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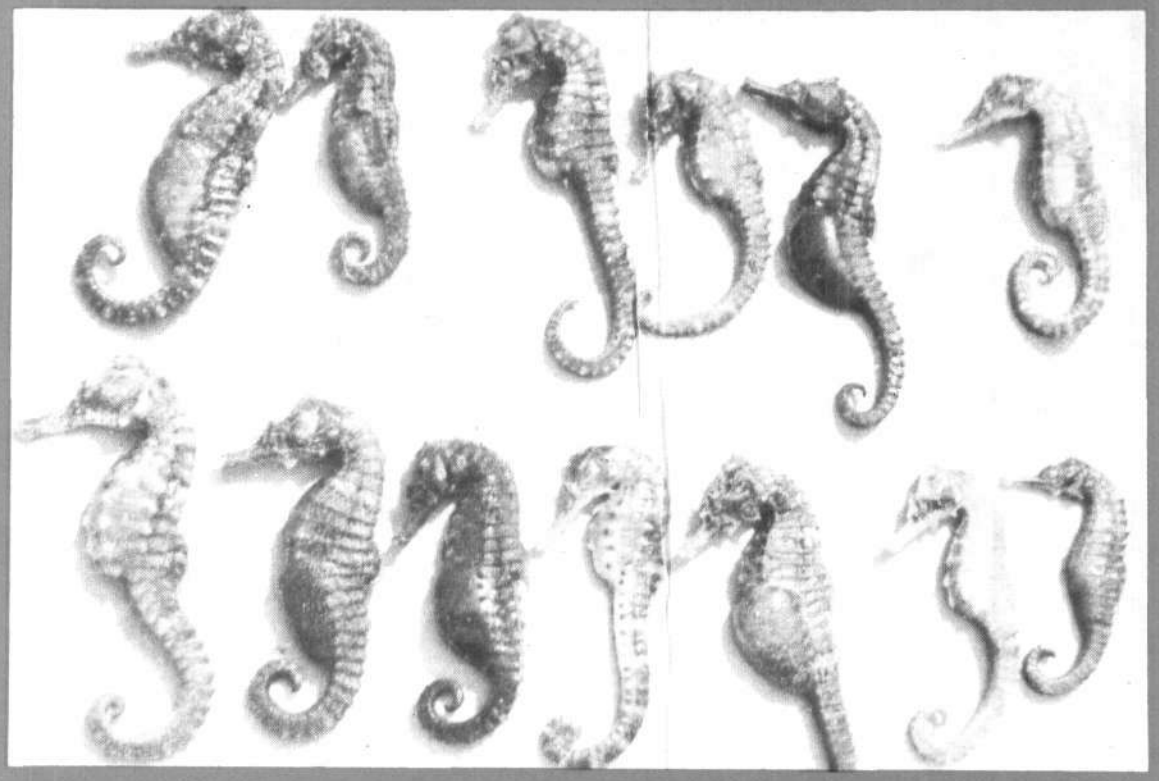

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NEED FOR CONSERVATION OF ECONOMICALLY IMPORTANT SEAWEEDS OF TAMIL NADU COAST AND TIME-TABLE FOR THEIR COMMERCIAL EXPLOITATION

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Seaweeds or marine algae are primitive plants and they constitute one of the commercially important marine living resources. They grow in the littoral and sublittoral region upto 20 or 25 m depth in the sea and also in the estuaries and backwater areas. They belong to four groups namely green, brown, red and blue-green algae based on the kind of pigments present in them and their morphological and anatomical characters.

The phytochemicals such as agar, carrageenan and sodium alginate are extracted from the seaweeds and they are used as gelling, stabilizing and thickening agents in food, confectionary, pharmaceutical, dairy, textile, paper, paint and varnish industries. Many protein-rich seaweeds such as *Ulva*, *Enteromorpha*, *Caulerpa*, *Codium* and *Monostroma* (green algae); *Sargassum*, *Hydroclathrus*, *Laminaria*, *Undaria*, *Macrocystis* (brown algae); *Porphyra*, *Gracilaria*, *Eucheuma*, *Laurencia* and *Acanthophora* (red algae) are used for human consumption in the form of soup, salad, curry etc. Jelly, jam, chocolate, pickle and wafer can be prepared from certain seaweeds. Marine algae are also utilised in different parts of the world as animal feed and fertilizer for land crops as they contain more than 60 trace elements, carbohydrate, iodine, bromine, vitamin and certain antibiotic substances.

About 700 species of marine algae have been reported along the east and west coasts of India (from the centres indicated in Fig. 1 and 2), Lakshadweep and Andaman-Nicobar. From the seaweed resources survey carried out by the Central Marine Fisheries Research Institute and other research organisations in different parts of Indian coast, it is estimated that the total standing crop of all seaweeds in Indian waters is more than one lakh tonnes (wet wt.) consisting of 6,000 tonnes (wet wt.) of agar yielding seaweeds and 16,000 tonnes (wet wt.) of algin yielding seaweeds.

The important and commonly occurring agarophytes in different localities of Indian coast are *Gelidiella acerosa*, *Gelidiella* spp, *Gracilaria* spp, *Gelidium* spp. and *Pterocladia heteroplatos*. Among the red algae, only *Gelidiella acerosa*, *Gracilaria edulis*, *G. corticata* var. *corticata*, *G. foliifera* and *G. verrucosa* are available in exploitable quantities. Species of *Sargassum*, *Turbinaria*, *Cystoseira*, *Hormophysa*, *Spatoglossum*, *Rosenvingea*, *Chnoospora* are the important algin yielding seaweeds of Indian waters. Among the brown algae, *Sargassum*, *Turbinaria*, *Cysto-*

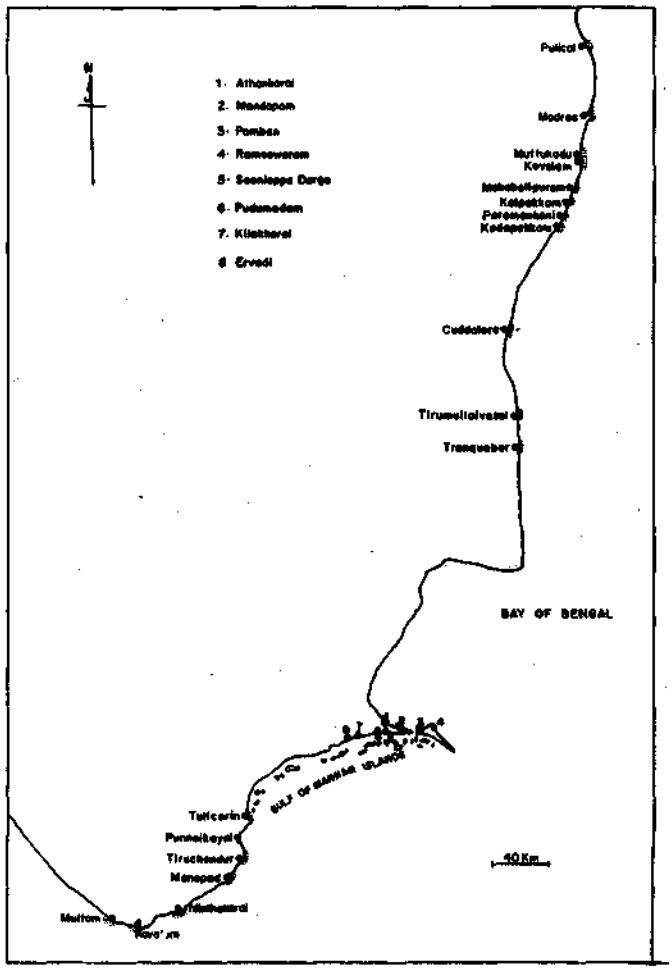

Fig. 1. Places along the south east coast of India where seaweed resources are available for exploitation.

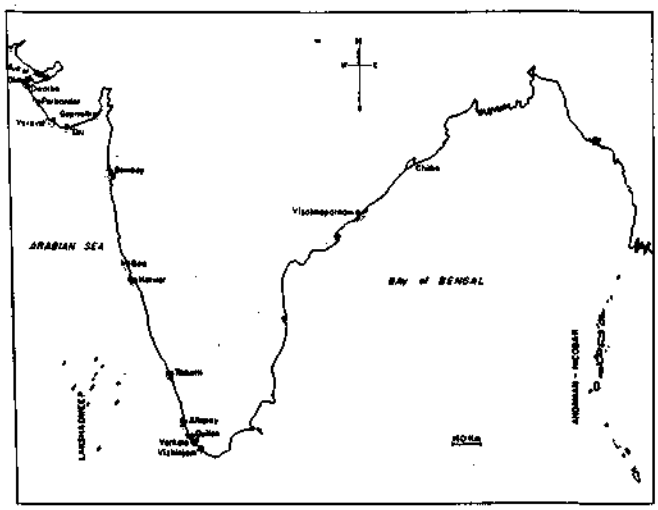

Fig. 2. Centres along the west coast and north east coast where seweed is available.

setra and *Hormophysa* grow in harvestable quantities. The carrageenan yielding red alga *Hypnea* also occurs in exploitable quantity at various parts of the coastline.

At present in India, the seaweeds are used as raw material only for the production of agar and sodium alginate. There are about 25 actively functioning agar and algin industries situated at different places in the maritime states of Tamil Nadu, Kerala, Andhra Pradesh, Karnataka and Gujarat. Now the red algae *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa*, *G. foliifera* and *G. verrucosa* are used for agar manufacture and

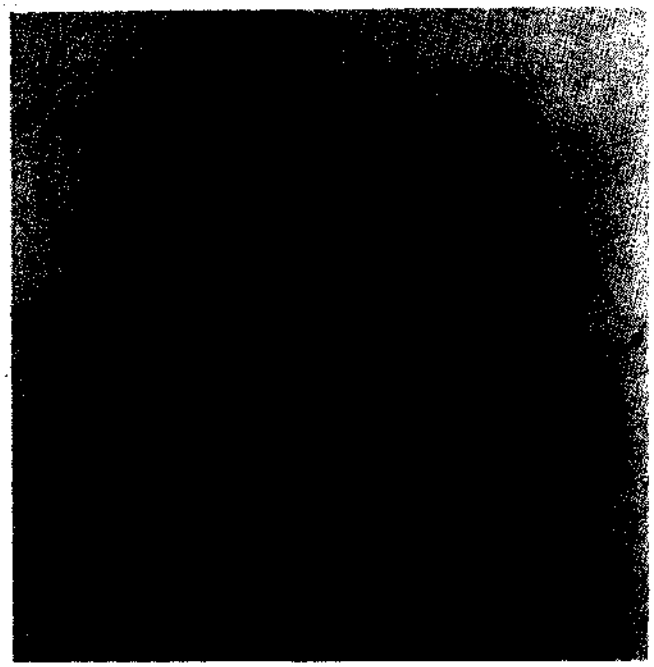

Fig. 3. *Gelidiella acerosa.*

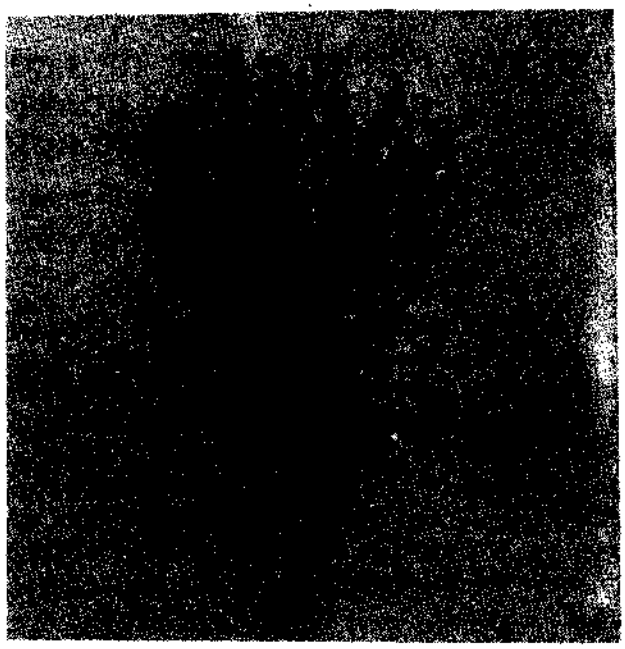

Fig. 4. *Gracilaria edulis.*

brown algae *Sargassum wightii*, *S. ilicifolium*, *S. myriocystum*, *Turbinaria conoides*, *T. ornata* and *T. decurrens* for sodium alginate. All these seaweeds are harvested since 1966 only from the natural seaweed beds occuring in the southern Tamil Nadu coast from Rameswaram to Kanyakumari (Fig. 1). The data collected by the CMFRI on the seaweed landings of Tamil Nadu for 13 years from 1978 to 1990 show that the

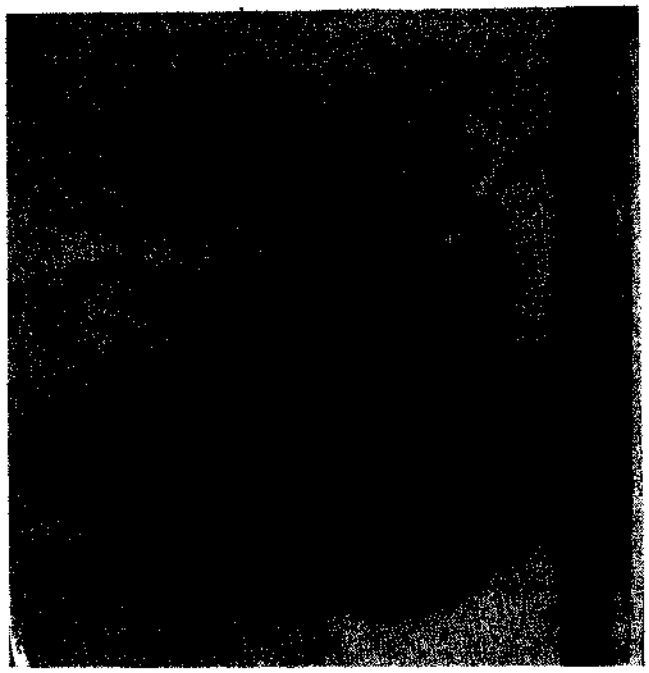

Fig. 5. *Gracilaria crassa.*

Fig. 6. *Gracilaria foliifera.*

Fig. 8. *Hypnea musciformis.*

quantity of agarophytes landed ranged from 248 to 883 tonnes (dry wt.) and alginophytes from 651 to 5537 tonnes (dry wt.) depending on the availability of seaweeds in the natural beds and raw material requirements from the seaweed industries.

Since 1980, many agar and algin manufacturing seaweed industries are coming up in India. As the demand for raw material of agar yielding seaweeds is more and their natural resources are less, the agarophytes *Gelidiella acerosa* and *Gracilaria edulis* are being over exploited. Because of the extensive and unrestricted commercial harvest of these seaweeds throughout the year, there is depletion in the stock of these red algae from the natural beds in Mandapam area during recent years. So it is necessary to

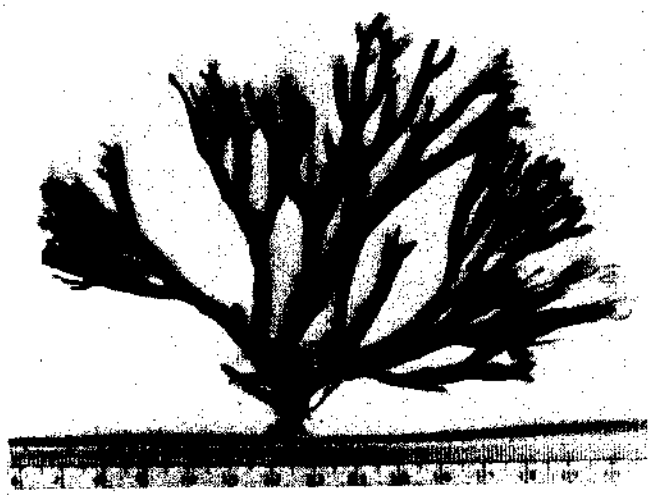

Fig. 7. *Gracilaria corticata.*

Fig. 9. *Sargassum wightii.*

Fig. 10. *Sargassum ilicifolium.*

conserve the natural stock of these two agar yielding seaweeds by adopting rational way of commercial exploitation. The natural resources of algin yielding seaweeds *Sargassum* and *Turninaria* in Tamil Nadu coast are adequate. As at present only about 50% of the standing crop of these plants is utilised, there is no paucity of raw material for algin production.

In order to conserve the natural stock of the commercially important agar and algin yielding seaweeds of Tamil Nadu coast and also to get consistant crop year after year, the seaweed collectors have to follow a suitable time-table as given in Table 1 for commercial exploitation of these seaweeds. This will ensure the regeneration and regrowth of the seaweeds by vegetative and reproductive growth to harvestable size plants for the next harvesting season by means of giving sufficient interval between successive harvests. A single harvest in a year is recommended for some years for *Gelidiella acerosa* and *Gracilaria* spp. However, in areas where there are rich growth of these seaweeds, harvesting may be practised twice in a year as given in Table 1. The resources of *G. corticata* var. *corticata* is available in exploitable quantity and it is wasted without any utilisation. Hence this red alga may also be harvested and used along with *Gelidiella acerosa* and other *Gracilaria* species. Similarly *Gracilaria verrucosa* occurring abundantly in the estuaries and backwaters of Madras, Chengai-MGR, South Arcot, Tanjore and Ramnad districts may be harvested during its peak growth period and utilised for agar manufacture.

From the studies made by the CMFRI on the ecology, biology, chemistry and effect of repeated harvesting on the growth of commercially important seaweeds of Mandapam area, it is evident that the plants of *Sargassum* and *Turbinaria* harvested during their peak growth period, generally from October to December/January, give maximum yield of sodium alginate with high

Fig. 11. *Sargassum myriocystum.*

TABLE 1. Time-table for commercial harvest of economically important seaweeds from Tamil Nadu coast

Seaweed species	Places of occurrence	Period of occurrence	Peak growth period	Suitable period for harvest
Agarophytes				
Gelidiella acerosa	Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Seeniappa Darga, Pudumadam, Kilakkarai, Ervadi and Manapad	Throughout the year	January to March & July-Sept.	January-March & July-September
Gracilaria edulis	Gulf of Mannar islands, Rameswaram, Pamban and Mandapam	-do-	January to April & Aug.-Sept.	January-March & August-September
G. crassa	Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Seeniappa Darga, Kilakkarai	-do-	-do-	-do-
G. follifera	Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Tuticorin, Idinthakarai, Kovalam and Muttam	-do-	-do-	-do-
G. corticata var. *corticata*	Mandapam, Seeniappa Darga, Pudumadam, Kilakkarai, Tuticorin, Manapad, Idinthakarai, Madras (Kovalam) and Mahabalipuram	-do-	June-Sept. & Nov.-Dec.	June-August & November-Dec.
G. verrucosa	Pulicat, Madras (Muttukadu), Paramankeni, Kadapakkam, Cuddalore, Thirumullaivasal, Tranquebar, Athankarai, Mandapam, Rameswaram and Tuticorin (Puuakayal)	March to November	May-Aug.	May-Aug.
Alginophytes				
Sargassum wightii	Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Seeniappa Darga, Pudumadam, Kilakkarai, Ervadi, Tuticorin, Tiruchendur, Idinthakarai, Kovalam, Muttam and Madras	Throughout the year	Oct.-January	Oct.-Dec.
S. myriocystum	Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Pudumadam, Kilakkarai, Ervadi, Tuticorin, Manapad, Idinthakarai and Kovalam	-do-	May-Aug.	May-August
S. ilicifolium	Gulf of Mannar islands, Mandapam, Seeniappa Darga, Pudumadam, Tuticorin and Madras	-do-	July-Oct.	July-Sept.
Turbinaria conoides	Gulf of Mannar islands, Pamban, Mandapam, Kilakkarai, Ervadi, Manapad and Tuticorin	-do-	Oct.-Dec.	Oct.-Dec.
T. ornata	Gulf of Mannar islands, Pamban and Mandapam	-do-	Sept.-Dec.	Oct.-Dec.
T. decurrens	Gulf of Mannar islands, Pamban and Mandapam	-do-	Nov.-Feb.	Dec.-January
Carrageenophytes				
Hypnea musciformis	Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Seeniappa Darga, Kialkkarai, Ervadi and Tuticorin	-do-	Oct.-March	Dec.-March
H. valentiae	Pulicat, Kalpakkam, Kadapakkam, Gulf of Mannar islands, Rameswaram, Pamban, Mandapam, Seeniappa Darga, Pudumadam, Kilakkarai, Ervadi, Tuticorin, Manapad, Idinthakarai, Kovalam and Muttam	-do-	Nov.-April	January-March

Fig. 12. *Turbinaria conoides.*

viscosity. Hence the algin industries should collect *Sargassum wightii, Turbinaria conoides, T. ornata* and *T. decurrens* during October-December/January and *Sargassum myriocystum* and *S. ilicifolium* during May-September and keep them in stock for the rest of the year for sodium alginate production. In recent years many algin industries do not follow this procedure and they exploit the young plants of these species during the period May to August. This results not only in the low yield of sodium alginate with poor viscosity, but also in the depletion of stock of these seaweeds and denudation of seaweed beds. The carrageenan yielding red algae *Hypnea musciformis* and *H. valentiae* occur abundantly in the Gulf of Mannar islands, nearshore areas, estuaries and backwaters in different localities of Tamil Nadu coast (Table 1). This potential resource

Fig. 13. *Turbinaria ornata.*

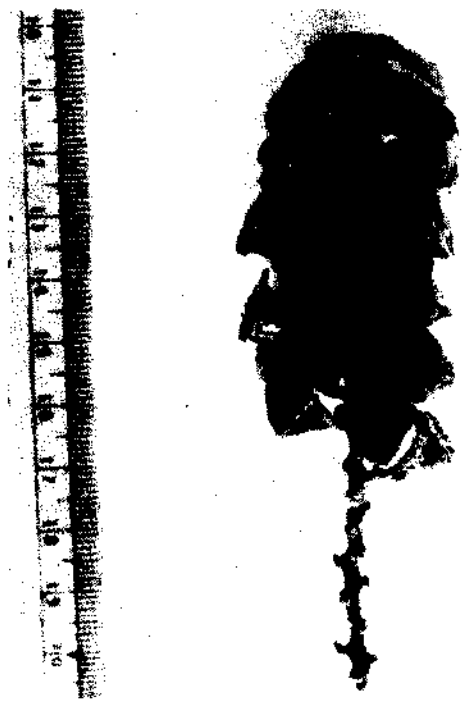

Fig. 14. *Turbinaria decurren*

TABLE 2. *Occurrence of agar, carrageenan and algin yielding seaweeds in other parts of Indian coast*

Seaweed	Places of occurrence
Agarophytes	
Gelidiella acerosa	Okha, Dwarka, Porbandar, Diu, Veraval, Lakshadweep and Andaman-Nicobar
Gracilaria edulis	Lakshadweep and Andaman-Nicobar
G. crassa	Andaman-Nicobar
G. corticata var. *corticata*	Dwarka, Bombay, Karwar, Goa, Tikkoti, Quilon, Varkala, Vizhinjam, Visakhapatnam and Andaman-Nicobar
G. foliifera	Gopnath, Okha, Bombay, Tikkoti and Andaman-Nicobar
G. verrucosa	Okha, Bombay, Goa, Chilka and Andaman-Nicobar
Alginophytes	
Sargassum wightii	Bombay, Goa, Alleppey, Vizhinjam and Andaman-Nicobar
S. tenerrimum	Gulf of Kutch, Okha, Dwarka, Bombay, Goa, Karwar, Visakhapatnam and Andaman-Nicobar
S. myriocystum	Andaman-Nicobar
S. ilicifolium	Bombay, Goa, Karwar, Visakhapatnam and Andaman-Nicobar
S. cinereum var. *berberifolia*	Gulf of Kutch, Bombay, Goa, Karwar and Vizhinjam
S. johnstonii	Okha
S. vulgare	Dwarka, Okha and Visakhapatnam
S. duplicatum	Lakshadweep and Andaman-Nicobar
Turbinaria conoides	Lakshadweep and Andaman-Nicobar
T. ornata	Dwarka, Lakshadweep and Andaman-Nicobar
T. decurrens	Andaman-Nicobar
Cystoseira trinodis	Okha, Dwarka and Bombay
Hormophysa triquetra	Okha and Andaman-Nicobar
Carrageenophytes	
Hypnea musciformis	Gopnath, Okha, Dwarka, Bombay, Goa, Karwar, Visakhapatnam, Lakshadweep and Andaman-Nicobar
H. valentiae	Bombay, Tikkoti, Vizhinjam and Lakshadweep

could be utilised for the production of carrageenan in our country.

Some precautions should be taken by the fishermen while collecting the seaweeds during the peak growth periods. The regeneration of the seaweeds continues as long as the basal remnants of the plants are intact with the substratum. Hence harvest should be made by pruning the plants leaving the basal part instead of removing the whole plants. The other seaweeds growing in the vicinity of harvesting species should not be removed. This will affect the ecosystem of the seaweed beds making it devoid of vegetation.

The commercial exploitation of seaweeds is concentrated for years together only along Tamil Nadu coast. The agar yielding seaweeds *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa*, *G. corticata* var. *corticata*, *G. foliifera* and *G. verrucosa* and algin yielding seaweeds *Sargassum* spp, *Turbinaria* spp, *Cystoseira trinodis* and *Hormophysa triquetra* occur in exploitable quantities at various parts of Indian coast other than Tamil Nadu and also in Lakshadweep and Andaman-Nicobar (Table 2). Attempts must be made by the seaweed based industries to exploit these seaweeds during the maximum growth periods from their places of occurrence in order to meet the raw material requirements and also to conserve the economically important seaweeds growing in Tamil Nadu coast.