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Sustainable Utilization of Biological Resources – Seaweed Farming a Good Option

C. Periyasamy, P. Anantharaman and **T. Balasubramanian**

CAS in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu- 608 502.
Email: periyasamy.c@live.com, paraman_cas@yahoo.co.in

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Abstract

India is rich in biodiversity especially marine biodiversity. Marine biodiversity includes both flora and fauna. Among the Indian sea waters, Bay of Bengal is known for its living resources particularly the pearl oysters, Sea cucumbers, Shells, Sea grasses and also seaweeds. Among the plants in the sea namely phytoplankton, cyanobacteria, sea grasses and seaweeds, only seaweeds are the better livelihood options for the coastal community. There are 1062 species of seaweeds worldwide, half of them are economically important and 280 are edible. Other seaweeds are mainly used as an excellent source of phycocolloids such as agar agar, alginate, carrageenan. Some others were used as food, fodder, feed and liquid seaweed fertilizers. Length of coastline of India including the coastlines of Andaman and Nicobar Islands in the Bay of Bengal and Lakshwadweep Islands in the Arabian Sea is 7517 km. Length of Coastline of Indian mainland is 6100 km. Coastline of Indian mainland is surrounded by Arabian Sea in the west, Bay of Bengal in the east, and Indian Ocean in the south are the length of total coastline of India. So we are having lot of sea front. So space is not a constraint. Tamilnadu itself is having a costal length of 1076 km. Seaweed farming is one undertaking where a family based enterprise its better than a corporate or company structure. This is because seaweed farming is highly labour intensive and needs daily maintenance. It is a family enterprise with the fisherman, his wife and children providing all the farming work like a labour. For seaweed farming we have to select the following such as commercially viable Species, Location, and Socio economic status of the growing community and Sound commercially viable technique. As per the "Biological Diversity Act 2002 and Biodiversity rules, 2004", in every local body shall constitute a Biodiversity Management Committee (BMC) with in its area of Jurisdiction". The will claim for their Biological resources from any company who utilize the biological resources for their Jurisdiction. National Biodiversity Authority (NBA) will get 5% of their sale value of the biological resource after licensing. Through seaweed farming, NBA has received more than 40 lakhs as on 2008. This amount will be distributed to the benefit claimers ie., Coastal community who do seaweed farming. Seaweeds are the primary producers and also trap the carbon sequences results a good mitigating agent for Global Warming. Over exploitation of seaweeds in the natural stalk results imbalance in the marine ecosystem. So Seaweed farming will solve the problem. Seaweed farming benefits to the coastal community have been proved in Ramnad, Pudukkottai and Tuticorin Districts. So Sustainable Utilization of Seaweeds has to be spread all over the country.

Key Words: Seaweed, Farming, Phycocolloids

Introduction

Benthic, Macrophytic Marine algae are called as seaweeds. In earlier days, these plants (Marine algae) usage were not studied well. Hence the name was given to these marine plants as "Seaweeds". The name Seaweeds is popularized among the Scientists and peoples. So we are unable to change the name "Seaweeds". But in literature, some scientist's use the term "Marine Plants" here and there but mostly use 'Seaweeds". Seaweeds are used in various applications such as food, fodder, medicine, Bio fertilizers and Phycocolloids extraction such as Agar agar, Alginate, Carrageenan and others like Fucoiden and pigments. Hence Sustainable Utilization of Seaweed farming is a good option for the ecosystem and Human.

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John (1994), suggesting that roughly 36000 known species of algae represent only about 17% of the existing species is a measure of our still rudimentary knowledge of this group of organisms. According to Dring (1982) over 90% of the species of marine plants are algae and roughly 50% of the global photosynthesis on this plant is algal derived. Thus every second molecule of oxygen we inhaled was produced by an alga, and every second molecule of carbon dioxide we exhale will be reused by an alga (Melkonian, 1995).

Fig: 1. Seaweed farming activities in Ramnad (*Kappaphycus alvarezii*)

Seaweed Resources

Top 10 countries producing seaweeds are China, Korea, Japan, Philippines, Indonesia, Chile, Taiwan, Vietnam, Russia and Italy. The world production of commercial seaweeds has grown by 119 per cent since 1984 and presently, 221 species of seaweeds are utilized commercially including 145 species for food and 110 species for phycocolloid production. Worldwide, there are 42 countries with reports of commercial seaweed activity and about 221 species of seaweeds are utilized commercially. Of these, about 145 species are used for food and 110 species for phycocolloid production. About 90% of seaweed production comes from culture based practices and china holds first rank in seaweed production, with *Laminaria* sp. accounting for most of its production. China is followed by North Korea, South Korea, Japan, Phillipines, Chile, Norway, Indonesia and USA (Sajid Khan and Satam, 2003).

Seaweeds grow abundantly along the Tamilnadu, Gujarat, Andhra Pradesh, Orissa, West Bengal, Kerala, Maharastra, Lakshadeep and Andaman Nicobar Islands. There are also rich seaweed beds around Mumbai, Ratnagiri, Goa, Karwar, Vizhijzn, Pulicot and Chilka. According to Anantharaman et al., 2006, total red seaweeds are 432 species, brown seaweeds are 194 species and green seaweeds are 216 species. Total potential seaweeds are 870000 tons, present natural collection is 22000 tons and through seaweed cultivation is 150 tons.

Seaweed Cultivation

Cultivation of *Gracilaria*, in China was started since 1950s (Wu, 1998, Tseng,2001, Zou *et al*., 2004). The main species cultivated was *Gracilaria lemanieformis*. Large scale cultivation of *Gracilaria* has been encouraged in Chinese coastal waters (Tseng and Fie, 1987, Fei *et al*., 1998; Yang and fie, 2003 and Fie, 2004). *Laminaria* japonica, cultured on long line rope cultivation in the coastal waters of China, constitutes over half of the worlds aquatic plant

production (Chiang, 1984, Fei *et al*., 1998 and Tseng, 2001).

With a view to develop suitable technology on commercial scale cultivation for augmenting supply of raw material to agar industries, CMFRI and CMCRI and related organizations since 1964, have attempted experimental cultivation of various species such as *Gelidiella, Gracilaria, Hypnea, Sargassum, Turbinaria, Cystoseira, Hormophysa, Caulerpa, Ulva, Enteromorpha* and *Acanthophora* in different field environments using various culture techniques (Kaliaperumal *et al*., 2004). These experiments revealed that *Gelidiella acerosa* can be successfully cultivated on dead coral stones and *Gracilaria edulis, Hypnea musciformis, Acanthophora* and *Entreromorphia flexuosa* on long line ropes and nets.

Kappaphycus cultivation has been going on since 1965 in Philippines, Indonesia, Malaysia, Tanzania and Madagascar. Experimental farming or intermittent commercial activities has occurred in several countries including China, Japan, Brazil, Vietnam, Cuba, Kiribati and recently in India. *Kappaphycus alvarezii*, is commercially known as "cottonii" in international seaweed market. This alga is the only major source of kappa-carrageenan, natural polysaccharide (carbohydrate), which has several uses. Philippines and Indonesia is the major producer of this seaweed followed by Malaysia, Tanzania and Madagascar.

Kappaphycus cultivation in India

Kappaphycus alvarezii (Doty) Doty (= *Eucheuma striatum* = *Kappaphycus striatum*), which were grown originally in Japan (Mairh et al., 1995) were initially cultured in Okha, west coast of India. Acclimatization and large scale cultivation of this alga was achieved on the coast of Mandapam, south east coast of India, during 1995 to 1997. Then the plants were also cultured in a farm near Kurusadai Island, approximately at the beginning of Gulf of Mannar Marine Biosphere Reserve. CSMCRI (Central Salt and Marine Chemicals Research Institute – Marine Algal Research Station - CSIR), Mandapam commenced farming on R&D basis and transferred the technology for the first time India and being cultivated in Tamilnadu since 2001. Pepsico India Holdings Private Limited, Gurgoan is deeply involved in the cultivation of this economically important seaweed from 2001 to June. 2008, which got the technology from CSMCRI in 2001. Subsequently transfer the technology to Aquagri Processing private limited. Currently there are several companies such as LINN PLANTAE PRIVATE LIMITED, Madurai, SNAP ALGINATE, Ranipet, MARINE LIXURS, Tuticorin are involved in cultivation and purchasing of this seaweed through buyback arrangement with SHG's. Nearly more than 1000 fishers are involved in seaweed farming.

Model Operation for one SHG

Project implementation and gradual expansion is worked out to one SHG of 5 members as follows. During expansion period of 45 days, farmers will earn Rs. 2500/- per month as a family assistance (25 days X Rs.100 raft floating as in Annexure I).
Agronomy

Kappaphycus alvarezii - cultivated in the following climatic condition in any area.
Seawater Temperature: 30^0 C ± 3 is ideal temperature for *Kappaphycus* cultivation.
Seawater Salinity: 30ppt ± 3ppt is the ideal salinity. But the plant survives upto 30 ppt ± 5ppt.
Water Motion: Moderate wave motion - good growth.

Project cost: 5 members per group basis

Table: 1.0 Details of Project cost for one SHG (5 Members)

1	SHG size	5 members/SHG
2	Cost of one raft (Including material cost, mother seed and raft maintenance cost)	Rs. 1000
3	No. of rafts per SHG member	45 rafts
4	Total rafts for the 5 members (5 x 50 member)	225
5	Total cost for 225 rafts (Rs.)	225000
6	Government subsidy 50% (Rs.)	112500.00
7	Net bank loan (Nationalized Bank) (Rs.)	112500.00
	Total loan component (Rs.)	225000.00

Raft expansion

Per SHG 5 rafts and seed has been provided every day and full expansion of 225 rafts will be finished on 45th Day. On 46th day the 5 grown rafts will be harvested for drying and 5 rafts will be replanted on the same day. Balance material (after replantation) will be dried. Every day 5 rafts will be harvested and 5 rafts will be replanted. This operation will be continued for their regular income.

Day: 1: 5 rafts. (SHG)

Day 45: 225 rafts floated (SHG). Daily operation of 5 rafts/ Day

Day 46 to 90: 225 rafts harvested and replanted. (SHG)

Bank Loan repayment model

Total unit cost/ 5 member group = Rs. 2, 25,000.00

Subsidy = Rs. 1, 25,000.00 Total bank loan = Rs. 1, 25,000.00

Monthly deduction = Rs. 10000 (@ Rs. 2000/ Head) Bank interest = 10.0% (rate varies)

Total repayment period = 3 Years maximum (9 months monitorial Period).

Daily operation/5 member per group (46th Day onwards-regular operation)

Table 02: Details of Daily operation and Income for one SHG (5 Members)

Sl. No.	Descriptions	
1	Total no. of rafts for SHG (5 members/Group)	225
2	Harvest cycle (period)	45
3	No. of rafts handling/day based (45d harvest cycle) Ist harvest	5
4	Total seaweed after harvest from 5 rafts (kg) @ 260 kg/raft	1300 kgs
5	Total seed required for replantation for 5 rafts	300 kgs
6	Net produce after deducting seed from 5 rafts/day	1000 kgs
8	Dry weed available from 1000 net produce (10:1 dry ratio)	100 kgs
9	Dry produce available for a month (100*30)	3000 kgs
10	Cost of one kg dry weed	Rs. 25.00
11	Monthly income from total dry produce (3000 x 25.00)	Rs. 75000.00

Monthly income of a 5-member per group and an individual

Table: 03. Details of Daily operation and Income for an Individual

Sl. No.	Descriptions	
1	Total dry produce per month (kg)	3000
2	Gross monthly income from total dry produce i.e. 3000 x 25.00 (Rs)	75000
3	Out of Rs. 25.00/kg, the SHG can utilize the same amount as detailed below (i) Bank loan repayment @ Rs.2000/Head *5 members = Rs.10000 (ii) Unforeseen expenditure & maintenance cost @ Rs.1000/Member/Month	60000
4	Net income to the group/month during loan period (Rs.) Sl.No.3	60000
5	Net income to an individual/month during loan period (Rs.) Sl.No.4 / 5 members	12000
6	Net income to the group/month after loan is settled (Rs.) Sl.No.2	75000
7	Net income to an individual/month after loan is settled (Rs.) Sl.No.2/ 5 members	15000

Annexure – I:Per raft Infrastructure cost

Sl.No	Particulars/Specifications	Qty reqd.	Rate (Rs)	Cost per Raft (Rs)
1	3-4" dia Hallow Bamboos of 12ftx4 for main frame + 4ftx4 for diagonals (without any natural holes, cracks etc)	64 feet	4.0/feet	256
2	Five-Toothed Iron Anchor of 15kg each (@ Rs.80 per kg) – One anchor can hold a cluster of 10 rafts	1.5kg	80/kg	120
3	3mm PP twisted rope for plantation – 20 bits of 4.5m each	0.4 kg	140/kg	56
4	Cost of HDPE braider pieces (20 pcs x 20 ropes = 400 pcs of 25cm each)	0.1 kg	200/kg	20

5	Braider twining charges @ Rs. 2.0/20 ties. For one raft 400 ties = Rs. 40	20 ropes	2/rope	40
6	Raft framing rope 6mx12 ties per raft i.e. 36mts of 6mm rope	0.65kg	140/kg	91
7	HDPE Used Fishing Net to protect the raft bottom (3.5mx3.5m size) + labour charges Rs. 10	1 kg	70/kg	70
8	2mm rope to tie the HDPE net (28mts)	0.064kg	140/kg	8.96
9	Anchoring rope of 10mm thickness (17m per cluster of 10 rafts)	0.08kg	140/kg	11.2
10	Rafts linking ropes per cluster 10 rafts – 6mm thick – 2 ties x 3m x 9pairs = 54m length	0.1kg	140/kg	14
11	Transport cost			50
12	Raft cost (column 1-11)			737.16
13	Seed material 150gm x 400 ties + 5 kg as handling loss	65kg	2.50/kg	162.5
14	Raft laying + maintenance cost	-	-	100
				999.66
Total raft cost (Rounded off)				1000.00

Conclusion

Through seaweed farming we can uplift the socio economic status of the fisherfolk in all coastal districts. By value added products, we can maximize our exports as well as minimize imports of the same. From our studies we can recommend the following for seaweed farming development in sustainable way.

1. Research on Seaweed cultivation techniques for indigenous species are needed.
2. Research on product quality development priority is required.
3. Large scale cultivation has to be motivated.
4. Proper monitoring of environmental impact studies has to monitor regularly.
5. Strain or species improvement through Biotechnological studies on seaweed.
6. Studies on co cultivation of shrimps, fishes with seaweeds.

As per the "Biological Diversity Act 2002 and Biodiversity rules, 2004", in every local body shall constitute a Biodiversity Management Committee (BMC) with in its area of Jurisdiction". The will claim for their Biological resources from any company who utilize the biological resources for their Jurisdiction. National Biodiversity Authority (NBA) will get 5% of their sale value of the biological resource after licensing. Through seaweed farming, NBA has received more than 40 lakhs as on 2008. This amount will be distributed to the benefit claimers ie., Coastal community who do seaweed farming. In Ramnad, Pudukkottai, Tuticorin and Tanjore, BMC formation process is going on and the amount of Rs. 40,00,000 + will be distributed among less than 500 fishers. So there will be a change in their life style very soon.

Palk Strait of Ramnad District, Pudukkottai, Tanjore and Tuticorin Districts were surveyed extensively and found suitable for seaweed cultivation. There are 500km coastal stretches available with potential of 50000 rafts, which would create an alternative income/ livelihood to 2000 fishers or 100 SHG's (20 members each) of coastal poor with turnover of Rs. 10 to 15 crores per annum.

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