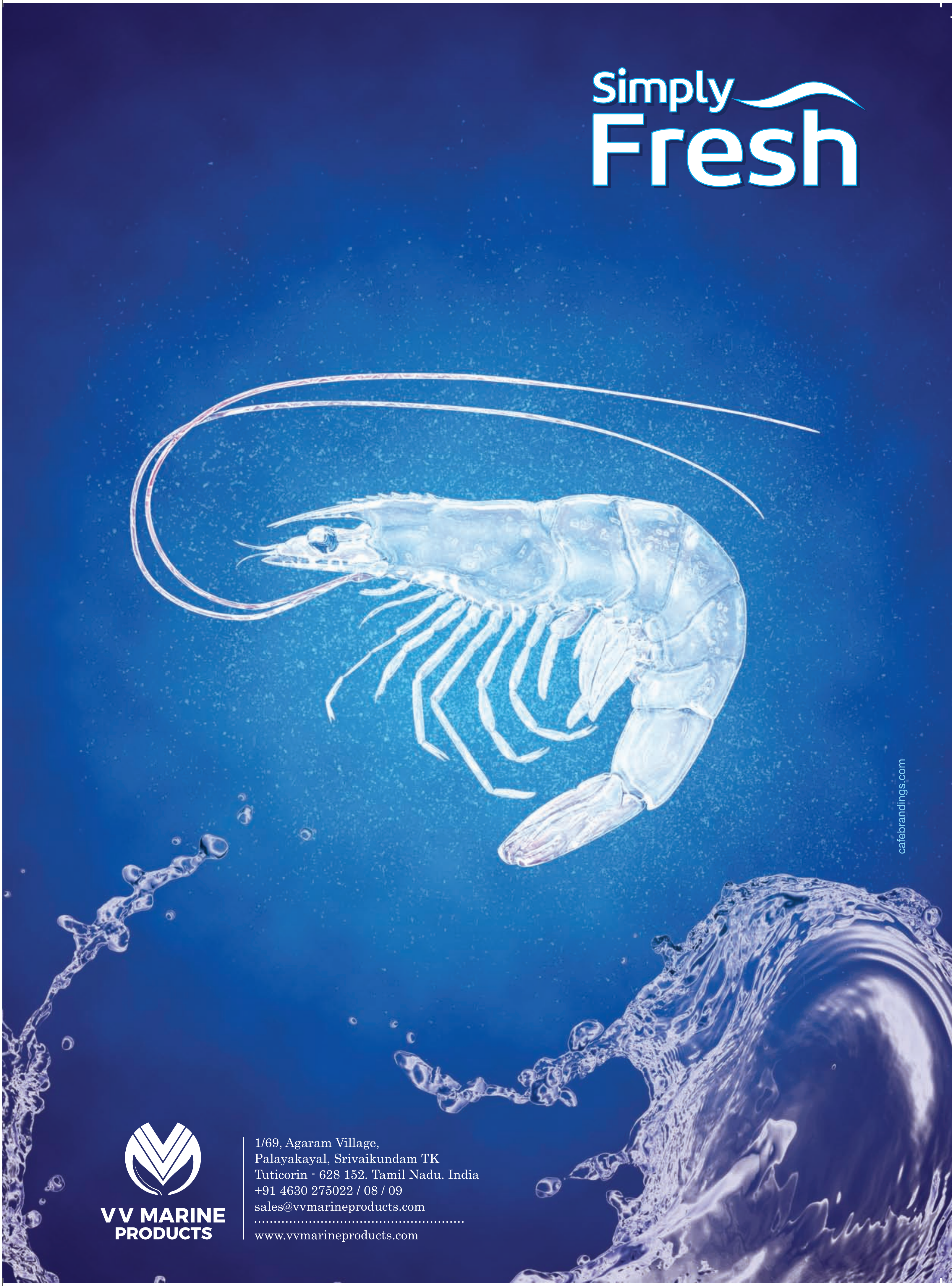
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fish importers include the Faroe Islands, China, Chile, Belarus, and Iceland. Russia's per capita fish consumption continues to decline, and this downward trend results mainly from the increasing prices and declining household incomes.

Fish processing sector in Russia

The fish processing sector in Russia develops at a slow pace as it requires a lot of investments. Russia's fish processing sector is concentrated in its Far Eastern region, where over half the processing capacity is located. Moreover, some 45% of total processing capacity is used for canned production. The strongest growth in processing has been in frozen fish fillets. With Russia's vast territorial and coastal resources, seafood production and export trends have to be understood on a regional basis.

THE STRONGEST GROWTH IN PROCESSING HAS BEEN IN FROZEN FISH FILLETS.

While the Far East exports mainly to East Asian countries, the Murmansk region in North-Western Russia is of far more importance for EU countries. This region accounts for 16% of the overall fish and seafood harvest in Russia, the majority of the regions catch actually being harvested from foreign zones including those of Norway, Greenland and the Faroe Islands. The annual regional fish catch is up to 660,000 tons , stabilizing in recent years after an earlier drop as a result of improved fish stocks in the Barents Sea, primarily for cod, and an increased catch quota for cod.

The Murmansk region exports 40% of its fish catch by volume and 70% by value and is improving its processing infrastructure as a result of government efforts to renovate coastal fishing. The EU, Norway, and the USA are the primary export destinations from this region. Cod, white fish, groundfish and king crab are the primary export products, white fish having the largest value.

Seafood exports from Russia

As per the estimates, Russia has exported seafood worth US$ 3.8 billion in 2016. Russia is a global leader in the fishing of Alaska pollock. In 2016, the Russian catch of pollock increased by 7% reaching 1.74 million metric tons.

It is Russia's main export fish and accounts for 53% of the total fish export. Alaska pollock is followed by Atlantic and Pacific cods, and herring. Russia's major export destinations are South Korea, China, and the Netherlands.

Seafood market of Russia

Russia has imported seafood worth US$ 1.6 billion in 2016 according to the estimated figures. The composition of countries where Russia has sourced its fish and seafood has changed considerably over the last 3 years. For example, imports of fish and seafood from the Faroe Islands tripled from 7% in 2014 to more than 22% in 2015. However, imports from Norway, where Russia had previously sourced the majority of its imported Atlantic salmon from, dropped from 28.4% in 2013 to 0% in 2015. This drastic drop was due to Russia's implementation of the food embargo introduced in August 2014. Russia's major fish importers other than the Faroe Islands include China (15%), Chile (12%), Belarus (10.3%) and Iceland (10%).

Countries exporting to Russia under Chapter 03

Major suppliers of fishery products to Russia include Chile, Faroe Islands, China, Belarus, Vietnam, Greenland, India, Turkey, Ecuador, Argentina in their order (Table 1). India ranks 7th among the nations exporting to Russia and the value of Indian exports under Chapter 03 accounts to USD 0.06 billion. In 2016, the top ten supplying countries accounted for about 90% of total Russian seafood imports under Chapter 03 on the value basis.

Table 1. Top 10 countries exporting to Russia under Chapter 03 (2016)

Countries	Value in US$ Million
Chile	327.277
Faroe Islands	280.054
China	215.837
Belarus	103.075
Viet Nam	88.528
Greenland	75.118
India	58.128
Turkey	39.205
Ecuador	34.392
Argentina	30.937
World	**1392.054**

2.Countries exporting to Russia under Chapter 16

The top countries exporting to Russia under Subheading 1604 (prepared and preserved fish, caviar and caviar substitutes prepared from fish eggs) are Belarus, China,

Thailand, Iceland, and Vietnam (Table 2). India has no exports under this Subheading to this market.

Table 2. Top 10 countries exporting to Russia under Subheading 1604 (2016)

Rank	Countries	Value in US$ Million
1	Belarus	95.43
2	China	47.09
3	Thailand	17.89
4	Iceland	4.41
5	Viet Nam	2.38
6	Italy	2.16
7	Finland	2.03
8	Denmark	1.42
9	Kazakhstan	1.34
10	Lithuania	0.75
	World	**177.807**

Under Subheading 1605 (Crustaceans, molluscs and other aquatic invertebrates, prepared or preserved) China, Chile, and Belarus top the table and India had exported seafood worth US$ 0.054 Million (Table 3).

Table 3. Top 10 countries exporting to Russia under Subheading 1605 (2016)

Rank	Countries	Value in US$ Million
1	China	16.12
2	Chile	14.00
3	Belarus	11.72
4	Viet Nam	2.01
5	Bangladesh	1.67
6	Peru	1.14
7	Thailand	0.82
8	Indonesia	0.45
9	Greenland	0.42
10	Norway	0.25
16	**India**	**0.05**
	World	**49.28**

Products of India's export interest preferred by Russia

Frozen fish, frozen surimi, prepared and preserved fish, cuttlefish, squid, shrimp and prawn also enjoy good demand in this market. Russia has imported US$ 0.16 billion frozen shrimp from various countries, for which India is having major export potential.

In general, Russia is a good market for other shrimps and prawn, frozen surimi under Chapter 03. This is also an important market for prepared and preserved fish, cephalopods, and shrimp products under chapter 16. Table 4 shows the specific products imported to Russia based on India's export interest.

Table 4. Specific products imported to Russia based on India's export interest with unit value (2016)

Sl. No.	HS Code	Product description	Value(US$ in '000s)	Unit value (US$/kg)
1	0306 17	Other Shrimps and prawns	161,157	6.93
2	0303 89	Frozen fish not elsewhere mentioned	94,732	1.45
3	0304 99 10	Frozen surimi	43,558	2.38
4	1604 20	Other prepared or preserved fish	23,572	11.90
5	1605 54	Cuttlefish and squid	10,709	3.38
6	1605 21	Shrimps and prawns not in airtight container	9,208	7.17
7	1604 16	Anchovies	3,005	3.31
8	0301 19	Other live fish	2,728	272.80
9	1604 15	Mackerel	766	2.26
10	1605 55	Octopus	610	5.92
11	0303 42	Yellowfin tunas (*Thunnus albacares*)	35	3.89
	Chapter 03 (in US$ '000s)		1,392,054	
	Chapter 16 (in US$ '000s)		2,27,166	
	Grand total (03 & 16) (in US$ '000s)		**1,619,220**	

Marine products export from India to Russia

The export of marine products to Russia during 2016-17 was 12,961 MT worth US$ 57.76 million. The major item exported from India is frozen shrimp. Item-wise exports to Russia are given in Table 5.

Q: Quantity in MT, V: Value in Rs. Crore, $: US Dollar Million						
ITEM		**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Frozen shrimp	Q:	2658	3597	5169	3189	5241
	V:	112.89	230.09	336.10	155.84	282.48
	$:	21.02	38.23	55.79	23.98	42.61
Frozen fish	Q:	10	23	78	0	71
	V:	0.18	0.51	1.02	0.00	0.92
	$:	0.03	0.09	0.17	0.00	0.14
Frozen cuttlefish	Q:	3	3	0	8	7
	V:	0.05	0.05	0.00	0.15	0.17
	$:	0.01	0.01	0.00	0.02	0.03
Frozen squid	Q:	3	6	28	26	13
	V:	0.06	0.10	0.51	0.58	0.26
	$:	0.01	0.02	0.08	0.09	0.04
Dried item	Q:	0	0	0	0	3
	V:	0.00	0.00	0.00	0.00	0.13
	$:	0.00	0.00	0.00	0.00	0.02
Live items	Q:	0	0	0	0	0
	V:	0.00	0.00	0.00	0.00	0.00
	$:	0.00	0.00	0.00	0.00	0.00
Chilled items	Q:	22	31	31	2	3
	V:	0.92	1.75	1.80	0.14	0.13
	$:	0.17	0.29	0.30	0.02	0.02
Others	Q:	6713	3720	3323	3568	7624
	V:	76.53	77.59	38.18	51.56	98.78
	$:	14.36	14.40	6.30	7.88	14.91
Total	**Q:**	**9409**	**7379**	**8629**	**6793**	**12961**
	V:	**190.64**	**310.11**	**377.62**	**208.27**	**382.87**
	$:	**35.61**	**53.03**	**62.65**	**31.99**	**57.76**

Table 5. Item-wise export of marine products to Russia

Constraints in seafood trade with Russia

Despite the rosy picture portrayed by the market, Indian exporters often face challenges in the form of regulations and procedural hurdles while export to Russia, which prevents them in exploring the market in its full potential and throttling the exports as it demands.

Stringent quality Standards: Russian microbiological standards are stringent than EU/USFDA or other major international standards, which makes it difficult for the exporters to meet the same.

The Total Plate Count (TPC) for raw products as per GoI standards is 5×10^5 whereas the limit for TPC as per Russian standard is at the stringent level of 1×10^5. Japan, which is one the major markets for Indian marine products, has fixed TPC at a limit of 30×10^5.

None of the international standards specifies a limit for coliforms in raw fishery products, whereas Russian standards specify a limit as Absent/0.001 gm & Absent/0.01 gm for different category of Fish & Fishery Product.

Procedure for testing and reporting of results: The testing procedure adopted for microbiological parameters and methods of reporting of results are rarely shared. Reasons for rejections are not clearly specified (with a test report, the method followed and contaminant found). There is no provision for re-testing of the consignment.

Language barrier: Most of the Russian regulations/ standards and export documents are in Russian, due to which Indian exporters are facing difficulty in understanding and interpreting the regulations/ standards and also in filling up the mandatory export documents.

Tariff issues in seafood trade with Russia

The MFN tariff for prepared and preserved fishes like mackerel, anchovies, sardine range from 12-15%, whereas for prepared and preserved crab, MFN tariff is 22.79%.

The major item of export frozen shrimp has MFN tariff of 5%. Tariff rates of major products exported from India are given in Table 6.

Table 6. Tariff rates of major products exported from India to Russia

Sl. No	HS Code	Product description	Tariff rate MFN	Preferential tariff (for GSP countries)
1	0306 17 90	Other shrimps and prawns	5.00%	3.75%
2	0303 43 00	Skipjack or stripe-bellied bonito frozen	8.00%	6.00%
3	0301 11 90	Live freshwater fish	8.00%	6.00%
4	0303 42 00	Yellowfin tunas (*Thunnus albacares*)	5.00%	3.75%
5	0303 89 30	Ribbonfish	6.00%	4.50%
6	0303 89 50	Pomfret (white or silver or black)	6.00%	4.50%
7	0303 89 80	Croakers, Froupers, Flounders	6.00%	4.50%
8	0301 19 00	Other live ornamental fish	8.00%	6.00%
9	0304 99 00	Surimi	3.00%	2.25%
10	0307 49(6 DIGIT)	Other cuttlefish and squid	8.00%	6.00%
12	1604 14 10	Prepared and preserved tunas	12.50%	9.38%
13	1604 15 00	Mackerel	14.00%	10.50%
14	1604 16 00	Anchovies	15.00%	11.25%
15	1604 20 00	Other prepared and preserved fish	12.50%	9.38%
16	1605 29 00	Other shrimps and prawns	5.00%	3.75%
17	1605 21 00	Other shrimps and prawns not in air tight containers	5.00%	3.75%
18	1605 10 00	Crab	22.79%	17.09%
19	1605 54 00	Cuttlefish and squid	8.00%	6.00%
20	1604 13 10	Sardines	12.00%	9.00%

Conclusion

Russia is one of the largest consumers of seafood in the world. There is a huge demand for value-added seafood products in this market. At present only 86 processing units from India are listed in the official site of Rosselkhonznadzor and permitted to export to the Russian market. The focus Russia exhibits to increase their export-oriented production may be one reason for their conservative attitude in limiting the number of units approved for exports from India. Recognition of more number of seafood processing units from India and effort for value addition will provide better opportunities for our seafood exporters in the Russian market.

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Noor Ice and Cold Storages Pvt. Ltd.

COMPANY PROFILE

We M/s. Noor Ice and Cold Storages Pvt. Ltd., have been exporting processed fish and fishery products for the past 10 years. Our Company is located at Taloja M.I.D.C., Maharashtra.

Our main markets are China, Japan, Dubai, Vietnam etc. Our major product of export is Lobster. Annually we export around 500mt Lobsters, 300mt Shrimps like sea white, sea tiger HOSO & HLSO vannamei etc. & 100 Mt Cephalopodes.

Presently we have 2 blast freezers & 2 plate freezers and very soon we will be starting our second unit which have IQF system and new German blast freezer technology for fast freezing, which will help us to make double production.

Our Company is approved from

Export Inspection Agency of India (EU APPROVAL NO.-1141)	*Marine Products Export Development Authority Registration no. (MA1/PP/013/08)*	*HACCP Certificates*	*FSSAI Certificates*

Common Name : Head-on White Shrimps **Scientific Name:** Fenneropenaeus indicus 	**Common Name :** Head-on Sea Tiger Shrimps **Scientific Name:** Penaeus monodon 	**Common Name :** Lobster **Scientific Name:** Panulirus homarus 	**Common Name :** Head-on Sea Flower Shrimps **Scientific Name:** Panaeus semisulcatus 	**Common Name :** Squid **Scientific Name:** Loligo spp. 	**Common Name :** Cuttlefish **Scientific Name:** Sepia spp. 

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Intended Use : International Market. Cooked And Consumed By General Public

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MPEDA participates in Matsyotsavam at Kozhikode

A view of MPEDA stall

The Fisheries Department, Govt. of Kerala organized 'Matsyotsavam 2017,' a fish festival at beach open ground in Kozhikode city with the aim of serving aqua farmers and fishermen. The festival held on November 19-21, 2017 was inaugurated by Mrs. J. Mercykutty Amma, Hon'ble Fisheries Minister of Kerala. Mr. A. Pradeep Kumar, Member of Kerala Legislative Assembly, Kozhikode, officials from Department of Fisheries, Matsyafed, and related departments attended the function. An adalat to solve the issues of fishermen was part of the festival.

NETFISH-MPEDA stall in Matsyotsavam at Kozhikode

MPEDA set up a stall with the support of Regional Division, Kochi and Sub Regional Division, Kannur. The stall exhibited different live specimens of Tilapia (GIFT), Vannamei, Tiger Prawn, Etroplus, Mangrove Crab, Milkfish, etc in four aquarium tanks. One aquarium tank with fresh water ornamental fishes was also exhibited. Agencies like Fish Farmers Development Agencies (FFDA), Agency for Development of Aquaculture in Kerala (ADAK), Matsyafed, Society for Assistance to Fisherwomen (SAF), Kerala State Coastal Area Development Corporation (KSCADC), Central Marine Fisheries Research Institute (CMFRI), Kerala University of Fisheries and Ocean Studies (KUFOS) also participated in Matsyotsavam. Aqua Farmers meet, Fishermen meet etc. were also conducted in this festival. At the fish food fest, more than 100 women entrepreneurs from Kasargod, Kannur, Kozhikode and Wayanad districts showcased various food and food products.

NETFISH too took part in the festival by setting up an exhibition stall. The stall displayed various self-explanatory posters depicting information on recent developments, issues and problems in the fisheries sector such as minimum legal size, plastic pollution, chemical adulterants in fish, trawl ban period, advantages of square mesh cod end etc. In addition to this, NETFISH leaflets in English and Malayalam languages related to personal hygiene, hygienic handling of fish and ice, sustainable fishing and conservation aspects were distributed to the visitors. Mr. T. Dola Sankar, Director (Marketing), MPEDA made a visit to the stall. The stall attracted good numbers of fishermen, students, and the general public.

Mr.T. Dola Sankar, Director (Marketing), MPEDA visiting NETFISH stall

MOFPI organizes 'The World Food India 2017' in New Delhi

Dr. Pau Biak Lun, Assistant Director, MPEDA interacting with a visitor

Food processing is crucial for the overall development and prosperity of an economy as it provides a vital connection and synergy between agriculture and industry zones. It aids to diversify and commercialize farming, improves the income of farmers, creates markets for export of agro products as well as generates more employment opportunities. Through the presence of such industries, a wider range of food products could be marketed to the distant locations. The Ministry of Food Processing Industry (MOFPI) organized 'The World Food India 2017' in New Delhi from November 3-5, 2017. The three-day event showcased India's potential to become the world food hub to the participating countries and the leading multinational companies. As per an estimate, India's current food processing industry is estimated to the tune of US$ 130 billion and indeed expected to attract huge domestic and foreign investment. World Food India 2017 provided a platform to explore Indian market across the value chain in food processing and food retail.

The event was inaugurated by the Hon'ble Prime Minister of India Mr. Narendra Modi on November 3rd at Vigyan Bhavan. Mr. Maris Kucinskis, Prime Minister of Latvia and Mr. Serzh Sargsyan, President of Armenia were also present at the event. Hon'ble President of India, Mr. Ram Nath Kovind was the Chief Guest during the valedictory session.

World Food India attracted participation from 61 countries. There was significant participation from Japan, USA, France, South Korea, Sri Lanka, among others. 60 Global CEOs including APAC leadership of leading companies and more than 200 global companies participated in the event.

On domestic front, more than 75 policy makers including 7 Union Ministers (Finance / Commerce & Industry/ Railways/ Surface Transport /Agriculture / DONER), Senior Officials, and Chief Ministers of Andhra Pradesh, Chhattisgarh, Haryana and 25 Ministers from 18 States participated during 3 days. 20 state sessions and a special session on the North Eastern States were held.

THE EXHIBITION

Spread over 40,000 square meters of area in C-hexagon lawns of India Gate, the WFI Exhibition had about 800 global and domestic exhibitors. These included industry across the food processing value chain machinery, technology and equipment, food processing sub-sectors; State Govts,

Mr. K. V. Premdev, Deputy Director, MPEDA interacts with a buyer from Thailand

Ministry of Agriculture, Food Safety Regulatory Authority of India (FSSAI), National Institute of Food Technology Entrepreneurship and Management (NIFTEM) etc. A footfall of approximately 75,000 visitors including invited progressive farmers visited the three-day event.

Mr. P. T. Sreejith, Assistant Director attends to a visitor

An exciting feature of the event was 'The Great India Food Street,' that has showcased Indian and foreign cuisines using Indian ingredients, flavours and fragrances, specially curated by Chef Sanjeev Kapoor. With a footfall of about 5,000 guests over the 3 days, the food street was a unique concept that acted as a platform for guests to learn about the globalization of Indian food through interactive chef talks and demonstrations, experience the traditional flavours as well as modern fusion food and give the attendees a wholesome experience about the diverse uniqueness that Indian food offers.

MPEDA PARTICIPATION

MPEDA ensured participation in World Food India 2017 with the stall B52 of Hangar B having an area of 6 X 3 m. Mr. K. V. Premdev, Deputy Director, Mr. P. T. Sreejith and Dr. Pau Biak Lun, Assistant Directors, Mr. K. Dinesh, Assistant along with staff of Trade Promotion Office, New Delhi organized MPEDA's participation in the mega exhibition.

It was a platform for various budding entrepreneurs to gain knowledge about Indian marine food export scenario and the schemes assisted by MPEDA.

The stall showcased various value added-products like ready to eat curries and biriyani in retort pouches, canned Tuna, Sardine, pasteurised Crab meat etc. The frozen products like shrimp block and IQF, Squids, Cuttlefish, Pomfret, Ribbonfish in IF form were displayed in a deep freezer and was the main attraction of the stall. Most of the visitors were enquiring about the process of freezing and the market options available. The show came to an end on November 5, 2017.

MPEDA's demonstration programme on Crab aquaculture

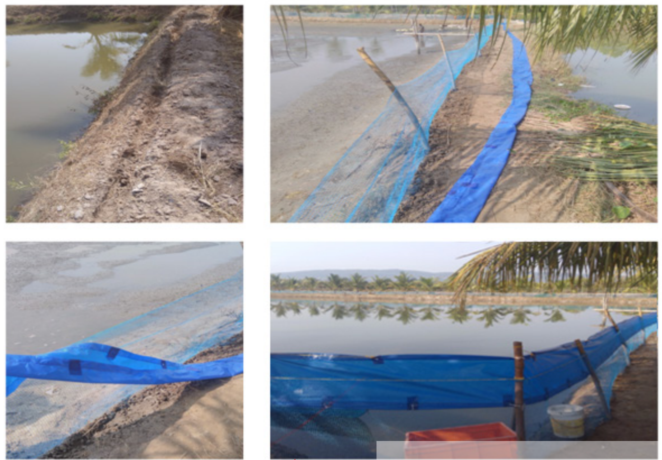
MANGROVE CRAB *(Scylla serrata)* CULTURE DEMONSTRATION PROGRAMME

MPEDA Sub Regional Division, Kannur conducted a demonstration programme on 'Crab aquaculture' as part of popularizing crab farming in this region. The farm of Mr. Muraleedharan Kalathil, situated in Madayi Village, Kannur Taluk, was selected for the demonstration after inspection by technical officers of MPEDA.

PREPARATORY WORKS

Farm at the time of selection

Technical Assistants of MPEDA modified the farm with crab fencing around the pond, repair work of bund and sluice, etc. Then the pond was prepared with the pond preparation protocol like drying, eradication, liming, water filling and application of fertilizer. Eradication was done using bleaching powder and fertilization using organic fertilizers and optimum NPK fertilizers. Proper care was taken to put the hide-outs in pond, mainly tiles and PVC pipe pieces.



Different stages of crab fencing work

CRABLET PACKING, TRANSPORTATION AND STOCKING

RGCA Demonstration farm, Karaikal supplied 4,000 crablets having a carapace width ranging from 1.6 to 3 cm on December 15, 2016. MPEDA Officials and representative of beneficiary transported these crablets in an air-conditioned vehicle by road. The crablets have been stocked in the pond after giving proper acclimatization. Leading aqua farmers of this area were present during the stocking of crablets. Transportation mortality was around 2%.

Details of Crablets obtained from RGCA			
Crablets size (cm)	No.	Rate (Rs)	Total (Rs)
1.6-2.0	2210	15.00	33150.00
2.1 -2.5	1148	17.00	19516.00
2.6-3.0	642	19.00	12198.00
Total	4000		64864.00

FEEDING

Chopped sardine was provided as feed at the rate of 40% of total biomass initially and gradually reduced to 2.5-3% of total biomass. Each meal provided in the form of chops (chopped in size proportionate to the claw of crabs). Feed is provided twice daily, 40% of the ration in the morning and 60% in the evening. 3,539 kg of feed was provided during the culture period.

Details of feed provided		
Period (months)	Quantity kg)	Rate(Rs)
December 16–February 17	912.5	58382.00
March	505.5	31945.00
April	475	40605.00
May	498	40615.00
June	420	38250.00
July	372	34550.00
August	356	29900.00
Total	***3539***	***274247.00***

Feeding crabs

PERIODIC MONITORING OF WATER QUALITY AND GROWTH

Officials from MPEDA Sub Regional Division visited the demonstration farm periodically and provided necessary suggestions and guidance. The water quality parameters such as pH, salinity, temperature, total Ammonia, dissolved Oxygen etc. were checked and recorded regularly. Sampling of crabs were done twice a month by using the ring net/ scoop net for checking the health and weight of the animal.

ISSUES FACED DURING CRAB CULTURE

The drastic changes in the water quality in terms of salinity and temperature highly affected the molting and subsequently the growth rate of crabs. During the period April to May, the salinity increased to 38 to 40 ppt and water temperature increased to 37°C. This eventually resulted in lesser feed consumptions as well as slow growth rate. During this period the molting completely stopped and mortality also observed. The issue has been addressed to a certain extent by water exchange and operating the paddle wheel aerator during noon time. Another issue was the increase in cost of feed (Sardine).

INAUGURAL HARVEST

The inaugural harvest of the cultured crabs was done on 17th August 2017. Farmers meet on 'Crab farming and species diversification' was organized at the farm site. A total of 104 farmers witnessed the inaugural harvest and participated in farmers meet.

Inaugural harvest

PRODUCTION AND INCOME

Crabs were harvested using ring net and scoop net. The harvested crabs were sorted, packed and sold to a local agent. A total of 1400 were harvested and sold for an amount of Rs. 5.88 lakh with a survival of 35%.

The culture details in a nutshell	
Water spread area	0.5 Ha
No of crablets stocked	4000
Date of stocking	16//12/16
Date of initial harvest	17/08/2017
DOC	244
Total quantity of feed used	3539 kg
No. of crabs harvested	1400
Quantity of crabs in Kg	764 kg
FCR	1:4.6
Survival rate	35%

Mr. Muraleedharan with harvested crabs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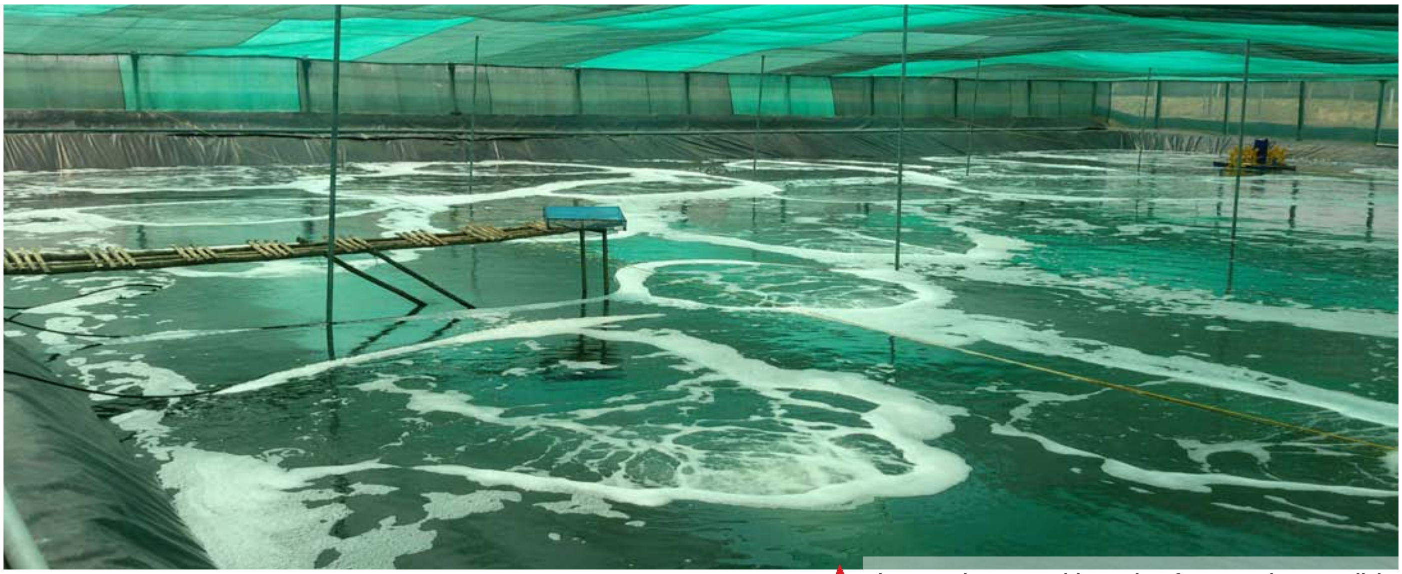
Shrimp production is set to reach a new high in 2017-18

VISWAKUMAR . M*

Shrimp production is set to reach a new high in 2017-18 too. The compiled production reports of tiger shrimp and vannamei during the period April-September 2017 compared to last year indicates that shrimp production (excluding scampi) increased by 25,600 MT with an overall increase of about 6.56%. Tiger shrimp production continued to decline, while vannamei showed an improvement in production.



Biosecured nursery with BFT in a farm at Balasore, Odisha

The state-wise details of the area under culture and production during the period April-September 2017 are given in the following tables. Table A to D provides the state-wise details for the first crop while Tables E gives the comparison with the previous year's shrimp production.

The first crop of tiger shrimp culture during April-September 2017 reported 42,416 MT. West Bengal, leads with 35,937 MT though its production has declined considerably in comparison with the previous years.

Tiger shrimp productions in all maritime states have declined in comparison with the previous years. Three states have recorded NIL production of tiger shrimp.

In the case of vannamei, Andhra Pradesh continued to dominate with a production of 265,677 MT while other maritime states, except Tamil Nadu, reported higher production. An overall increase of about 35,000 MT of vannamei helped the total production to register an increase despite the decline of tiger shrimp production. West Bengal, Tamil Nadu, Kerala and Karnataka reported a decline in overall shrimp production in comparison with the previous years.

Scampi production recorded only from village ponds, reservoirs and polyculture with IMCs. Production of Scampi from monoculture and scientific culture become negligible over the years.

TRENDS IN PRODUCTION AND EXPORTS DURING THE PERIOD APRIL-SEPTEMBER 2017 WITH THE PRODUCTION OF PREVIOUS 5 YEARS AND PROJECTION FOR 2017-18

The details of shrimp production for the period April-September over the last 5 years and total production for the whole year were analyzed to get the average quantum of increase in production during the second half of the year. It was noticed that increase in production is achieved during the second half of the year and it ranged from 36% (2012-13) to 55% (2013-14) with an average of 46% for the 5 years (2012-13 to 2016-17). Assuming that second half of the year 2017-18 maintain an average increase of 46% over the first half-year production, the projected total production for this year is expected to touch 6,00,000 MT (Fig. 1).

*Assistant Director, The Marine Products Export Development Authority, Kochi-36, Kerala.

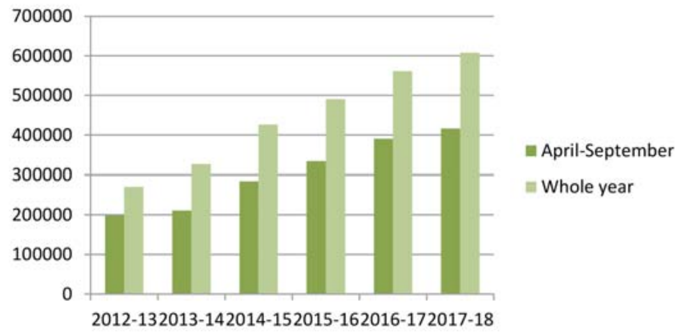


Fig. 1 Comparison of first crop production and total annual production over the last five years and projected production for 2017-18

Shrimp exports also show similar growth trends over the years as indicated in the following diagram (Fig.2) representing the aquaculture production and shrimp exports during April-September periods. It clearly indicates that if the production trend continued in the second half of this year, will achieve a new high for shrimp exports for the current year too.

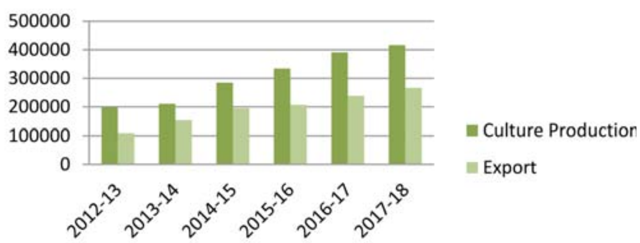


Fig. 2 Comparison of aquaculture shrimp production and shrimp exports for the last 6 years

Table A. State-wise details of tiger shrimp production during first crop (April-September 2017)

Sl. No	State	Area (Ha)	Production (MT)	Productivity MT/ha/yr.
1	West Bengal	50,794	35,937	0.71
2	Odisha	2,294	3,463	1.51
3	Andhra Pradesh	1,789	2,427	1.36
4	Kerala	900	502	0.56
5	Karnataka	302	59	0.19
6	Tamil Nadu	10	28	2.80
7	Goa	0	0	0.00

8	Maharashtra	0	0	0.00
9	Gujarat	0	0	0.00
	Total	***56,090***	***42,416***	***0.76***

Table B. State-wise details of *L. vannamei* production during first crop (April-September 2017)

Sl. No	State	Area (Ha)	Production (MT)	Productivity MT/ha/yr.
1	Andhra Pradesh	47,907	2,65,677	5.55
2	Gujarat	4,665	33,899	7.27
3	Odisha	5,825	25,261	4.34
4	Tamil Nadu	5,041	24,868	4.93
5	West Bengal	4,097	19,186	4.68
6	Maharashtra	844	4,153	4.92
7	Karnataka	198	760	3.85
8	Kerala	38	170	4.46
9	Goa	2	4.5	2.25
	Total	***68,616***	***3,73,980***	***5.45***

Table C. State-wise details of total shrimp production during first Crop 2017-18

Sl. No	State	Area (Ha)	Production (MT)	Productivity MT/ha/yr.
1	West Bengal	54,891	55,123	1.00
2	Odisha	8,119	28,724	3.54
3	Andhra Pradesh	49,696	2,68,104	5.39
4	Tamil Nadu	5,051	24,896	4.93
5	Kerala	939	673	0.72
6	Karnataka	500	819	1.64
7	Goa	2	5	2.25

8	Maharashtra	844	4,153	4.92
9	Gujarat	4,665	33,899	7.27
	Total	**1,24,706**	**4,16,395**	**3.34**

Table D. Details of Scampi production from village ponds and reservoirs during April-September 2017

Sl. No.	State	Area (Ha)	Production (MT)
1	West Bengal	4,236	473
2	Odisha	994	722
3	Andhra Pradesh	112	38
4	Tamil Nadu	29	27
5	Kerala	0	0
6	Karnataka	0	0
7	Goa	0	0
8	Maharashtra	0	495
9	Gujarat	0	1,620
	Total	**5,371**	**3,375**

Table E. Comparison of area under culture and production of shrimp during first crop during 2017-18 with that of previous year 2016-17

Sl. No.	State	First crop 2017-18		First crop 2016-17		% increase	
		Area (Ha)	Prod. (MT)	Area (Ha)	Prod. (MT)	Area (Ha)	Prod. (MT)
1	West Bengal	54,891	55,123	51,062	56,756	7.50	-2.88
2	Odisha	8,119	28,724	6,033	21,837	34.57	31.54
3	Andhra Pradesh	49,696	2,68,104	53,214	2,43,727	-6.61	10.00
4	Tamil Nadu	5,051	24,896	5,762	30,585	-12.34	-18.60
5	Kerala	939	673	2,479	1,499	-62.13	-55.11
6	Karnataka	500	819	954	972	-47.58	-15.76
7	Goa	2	5	0	0	-	-
8	Maharashtra	844	4,153	716	2,438	17.84	70.32
9	Gujarat	4,665	33,899	4,811	32,959	-3.05	2.85
	Total	***1,24,706***	***4,16,395***	***1,25,031***	***3,90,773***	***-0.26***	***6.56***

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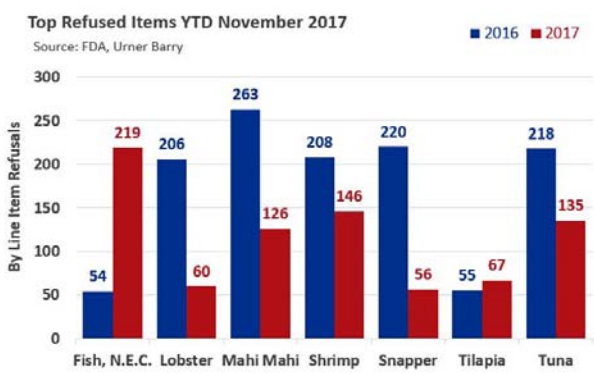
FDA seafood refusals down over 27% in November, unclassified fish up YTD

Total refusals of seafood shipments in November 2017 were down over 27%. This has been a trend throughout 2017, which saw mostly lower refusals compared to a year ago.

Snapper saw the most significant drop in refusals, with 56 line items refused in November versus 220 a year ago. Lobster was not far behind, with 60 line items refused in November compared to 206 in 2016.

Unclassified fish remains the top refused item year to date, rising to 219 line items in 2017 versus 54 in 2016. Tilapia also ticked up slightly, with 67 line items YTD refused compared to 55 in 2016.



Mahi Mahi, Shrimp and Tuna refusals are down YTD. Mahi Mahi is at 126 line item refusals in 2017 compared to 263 in 2016. Shrimp refusals for this year are at 146 so far, compared to 208 a year ago. Tuna is at 135 in November 2017, compared to 218 in 2016

FDA IMPORT ALERT UPDATES- DECEMBER 7, 2017

FDA Import Alert Changes: Urner Barry monitors those changes in FDA Import Alerts concerning seafood and disseminates these changes as information. It is incumbent that users verify the accuracy, completeness and timeliness of the information in these reports. Be aware of company names that have been changed/corrected. This change could appear to be a drop or add to a list but it was simply a name change. Be sure to read the complete post before making any determination. Our reports are not a substitute for independent professional advice and users should obtain any appropriate professional advice relevant to their particular circumstances.

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Companies Removed from Green List

Alert Number	Country	Company	Date Originally Published	Alert Type	Alert
16-35	INDIA	EDHAYAM FROZEN FOODS PVT. LTD	5/19/2014	16 J - - 05 Desc:Raw Shrimp	Green
16-35	INDIA	EDHAYAM FROZEN FOODS PVT. LTD	5/19/2014	16 X - - 21 Desc:Raw Shrimp	Green

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New fish species found in Meghalaya

A new species of blind fish has been discovered inside a cave in East Jaintia Hills district of Meghalaya, a New Zealand-based science journal has revealed.The fish - *Schistura larketensis* - gets its name from Larket village, where the cave has been found, the journal, Zootaxa, said.

Schistura larketensis

The species has apparently lost its sight living in the perpetual darkness inside the cave, a joint team of scientists from the Gauhati University and the North Eastern Hill University said.It has also lost its pigments too while adapting to its habitat in the dark waters, they said.Khlur Mukhim, a leading researcher from Gauhati University, came across the blind fish in the cave several years ago during an expedition. The cave is about 880 meters above sea level and over 7 km in length.

Mr. Mukhim said that the study came out recently though it was found several years ago as he had to corroborate the available facts and figures to establish that the fish was actually blind and belonged to a new species.The fish sample was collected from small stagnant pools, a few square meters in area and about 1-2 m in depth, about 1,600 feet from the cave entrance.The pool bed is mostly sandy with pebbles. Other species found inside the cave include weakly pigmented crabs and crayfish, spiders, crickets, cockroaches and millipedes, small frogs and snakes.

Scientists had, in the past, chanced upon porcupine paws and quills on the muddy floor of a passage in the same cave.

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NOAA temporarily eases entry rules to prevent Seafood Trade Disruption on January 1st

John Henderschedt, Director, NOAA Fisheries' Office of International Affairs and Seafood Inspection, spoke with us on NOAA's implementation of the Seafood Inspection Monitoring Program, and about the potential for Congress to add shrimp and abalone to the required species under the budget bill.

SIMP, as it is known, will become effective January 1st, after which all seafood imports of the affected products will require extensive new documentation designed to deter IUU fishing.The species subject to the new rule are Atlantic and Pacific Cod, Blue crab, Mahi Mahi, Grouper, King Crab, Sea cucumbers, Red Snapper, Sharks, Swordfish and all Tunas.

Since October, NOAA has had a pilot program under which customs brokers using the ACE (Automated Customs Entry) system could test their computer systems with the ten additional data fields required by SIMP. However, Henderschedt says only about 100 test entries have been made on this pilot system. After January 1st, there will literally be hundreds of entries per day that will be required to provide the new data fields.

If the automated customs system began rejecting entries with incomplete or missing data, chaos could result and there would be a significant disruption of the seafood trade.

Henderschedt says that "The agency considers this to be an important and beneficial regulation, and has not considered delaying the mandatory compliance date of January 1st." "But we do not want to try and establish that compliance where there is potentially a significant disruption to trade, so we have communicated through the cargo service messaging system that for some period of time early in 2018 there is a way brokers can get a 'may proceed' designation without the inclusion of SIMP data.

Hendershedt says that to clear entries with no trouble, brokers should leave the entire section for SIMP data blank. At that point they will get a 'may proceed' notification, and the shipment will be cleared for entry. If they input partial information, the shipment will get kicked back. NOAA emphasized that initially, due to the computer architecture, there are two choices: full data that is SIMP compliant, or leaving the entire SIMP data fields blank.

If the fields are partially filled out, such as with some of the information, but not all, the entry will be kicked back. NOAA emphasizes that the SIMP data is still going to be required for that shipment, but that it can be filled back in by the broker or filer, as the importer is called, at a later date.

Henderschedt says "we are taking an approach that we are giving importers reasonable amount of time to get the info post entry." At some point early in the New Year, NOAA will inform the industry how long the period of accepting entries without SIMP data will last and will communicate the time frame for this temporary process.

Henderschedt says that this is a record keeping requirement, and that if an entry is audited, the proper SIMP information will have to be produced. However, he says that NOAA will be more focused on informed compliance. If a filer brings in an entry without SIMP data, they will get a message back from NOAA that the entry is missing data. "Informed Compliance is our end game. We intend to engage with the seafood industry to remind people to bring their entries into compliance."

Another issue is that NOAA wants to allow entries without having anyone from NOAA needing to directly intervene before an entry can be cleared. This is why filers must use the system to either fill out complete SIMP data or none at all. A partial SIMP data collection will be kicked back by the automated entry system. NOAA will have staffing from 8 am to 8 pm Eastern Time to answer questions and provide assistance, but a clean entry will not require any intervention from NOAA during the initial period of implementation.

As many in the industry are aware, there is a possibility that shrimp and abalone may be added to the species list by Congress as part of the upcoming budget.

NOAA has made comments to the executive branch about this issue, which they have not released. However, the original reason that shrimp was not included was that the data collection being asked of foreign suppliers was not able to be generated by US aquaculture growers, and this left the regulation vulnerable to being overturned by the WTO as an improper restraint of trade.

Further, NOAA says there are immense technical issues, and structural issues that would have to be resolved if the budget required shrimp to be listed under the SIMP program.

In short, it appears that if shrimp were to be listed it would create tremendous complications, and that the preparations made so far for SIMP, including the programing and infrastructure for compliance, could not accommodate shrimp imports without time consuming changes and reprograming.

Henderschedt believes in the regulation. "Over time, the objective is to eliminate the US market as a potential target for mis-represented or IUU seafood."

As the supply chain becomes more transparent and robust, NOAA believes that the bad apple importers who take risks and fail to document their supply chain will be eliminated, and as similar regulations are introduced in other global seafood markets, it will lead to a major reduction in the economic value of IUU fishing.

Henderschedt concludes, "we (NOAA) want as seamless a ramp up as possible. We will be communicating further with respect to winding down the informed compliance period." Overall this regulation will achieve positive benefits, he said.

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Thailand has suspended import of shrimp from India

In another setback for Indian seafood exporters, Thailand, an emerging market for Indian shrimp products, has gone for a temporary suspension of import of shrimps from India.

Thailand accounts for about 13% of 1.70 billion dollar exports made to South East Asia. South East Asia has share of about 30% of the 5.7 billion dollar India seafood exports market.

Export of shrimps to Thailand is not taking place for last three months, said the sources. It has also suspended import of shrimps from Malaysia.

The Commercial Section of Royal Thai Consulate General has confirmed the suspension of issue of import license for five categories of shrimps (Penaeus Esculentus, Fenneropenaeus, Penoeus Vannamai, Pernaeus Monodon, Penaeus Stylirostris).

The action of suspension by the Department of Fishery, Thailand is to prevent the Infectious Myonecrosis (IMNV) spreading as per the guidelines of World Organization for Animal Health. "Thailand has been a vibrant market with high potential for mutual collaborations in the food processing sector. It is a setback for the seafood industry. It is surprising that the government here is not aware of it", said Mr. Rajen Padhi, Director General of Utkal Chamber of Commerce and Industry and a seafood consultant.

This shock has come at a time when the European Union (EU), the third largest market of Indian exporters, has flagged off quality issues with India prompting the former to send an audit team to inspect the facilities here.There was a growing concern that the EU is seriously worried over the use of antibiotics in Indian shrimps - a fact that has surfaced continuously in its findings. It is also dissatisfied with the response it got from the Indian authorities and is, thus, considering a ban.

Last year, the EU had strengthened its inspection norms for aquaculture products sent from India. Earlier, the norm was testing samples from at least 10% of the consignments, which was enhanced to 50% in 2016.

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