INTERNSHIP REPORT

SEA WEED CULTIVATION

Internship Program at:

(CSIR- National Institute of Oceanography, Dona Paula, Goa-India)

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CONTENTS

INTRODUCTION

ABOUT CSIR-NIO

The National Institute of Oceanography (NIO) with its headquarters at Dona Paula, Goa and regional centers at Kochi, Mumbai and Vishakhapatnam, is one of the 37 constituent laboratories of the Council of Scientific & Industrial Research (CSIR), New Delhi. CSIR-NIO was established on 1 January, 1966 following the International Indian Ocean Expedition (IIOE) in the 1960s. The Institute has since grown into multi-disciplinary oceanographic research institute of international repute. The principal focus of research has been on observing and understanding special oceanographic characteristics of the Indian Ocean. The results have been reported in more than 5000 research articles so far.

The institute has a sanctioned strength of 200 scientists and 100 technical support staff. The major research areas include the four traditional branches of oceanography: biological, chemical, geological/geophysical and physical as well as ocean engineering, marine instrumentation and marine archeology.

The institute has numerous state-of-the-art laboratories at its headquarters in Goa as well as the regional centers. It also operates two research vessels RV Sindhu Sankalp (56 m) and RV Sindhu Sadhana (80 m) that are equipped for multidisciplinary oceanographic observations. The institute has a library with 15,000 books and 20,000 back volumes of research journals, making it the best collection of printed literature on ocean sciences in the country.

In addition to basic research, the institute also carries out applied research sponsored by the industry. These studies include oceanographic data collection, environmental impact assessment and modelling to predict environmental impact. The institute also provides consultancy on a number of issues including marine environmental protection and coastal zone regulations.

With the largest collection of scientists in the country, and equipped with suitable ocean research infrastructure, CSIR-NIO serves as an advanced center of education in ocean sciences. It has a School of Oceanography under the Academy of Scientific & Innovative Research (AcSIR). In addition, it is a recognized center for doctoral research by a large number of universities. There are at present over 100 Junior/Senior Research Fellows (qualified through CSIR/UGC eligibility criterion) pursuing their doctoral degrees in the institute. In addition, about 300 undergraduate and postgraduate students pursue their project research at this institute every year.

SEAWEED

Seaweeds or macroalgae refers to the thousands of species of macroscopic, multicellular, marine algae. These includes some type of *Rhodophyta* (red), *Phaeophyta* (brown) and *Chlorophyta* (green) macroalgae. Seaweed species such as kelps provide essential nurser habitat for fisheries and other marine species and thus protect food sources; other species such as planktonic algae play an important role to capture carbon, producing at least 50% of earth's oxygen. Seaweed's appearance resembles non-woody terrestrial plants. The various parts of a

seaweed consist of a thallus including lamina (sorus, *pneumatocyst*, kelp), stipe, holdfast (haptera).

Seaweed has a variety of uses, for which it is farmed or foraged.

- Seaweed is consumed across the world particularly in East Asia and Southeast Asia as well as in South Africa, Belize, Peru, Chile and Scotland. Gim, nori and zicai are sheets of dried *Porphyra* used in soups, sushi and *onigiri* (rice balls). *Chondrus crispus* (Irish moss or carrageenan moss) is used in food additives, along with *Kappaphycus* and *Gigartinoid* seaweed.
- Alginates are used in wound dressings and dental moulds. In microbiology, agar is used as a culture medium. Carrageenans, alginates and agaroses with other macroalgal polysaccharides have biomedicine applications.
- Other seaweed maybe used as fertilizer, compost for landscaping or to combat beach erosion through burial in beach dunes. It is also under consideration as a potential source of bioethanol.

SEAWEED CULTIVATION

Seaweed farming or cultivation is the practice of cultivating and harvesting seaweed. It comprises of the management of naturally found batches. In its most advanced form, it consists of fully controlling the life cycle of the algae. The top seven cultivated seaweed taxa are *Eucheuma* spp., *Kappaphycus alvarezii, Gracilaria* spp., *Saccharina japonica, Undaria pinnatifida, Pyropia* spp., and *Sargassum fusiforme*. *Eucheuma* and *Kappaphycus alvarezii* are farmed for carrageenan (gelling agent), *Gracilaria* is farmed for agar while the rest are farmed for food. The largest seaweed producing countries are China, Indonesia and the Philippines.

In India, seaweeds are used as raw materials for the production of agar, alginate and liquid seaweed fertilizer (LSF). There are about 20 agar industries, 10 algin industries and a few LSF industries situated at different places in the maritime states of Tamil Nadu, Karnataka, Andhra Pradesh and Gujarat. The red algae *Gelidiella acerosa, Gracilaria edulis, G. crassa, G. foliifera* and *G. verrucosa* are used for agar manufacture and brown algae *Sargassum* spp., *Turbinaria* spp. and *Cystoseira trinodis* for the production of alginates and liquid seaweed fertilizer. The quantity of seaweeds exploited is inadequate to meet the raw material requirement of Indian seaweed industries. Seaweeds such as *Gracilaria edulis, Hypnea musciformis, Kappaphycus alvarezii, Enteromorpha flexuosa* and *Acanthophora spicifera* can be successfully cultivated in long-line ropes and nets by vegetative propagation method. This activity has a potential to provide income and employment to about 200,000 families.

OBJECTIVES OF INTERNSHIP

To intern under the Seaweed Cultivation Project and to learn the various techniques and methods of seaweed cultivation along with the various factors which affect the growth and regulation of seaweed and the various beneficial uses of the seaweed.

WORK DONE

I worked under The Seaweed Cultivation Project carried out under the guidance of Dr. Manohar Cathrine Sumathi and Dr. Ravi Singh Baghel with project associates Mr. Viraj Vaigankar, Mr. Charles Po and Mr. Manish along with other fellow interns Miss. Rashmi Anurlekar and Miss. Feazel Dias.

Basically, three sites or areas were allocated for seaweed cultivation. These were Dona Paula Beach, Hollant Beach and Bogmalo Beach at Vasco.

At each site rafts were inserted in the sea wherein the seaweeds were cultivated. The rafts were made by tying four strong bamboo sticks in the shape of a square with the help of thick ropes. Floaters or buoys were attached to the rafts to support buoyancy.

Species Cultivated

Gracilaria cortica, Gracilaria edulis, Gracilaria deblis, Gracilaria cortica var. cylindica, Gracilaria Salicornia, Solaria spp., *Kappaphycus alvarezii* and *Ulva* spp.

Methods Used

Two methods were used in cultivating the seaweeds:

- **Monoline**
  In this method, a nylon rope measuring about 5-6 m was cut. Small pieces of samples of seaweeds were first tied with a thread and then these samples were seeded on the nylon rope. Each rope contained about 200-300 g of the sample. This method is time consuming.
- **Tube net**
  In this method, a net in the shape of a tube is cut into desired sizes required. Then a rope is inserted in between and one end of the net is tied to the rope. A PVC pipe of suitable diameter is inserted in the net and the samples are seeded in the net manually. This pipe acts as a funnel to make sure that the net is fully filled and there are no spaces left in between. After filling the other end is tied to the rope. This is the simplest and easiest method of cultivation.

After the monolines and tube nets are ready, these are tied to the raft horizontally from one end to another. Then, these rafts are inserted in the sea with the help of divers.

Apart from the samples inserted these sites, some samples made were also transported to other sites outside Goa located in Maharashtra and Karnataka.

While seeding the samples, the samples were kept wet using sea water only to keep it hydrated, since drying of seaweeds results in fast mortality.

The growth of seaweeds at Dona Paula and Bogmalo beach were pleasing and showed a good growth rate at each cycle, whereas the seaweeds at Hollant beach showed a very poor growth rate due to harsh water currents, pollution and growth of other undesired seaweeds such as *Sargassum.*

TABULATION OF WORK DONE

Site	Date	Species Of Seaweeds Cultivated	No. Of Monolines Made	No. Of Tube Nets Made
Dona Paula Beach	15th November, 2022	*Gracilaria cortica, Gracilaria edulis, Gracilaria deblis, Gracilaria Salicornia, Solaria* spp., *Kappaphycus alvarezii* and *Ulva* spp.	7	4
	5th December, 2022		9	-
	7th December, 2022		11	6
	21st December, 2022		15	4
	22nd December, 2022		14	6
	12th January, 2023		18	9
	13th January, 2023		20	5
Hollant Beach	6th January, 2023	*Gracilaria cortica var. cylindica, Kappaphycus alvarezii, Gracilaria deblis* and *Gracilaria Salicornia*	4	2
	17th January, 2023		6	3
	23rd January, 2023		6	2
Bogmalo Beach	23rd December, 2022	*Kappaphycus alvarezii*	10	2
	7th January, 2023		11	-
	18th January, 2023		13	-

PICTORIAL EVIDENCE

Monolines of *Kappaphycus alvarezii* tied to raft

Sample of *Gracilaria edulis*

Raft Preparation

Seeding of *Gracilaria Salicornia*

Sorting out the fresh samples

Sample storage ready to be inserted in the sea water

CONCLUSION/OUTCOME

The Seaweed Cultivation Internship intended in giving knowledge about the different types of seaweeds which are cultivable and can show significant amount of growth rate if subjected to proper conditions and environment to thrive in. Moreover, it gave me knowledge about the different methods which can be used to cultivated the seaweeds which are suitable for many different species of seaweeds. It also helped in gaining knowledge about the different factors that affect the growth and regulation of the seaweeds. This is further helpful in setting up a seaweed cultivation farm, since seaweeds have enormous number of uses from food industry to biomedical industry and also can raise job opportunities.