

Seaweed exploitation in India

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ABSTRACT

Data on the quantity of seaweeds harvested from the natural seaweed beds of Tamil Nadu coast were collected at monthly intervals from different landing centres for a period of 4 years from 1996 to 1999. During this period, the quantity of agar yielding seaweeds viz. *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa* and *G. foliifera* varied from 746 to 1296 tonnes (dry wt) and that of algin yielding seaweeds *Sargassum* spp., *Turbinaria* spp. and *Cystoseira trinodis* varied from 1884 to 3817 tonnes (dry wt) per year. From the data on collection of seaweeds from the Gulf of Mannar and Palk Bay, commercial harvest is suggested only during their peak growth period from July / August to January every year. The harvest of commercially important seaweeds in a rational way from other parts of the Indian coast and also from Lakshadweep and Andaman - Nicobar islands is recommended. The necessity for starting large scale cultivation of seaweeds particularly agarophytes is also emphasised for successful running of Indian seaweed industries.

Introduction

Seaweeds are important renewable resources found in sea, estuaries and backwaters. They are the only source for the production of phytochemicals namely agar, agarose, carrageenan and algin. In India, seaweeds are mainly used for the commercial production of agar, alginates and also liquid seaweed fertilizer. Thus the seaweed industries offer employment to hundreds of people living in the coastal areas.

The commercial exploitation of seaweeds is going on in India since 1966 (Silas and Kalimuthu, 1987). Detailed account on the distribution, potential areas for commercial exploitation of seaweeds, their

standing crop in different maritime states of India and the seaweed resources in estuaries and backwaters of Tamil Nadu and Pondichery was given by Kaliaperumal *et al.* (1995), Kaliaperumal *et al.* (1987), Kaliaperumal and Kalimuthu (1997) and Kalimuthu *et al.* (1995). However, the need for commercial cultivation of agar yielding red algae was also stressed by Kalimuthu and Kaliaperumal (1996) due to the increasing utilisation of agar. Knowledge on the availability and exploitation of seaweeds in the previous years will help for the rational exploitation and for the sustainable utilisation in the future. Information on the total quantity of agarophytes viz. *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa* and *G. foliifera*

and the alginophytes viz. *Sargassum* spp., *Turbinaria* spp. and *Cystoseira trinodis* is also available (Kalimuthu *et al.*, 1990; Kalimuthu and Kaliaperumal, 1996; Kaliaperumal and Kalimuthu, 1997). Data collected on the quantity of seaweeds exploited from the natural seaweed beds of Tamilnadu coast during the period 1996 to 1999 are presented in this paper to fulfill the existing gap and to give guidelines for the suitable utilisation of these renewable resources.

Seaweed Industry in India

A status report of the Indian seaweed industry was given by Kaladharan and Kaliaperumal (1999). The over exploitation of agar yielding seaweeds has led to the scarcity of raw material to agar industries. To overcome the paucity of raw material *Gracilaria edulis* for agar production, *Gracilaria crassa* and *G. foliifera* from Mandapam area and *Gracilaria* sp. from Kattumavadi area in Palk Bay are harvested since 1990 (Kalimuthu and Kaliaperumal, 1991).

Agar is produced in the forms of mats, shreads and powder. The bacteriological grade agar with a gel strength of 600 g/cm² is manufactured from the red alga *Gelidiella acerosa*. *Gracilaria edulis* and other *Gracilaria* spp. yield food grade agar with a gel strength range of 120 to 150 g/cm².

The annual production of agar in India ranges from 110 to 132 tonnes utilising about 880 to 1100 tonnes of dry agarophytes. The present cost of 1 tonne of raw material varies from Rs. 12000 to 15000 for *Gelidiella acerosa* and Rs. 4000 to 5000 for *Gracilaria edulis* and other *Gracilaria* spp. The market rate of agar ranges from Rs. 200 to 300 per kg for food grade and Rs. 450 to 600 per kg for bacteriological grade depending on the quality.

At present, resource of alginophytes is

quite adequate. The brown algae viz. *Sargassum* spp. and *Turbinaria* spp. are mainly used for the production of alginates in India. Alternately trials were made using *Cystoseira trinodis* during 1996-1998. *Sargassum* spp. are preferred over *Turbinaria* spp. since the yield and quality of alginates are high in the former. The total annual production of alginates in India ranges from 360 to 540 tonnes utilising 3600 to 5400 tonnes of dry alginophytes. Alginates are produced either as granules or powder and marketed at the rate of Rs. 100 to 150 depending on their quality.

Observations

The species of seaweeds harvested in Tamilnadu coast during the period from 1996 to 1999 and their major landing centres are given in Fig. 1 and Table 1. Data collected at monthly intervals on the seaweeds landed at different landing centres of Tamilnadu coast showed that the quantity of agar yielding seaweeds (*Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa* and *G. foliifera*) exploited from the natural seaweed beds of Tamilnadu varied from 746 to 1296 tonnes (dry wt) (Table 2 and 4). The quantity of algin yielding seaweeds (*Sargassum* spp. *Turbinaria* spp. and *Cystoseira trinodis*) varied from 1884 to 3817 tonnes (dry wt) (Table 3 and 4). The total quantity of all these seaweeds exploited in a year varied from 2780 to 5113 tonnes (dry wt) (Table 4). A minimum quantity of 51 tonnes of seaweeds and maximum quantity of 4278 tonnes (dry wt) of seaweeds were landed at Valinokkam and Kilakkarai respectively (Table 5).

Discussion

A time-table for the commercial harvest of economically important seaweeds from the natural beds of the Gulf of Mannar and Palk Bay in Tamilnadu was proposed by Kaliaperumal and Kalimuthu (1997) based on

Table 1. Seaweed species harvested along the Tamilnadu coast during 1996-1999 and their major landing centres

Species	Landing centres
AGAR YIELDING SEAWEEDS	
<i>Gelidiella acerosa</i>	Kilakkarai, Pamban, Rameswaram
<i>Gracilaria edulis</i>	Vedalai, Mandapam, Pamban, Kattumavadi area
<i>G. foliifera</i>	Mandapam
<i>G. crassa</i>	Kilakkarai
ALGIN YIELDING SEAWEEDS	
<i>Sargassum spp.</i>	Kilakkarai, Periapattanam, Seeniappa Darga, Kanyakumari area
<i>Turbinaria spp.</i>	Kilakkarai, Vedalai, Rameswaram
<i>Cystoseira trinodis</i>	Vedalai, Ervadi

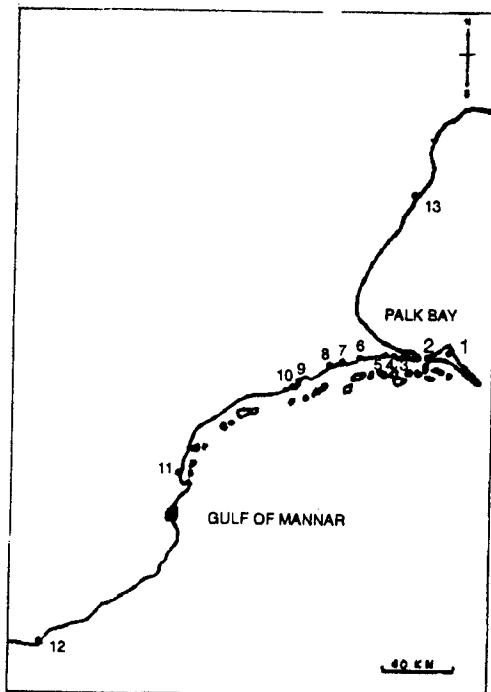


Fig. 1. Map showing the major seaweed landing centres along Tamilnadu coast.

1. Rameswaram
2. Pamban
3. Mandapam
4. Vedalai
5. Seeniappa Darga
6. Periapattanam
7. Kilakkarai
8. Ervadi
9. Valinokkam
10. Mundal
11. Tharavaikulam
12. Kanyakumari area
13. Kattumavadi area

the studies made on the growth fruiting behaviour and effect of repeated harvesting on the growth and phycocolloid content. According to this time-table, the suitable period for collection of the agarophytes *Gelidiella acerosa*, *Gracilaria edulis* and *Gracilaria spp.* and alginophytes *Sargassum spp.*, *Turbinaria spp.* and *Cystoseira trinodis* is from July / August to January every year when these algae grow to harvestable size. If this time-table is strictly followed for the commercial harvest of seaweeds, there will not be any depletion in the natural stock of seaweeds in Tamilnadu coast and the crop could be obtained consistently every year. In addition to this, exploitation of seaweeds has to be made from other seaweed growing areas including Andaman-Nicobar and Lakshadweep.

There is much demand for the agar yielding seaweeds because of the steady and good market for agar and increase in the number of agar units every year. But the available raw material from the wild is less. Even with maximum effort, the quantity of agar yielding seaweeds harvested is limited due to continuous and indiscriminate exploitation from the natural seaweed beds.

Table 2. Landings of agarophytes (dry wt. in tonnes) from different landing centres of Tamilnadu during 1996 - 1999.

Name of the landing centre	<i>Gelidiella acerosa</i>				<i>Gracilaria edulis</i>				<i>Gracilaria foliifera</i>				<i>Gracilaria crassa</i>				Total
	96	97	98	99	96	97	98	99	96	97	98	99	96	97	98	99	
1. Rameswaram	43	69	28	42	10	2	10	18	-	-	-	-	-	-	-	-	222
2. Pamban	58	79	90	39	20	36	48	48	3	-	-	-	-	-	-	-	421
3. Mandapam	-	-	-	-	40	-	134	95	17	-	-	-	-	-	-	-	286
4. Vedalai	5	13	14	2	79	70	195	116	-	-	-	-	-	-	-	-	494
5. Seeniappa Darga	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	15
6. Periapattanam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. Kilakkarai	114	165	126	214	2	9	34	94	-	-	-	-	-	-	-	35	793
8. Ervadi	15	75	56	53	-	-	5	-	-	-	-	-	-	-	-	-	204
9. Valinokkam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. Mundal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. Tharavaikulam	45	22	8	-	-	-	-	-	-	-	-	-	-	-	-	-	75
12. Kanyakumari area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13. Kattumavadi area	-	-	-	-	450	206	548	125	-	-	-	-	-	-	-	-	1329
Total	280	423	322	365	601	323	974	496	20	-	-	-	-	-	-	35	3839

Table 3. Landings of alginophytes (dry wt. in tonnes) from different landing centres of Tamilnadu during 1996 - 1999.

Name of the landing centre	<i>Sargassum</i> spp.				<i>Turbinaria</i> spp.				<i>Cystoseira trinodis</i>				Total
	96	97	98	99	96	97	98	99	96	97	98	99	
1. Rameswaram	30	103	23	13	49	73	16	20	-	-	-	-	327
2. Pamban	119	121	15	-	-	-	11	-	-	-	-	-	266
3. Mandapam	42	16	35	8	-	12	12	-	-	-	-	-	125
4. Vedalai	486	853	670	115	36	63	50	15	35	-	94	-	2417
5. Seeniappa Darga	577	217	751	303	5	-	-	-	-	-	-	-	1853
6. Periapattanam	213	296	819	190	-	10	-	-	-	-	-	-	1528
7. Kilakkarai	481	1010	714	695	117	168	155	145	-	-	-	-	3485
8. Ervadi	7	205	261	40	50	10	-	-	26	-	-	-	599
9. Valinokkam	-	11	-	40	-	-	-	-	-	-	-	-	51
10. Mundal	55	-	-	-	-	-	-	-	-	-	-	-	55
11. Tharavaikulam	38	-	-	-	-	-	-	-	-	-	-	-	38
12. Kanyakumari area	250	90	191	300	-	-	-	-	-	-	-	-	831
13. Kattumavadi area	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2298	2922	3479	1704	257	336	244	180	61	-	94	-	11575

Table 4. Quantity of seaweeds harvested from Tamilnadu coast during 1996 - 1999.

Year	Agar yielding seaweeds					Algin yielding seaweeds				Grand Total
	<i>Gelidiella acerosa</i>	<i>Gracilaria edulis</i>	<i>Gracilaria foliifera</i>	<i>Gracilaria crassa</i>	Total	<i>Sargassum</i> spp	<i>Turbinaria</i> spp	<i>Cystoseira trinodis</i>	Total	
1996	280	601	20	-	901	2298	257	61	2616	3517
1997	423	323	-	-	746	2922	336	-	3258	4004
1998	322	974	-	-	1296	3479	244	94	3817	5113
1999	365	496	-	35	896	1704	180	-	1884	2780
Total	1390	2394	20	35	3839	10403	1017	155	11575	15414

Table 5. Total quantity of seaweeds landed at different landing centres of Tamilnadu during 1996-1999.

Name of the seaweed landing centre	Quantity of seaweeds landed (dry wt in tonnes)
Rameswaram	549
Pamban	687
Mandapam	411
Vedalai	2911
Seeniappa Darga	1868
Periapattanam	1528
Kilakkarai	4278
Ervadi	803
Valinokkam	51
Mundal	55
Tharavaikulam	113
Kanyakumari area	831
Kattumavadi area	1329

The quantity of agarophytes (dry wt) landed in a year varied from 248 to 1289 tonnes during 1978 - 1991, from 447 to 761 tonnes during 1992 - 1995 and from 746 to 1296 tonnes during 1996 - 1999. A comparison of these data clearly shows the pressure on the exploitation of natural stock of these red algae. The quantity of alginophytes harvested every year since 1978 is based only on the need of the industries and the low quantity

exploited during 1996-1999 is due to the lesser demand for Indian alginates in the market.

The annual requirements of raw material for Indian seaweed industries is about 2000 tonnes (dry wt) of agarophytes and 12,000 tonnes (dry wt) of alginophytes. The available resource of agarophytes is inadequate to meet the demand of agar industries. Hence there is an immediate need to start commercial scale cultivation of agarophytes in order to augment the supply of raw material to the Indian agar industries for their successful running throughout the year. The large scale cultivation of the agarophytes *Gelidiella acerosa*, *Gracilaria edulis* and *Gracilaria* spp. could be taken up in the lagoons of Gulf of Mannar islands, Lakshadweep and Andaman-Nicobar islands and in the bays and calm areas of the east and west coast of India.

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Literature cited

- Kaladharan, P. and N. Kaliaperumal 1999. Seaweed industry in India. ICLARM (NAGA), 22 (1) : 11-14.
- 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.
- Kalimuthu, S. and N. Kaliaperumal 1991. Unusual landings of agar yielding seaweed *Gracilaria edulis* in Kottaipattinam-Chinamanai area. *Mar. Fish. Infor. Serv. T & E Ser.*, 108 : 10-11.
- Kalimuthu, S. and N. Kaliaperumal 1996. 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 Tamilnadu and Pondichery. *Seaweed Res. Utiln.*, 17 (1 & 2) : 79-86.
- Silas, E. G. and S. Kalimuthu 1987. Commercial exploitation of seaweeds in India. *CMFRI Bull.*, 41 : 55-59.