

GOLDEN JUBILEE CELEBRATIONS

Souvenir

2000

**Issued at the National Symposium on
Eco - Friendly Mariculture Technology
Packages - An Update, held at
Mandapam Camp, 25 - 26 April 2000
to mark the Golden Jubilee Celebration of
Staff Recreation Clubs**

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Seaweed exploitation and Industry in India

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Since the inception of Central Marine Fisheries Research Institute at Mandapam in 1947, research on seaweeds and their utilisation is being carried out. Later on research on Indian seaweeds was started by Central Salt & Marine Chemicals Research Institute, Bhavnagar, National Institute of Oceanography, Goa and some State Government Fisheries Departments. In addition Universities of Madras, Annamalai, Andhra and Kerala have also started investigations on various aspects of seaweeds and seagrasses. These studies made by various organisations have contributed to the development of agar and algin industries in India.

Seaweeds are the only source for the production of phytochemicals such as agar, carrageenan and algin which are widely used as human food, animal feed and manure. Seaweeds grow submerged in intertidal, shallow and deepwaters upto 180 m depth in the sea and also in estuaries and backwaters. Seaweeds grow abundantly along Tamil Nadu and Gujarat coast and in Lakshadweep and Andaman-Nicobar archipelagos. There are also rich seaweed beds around Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam and Visakhapatnam coast and in the Ashtamudi, Pulicat and Chilka Lakes.

In India seaweeds are exploited commercially from Tamilnadu coast since 1966 and they were exported to foreign countries till 1970. After agar and algin industries were started in the country in 1970, the export of seaweeds was banned. During the last five years some quantity of *Gracilaria verrucosa* collected from Chilka lake was exported to Japan. At present the seaweeds harvested from the natu-

ral seaweed beds of Tamil Nadu coast are used only for the manufacture of agar, alginates and liquid seaweed fertilizer. The red algae *Gelidium acerosa*, *Gracilaria edulis*, *G.crassa* and *G.foliifera* are used for extracting agar and *Sargassum* spp *Turbinaria* spp and *Cystoseira trinodis* are used for alginates. There are 22 units producing agar and 18 units producing alginates. Most of them are small scale industries without much sophisticated machineries.

The commercial exploitation of seaweeds is concentrated for several years only along south Tamilnadu coast from Rameswaram to Kanyakumari. The natural resources of algin yielding seaweeds *Sargassum* and *Turbinaria* in Tamilnadu coast are adequate. At present only about 50% of these plants is harvested. The agarophytes *Gelidium acerosa* and *Gracilaria edulis* are not available in sufficient quantities to meet the raw material requirement of the agar industries. Hence other species of *Gracilaria* such as *G.foliifera* and *G.crassa* are harvested for agar production whenever there is scarcity for *G.edulis*. This paucity of *G.edulis* came to an end after the collection of free floating *G.edulis* from Kottaipattanam - Chinnamanai area in the Palk Bay side since 1990.

Data collected by the Central Marine Fisheries Research Institute during the last 22 years from 1978 to 1999 show that the quantity of agarophytes harvested ranged from 248 to 1296 tonnes (dry wt) and alginophytes from 651 to 5537 tonnes (dry wt) in a year. An average of 50 tons of agar and 500 tons of alginates are produced annually in India and some quantity of agar and alginates is exported to foreign countries such as Malaysia, Singa-

pore, U.A.E. and Saudi Arabia. The present marketing rate for food grade agar is Rs.200 to 250/- and for B.G. grade agar is Rs.500 to 600/kg. The cost of Sodium alginate is Rs.100 to 150 per kg. The rate for the raw material of *Geldiella acerosa* is Rs.12,000, *Gracilaria* spp Rs.4000 and for *Sargassum* spp. *Turbinaria* spp and *Cystoseira trinodis* is 2500 per tonne (dry wt)

As the demand for agar is increasing and new units are being set up, exploitation of agarophytes will increase. The existing agar manufacturers can take up carrageenan production also using *Hypnea* spp as raw material or by using imported *Eucheuma* and *Kappaphycus*. The agar, algin and carrageenan yielding seaweeds growing in harvestable quantities in other parts of Indian coast, Lakshadweep and Andaman-Nicobar islands (Table 1) may be exploited during their maximum growth periods.

Based on the studies made by the Central Marine Fisheries Research Institute on the growth, fruiting behaviour, effect of repeated harvesting on the growth and phycocolloid contents of agar, algin and carrageenan yielding seaweeds of Tamil Nadu, a time-table for commercial harvest of these seaweeds is given in Table 2. In order to conserve the natural stock of economically important seaweeds of Tamilnadu coast and also to get consistent crop every year, the seaweed harvestors should follow this time-table. This will ensure regeneration and regrowth of seaweeds by vegetative and reproductive growth to harvestable size plants in the next harvesting season by means of giving sufficient interval between one harvest and the other. A single harvest in a year is recommended for all species. However the harvest may be done twice in a year during the periods indicated in Table 2 for *Geldiella acerosa* and *Gracilaria* spp in areas with rich growth of these algae.

Cultivation of agar yielding seaweeds could form additional source for supply of

raw materials to Indian agar industries. The CMFRI has developed viable technology for the commercial scale cultivation of agar yielding seaweed *Gracilaria edulis* using coir rope net method and Central Salt & Marine Chemicals Research Institute for *Geldiella acerosa* using coral stone method. The bays and creeks present in the open shore along the east and west coast, lagoons of coral reefs in the southeast coast of Tamilnadu, Andaman-Nicobar islands and atolls of Lakshadweep have immense potential for cultivation of seaweeds. The commercial scale cultivation of seaweeds may be undertaken in these areas by the seaweed utilisers and private entrepreneurs by availing the financial assistance from banks and other funding agencies connected with rural development programmes. Seaweed cultivation on large scale could not only augment supply of raw material to the seaweed industries, but it would also provide employment to the people living in the coastal areas of mainland, Lakshadweep and Andaman-Nicobar Islands. This would help in improving their economic status and thus help in rural upliftment.

Table 1. Occurrence of agar, carrageenan and algin yielding seaweeds in other parts of Indian Coast

Name of the seaweed	Place of occurrence
Agarophytes	
<i>Geldiella acerosa</i>	Okha, Dwarka, Porbandar, Diu, Veraval, Lakshadweep and Andaman-Nicobar
<i>Gracilaria edulis</i>	Lakshadweep and Andaman-Nicobar
<i>G.crassa</i>	Andaman-Nicobar

<i>G.corticata</i> var <i>corticata</i>	Dwaraka, Bombay Karwar, Goa, Tikkoti Quilon, Varkala, Vizhinjam. Visakhapatnam and Andaman - Nicobar.	<i>S.cinereum</i> var <i>berberifolia</i>	Gulf of Kutch, Bombay, Goa, Karwar and Vishinjam.
<i>G.foliifera</i>	Gopnath, Okha, Bombay, Tikkoti and Andaman-Nicobar	<i>S.johnstonii</i>	Okha
<i>G.verrucosa</i>	Okha, Bombay, Goa, Chilka and Andaman- Nicobar	<i>S.vulgare</i>	Dwaraka, Okha and Visakhapatnam
Alginophytes		<i>S.duplicatum</i>	Lakshadweep and Andaman-Nicobar
<i>Sargassum wightii</i>	Bombay, Goa, Alleppey, Vizhinjam and Andaman-Nicobar	<i>T.ornata</i>	Dwarka, Lakshadweep and Andaman-Nicobar
<i>S.tenerrimum</i>	Gulf of Kutch, Okha, Dwaraka, Bombay, Goa, Karwar, Visakhapatnam and Andaman-Nicobar	<i>T.decurrens</i>	Andaman-Nicobar
<i>S.myriocystum</i>	Andaman-Nicobar	<i>Cystoseira trinodis</i>	Okha and Andaman- Nicobar
<i>S.ilicifolium</i>	Bombay, Goa, Karwar, Visakhapatnam and Andaman-Nicobar	<i>Hormophysa</i> <i>triquetra</i>	Okha and Andaman- Nicobar
		Carrageenophytes	
		<i>Hypnea musciformis</i>	Gopnath, Okha, Dwarka, Bombay, Goa, Karwar, Visakhapatnam, Lakshadweep and Andaman-Nicobar
		<i>H.valentiae</i>	Bombay, Tikkoti, Vizhinjam and Lakshadweep

Table 2. Time-Table for commercial harvest of economically important seaweeds from Tamil Nadu Coast

Name of the seaweed	Period of Occurrence	Suitable period for harvest
Agarophytes		
<i>Gelidiella acerosa</i>	Throughout the year	January to May July to September
<i>Gracilaria edulis</i>	-do-	January to March & August to September
<i>G.crassa</i>	-do-	-do-
<i>G.foliifera</i>	-do-	-do-
<i>G.corticata</i> var. <i>corticata</i>	-do-	June to August November to December

<i>G. verrucosa</i>	March to November	May to August
Alginophytes		
<i>Sargassum wightii</i>	Through out the year	October to-December
<i>S. myriocystum</i>	-do-	May to August
<i>S. ilicifolium</i>	-do-	July to September
<i>Turbinaria conoides</i>	-do-	October to December
<i>T. ornata</i>	-do-	-do-
<i>T. decurrens</i>	-do-	December - January
Carrageenophytes		
<i>Hypnea musciformis</i>	-do-	December to March
<i>H. valentiae</i>	-do-	January to March
