

Present scenario of seaweed exploitation and industry in India

N. KALIAPERUMAL, S. KALIMUTHU AND J. R. RAMALINGAM

Regional Centre of Central Marine Fisheries Research Institute

Marine Fisheries - 623 520, India

ABSTRACT

Data collected on the commercial exploitation of seaweeds from the natural seaweed beds of Tamilnadu during 4 years period from 2000 to 2003 showed that the quantity of agarophytes viz. *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa*, *G. foliifera* and *G. verrucosa* varied from 965 to 1518 tonnes (dry wt) and alginophytes *Sargassum* spp and *Turbinaria* spp from 1433 to 2285 tonnes (dry wt) per year. The commercial harvest of seaweeds in Gulf of Mannar and Palk Bay is recommended only during the peak growth period of the algae from July / August to January. The harvest of commercially important seaweeds in a rational way from other parts of Indian coast, Lakshadweep and Andaman-Nicobar Islands is suggested. The need for large scale cultivation of agarophytes to augment the resources and uninterrupted supply of raw materials to the seaweed industries is emphasised.

Introduction

Seaweeds form one of the commercially important marine living renewable resources. They occur in the intertidal and shallow waters of the sea and also in estuaries and backwaters. Seaweeds are used as human food. They are the only source for the production of phytochemicals such as agar, agarose, carrageenan and alginate. In India, seaweeds are used as raw materials for the manufacture of agar, alginates and liquid seaweed fertilizer. The seaweeds exploited from the natural seaweed beds are used as source for these finished products. The seaweed trade and industries offer employment to hundreds of people in the coastal and rural areas.

The luxuriant growth of several species of green, brown and red alga occur

along the southeast coast of Tamil Nadu from Mandapam to Kanyakumari, Gujarat coast, Lakshadweep and Andaman-Nicobar Islands. Fairly rich seaweed beds are present in the vicinity of Mumbai, Ratnagiri, Karwar, Goa, Varkala, Vizhinjam, Visakhapatnam and in coastal lakes Chilka and Pulicat (Kaliaperumal *et. al.*, 1987 and 1995). About 271 genera and 1153 species of marine algae belonging to four groups of algae namely Chlorophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae have been recorded so far from Indian waters. The total standing crop of seaweeds from intertidal and shallow waters of all maritime states and Lakshadweep was estimated as 91,339 tons – wet weight (Kaliaperumal and Kalimuthu, 1997). The quantity of seaweeds estimated in deep waters of Tamil Nadu was 75,373 tons (wet wt) in an area of 1863 sq.km from

Rameswaram (Dhanushkodi) to Kanyakumari (Kaliaperumal, 1994; Kaliaperumal *et al.*, 1998). The seaweed resources in estuaries and backwaters of Tamil Nadu and Pondicherry was given by Kalimuthu *et al.* (1995). The need for commercial cultivation of agar yielding red algae due to paucity of raw material to agar industries was given by Kalimuthu and Kaliaperumal (1994).

Knowledge on the seaweed resources and their level of exploitation in the previous years will be useful for the rational exploitation and for the sustainable utilisation in the coming years. Information collected on the quantity of agarophytes, viz. *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa*, *G. foliifera* and *G. verrucosa* and the alginophytes viz. *Sargassum* spp, *Turbinaria* spp and *Cystoseira trinodis* exploited from the natural seaweed beds in Tamil Nadu from 1978 to 1999 are given by Silas and Kalimuthu (1987), Kalimuthu *et al.* (1990), Kalimuthu and Kaliaperumal (1994), Kaliaperumal and Kalimuthu (1997) and Ramalingam *et al.* (2000). Data collected on the quantity of seaweeds harvested from wild crop in Tamil Nadu coast during the period 2000 to 2003 are presented in this paper together with the present status of seaweed industries in India.

Seaweed exploitation

The species of seaweeds harvested in Tamil Nadu coast during the period from 2000 to 2003 and their landing centers are given in Table 1 and Fig. 1 respectively. Data collected at monthly intervals on the seaweeds landed at different landing centers of Tamil Nadu coast showed that the quantity of agar yielding seaweeds *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa*, *G. foliifera* and *G. verrucosa* exploited from the natural seaweed beds of Tamil Nadu varied from 965 to 1,518 tonnes – dry weight (Table 2 and 4). The quantity of algin yielding seaweeds *Sargassum* spp. and *Turbinaria* spp varied

from 1,433 to 2,285 dry weight (Table 3 and 4). The total quantity of all these seaweeds exploited in a year varied from 2569 to 3683 tonnes dry weight (Table 4). Minimum quantity of 155 tonnes (dry wt) of seaweeds at Valinokkam and maximum quantity of 4,560 tonnes (dry wt) at Kilakkarai were landed (Table 5).

Seaweed industry in India

A detailed account of seaweed industry in India is given by Kaladharan and Kaliaperumal (1999). In India, production of agar was started in 1966. Seaweed was exported till 1975 when the Government of India banned the export of seaweeds (Silas and Kalimuthu *et al.*, 1987) in order to meet the requirement of the local agar industries. Now agar and alginates are manufactured in India and there is no production of carrageenan. There are about 25 seaweed processing units of which 20 units produce agar. Almost all units are of small scale industries without sophisticated machineries.

Agar is produced in the form of mats, shreds and powder and sold in the local market. Some quantities of agar is exported to foreign countries such as Singapore, Malaysia and Gulf countries. The raw materials used for agar extraction are *Gelidiella acerosa*, *Gracilaria edulis*, *G. foliifera*, *G. crassa* and *G. verrucosa*. Till 1990, there was scarcity of raw material, particularly *G. edulis*, to agar industries due to over exploitation in Mandapam area. To overcome the paucity of *G. edulis* for agar production, *Gracilaria foliifera* and *G. crassa* from Mandapam and *Gracilaria verrucosa* from Sethubavachatram area in Palk Bay are harvested since 1990. (Kalimuthu and Kaliaperumal, 1991). The bacteriological grade agar with a gel strength of 600 g/cm² is manufactured from *Gelidiella acerosa*. *Gracilaria edulis* and other *Gracilaria* spp yield food grade agar with a gel strength ranging from 120 to 150 g/cm².

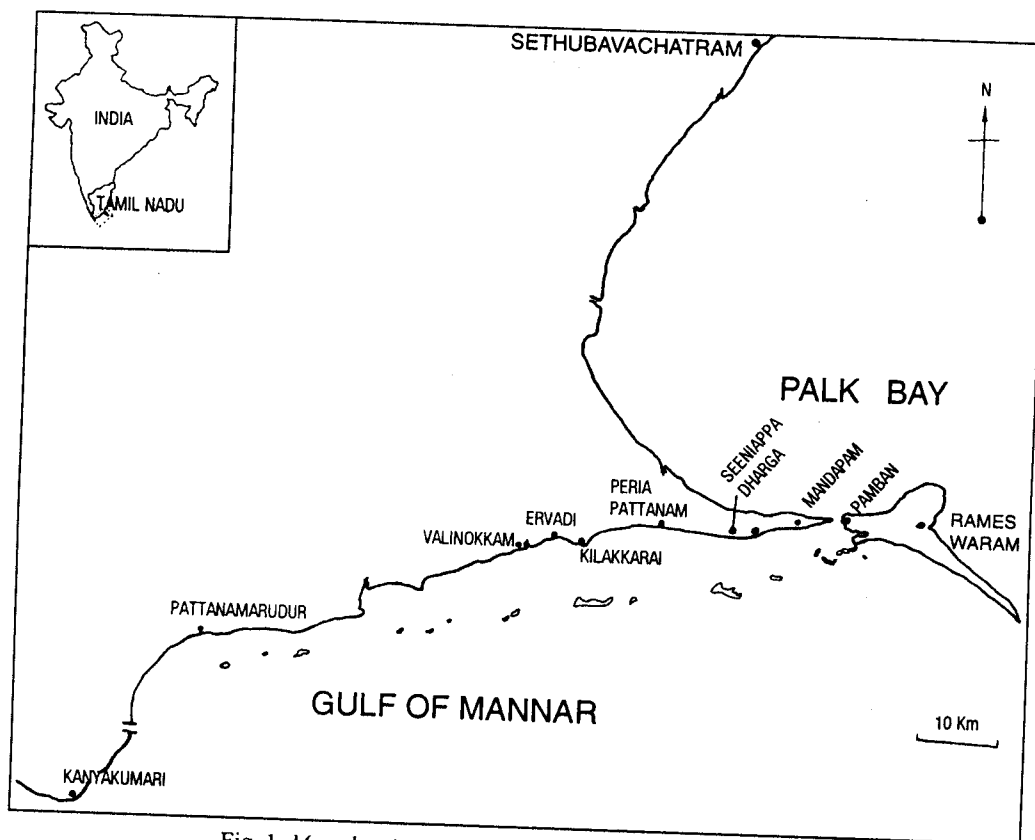


Fig. 1. Map showing seaweed Landing centres in Tamilnadu

Table 1. Species of seaweeds exploited in Tamil Nadu during 2000-2003 and their landing centres

Species	Landing Centres
Agar yielding seaweeds	
<i>Gelidiella acerosa</i>	Rameswaram, Pamban, Vedalai, Seeniappa Dharga, Kilakkarai, Ervadi, Pattanamarudur
<i>Gracilaria edulis</i>	Rameswaram, Pamban, Mandapam, Vedalai, Seeniappa Dharga, Kilakkarai, Ervadi, Pattanamarudur
<i>G. foliifera</i>	Mandapam
<i>G. crassa</i>	Kilakkarai
<i>G. verrucosa</i>	Sethubavachatram
Algin yielding seaweeds	
<i>Sargassum</i> spp	Rameswaram, Pamban, Mandapam, Vedalai, Seeniappa Dharga, Periapattanam, Kilakkarai, Ervadi, Valinokkam, Kanyakumari
<i>Turbinaria</i> spp	Rameswaram, Mandapam, Kilakkarai

Table 2. Quantity of agarophytes landed (dry wt in tonnes) in Tamilnadu during 2000 - 2003

Name of landing centre	<i>Gelidiella acerosa</i>				<i>Gracilaria edulis</i>				<i>Gracilaria foliifera</i>				<i>Gracilaria crassa</i>				<i>Gracilaria verrucosa</i>				Total
	2000	2001	2002	2003	2001	2002	2003	2004	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	
Rameswaram	66	40	51	31	14	35	33	40	-	-	-	-	-	-	-	1	-	-	-	-	311
Pamban	84	46	75	89	35	15	33	1	-	-	-	-	-	-	-	-	-	-	-	-	378
Mandapam	-	-	-	-	127	105	125	38	25	-	-	-	-	-	-	-	-	-	-	-	420
Vedalai	1	-	8	-	450	80	139	138	-	-	-	-	-	-	-	-	-	-	-	-	816
Secniappa Dharga	5	53	28	97	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	193
Kilakkarai	172	207	260	252	33	42	124	60	-	-	-	-	28	-	-	20	-	-	-	-	1198
Ervadi	124	139	110	102	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	480
Pattanamurudur	39	75	39	94	-	75	-	2	-	-	-	-	-	-	-	-	-	-	-	-	324
Sethubavachatram	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	310	224	130	-	664
Total	491	560	571	665	664	352	464	279	25	-	-	-	28	-	-	21	310	224	130	-	

Table 3. *Quantity of alginophytes (dry wt tonnes) landed in Tamil Nadu during 2000-2003*

Name of Landing Centre	<i>Sargassum spp</i>				<i>Turbinaria spp</i>				Total
	2000	2001	2002	2003	2000	2001	2002	2003	
Rameswaram	9	-	11	-	-	9	-	10	39
Pamban	-	2	-	-	-	-	-	-	2
Mandapam	-	10	43	50	-	-	-	59	162
Vedalai	100	25	215	130	-	-	-	-	470
Seeniappa Dharga	280	186	285	315	-	-	-	-	1066
Periapattanam	145	30	20	111	-	-	-	-	306
Kilakkarai	682	611	865	850	99	-	50	205	3362
Ervadi	10	205	11	145	-	-	-	-	371
Valinokkam	30	55	10	60	-	-	-	-	155
Kanyakumari	810	300	300	350	-	-	-	-	1760
Total	2066	1424	1760	2011	99	9	50	274	7693

Table 4. *Quantity (dry wt in tonnes) of agar and algin yielding seaweeds exploited from Tamil Nadu during 2000 - 2003*

Seaweed	Years				Total
	2000	2001	2002	2003	
Agarophytes					
<i>Gelidiella acerosa</i>	491	560	571	665	2287
<i>Gracilaria edulis</i>	664	352	464	279	1759
<i>G.foliifera</i>	25	-	-	-	25
<i>G.crassa</i>	28	-	-	21	49
<i>G.verrucosa</i>	310	224	130	-	664
Total	1518	1136	1165	965	4784
Alginophytes					
<i>Sargassum spp</i>	2066	1424	1760	2011	7261
<i>Turbinaria spp</i>	99	9	50	274	432
Total	2165	1433	1810	2285	7693

Table 5. Total quantity of seaweeds landed (dry wt in tonnes) in Tamil Nadu during 2000-2003

Name of the seaweed landing centre	Agarophytes	Alginophytes	Total quantity of seaweeds landed
Rameswaram	311	39	350
Pamban	378	2	380
Mandapam	420	162	582
Vedalai	816	470	1286
Seeniappa Dharga	193	1066	1259
Periapattanam	-	306	306
Kilakkarai	1198	3362	4560
Ervadi	480	371	851
Valinokkam	-	155	155
Pattanamarudur	324	-	324
Kanyakumari	-	1760	1760
Sethubavachatram	664	-	664

In India, about 100 tonnes of both bacteriological and food grade agar is produced annually utilizing approximately 1000 tonnes of dried agarophytes. Now the cost of one tonne of raw material varies from Rs.18,000 to 20,000 for *Gelidiella acerosa* and Rs.4,000 to 7000 for *Gracilaria edulis* and other *Gracilaria* spp depending on the purity and moisture content of seaweeds. The market rate varies from Rs.500 to 650 per kg for bacteriological grade agar and Rs.250 to 350 per kg for food grade agar based on their quality.

The alginophyte resources are quite adequate. The brown algae *Sargassum* spp and *Turbinaria* spp and also *Cystoseira trinodis* are used for the production of alginate in the country. *Sargassum* spp are more preferred than the other two species since the yield and quality of alginates are superior. The annual production of alginates in India is about 300 tonnes utilizing approximately 3000 tonnes of dried alginophytes. Alginates are produced in granules or powder form and marketed locally at the rate of Rs.150 to 200 depending on the quality of the products. In recent years, the market for alginates has come down due to import of superior quality of alginates from other countries with high

viscosity and reasonable rates. Because of this, a few algin industries have switched over from alginate production to Liquid Seaweed Fertilizer production.

Discussion

Studies on the growth, fruiting behaviour and effect of repeated harvesting on the growth and phycocolloid content revealed that the suitable period for collection of the agarophytes *Gelidiella acerosa*, *Gracilaria edulis* and *Gracilaria* spp and alginophytes *Sargassum* spp, *Turbinaria* spp and *Cystoseira trinodis* from the natural beds of Gulf of Mannar and Palk Bay in Tamil Nadu is from July /August to January every year when these algae grow to harvestable size. (Kaliaperumal and Kalimuthu, 1997). If commercial exploitation of seaweeds is done only during this period, there would not be depletion in the natural stock and the crop could be obtained consistently every year. Exploitation of seaweeds has to be made from the other maritime states of the mainland and also from Andaman – Nicobar and Lakshadweep islands to reduce the pressure of seaweed harvest in Tamil Nadu.

The demand for agar yielding seaweeds is more while the availability of raw

material from wild is less. The agarophytes are harvested indiscriminately and continuously from the natural seaweed beds. The quantity of alginophytes harvested every year since 1978 is based only on the need of the industries and the low quantity exploited during 2001 and 2002 (Table 4) is due to the less demand for alginates in the Indian market. The annual requirement of raw material for Indian agar industries is about 2000 tonnes (dry wt). The available agarophyte resources are inadequate to meet the demand of agar industries. Hence, commercial scale cultivation of agarophytes should be taken up immediately in order to augment the resource and uninterrupted supply of raw material to the industries. The large scale cultivation of agarophytes *Gelidiella acerosa*, *Gracilaria edulis* and *Gracilaria* spp could be done at the bays and creeks in the openshore along the east and west coast, lagoons of coral reefs in the southeast coast of Tamil Nadu, Andaman-Nicobar islands and atolls of Lakshadweep.

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Literature cited

- Kaladharan, P. and N. Kaliaperumal 1999. Seaweed industry in India – *ICLARM (NAGA)*, 22 : 11-14.
- Kaliaperumal,N. 1994. Seaweed resources of Tamil Nadu Coast. *Biology Education*, 11(4): 281-293.
- Kaliaperumal, N. and S. Kalimuthu 1997. Seaweed potential and its exploitation in India. *Seaweed Res. Utiln.*, 19(1&2):33-40.
- Kaliaperumal,N., V.S.K.Chennubhotla and S.Kalimuthu 1987. Seaweed resources of India: *CMFRI Bull.*, 41: 51-54.
- Kaliaperumal, N., S. Kalimuthu and J.R.Ramalingam 1995. Economically important seaweeds. *CMFRI Special Publ.*, 62: 1-36.
- Kaliaperumal, N., V. S. K. Chennubhotla, S.Kalimuthu, J.R.Ramalingam, S.Krishna pillai, K. Muniyandi, K. Rama Rao, P. C. Thomas, S. H. Zaidi and K.Subbaramaiah 1998. Seaweed resources and distribution in deep waters from Dhanushkodi to Kanyakumari, Tamilnadu. *Seaweed Res. Utiln.*, 20(1 & 2) : 141-151.
- Kalimuthu, S. and N. Kaliaperumal 1991. Unusual landings of agar yielding seaweed *Gracilaria edulis* in Kottaiappattinam – Chinamanai area. *Mar. Fish. Infor. Serv., T & E Ser.*, 108: 10-11.
- Kalimuthu, S. and N. Kaliaperumal 1994. Commercial exploitation of seaweeds in India and need for their large scale cultivation. *Proc. Natl. Symp. on Aquaculture for 2000 AD*. Palani Paramount Publications, Palani. pp. 215-219.
- Kalimuthu, S., N. Kaliaperumal and J.R.Ramalingam 1990. Present status of seaweed exploitation and seaweed industry in India. *Mar. Fish. Infor. Serv. T & E Ser.*, 103: 7-8.
- Kalimuthu, S., N. Kaliaperumal and J.R.Ramalingam 1995. Distribution of algae and seagrasses in the estuaries and backwaters of Tamil Nadu and Pondicherry. *Seaweed Res. Utiln.*, 17 (1 & 2): 79-86.
- Ramalingam, J.R., N. Kaliaperumal and S.Kalimuthu 2000. Seaweed exploitation in India: *Seaweed Res. Utiln.*, 22 (1 & 2): 75-80.
- Silas, E. G. and S. Kalimuthu 1987. Commercial exploitation of seaweeds in India. *CMFRI Bull.*, 41: 55-59.