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Exploring the Status, Constraints and Prospects of Processing, Value Addition and Waste Utilization of Marine Fishes in Andaman and Nicobar Islands

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Abstract

Andaman and Nicobar group of Islands is a tropical archipelago well known for its pristine waters, marine ecosystems with rich icthyofaunal diversity. Fisheries sector plays a significant role in providing livelihood and employment to the Island population and the aboriginal tribes. Among fishing sector, marine fishery sector plays a major role in providing fish supplies with a estimated landings of 39,284 tonnes in 2017-18. Majority of the catches landed are consumed in fresh form from domestic markets whereas fishes in chilled, frozen and dried forms are exported to mainland, India. Fish processing activities are very limited and confined associated with constraints such as limited fish supplies, lack of adequate infrastructure, demand- supply tradeoff and lack of technical knowledge among the stakeholders. This paper provides a brief outlook on the marine fishing sector, landings and the possible ways to promote processing and value addition in fishes. As marine fish catches are landed with various bycatches, such underutilized and low value fishery resources can be utilized for product development and value addition, and the waste generated from fishery sector can be utilized for byproduct development. The existing infrastructure and fish utilization pattern can be restructured and strengthened for post harvest management of fishery resources. Fish processing sector has immense scope to provide additional income, livelihood and employment to the Islanders especially in empowering fisherwomen.

Keywords: Fishery resources, product development, value addition, byproducts

Introduction

Andaman and Nicobar Islands (ANI) is one of the union territories of India, located in the South East of Bay of Bengal as a linear strip of emerald Islands in close proximity to South East Asian countries. The ANI archipelago consists of 572 Islands and Islets, having an aggregate coastline of 1912 km which accounts for one fourth of India's coastline and the Islands are also known as Bay Islands (ANDFISH (2005); Roy et al. (2006)). The Islands are spread over 8200 Sq.km of geographical area and encompasses 0.6 million km^2 of Exclusive Economic Zone (EEZ), which accounts for 30% of India's total EEZ. The continental shelf forms nearly 6.60% of the total Indian Continental shelf that is about 34965 Sq.km.

Marine fishery resources

The presence of diverse marine ecosystems and habitats like mangroves, creeks, lagoons, estuaries, muddy shores and coral reefs are the major reasons for enormous diversity of finfish and shellfish resources. Around 1434 fish species were reported from the Island water bodies including marine and freshwater habitats (Rajan et al. (2013)), among which, 400 species are of commercial importance as food fishes (Rajan et al. (2013)). Currently capture fisheries is the major contributor to marine fish production as mariculture activities are yet to take off on commercial scale to achieve fish production in the Islands. The estimated marine fisheries potential of the Island is 1.48 lakh tonnes (Anonymous (2018), Andaman and Nicobar Islands Fisheries Policy) (Table 1). In spite of the huge potential, the fish harvest stands at 39,284 tonnes during 2017-18 (Fig. 1). The reasons for lower harvests are mainly attributed to the lack of efficient fishing fleet, lack of offshore fishing crafts, infrastructure facilities and skilled manpower. Some of the resources available along with the potential and catches are given in Table 1.

Table 1. The major catches of pelagic, demersal and oceanic resources and its potential

Resources	Potential	Major catches
Pelagic	0.56 lakh tonnes	Seer fishes, coastal tunas, barracudas, anchovies, sardines, wolf herring, mackerel, carangids, ribbon fishes, etc.
Demersal	0.32 lakh tonnes	Silver bellies, elasmobranchs, perches, pomfrets, thread fins, croakers, gerrids, goat fishes, silver grunt, drift fishes, lizard fishes, flat fishes, bulls eye, cephalopods, shrimps, crabs, lobsters, etc.
Oceanic	0.60 lakh tonnes	Tunas (yellow fin tuna, skipjack tuna, big eye tuna), bill fishes (marlins, sailfishes, swordfish), wahoo, dolphin fish, flying fish, oceanic squids, etc.

(Source: Anonymous (2018), Andaman and Nicobar Islands Fisheries Policy; Kundu and Kiruba Sankar (2019)).

Diverse fishery resources are available in the Island waters but majority of these resources are not properly exploited, especially the oceanic resources which has not been harnessed to its potential. The major fishing gears operated in the Island are ring seine, gill net, hand-line, long-line and trawl net. During 2017-18, out of 39284 tonnes of total marine fish production 29130 tonnes was from South Andaman, 9749 tonnes was from North and Middle Andaman and 405 tonnes from Nicobar district. Pelagic resources constitute 19478 tonnes, followed by demersal 16731 tonnes, and oceanic 3075 tonnes.

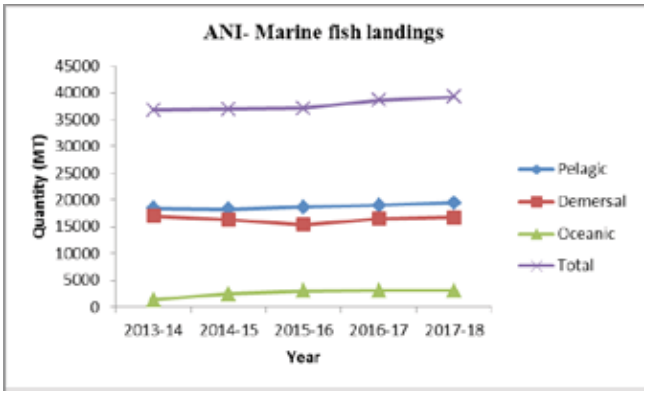

Fig.1. Marine fish landings of ANI (Source: Unpublished data from Department of Fisheries (2017-18), Andaman and Nicobar Administration).

Fish processing sector

Fish processing involves stepwise processes associated with fish and fish based products from the time of harvest till it reaches the consumers. Quality loss usually happens in fish as it is a perishable commodity. Processing activities explores ways of fish preservation by lowering the temperature or by using high temperature or by reducing water activity, etc. Before the development of advanced fish processing techniques people used to preserve fish by traditional fish preservation techniques such as curing methods which involves sun drying, salting, smoking, marination and fermentation.

Inspite of enormous potential and payoffs, fish processing activities are still confined to sun drying, salting, chilling and freezing of available fish catch. Fisher folk use to dry the excess and low valued fishes for sale in local market. Among the fishery products, fish and prawn pickles, fish cutlets, fish finger, canned fish, etc. are available in supermarkets and retail shops. Few Self Help Groups (SHG's) were actively involved in preparing and selling pickles in small scale manner. Traditional methods like sun drying, salting, smoking, marination, etc. are very popular among tribal population in Nicobar Islands. There is a greater demand for fish based products in these Islands which are mainly imported from mainland. Fishes in chilled, frozen and dried forms are exported from the Islands to mainland, India. At present, no proper utilization and recycling of fish wastes is happening in the Islands. The waste generated from fish markets are directly thrown into the waste baskets without any further treatment.

Current state of catch utilization

Most of the available catch is sold as fresh in the local markets. Nearly 15 % of the catch is processed in the form of salted or sundried with some defects identified as poor salting, high sand content and rancidity (Mustafa, (1983)). Out of 36980 tonnes, during the year 2014-15 the marine fishes marketed as fresh (24037 tonnes), frozen (5547 tonnes) and salt dried (7396 tonnes) (Shirke et al. (2018)). The disposition data of marine fish catches and the details of fish and fishery products exported from the Island are given in fig.2 and table 2 respectively.

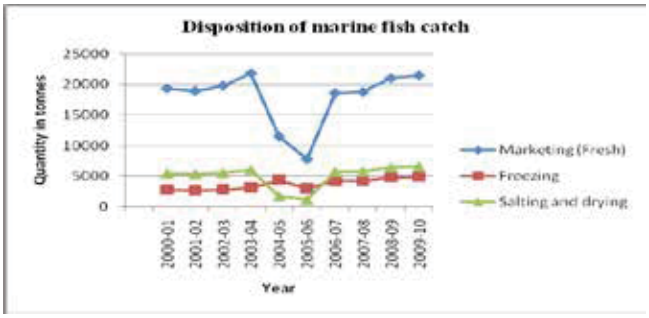

Fig.2. Disposition of marine fish catch (Source: Unpublished data from Department of Fisheries, (2017-18). Andaman and Nicobar Administration).

Table 2. Fish and fish products exported from the Island for last five years (Quantity in Kg)

Item	2012-2013	2013-2014	2014-2015	2015-16	2016-17	2017-18
Crab	52585	41022	58895	89906	121477	135541
Lobster	12511	3994	2107	7147	6016	7766
Prawn	74	0	15	0	0	0
Fish	1399669	1589066	1627280	1525999	2037458	2183885
Tuna	0	10000	0	0	117262	157780
Shark fin	4,277	631	230	482	766.5	601
Shark flesh	331584	147928	103489	141946	214066	154150
Dry fish	31,958	47303	4314	19074	51578	6290
Total	**1,832,658**	**1,839,944**	**1,796,330**	**1,784,554**	**2,548,624**	**2,646,013**

(Source: Unpublished data from Department of Fisheries, (2017-18). Andaman and Nicobar Administration).

Marketing of fish and fishery products

Andaman and Nicobar Islands are included in the list of highest fish consuming states/UT in India. A study showed that majority of Andaman's population consumes fish 3 to 4 days in a week (Suresh, (2012)). Average yearly fish consumption of an individual in the Island is 53.57 Kg (Unpublished data from Department of Fisheries, Andaman and Nicobar Administration, 2017-18). The mode of fish marketing is categorized into five ways such as door to door selling, export agent, street vendors, auction and market (Suresh, (2012)). Majority of sellers prefers to be street vendors as it gives good profit in less time. Door to door selling of fish is also a common practice to sell fishes. The other mode of fish sale is by involving the export agents. The fishermen sell highly priced, good quality fresh fishes to them directly to earn good profit. The agents come and collect the fishes directly from them in the landing centres. These agents provide inputs for fishing like baits, ice and fuel to the fishermen. They export the fishes to mainland in chilled or frozen condition. This mode is to maintain the demand of Island fishes in export market as well as local markets. The other mode of sale is through auction, which involves high risk of losing money, at the same time this is the easiest way to earn huge profit. The fishermen sell fish to exporters or vendors or other business owners who offers the highest price. Purchase of fish from market is the most common business mode through which customers are buying fish from different market from the vendors. The study in Port Blair, South Andaman reported that fish markets are the major platform for the domestic fish sale but fish marketing is highly unorganized and unregulated

(Shirke et al. (2018)). An earlier study found that fish varieties such as perches (snappers, groupers & emperors) were found to be more preferred by the Islanders followed by mackerel, sardine, anchovies & carangids and prawns (Shirke et al. 2016)).

Infrastructure

The available infrastructure for post harvest management of marine landings includes fish landing centres, fish markets, cold stores, ice plants and fish processing plants. Other than landing centres, fish landed at 46 landing points also in different locations in Andaman and Nicobar Islands. Out of 8 landing centres, 3 landing centre is at South Andaman, 4 is at North and Middle Andaman and 1 is at Nicobar district. Construction of 9 landing centre and 2 fish market is going on in different locations. Till now 2 modern fish markets are there in the Island in which one is functional at Junglighat, South Andaman and the other one is not yet functional which is constructed at Mohanpura, South Andaman. The total number of cold storage available is 08 with a capacity of 290 tonnes/day and ice plant is 15 with a capacity of 223 tonnes/day. The available infrastructures for Island fisheries are listed below (Table 3).

Table 3. Infrastructure available in the fisheries sector

Infrastructure	Number of units	Remarks
Fish landing centres	**08**	Construction of 09 more landing centres is going on and work of 02 landing centres is yet to commence.
Fish markets	**17**	02 Fish markets are under construction in North and Middle Andaman
Fish processing plant	**03**	Total capacity 130 tonnes/day
	01 (Public undertaking)	100 tonnes/day
	02 (Private units)	30 tonnes/day
Ice plants	**15**	Total capacity 223 tonnes/day
	03 (Govt.)	30 tonnes/day)
	09 (Private units)	Total capacity is 178 tonnes/day
	03 (Public undertaking)	15 tonnes/day
Cold storages	**08**	Total capacity of all cold storages is 290 tonnes/day
	03 (Govt.)	45 tonnes/day
	02 (Private units)	Total capacity of 125 tonnes/day
	03 (Public undertaking)	120 tonnes/day

(Source: Unpublished data from Department of Fisheries, (2017-18). Andaman and Nicobar Administration)

Constraints

- Lack of diverse fishing methods which lead to low catches followed by shortage of raw materials for fish processing activities
- Limited infrastructure facility for proper post harvest handling of fishes
- Lack of technical knowledge among the Islanders regarding the fish processing techniques and its potential in employment

- Limitation in transportation and trade between the Islands and to mainland, India, due to remoteness of the Island; Nonexistence of air connectivity to foreign markets; poor information and communication linkages etc. also hinders the developmental activities.
- Intense competition from mainland for processed fish products such as pickle, canned foods etc. Quality demand will be on par with that of mainland products.

Product development and value addition

The diverse fishery resources can be well utilized for developing products that could be marketed within the Island for local consumption as well as outside the Island. Utilization and consumption of low valued fishes that have less demand and fewer prices in the market can be promoted through value addition of these resources. According to the preference and requirement of the market, the resources can be converted into different forms or products with different nature which can earn more profit at the time of sale. Value added products from fish can be of different type such as mince based, surimi based and battered and breaded products. Convenience products such as ready to eat, ready to serve, ready to cook products have greater demand in global market as it gives ease to the consumers in the preparation of their meal. Specialty products such as sausages, skewered shrimp, wafers and analog products also have high demand in the international markets. The fishery resources of these Islands can be utilized to develop such high value products for earning more profit (Table 4).

The fish catches landed are sufficient enough to cater local consumption. Any unutilized fish landings and low value fishes can be utilized for processing and value addition. Marketing of fish in fresh form in the mainland may not be economically viable as transport and holding cost will be added on the product cost, it won't be able to challenge local market condition. So marketing of fish in processed form will be a sustainable option (ANDFISH, 2005).

Table 4. Popular fish based products

Products	Suitable fishes	Technology Advantage
Chilled & Frozen products	High value fishes like grouper, pomfret, shrimps, tuna, etc.	Preservation of fish at low temperature closest to fresh state, high potential in domestic and export market
Salted and dried products	Small sized, low value fishes are mostly preferred. Examples: Anchovies, small shrimps, lesser sardines, etc.	Shelf life extension of fish by reducing the water activity without much financial input and sophisticated equipments. Storage of products at ambient temperature is possible
Canned products	Tuna, mackerel, sardine, crab, shrimps, etc.	Preservation of fish with the application of high temperature for commercial sterility and longer shelf life. Products are stable at room temperature without any cold chain requirement
Pickle	Both finfish and shellfish are preferred. Example: Tuna, shrimp, clam, etc.	Easy & one of the safest preservation technique and it is a highly demanded value added product with market potential in domestic and export market.
Fish kheema/ fish mince and mince based products (Example: Fish ball, fish cakes etc.)	Low value & white fleshed fishes are mostly used. Example: Threadfin bream	Better utilization of low value fishes. Highly acceptable product by consumers.

Coated products/ battered & breaded or enrobed products (Fish cutlet, fish finger etc.)	Low value fishes, fishes with less pin bones are mostly preferred eg. Nemipterus, ribbon fish, tuna. Coated shrimps & cephalopods products are also popular.	Better utilization of low value fishes through value addition. Highly acceptable product by consumers.
Surimi and surimi based products like sausages	Lean, white fleshed fishes like thread fin bream, bigeye snapper, croaker etc. Mackerel & sardine can also be used.	Better utilization of low value fishes through value addition. High demand in export markets.
Convenience products (Fish curry, fish burger, fish samosa, fish wafer, soup powder etc.)	Any fish can be used. For fish curry, high priced fishes like pomfret, seer fish etc. are mostly preferred. Lean white fleshed fishes like threadfin bream, big eye snapper, etc. can be used for burger, samosa, etc. Low cost, lean white fleshed fishes are mostly preferred.	Better utilization of low value fishes through value addition. Increasing demand for ready to eat, ready to cook products.

(Source: Datta, (2015))

The low value fishery resources of the Islands such as sardines, mackerel, threadfin bream and ribbon fish, etc. can be targeted for its better utilization. One of the potential resources for processing, and value addition is the oceanic tuna resources which are quite underutilized in comparison to coastal tunas. Development of a cold chain by connecting the existing ice plants and cold stores in the entire island is essential to maintain the quality of fish catches. Adoption of sanitary handling practices is an utmost necessity to manage the catches suitable for processing and to avoid any possible contamination with pathogens of public health significance.

Fish waste utilization and byproduct development

Another potential area under fish processing is byproduct development from fish wastes. Fishes are mostly consumed as fresh in the Island, even though some portion are still utilized after some kind of preservation and processing. Wastage can happen during handling and processing of fish along with the wastes from fish markets by the dressing and cleaning activities of fish for customers. Similarly, bycatch, discarded fishes due to quality loss/spoilage or less demand and wastes from fish processing units will also contribute to the wastes generated in the fisheries sector. Fish is known for its rich nutrient reserves and the waste materials generated from fish are also a good source of high quality protein, minerals, fat etc. which are having potential for recycling. Different byproducts such as fish meal, fish silage, fish oil, chitin, etc. can be developed from these waste materials (Table 5). Post harvest losses can be reduced if we could utilize these wastes effectively converting them to products. This technology could be well suited for the Island as there is no demand for sophisticated equipments or a big industry set up to process the products.

Table 5. Popular byproducts from fish wastes

Products	Product application	Type of wastes material/ Waste part utilized (whole fish, head, skin, bone, etc.)
Fish meal	Livestock feed supplement	Wastes from high fat fishes like anchovies, sardines etc., small bycatch fishes & wastes from fish processing units
Gelatin	Food industry: as a gelling, emulsifying, dispersing or thickening agent & other industrial application: in photoengraving and chemical etching of metal parts; in optical industry in the formulation of coating for light sensitive materials like blue print papers	From skin and bones of fish
Fish Calcium	Food industry; used to combat calcium deficiency in the diet, particularly for children	Bone of fishes especially tuna
Fish silage	Used in animal feeding	Whole fish wastes or parts of fish
Fish glue	Industrial application; used in furniture, box making etc.	Fish head & skin
Fertilizer from fish waste	Agricultural application	Fish offal & low value fishes
Fish oil	Industrial application; as drying oils in paint and varnishes, manufacture of detergents, soaps, lubricants etc. & food industry; cooking oil and medium in fish canning	Fatty fishes or wastes with high oil content
Chitin & chitosan	Industrial application; purification of drinking water, treatment of waste water, In Food industry; as clarification agent in fruit juices, thickening and stabilizing agent, animal feeding, In cosmetics as moisturizer, and in pharmaceutical industry; slow releaser of drugs etc.	Exoskeleton of crustaceans
Isinglass/ fish maws	Used for production of gelatin or glue, clarifying agent for beer, cider, wine, vinegar etc., adhesive base, ingredient in Indian ink and as a sizing agent in textiles	Air bladder of fish
Pearl essence	For making artificial pearls, as spray or dip for several items to impart iridescent sheen. Used on diverse articles such as shoe, pencil, fishing rod, ash tray, vanity bag, book cover etc.	Fish scale

(Source: Balachandran, 2001)

Fisher folk are aware of waste utilization; however they lack technical knowledge regarding the technology of byproduct development. Further, capacity building programmes such as trainings should be conducted for the stakeholders to popularize the products. This could be a promising sector for their livelihood and development of self employment. At present, the bay islands are encouraged towards conversion of organic agriculture

and hence the products like fish silage, fish compost/ fertilizer, etc. can be used effectively for the agriculture sector. There is high demand for feed for livestock as there is no much availability of them in the Island, so the production and supply of products like fish meal can be a good option for earning profit. Diverse products can be developed from these wastes which have industrial applications too; these products can be marketed well in the Island and can be exported.

Marketing chain - recommendations and proposal

The demand for fish is high in the Islands as majority of the Island population are fish consumers considering the abundant fishery resources in the Islands. Diverse products can be developed and marketed in the Islands according to the demand and preference of the population. Market surveys are essential for a comprehensive study to know the taste preference of the fish consuming population. Smart marketing tools can be used effectively to market fish and fishery products and Women Self Help Groups should be promoted to engage them in production, packaging and marketing of fishery products. Marketing of products can be strengthened by exploring the new marketing strategies such as targeting the ever growing tourist population and by expanding the market outlets at various prominent places including popular tourist destinations. The products can be sold through retail markets, supermarkets, self help group units and department units. The fish markets should be converted into modern fish markets with proper hygiene and facilities for waste disposal, storage facilities, etc. This will create a space for hygienic marketing of fish as well as demand of products can be increased by attracting the customers with the supply of safe-quality produce. The marketing system should be more regulated and organized with involvement of limited intermediaries and with proper logistical support.

Marketing of the Island fishes and fish products can be possible with an eco-label, 'Andaman brand' etc. which will fetch more price than a regular product in the market. Packaging of fish and fishery products is another important area. Packaging material need to be selected with utmost care for local market and export by avoiding the use of single use plastic for packing the fish products. Products can be marketed after proper quality check with adequate label carrying full information about the product inside. The export is possible after getting the export clearance from the competent authority.

The marketing channel for fish marketing involves many intermediaries such as auctioneer, wholesaler, retailers, processing agents and fish vendors etc. In the marketing chain of fish, the number of intermediaries can be limited as much as possible to increase the profit share of fishermen community. This can be achieved by strengthening of fishermen cooperative and by increasing the role of fishermen not only in production and harvest but also in processing, packaging and marketing.

Future prospects of fish processing sector

Productive areas for development of processing, value addition and waste utilization sector is shown in Fig 3. Production of high end products such as convenience products in retort pouches, canned tuna and specialty products like analog products, sashimi grade tuna, etc. should be targeted which have high demand in the international markets. Infrastructure facilities for proper handling, preservation, processing, storage and transportation of fishery resources can be strengthened with establishing most modern export friendly set up and sophisticated equipments including hygienic waste disposal systems. Facilities for preserving fish onboard should also be improved for getting better quality raw material for processing. A well managed cold chain between the Islands including cold store, reefer containers, ice plants etc. should be established. Supply of good quality inputs like ice, potable water should be assured for production of quality fish. Data collection on post harvest loss and quantification of wastes generated from the fisheries sector should be carried out. The wastes generated should be collected and used judiciously for developing products with diverse applications. Facilities for production of diversified value added products and byproducts should be developed in the Island. Export of fishery products via sea and air should be strengthened, the strategic location of A&N Islands with its proximity to the world tuna markets located at Singapore and Bangkok

can be utilized for earning foreign money through export of sashimi grade tuna.

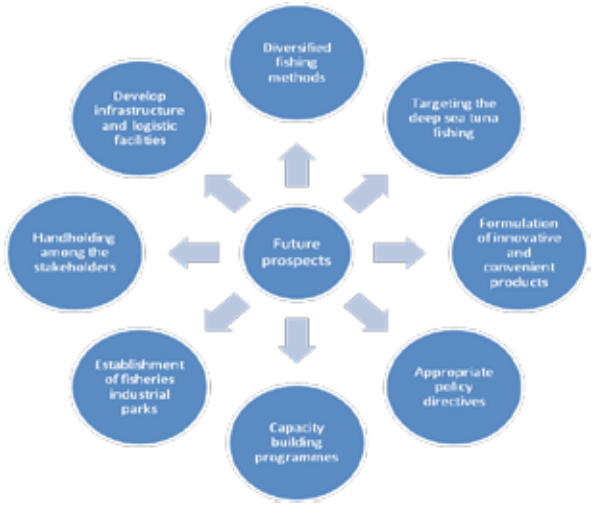

Fig. 3.Future prospects for the development of fish processing in ANI

Sustainable and judicious use of marine fishery resources is essential to promote livelihood and employment activities in the Islands. Fisheries sector plays a huge role in the livelihood of Island population including the tribal population. More than subsistence fishing, fisheries and its allied sectors should be seen as a business activity to reap the benefits in fishery sector. Fish processing sector should be promoted and could be well adapted in Island conditions with a quality brand. The development of new innovative and diverse value added products and byproducts from the fishery resources can meet the existing demand of local market. Further, these products can be exported to mainland, India and nearest South East Asian countries. Scientific data in the area of fish processing should be strengthened to add more information to the existing database. The sector is if engaged proactively could play a significant role in promoting trade, securing food and nutritional requirement of the population along with improvement in livelihood and employment opportunity of the Islanders.

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