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WORKSHOP

CULTIVATION OF SEAWEEDS IN LATIN AMERICA

02-08 APRIL, 1989 - SAO SEBASTIAO, SP - BRAZIL

REPORT TO UNIDO

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1. Objectives

The objective of this report is : 1. to summarize the state of the art of seaweed cultivation in Latin America) and 2. to report on the opinion of the scientists participating in the workshop in what concern the stablishment of a CENTRE OF EXCELLENCE IN SEAWEED TECHNOLOGY IN BRAZIL. In addition to that I present also my personal opinion on the problematic of seaweed cultivation in the whole region.

2. The Workshop

The workshop was organized by the International Foundation for Science and University of Sao Paulo.

The meeting was held at the Marine Biological Centre of the University of S. Paulo in Sao Sebastiao, at about 200 Km east of S. Paulo city.The Centre is located by the sea having two small private beaches. The facilities include a laboratory, a library, meeting room , refectory and dormitories for 40 people. All the participants were lodged at the Centre during the whole meeting. This, plus the informal atmosphere of the facilities and the flexibility of the workshop organization allowed extensive opportunities for discussion among the participants even during the meals and evenings

The idea of the meeting was to put together young scientists of Latin American countries that were actively engaged in projects aimed towards seaweed mariculture to share their experiences.

In order to attain these goals the meeting was planned not as an ortodox meeting comprising formal and condensed communications followed by quick discussion, but as an informal communication of results and also of unsuccess. In fact problems and difficulties were stressed as much as positive results and plenty of time for discussions was provided for each participant. Besides the participants mentioned above, a group of experts in the field of applied phycology was invited to contribute to the discussion.Those included experient scientists from Japan, United States, Brazil, Chile, Sweden and Tanzania. Among the participants there were representatives from all Southern American countries, except by Paraguay and Bolivia, that do not have seacoasts. Other countries that develop activities in the cultivation of seaweeds of commercial importance that participated in the meeting were Mexico, Cuba and St. Lucia.

Each of the invited experts presented also a conference on their specific subjects of research approaching mariculture in a broader sense: i.Professor Isamu Akatsuka from Japan dealt with the cultivation of seaweeds for human consumption. He described the methodologies for the cultivation of the species of more

significant commercial value such as PORPHYRA (nori), LAMINARIA (kombu) and UNDARIA (wakame) among others, commenting on their economic value in Japan. His conference was enriched by cultivation devices that he brought from Japan to better illustrate the techniques; ii. Dr. Thomas Mumford, from Washington (USA), explained in detail the cultivation of the edible algae PORPHYRA in the state of Washington, commenting on the techniques, economics and legal aspects of sea utilization in the USA. His speach was illustrated by two videos showing the cultivation and processing of nori in Japan and in the USA; iii. Dr. Lena Kautsky, from Sweden, spoke on seaweed productivity, discussing the factors that control biomass production in seaweeds.She addressed the aspects that are basic for implementing their growth; iv. Dr. Keto E. Mshigeni, from Tanzania, presented the results of seaweed farming in the Indian Ocean. He described in detail the cultivation of EUCHEUMA, a red algae producing carrageenan in the tropical east coast of Africa. This was quite pertinent because the marine environment and the flora in this region is very similar to the tropical Atlantic coast of South America and the Caribbean; v. Dr. Bernabe Santelices, from Chile, talked about the results obtained in Chile on the farming and management of the natural beds of GRACILARIA CHILENSIS, the main source of agar in the world. He also mentioned the problem of overexploitation of the natural beds and commented on the exploitation of other Chilean species of

seaweeds such as LESSONIA, PORPHYRA, GELIDIUM and GYMNOGONGRUS; vi. Dr. Eurico C. de Oliveira, from Brazil, presented two communications. The first dealt with the rationale for the cultivation of seaweeds in Latin America, where he stressed more the "know why" rather than the "know how" of seaweed cultivation. He emphasized that mariculture, in all instances, should be concerned with the production of marketable biomass at a competitive price. The second presentation dealt with the importance of stablishing a coordinated programme to develop seaweed exploitation and industrialization in Latin America, in such a way that progress in one country could be quicky shared with other countries in the area; in this presentation it was stressed the need of support from an international organization such as UNIDO. The presentation of this paper was followed by extensive discussions on the possible stablishment of an UNIDO Centre of Excellence for Development of Sseaweed Technology in Latin America. Details of that discussion will be presented in the item 4.

The representatives of each country reported on the activities of seaweed exploitation and cultivation in their regions and presented the results of their specific projects.

During the week at the Marine Station there were opportunities for the participants to see the facilities to cultivate seaweeds in small outdoor tanks and to see an experiment on cultivation of the red algae HYPNEA MUSCIFORMIS, a raw material for the production of carrageenans, on bamboo rafts.

3. The state of the art of seaweed cultivation in Latin America

Latin American countries do not have a strong tradition in the utilization of seaweeds, with the exception of Chile and Peru, where a few species are used locally as human food, in the majority of the other countries of the region seaweeds where seaweeds occur in abundance, this is considered as a nuisance, rather than a benefit, because interfers negativelly with tourism and fishing. An exception to this situation occur in some particular beaches in Argentina and Brazil where, in the last decades, some species of seaweeds, and of GRACILARIA, in particular, are harvested and selled to local agar industries or to exporters.

In St. Lucia, in the Caribbean, a species of GRACILARIA, known locally as "sea-moss" is also utilised traditionally by the local population.

In what concerns mariculture, the objective of this workshop, we will concentrate our observations in the cultivation of red algae producing mucilages (agarans and carrageenans). This, because I believe that there is no economic viability in the cultivation of brown algae in Latin America

To start with, commercial cultivation of seaweeds in Latin America , presently, occurs only in Chile. Even in this country, although the cultivation of GRACILARIA CHILENSIS can be considered as an atractive commercial activity, it is still modest, in comparison with the production harvested from the natural beds.

On all other countries of the region, cultivation is made only at an experimental or pilot level. Nevertheless according to Smith (1984) the cultivation of GRACILARIA in St. Lucia is going to become commercial, thanks to the peculiarities of the utilization of this seaweed in that island. There the production is still very small, but even so can be economic due to the extremely high prices that the weed get into the local market, where it is utilized in beverages considered to be aphrodisiac.

On the other hand, perhaps stimulated by the great success of the cultivation of the carrageenan producing red algae, EUCHEUMA spp in the Philippines, there is a wave of interest in the mariculture of red algae all over Latin America. This IFS/USP workshop is a good example of this

interest, for one could see that there are experiments going on, or to be iniciated, on most countries in the region.

In ARGENTINA, experiments on cultivation have been made by the group of Alicia Boraso de Zaixo, from the Centro Nacional Patagonico, in Puerto Madryn, Chubut. The cultivated algae is an unidentified species of GRACILARIA that is processed locally for the production of agar (cf. Boraso de Zaixo 1984 ; Mayer, 1981). More information on the commercial activities will be found in the paper of Piriz, M.L., to be published in the proceedings of this workshop (cf. also Piriz, 1988) However the experiments made so far in Argentina are still very preliminary, and the informations too fragmentary to support any prognostics on its productive potential.

There is no activity of mariculture going on in URUGUAY, but just plans. In this country the best algae for the production of agar is a Gelidiaceae, PTEROCLADIA CAPILLACEA, a species that produces an excellent agar, and that was harvested commercially in the past in the Uruguayan coast. The algal ressources in Uruguay are quite modest, and no commercial activity is going on in seaweed business in the country at this moment (A. L. Alvarez, personal communication).

In BRAZIL several experiments to mariculture different species of red algae have been made in the country in the last two decades. The situation was reviewd successively by Oliveira (1981 , 1984) . Most experiments

were made in the tropical coasts of the northeastern provinces, using GRACILARIA spp, but also HYPNEA MUSCIFORMIS (cf. Oliveira, 1988). Attempts to cultivate the last species, a K carrageenan producer, was also made in the State of S. Paulo (Oliveira & Berchez, 1987 ; and Berchez and Oliveira, to be published in the Proceedin of this workshop). In Brazil there were also assays to cultivate red algae in outdoor tanks in S. Paulo (Oliveira, Paula & Berchez, to be published in this workshop) and in the state of Rio de Janeiro (Yoneshigue and Neves, 1984). Although good growth rates were obtained for some species in tanks, this methodology was considered as economically not viable and the experiments were discontinued. One experiment was also made to cultivate commercial red algae in association with shrimps in the State of Bahia (E. C. de Oliveira, unpublished). In this case the selected species of algae were introduced in large ponds (5 ha, or bigger), used to farm species of salt water shrimps (Peneus), however without much success. In my opinion the cultivation of seaweeds did no go commercial in Brazil because of two reazons : 1. the extremely low value of the seaweeds in the local market; and 2. because the experiments were always made for short period of time, and without the support of the local industries.

There are no phycological activities going on in the GUYANAS. The marine flora is very porr probably as a consequence of the strong influence of the Amazon River, whose main water flux is deflected to the northwest,

decreasing the salinity and promoting an intense turbidity in the northernmost part of the Brazilian coast and the Guyanas, making the environment unfavorable for the growth of seaweeds.

In VENEZUELA, the interest in the cultivation of seaweeds is very recent. Preliminary experiments are being made by the group of Dr. Andres Lemus of the University of Oriente, in Cumana, and by Raul Rincones (cf. summary presented by this author in this workshop). However the experiments are just starting and there are no backgrounds to justify future projections. A positive aspect in the experiments that are being made in Venezuela is that a local industry of beer is investing seriously in R & D, aiming to stablish a processing plant for agar.

In COLOMBIA the situation is still less developed. Here the few phycologists working in the country concentrate the research activity on taxonomy. An assay to cultivate a red algae, GRATELOUPIA, was reported in this workshop by German Bula-Mayer (cf. abstracts). His results are preliminary, and even if successfull, I do not believe that there is a market for this species.

In ECUADOR there are no active phycologists, and the flora of marine algae is still poorly known. This country as is well known, have extensive areas of ponds utilized for the cultivation of salt water shrimps. In fact Ecuador is one of the largest producer of farmed shrimps in the world, having thousands of hectares of ponds. Therefore, if a

successfull methodology is developed to cultivate valuable seaweed in a polyculture system associated with shrimps, such as the system utilized in Taiwan (Chiang,1981) , a considerable production could be attained.

In PERU, as already said, a few species of seaweeds are used as food for the local population , but this does not seem to be economically very significant. Recently I was told that there are plans to stablish a small plant for the production of agar in the country. There are no activities in seaweed mariculture in Peru so far.

In CHILE the situation is quite different. This country is the largest producer of GRACILARIA in the world, producing also a significative amount of agar. In fact, Chile produced 117,521 tons of Gracilaria (90 % humidity) and 777 Kg of agar in 1985. Altough the global production of Gracilaria declined to 69,852 in 1986, and to 56,802 in 1987, the production of agar increased, in the same period, to 976 and 872 Kg, and to 1,041 Kg in the first10 month of 1988. In 1988, the exportation of agar and of dried alga reached over 18 million US$ dollars. What is interesting to note here is that, the amount produced from mariculture increased graddually from 4.2 % , in 1985 to 38.7 % in 1988, of the total production (Instituto de Fomento Pesquero, Cultivo de Gracilaria en Chile- evaluacion tecnica, economica y social. 1989; see also Ponce, 1988).

If one consider also the production of other commercial algae such as IRIDAEA, MACROCYSTIS and LESSONIA, the total amount of money coming out from seaweeds is significative to the economy of this country. Here we find the only example of success in the cultivation of seaweed in Latin America. The cultivation was certainly stimulated by the good price of the Chilean Gracilaria, that can reach more than 1,400 US$ per dried ton. The technology for cultivation was developed by a joint effort of the Universities, Government and the Industries, and was an answer for the dramatic reduction of the natural beds due to overharvesting (Ponce, 1988). The methodology of cultivation of the GRACILARIA CHILENSIS cannot be readly extrapolated to other countries in Latin America, specially for the Atlantic coast. This is so because the Chilean species have a very peculiar habitus in the genus, that is to grow partially buried in the sediment, what is not the case in the other species. The trend in Chile now is such, that one can foresee that in the near future, most, if not all of the Chilean production of Gracilaria will come from marine farms.

In the CARIBBEAN, efforts to mariculture mucilage producing algae have been made in St. Lucia, as I have already mentioned. The methodology used is based on the vegetative propagation of inucula inserted into polyethylene ropes attached to floating rafts. This is similar to the methodology used in Brazil, originally developed by Raju &

Thomas (1971) in India. The peculiarities of the situation of Gracilaria utilization in St. Lucia was already mentioned here.

The other Latin American country that have invested in seaweed cultivation is MEXICO (cf. the abstract by Zertuche, attached). The experiments in Mexico are being made in Ensenada and San Quintin, in Baja California. The species used in the experiments is GRACILARIA PACIFICA.However, also in this case the experiments are very recent to support further prognostics.

Very recently CUBA got interested in the production of agar due to the relativelly high consumption of this product in the country, and the difficulties that Cuba have to import it. As the local natural stocks of agarophytes are practicallv non existing, a project was stablisned to study the viability of farming a local agarophyte. The experiment is very recent and is being conducted by Arsenio Areces. The species selected for cultivation is BRYOTHAMNION TRIQUETRUM (see abstract attached.

It seems that there are no other country in Central America and in the Caribbean that levelops any activities in mariculture, or even in seaweed exploitation.4. The role of UNIDO in developing seaweed technology in Latin America.

4. The role of UNIDO in developing seaweed technology in Latin America

According to previous arrangements between UNIDO and myself, I included in the programme of the workshop a presentation to introduce the audience to the UNIDO proposal of stablishing a CENTRE OF EXCELLENCE in Seaweed Technology in South America.

The rare opportunity of having together representative scientists of every country in Latin America interested in seaweed exploitation made this workshop the most adequate forum for such a discussion.

In my presentation, first I made clear that it was being made on behalf of UNIDO, and that this organization wanted to know the opinion of the participants about the possibility of stablishing the centre referred to above in South America, and probably in Brazil. After that I presented an introduction with a historical summary trying to show how UNIDO got interested in seaweed businesss. This was based on two documents, 1. the Peter Robinsons Report "A case study on Brazil in the field of marine algae (seaweeds) cultivation and processing" and ,2. a report of the experts group meeting on "The utilization of marine algae (seaweeds) for human food and animal fodder in agriculture and industry", hold in Riga, USSR, 4-8 Aug., 1986.

After that I stressed the more relevant points of the Robinsons report and read his conclusions and suggestions.

A general discussion followed the presentation with most people wanting to know more details about UNIDOs activities ,and details about the Robinsons report as well as the reazons why Brazil was selected for the case study. A proposal was made that it would be more convenient to interrupt the discussion and return to it later, leaving more time for bilateral and informal conversation among the participants . Accordingly a new discussion was scheduled for saturday morning, the last day of the workshop. This meeting led to the following conclusions :

1. The stablishment of a Centre of Excellence for applied seaweed research in Latin America was considered very important to the industrial development of the region, provided it would be used as a training centre for young scientists of all interested countries from Latin America, as well as from other developing countries.

2. In what concern its possible location in Brazil, nobody oposed to the idea, once Brazil was recognized as the more traditional centre of phycological investigation in Latin America.

3. In what concern the specificity of the Centre, i. e, the main lines of research it was agreed that this should be decided by the hosting country; however it was suggested biotechnology and mariculture as areas of general interest.

4. There was a consensus that there should be more cooperation within Latin America, once it became obvious that there are a considerable difference in scientific and

technological developmnt among the countries in what concern the knowledge and utilization of the seaweeds resources of each country. As a first step towards strenghtening the local cooperation it was suggested the stablishment of a system to circulate the more relevant information on applied phycological knowledge within the region. A proposal was made to stablish a sort of "Latin American Association of Applied Phycology", that should be responsible for the edition of a newsletter to be circulated all over the region. The representatives of the IFS that were present at the meeting considered this an interesting idea, and would look for the possibility of securing some funds to implement the idea and to give it the necessary momentum to start moving.

5. Final remarks

1. From all the presentations it became very clear that each country in Latin America have its own reality, presenting quite different stages in phycological knowledge and in the utilization of their resources. Some are already exploiting their resources in an effective way such as is Chile, Brazil, Argentina and Mexico, although certainly not at the limits of their posiiblities. Some countries, such as Venezuela and Peru are planing to start activities in this area, whyle others, such as Ecuador probably do not know yet what seaweeds do they have in their country.

2. The above made also clear that the countries that are starting in seaweeds business, or are planing to start, could profit a lot with the experiences already acquired by neighbour countries. It was curious to see that in some cases, and Brazil is one example of that, a good flux of information does not exist even within the country itself.

3. Therefore the stablishment of a system to circulate in an exp dite way, and to the right people, the really relevant information on seaweed technology would be most wellcome.

4. But, much better than that would be to have a centre of production of new data on applied phycology that could quickly be difused within Latin American countries through the training of young scientists, and orientation of areas of research that are really the botle necks for improving production of valuable seaweeds and increase the efficiency of the local extractive industries. This certainly would avoid too much dispersion in researchs intended to be applied such as the cultivation of species that may grow well but have no market.

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