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Alternative employment generations for Fishermen – A way forward for reducing pressure on coastal Marine Fishing

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Abstract

As per census - 2011, the total number of population in West Bengal is about 9.03 crores, now it is over 10 crores, out of which about 3,80,138 are marine sea going fishermen. They depend upon the mainly marine fishery resource in maintenance of their live and livelihood directly. All types and sizes of marine fishes are being caught by our fishermen throughout the year except 61 days fishing banned period in West Bengal from 15th April to 14th June. In West Bengal, total 45 Khuties and 18729 numbers of fishing boats are operated for fishing in sea and rivers. There is huge scarcity of availability of marine fishes at present. The marine fishery is diminishing year after year. For survival of marine fishery resources, we need to find out alternative employments except fishing. I humbly recommend our fishermen and entrepreneurs to make focus on edible marine molluscs collection, cage culture, pen culture and sea weeds culture practices. Our nation needs a plenty of protein enriched foods in future. Edible molluscs meats are good source of protein food which may be considered as human food if serve it before people in delicious forms. Cage culture, Pen culture and Sea Weeds Culture are also three another alternative ways of maintaining livelihood and effective to reduce pressure on coastal fishing in West Bengal.

Keywords: Live and Livelihood, Alternative Employment, Edible Molluscs, Delicious Forms, Cage Culture, Pen Culture, Sea Weeds Culture.

Introduction

The importance of fish is well known from time immemorial. Dietary animal protein is easily available from fish. We depend on the fish mainly to mitigate the demand of protein in our body and consume fish as good protein source because it is easily digestible due to low percentage of connective tissues and presence of fibre in it. In West Bengal, about 188 numbers of fishing villages, 76981 numbers of fishermen families, 52532 numbers of traditional fishermen families and 380138 numbers of fisher folk populations are attached with marine fishery[1].

Marine fishermen venture into the sea (Bay of Bengal) for fishing of sea foods like marine fishes, prawn, crabs, cephalopods, lobsters etc throughout the year except 61 days fishing banned period followed in West Bengal (15th April to 14th June) for maintenance of their life and livelihood. At present 45 numbers of Khuties (35 in Purba Medinipur and 10 in South 24 Parganas district) are there in West Bengal, they catch fishes from inshore area and dried these fishes to produce dry fish during winter.

In our state, total 18729 numbers of fishing boats (7031 numbers of Motorised non Mechanical, 3935 numbers of Motorised-mechanical and 7763 numbers of Non-motorized) are operated for fishing in sea and rivers. There is scarcity of marine fishes in sea due to not follow the mesh size regulation, escaping of brooder and small size fishes, releasing of endangered fish species, deep sea fishing etc. The fishery department, Govt. of West Bengal strictly keeps vigil on the matter and try to implement the rules and regulations of marine fishery acts but hundred percent not successful till now. As a result the marine fishery resource is diminishing and in future it will be fully damaged if we do not take precaution and not think alternative ways of employments. I humbly suggest four alternative professions for our fishermen to accept in large scale. These are - collection of edible marine molluscs species along the sea beach, cage culture, pen culture and sea weeds culture in in-shore water of West Bengal coast. We should give pressure on culture of fishes and other economically importance aquatic organisms to reduce pressure on marine fishing.

Materials and Methods

West Bengal, the state of India is situated on the eastern neck side of India, stretching from the Himalayas in the north part to the Bay of Bengal in the south part. It lies between $21^0 25'$ North to $27^0 13'$ North latitude and $85^0 50'$ East to $89^0 50'$ East longitude. This state is blessed with the sea like the Bay-of-Bengal and several rivers like the Ganga, the Brahmaputra, the Kansabati, the Rupnarayan, the Holdy, the Damodar, the Ajay, the Torsha, the Raidak, the Teesta, the Jaldhaka and the Mahananda etc. Most of the rivers of West Bengal are originated from the Himalayan in the northern India or from the

Chhota Nagpur plateau in the western part and flow south or southeast wards over the state.

Due to the rivers in the western plains, the water is very scarce or bare at any other time of the year, especially in the fall of the March - April, except during the monsoon. Most of rivers of West Bengal state locate in Eastern India. This state has short coastal line which is about 158.2 km, out of which 94 km is the Sunderban reserve forest where fishing is strictly prohibited. Only 64.2 km is allowed for fishing. We are enriched here with all types of fishery like cold water fishery, marine water fishery, brackish water fishery and fresh water fishery.

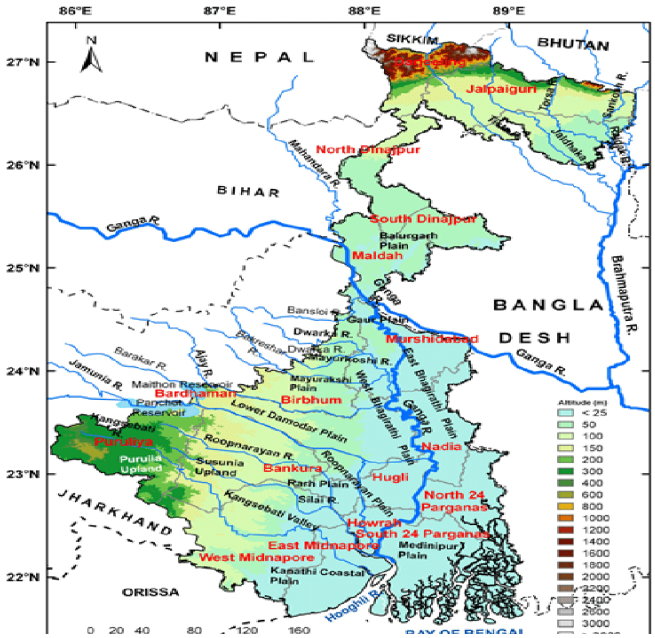

Figure-1: Map of West Bengal with its rivers.

The sea Bay-of-Bengal is fully shallow with very slow wave action on the beach and an extensive water area about 250 m of the intertidal zone is exposed during low tides. The slop of the sea beach in West Bengal coast is very low up to the low water mark. The shore was subjected to considerable erosion in the very recent past and the bank is presently protected with the strong construction of a sloping sea wall. The climate of West Bengal coast is observed by Chatterjiee and Mitra, is presented in the Table–1.

Table-1: Climatic conditions of West Bengal coast[2].

Parameters	Limit
Annual rainfall	1000 mm to 1300 mm
Atmospheric temperature	16^0C to 35.5^0C
Relative humidity	50% in December and 78% in July
Wind flow (Average)	30 Km / hour
Tidal amplitude (Average)	2 meters

Figure-2: Fishing Trawler fishing in the sea.

We have inshore area (up to 20 m depth) of about 777 km^2, offshore water area (20 – 75 m depth) of about 1813 km^2 and the Continental Shelf (up to 182 m depth) of about 17.049 km^2. These resources in West Bengal are not enough for huge fishing year after year. Thinking of alternative employment for our fishermen is urgent now.

Table-2: Fishery resources of marine sectors in West Bengal coast[1].

Marine Environment	Area
Inshore water area (Up to 20 m depth)	777 km^2
Offshore water area (20–75 m depth)	1813 km^2
Continental Shelf (up to 182 m depth)	17.049 km^2
Coastal line of West Bengal Coast	158.2 km

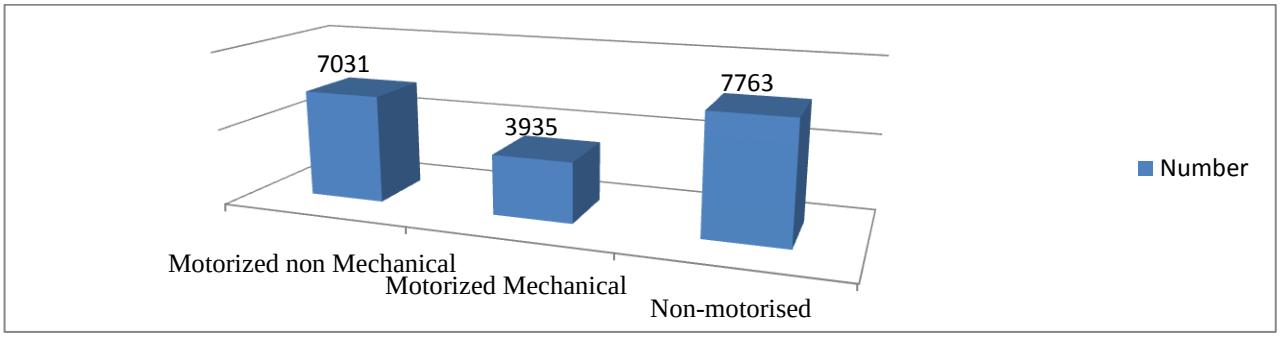

Figure-3: Number of Fishing Boats, operated for fishing in West Bengal coast.

Results and Discussion

Due to over fishing in the Bay-of-Bengal inshore water throughout the year, its conservation is mandatory from today and onwards for our future generations. There are four ways of alternative employments I humbly recommend to our coastal fishermen which are discussed below briefly to reduce the pressure on marine fishing.

Edible Marine Molluscs: There are several employment opportunities on molluscs fishery in coastal belt which are as molluscs shell collection is a traditional vogue along the sea beach of West Bengal by a little number of poor people and children in early morning. They earn money by selling the shells and conch in markets and maintain their livelihood.

It has taken an interview with some poor villagers of different coastal villages like Junput, Dadanpatrabar, Tajpur, Khejuri, Sankarpur, Soulaand Digha coast. From this observation, it acquainted those 4 cephalopods out of 4 available cephalopods species, 2 gastropods out of 35 available gastropods species and 12 bivalves out of 54 available bivalves species are suitable for human consumption. These edible molluscs species have huge future prospect in developing country like India. Butlocal common cwowd do not have knowledge on eatable molluscs meat. It is a matter of concern to all in India. The meat of edible molluscs is mostly nutritious and few are highly delicious. Most of the rich as well as poor villagers do not consume molluscs meat. But it is right that market price of eatable molluscs meats are inexpensive than sea water fishes found in the Bay of Bengal.

Anadara granosa *Anadara inequivalvis* *Anadara antiquata*

Crassostrea gryphoides *Donax incarnates* *Donax scortum*

Katelysia opima *Meretrix meretrix* *Meretrix casta*

Perna viridis *Saccostrea cucullata* *Solen brevis*

Olivancillaria gibbosa *Umbonium vestiarium* *Loligo duvauceli*

Octopus macropus *Sepia aculeata* *Sepiella inermis*

Figure–4: Edible marine molluscs available in West Bengal coast[2].

Table–3: Nutritive values of obtained marine eatable cephalopods in West Bengal Sea coast[4].

Specimen	% of Protein Content	% of Fat Content	% of Carbohydrate Content
Loligo duvauceli (d'Orbigny, 1848)	12.17±0.84	0.56±0.08	2.14±0.12
Octopus macropus (Risso, 1826)	12.71±1.02	0.60±0.06	1.74±0.18
Sepia aculeata (Ferussac and d'Orbigny, 1848)	11.48±0.91	0.51±0.08	1.76±0.20
Sepiella inermis (Ferussac and d'Orbigny, 1848)	14.53±1.52	0.69±0.05	1.32±0.15

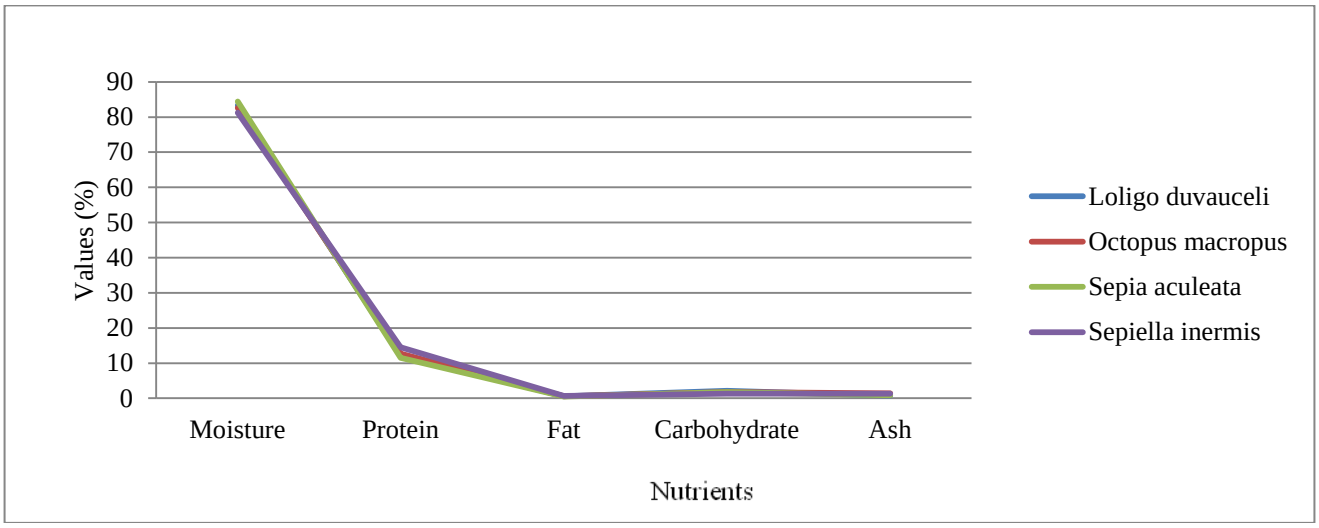

Figure-5: Proximate compositions of marine eatable cephalopods meat found in West Bengal coast.

Business on edible molluscs meat and molluscs shell has a huge scope in near future in India for employment generation to unemployed youths.

There are several opportunities of molluscs which are:

The molluscs meats both eatable and non-eatable species are used as feed of ducks and poultry birds etc. But the molluscs flesh can be utilized as feed of all carnivorous cultivable fishes like Magur, Singhi, Koi etc including prawns and shrimps. It is seen that carnivorous aquatic cultivable species show very quick growth rate to take molluscs flesh as food because molluscs flesh contains maximum values of protein.

The shell of bivalve and gastropods may be abundantly used as home and pandal decorating materials. Presently molluscs shell is used as lime, garlands preparation.
Writing ink may be prepared from *Sepia* sp (Cephalopods) and cuttle fish bone may be used to polish furniture.

The Conch (*Xancus pyrum*) is used to make sound in any kind of spiritual activities to the people of Hindu community.

There are four molluscs meat and shell processing industries scatter on the way from the Digha to Talsari of Odisha State but no such industry is seen in West Bengal.

Setting up of molluscs flesh and shell processing industry in West Bengal will be a good source of job opportunity to unemployed youth in present time.

Edible molluscs flesh may be exported after proper processing because demand in abroad is good.

The Cage Culture Practices: Among the various intensive culture practices, cage culture is equally important and interesting culture practice. This culture practice originates in the far-east near about a century ago. It was used in early years primarily for fresh water fish culture, it was extended during the last two decades for marine fishes too. Thailand, Island of Java, Indonesia, Singapore, Japan, Malaysia, Norway and Philippines have now undertaken cage culture practices in a large scale.

Cage culture is very poor in India. The cage culture practice needs sufficient tidal water flow in order to carry away the faecal wastes of fish from cages and bring in natural food.

Depending upon the environmental parameters, topography and types of cages and fish cultured, sub-littoral areas or offshore environments could be selected for attempting cage culture. While selecting sub-littoral areas, the variation between high tide and low tide water should be as small as possible and there should be adequate recirculation. Cage culture is possible in West Bengal in post monsoon from October to February and pre monsoon period from March to May in every year.

There are three types of cage i. Surface cages resting on the bottom layer thus occupying the full water column. ii. Cages floating at the surface layer of water body and iii. submerged cages are either floating in mid water or resting on the bottom. However floating cages find wide application in Indian coastal waters. The cultivable species which are most popular for cage culture are shown in Table–3.

There are several advantages of cage culture. The cage culture practices may provide alternative employment to the coastal fishermen and reduce the pressure on marine fish catch. As the growing fin fish and shellfish are in continuous contact with quality tidal waters rich in natural fish food organisms, the growth of these in cages is always greater than in coastal water ponds.

As the potential for cage culture development is large, it can be well developed and made into lucrative venture with minimizing risks.

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Table–3: Cultivable fish and shrimp species in cages.

Common Name	Scientific Name	Family	Stocking Density
Milk Fish	*Chanoschanos*	Chanidae	10 – 20 nos/m^2
Bhetki/Asian Seabass/Cockup	*Lates calcarifer*	Latidae	
Pearl Sport	*Etroplussuratensis*	Cichlidae	
Tiger Shrimp	*Penaeus monodon*	Penaedie	
White Shrimp	*Penaeus indicus*	Penaedie	

Figure–10: Cage culture practice.

Table–4: Cultivable fish and shrimp species in pens.

Common Name	Scientific Name	Order	Stocking Density
Milk Fish	*Chanoschanos*	Chanidae	10 – 100 nos/m^2
Bhetki/Asian Seabass/Cockup	*Lates calcarifer*	Latidae	
Pearl Sport	*Etroplussuratensis*	Cichlidae	
Grey Mullet	*Mugil cephalus*	Mugilidae	
Tiger Shrimp	*Penaeus monodon*	Penaedie	
White Shrimp	*Penaeus indicus*	Penaedie	

The Pen Culture Practices: Culture of fin fish and shell fish in pens or enclosures in running waters like brackish waters is not only unique but also practicable. As it is one of the interesting culture practices aimed at increasing fish yield, the pen culture practice is in vogue in countries like Bangladesh, Egypt, Hungary, China, Turkey, Israel, Nigeria, Tanzania, Poland, Netherland and Ireland. This practice is gaining importance at present in our country too especially in coastal localities such as Kovalam, Mandapam, Chilka and Pulicat lakes.

This culture may be started in brackish water bodies like estuaries, lagoons and inshore water of West Bengal to reduce pressure on marine fishing.

Suitable Sites for Pen Culture: Careful site selection and proper pen design are essential to make the pen culture practice viable. Usually protected bays, lagoons and other brackish water areas are more suitable for the installation of pens. Areas used for navigation, mooring, inshore fishing and pleasure boating should be avoided.

Site must be sheltered against high winds; best site is on the leeward side of prevailing winds with moderate flow of culture. i. Moderate tidal amplitude and areas where culturable seeds for stocking in pens are abundant, areas with the nearby estuarine mouth which is wide enough and remain open throughout the year for free inflow and out flow of water, speed of water flow should be 0.2 – 0.5 m/second in order to bring water with rich natural food and oxygen into the pen and remove fish wastes out of pen, there pen should be installed. ii. Temperature, salinity, pH and dissolved oxygen of water column of the site should be 24°C – 34°C, 10 – 30 ppt, 7.5 – 8.5 and >4 ppm respectively. iii. Turbid and polluted water should be avoided. Depth of water where pen is installed must be more than 1 metre even during low tide.

Type of Pens: The pens resemble duck fences on land and their size varies from 50 m^2 to 1000m^2. The pen may be single or double layered enclosure and take different shapes like circular, rectangular, squire or hexagonal. However for easy sampling and harvest, rectangular pens are ideal.
For the construction and installation of pens in shallow coastal and brackish waters, poles of casuarinas, split bamboo and polyethylene (nylon) nets of smaller mesh size (0.5 – 1 cm), nylon ropes are commonly employed depending upon the environmental condition, size of pens and stocking of fish cultured.

All types of pen fall under the three categories, we can deal with the construction and design of pens, in a different classification, as indicated below:

Rigid pens: Net enclosures and Embanked pens. Outer barrier nets. Flexible pens (netting). The net enclosures and embanked pens have been already referred to under 'pen culture in different parts of the world.

Species suitable for Pen Culture: The cultivable species which are most popular for the pen culture are shown in the Table–4.

There are several advantages of pen culture like greater production in limited space has been possible in pens owing to continuous water movements with food supply and oxygen besides maintaining good water supply. Pen is a complete ecosystem as the natural bottom is available to fish.

Pen culture plays an important sociological role in providing alternative employment to coastal fishermen. As there is no scarcity of water, pen culture can be a continuous process in West Bengal.

In pens fish diseases outbreak is very limited due to flow of water. There is no expenditure absolutely on the collection of fish seeds. Harvesting of fish and shellfish is not at all a problem in pens; the harvest may be made at the time of requirements or demand in market.

Sea Weeds Culture: Sea weeds are macrophytes and sedentary, growing mainly on rocks and other plants in the sub-tidal and intertidal environments. Total number of 90 species of brown coloured sea weeds, 350 species of red coloured sea weeds & 25 species of green coloured sea weeds are abundantly available in the world seas and are economically important as they find application in human and animal foods, green manure, pharmaceuticals, industries etc.

Agar agar is produced from sea weeds which are used as media in bacteria culture. Medicine of Goitre disease is prepared from sea weeds. Sea weeds are used as food of human beings and fishes. In India, coastal localities such as Tamilnadu, Gujarat, Visakhapatnam, Bombay, Ratnagiri, Kovalam, Chilka and Pulicat lakes, Andaman and Nikobar Island have luxuriant growth of sea weeds but in West Bengal there is no sea weeds culture seen.

Cultivable Sea Weeds Species: The most important edible sea weeds suitable for aquaculture are: The green algae i. *Caulerpa racemosa*., ii. *Enteromorpha spp*.. The red algae such as i. *Gracelaria edulis*., *ii. Gelidiella acerosa.*

Culture Procedure -Sea weeds are cultured in making frames which are fabricated with ropes of hemp fibres. A culture frame of 5 ×2.5 metres may have a net with about 130 meshes. In a cultivable unit of 1 ha area, 200 frames may be installed.
The culture frames are suspended in the sub-littoral zones. No soil, no fertilizers are required for sea weeds culture.

Production: After 80 days culture period 30 kg to 50 kg sea weeds are produced from 1 kg seed materials. *Gracelaria edulis* has given a yield of 50 Kg and *Gelidiella acerosa.* has given a yield of 30 Kg in a culture period of 80 days. The sea weeds are sold @ Rs. 10.00 – Rs.12.00/Kg

Uses of Sea Weeds: Agar agar is produced from sea weeds. It is used as media for bacteria culture in laboratory. Medicine is prepared from sea weeds i,e. Medicine of Goiter disease. Few marine weeds are directly eaten by human beings. Marine weeds are also applied as food of fishes.

Unemployment is a burning problem in running decade. These four alternative ways of employments may open the door of jobs among the interested unemployed people and alternative employments to present fishermen of West Bengal and in parallel with it, alternative employments will able to reduce huge pressure on marine fishing.

Figure-11: Pen culture practice.

Figure-12: Sea weeds culture practice.

Conclusion

To stop or less inshore fishing in the Bay-of-Bengal, the fishery department, entrepreneurs and fishermenshould show interest on collection of edible marine molluscs species, cage culture, pen culture and sea weeds culturein large scale in all estuaries, inshore water and other brackish water bodies along the sea shore of West Bengal coast. From practical experiance it is seen that the Bay-of-Bengal becomes very rough during monsoon from the month of June to September due to on and on natural calamities along the West Bengal coast more or less in every year. But during premonsoon period from March to May and post monsoon period from October to February the sea becomes very calm and the edible molluscs collection, cage culture, pen culture, sea weeds culture can be done very smoothly. It is humbly invited to all researchers to do further research on mentioned topics for alternative employment generation of fishermen to maintain their live and livelihood and to reduce huge pressure on marine fishing.

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