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EXPLOITATION AND MANAGEMENT OF SEAWEED RESOURCES IN NORTHEAST BRAZIL*

MUTTUTAMBY DURAIRATNAM

Departmento de Oceanografia e Limnologia, Praia de Mae Luiza, Universidade Federal do Rio Grande do Norte, Natal-590 00, *RN, Brazil*

ABSTRACT

The northeastern coast of Brazil favours the growth of many algae including those producing agar, agarose, carragheens, alginates and mannitol. More than 300 species growing on corals, reefs, rocks and sand stones are widely distributed along this coast. The seaweeds of economic importance found in Northeast Brazil are listed in this paper. The export of raw materials in tropical countries consists of two principal types. One of the colloids produced is agar and the other carragheen. Species of *Hypnea* and *Solieria* produce caragheen and the raw material is exported to America and Europe. Species of *Gracilaria* produce agar. About twenty species of *Gracilaria* are found in Northeast Brazil. The raw material is mainly exported to Japan. Both agar and carragheen are produced by two companies, Brazil Agar from the State of Paraiba and C. Algas from the State of Sao Paulo. At present each company produces four tonnes of agar per month due to a shortage of raw materials. The raw material of *Gracilaria* and *Hypnea* are exported to Japan and America. It is estimated that about 1500 tonnes of raw material can be harvested annually. During the last ten years there has been a depletion of stock due to over exploitation. To prevent over exploitation and proper management of the resources the following steps should be taken to develop the seaweed industry.

1. Legislation should be passed that during the peak reproduction period harvesting should be on a reduced basis or completely avoided. 2. Raking of seaweeds over loose substrata or where seaweeds are attached to stones or pebbles should be avoided. 3. For proper management of the seaweed resources the gear used for harvesting must not scrape the substratum. 4. Ecological studies should be undertaken in the field and in the laboratory to determine the best period of harvesting. 5. Efforts should be made to prevent pollution in the areas of harvesting. 6. Carry out culture experiments on algae similar to that carried out in Taiwan. 7. Encouragement of community organisation of a seaweed production is needed.

INTRODUCTION

THE PAPER deals with the exploitation of seaweeds of economic importance especially those producing agar, carragheens, alginates in Northeast Brazil with special reference to the State of Rio Grande do Norte. Research carried out showed that there was an over exploitation of seaweeds producing agar and carragheens and it was necessary for proper management to preserve the stocks.

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HISTORICAL DEVELOPMENT

The littoral and sublittoral regions of the coast of Northeast Brazil has a reasonably good growth of marine algae producing agar,

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agarose, carragheens, alginates and mannitol. Hardly any research work on algae of economic importance has been carried out before 1970, except some algae of probable use in industry was given by Camara (1966). Pinheiro and Ferreira (1968) had given a list of seaweeds of industrial importance for Northeast Brazil. Durairatnam (1980) had described the Agar producing seaweeds and their distribution in Northeast Brazil. He carried out an extensive survey and made collections of agar and carragheen producing seaweeds from the States of Ceará, Rio Grande do Norte, Paraiba and Pernambuco during 1975 and 1976. The survey indicated that the seaweeds of economic importance were confined to shallow regions upto a depth of 5 m they were also found at a depth upto 10 m. They were found growing on coral beds on rocky substratum covered with sand or clay. About 40 stations were examined between Ceará and Pernambuco. Where wading was possible samples were taken by the quadrat method with a frame with sides 15 cm. It was placed on a coral bed and the enclosed algae collected. Where the bed prevented normal wading the frame was dropped and the seaweeds enclosed by the frame was collected by diving. The standard 1 m quadrat could not be used since it was not possible to make complete harvesting of the quadrat covered by a large quadrat. Therefore collections were made with a small quadrat using 5 frames in the same location and the average used for analysis. The stations fixed between stations in deeper areas was based on a fixed running time of the launch at regular speed. In shallow regions the distance fixed was arbitary. The available dried raw material of agar and carragheen producing seaweeds ranged from 600 to 2100 tonnes per year. The amount available year after year varied depending on ecological conditions as well as the amount harvested every year. Much depends on the rainy season, as *Gracilaria* grows best when the salinity is 25‰.

The agar producing seaweeds available in Northeast Brazil are :

RHODOPHYTA

Order Gelidiales

Gelidiaceae
Gelidium crinale (Turner) Lamouroux
G. pusillum (Stackhouse) Le Jollis
G. corneum (Hudson) Lamouroux
Gelidiella acerosa (Forsskal) Feldmann et Hamel
Pterocladia capillacea (Gmelin) Bornet et Thuret

Order Gigartinales

Gracilariaceae
Gracilaria verrucosa (Hudson) Papenfuss
G. sjoestedtii Kylin
G. edulis (Gmelin) Silva
G. debilis (Forsskal) Boergesen
G. ferox J. Agardh
G. cylindrica Boergesen
G. textorii (Suringer) J. Agardh
G. curtissiae J. Agardh
G. folilifera (Forsskal) Boergesen
G. mammillaria (Montagne) Howe
G. corticata J. Agardh
G. cuneata Areschoug
G. cervicornis (Turner) J. Agardh
G. ornata Areschoug
G. bursapastoris (Gmelin) Silva
G. blodgetii Harvey
G. cearensis Joly et Piheiro
G. venezuelensis Taylor
G. millardetii (Montagne) J. Agardh

Order Ceramiales

Rhodomelaceae
Amansia multifida Lamouroux
Bryothamnion seaforthii (Turner) Kuetzing
B. triquetrum (Gmelin) Howe
Vidalia obtusiloba (Mertens) J. Agardh
Digenia simplex (Wulfen) C. Agardh

The Carragheen producing seaweeds of Northeast Brazil.

RHODOPHYTA

Order Gigartinales

Hypneaceae
Hypnea musciformis (Wulfen) Lamouroux
H. spinella (C. Agardh)Kuetzing
H. cervicornis J. Agardh

Solieriaceae
Solieria tenera (J. Agardh) Wynne e Taylor

Durairatnam and Santos (1960) and Durairatnam (1984) had shown that very good quality agar comparable with Grade 1 Japanese agar can be produced with *Gracilaria verrucosa*, *Gracilaria sjoestedtii*, *Gracilaria cylindrica* and *Gracilaria debilis*, found in large quantities in Northeast Brazil. They also showed that carragheen produced from *Hypnea musciformis* was of very good quality and gave a yield of more than 45%.

A portion of the resources in the state of Rio Grande do North, where there is a dense population has been completly explored, but a major part have not been explored, where the population is small.

In general Brazilian seaweed potentials are exploited without proper management, particularly with regard to the species producing carragheens and agar.

Table 1 and 2 show the import of agar, carragheens, alginates and other products into Brazil, as recorded by the Bank of Brazil during the years 1981, 1982 and 1983. According to Durairatnam (1986) the seaweeds producing alginates and mannitol in Northeast Brazil is as follows :

TABLE 1. *Import (in US $) seaweeds and their products into Brazil during* 1981, 1982 *and* 1983. [*Source Cacex, Bank of Brazil (Authorised Imports)*]

Discrimination	1981	1982	1983
Algae used as human food ..	43.9	95.7	141.5
Algae used for medicinal purposes	21.4	35.2	12.2
Uses in general ..	3.0	3.0	—
Agar ..	263.7	309.0	193.3
Carragheens ..	1504.6	1423.6	1918.0
Alginic acid ..	1396.3	1260.8	1335.7
Total	3232.9	3127.3	3600.7

TABLE 2. *Import (in Kg) seaweeds and their products into Brazil during* 1981, 1982 *and* 1983 [*Source Cacex, Bank of Brazil (Authorized Imports)*]

Discrimination	1981	1982	1983
Algae used as human food ..	2,615	12,864	10,503
Algae used for medicinal purposes	4,845	2,595	7,370
Ases in general ..	2,000	2,000	—
Carragheens ..	1,60,984	1,47,421	1,85,619
Ulginic acid ..	1,54,882	1,49,525	1,40,415

PHAEOPHYTA

Order Dictyotales

Dictyotaceae
Dictyota dichotoma (Hudson) Lamouroux
D. mertensii (Martius) Kuetzing
D. ciliolata Kuetzing
D. cerviconis Kuetzing
D. jamaicensis Taylor
Dictyopteris delicatula Lamouroux
Di. jolyana Oliveira Filho e Furtado
Di. justii Lamouroux
Di. laglogramma (Montagne) Vickers
Padina gymnospora (Kuetzing) Vickers
P. vickersiae Hoyt et Howe
Spathoglossum schroederi (Agardh) Kuetzing
Stypopodium zonale (Lamouroux) Papenfuss
Lobophora variegata (Lamouroux) Womersley

Order fucales

Sargassaceae
Sargassum vulgare Agardh
S. hystrix J. Agardh
S. cymosum Agardh

Durairatnam (1984) had shown that the yield of alginic acid in *Sargassum vulgare* varied from 11 to 17.4%. Although a survey has not been carried out to determine the quantity of *Sargassum* available large quantities are available in practically all the areas growing up to a depth of 10 m. The amount is sufficient to put up an industry to produce alginates on a small scale.

Sudene carried out a project on algae in 1981 and reported on the marine algal flora upto a depth of 45 m. They also attempted a culture of *Gracilaria* and *Hypnea*.

Potential, Production and Export of Algae

The distribution and density of algae in a particular area varies according to the type of substratum, hydrological conditions and the position of the species at a given moment. There is a great variation from one area to the other, from species to species and in the same form in the different months. This makes it difficult to determine the potential in a determined area. Extensive study and research is necessary to reasonably estimate the production of algae in each region. The market for the sale of algae is different from other products. Generally it is difficult to get data on production of algae in the different regions. Production data is often confused with export data. Export of seaweeds is one of the sources of the country's foreign exchange. Attempts to increase the state revenue from this source must include application of mariculture techniques and standardization of export products.

Culture of Algae

To improve the continued export of the raw material or the finished product it is necessary to maintain the good quality of the algae. In Northeast Brazil the material for export is collected from the natural beds. In most areas there have been over production and the banks very badly damaged resulting in the depletion of the raw material. Further the seaweeds exported contains many impurities such as corals and other algae. As such importers are hesistant to buy the raw materials. Cultivation of algae will substitute for the loss of algae lost in the harvested areas in the sea.

Modern method of cultivation is carried out in large tanks in Thailand. This method should be adopted as *Gracilaria* grows better since the salinity can be controlled in the region of 23‰. Generally the salinity in the sea is 35‰ and if this limit is exceeded it begins to die. Also many epiphytes grow on *Gracilaria* and discolours the algae. As a result the colour changes to green or brown and the quality of agar becomes inferior. Further fertilizers cannot be used in the sea to improve the growth. For this reason the polyculture of *Gracilaria* with prawns, crabs and fish as adopted in Taiwan is superior. They cultivate in 350 hectares which gives a yield of 3500 tonnes of dried good quality *Gracilaria*.

Conclusion

During the last ten years there has been a complete depletion of seaweed stocks due to over exploitation. To prevent over exploitation and proper management of the seeweed resources the following steps should be taken,

1. Legislation should be passed that during the peak reproduction period harvesting should be on a reduced basis or completely avoided.

2. Raking of seaweeds over loose substrata or where seaweeds are attached to stones or pebbles should be avoided.

3. For proper management of the seaweed resources the gear used for harvesting must not scrape the bottom.

4. Ecological studies should be undertaken on the shore and in the laboratory to determine the best periods during the year for harvesting.

5. Efforts should be made to prevent pollution of the seaweed beds.

6. Carry out culture experiments on algae similar to that carried out in Taiwan.

7. Encourage community organisations to involve in seaweed production.

8. Improve marketing structure in order to exploit new areas or new species.

9. Enhancement of export of seaweeds needs export regulations and standardisation of the quality of the commodity.

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