Seaweed Cultivation in Bangladesh: Problems and Potentials

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ABSTRACT

Seaweed farming is highly developed in many south-east Asian countries. However, the seaweed industry in Bangladesh is an initial stage. People in Bangladesh are still not aware of the seaweed potential, although Bangladesh has a coastal zone of 480 km coastline and 25,000 km^2 of coastal area with a huge population, supporting a variety of land use practices. This coastal area with sandy and muddy beaches, estuaries and mangrove swamps can be provided suitable substrate and habitats for various seaweeds cultivation. Bangladesh is rich with 133 species of seaweed and eight of them are commercially important. These could be produced commercially in a large scale. Seaweed having immense medicinal vales and delicious food also has the export potentials as seafood to fetch substantial foreign exchange. Seaweed is also an ingredient for bio-chemicals, pharmaceuticals and cosmetics industries. Bangladesh should therefore promote the cultivation and consumption of seaweed among their people. Efforts are needed to increase production through improving harvesting techniques, creation of artificial habitats and seeding of suitable coastal areas. The technology for the cultivation of different commercially important seed stocks and their improvements should be developed through research. In addition, extensive surveys need to be conducted to identify suitable sites for large-scale seaweed culture.

Key words: Seaweed, Bangladesh, cultivation, potential

INTRODUCTION

Seaweed is a marine alga that is generally classified as a plant. Seaweed is a primitive type of plants lacking true roots, steams and leaves (Robinson, 1980). Seaweeds form a very important part of the marine ecosystem. Seaweeds can physically dominate the whole benthic environment and provide not only the primary food sources but also habitats for a whole range of other marine organisms. Seaweed is found throughout the world's oceans and seas, and none is known to be poisonous (Zemke-White and Ohno, 1999). Most seaweed species are red (6000 species), brown (2000 species) or green (1200 species) (Robinson, 1980).

Seaweed has become a very versatile product widely used for food in direct human consumption. Therefore seaweeds are valuable sources of human food. Almost everywhere in the world, from ancient times, people have been consuming seaweeds. The Japanese, the Chinese, the Filipinos and the Hawaiians consider seaweed a food of great delicacy and have been using it in their diets for centuries

(Armisen, 1995). Seaweed has been a staple food in many other countries for a very long time. The green seaweeds such as: *Enteromorpha, Ulva, Caulerpa* and *Codium* are utilized exclusively as source of food. These are often eaten as fresh salads or cooked as vegetables along with rice. *Porphyra* (Nori), *Laminaria* (Kombu) and *Undaria* (Wakame) are used for making fish curry and meat dishes as well as soups and accompaniments (Sajid and Satam, 2003).

Seaweed has plenty of essential nutrients, especially trace elements and several other bioactive substances. The protein contains in seaweed are of very high quality and have all the essential and non-essential amino acids. The lipids, which are present in very small amounts, are unsaturated and thus afford protection against cardiovascular pathologies. Seaweed has abundant vitamins, including beta-carotene, which is the precursor of vitamin A, the vitamins of the B group, including B12, vitamin C, D, E and K. The very high levels of enzyme activity in seaweed help the assimilation of all these vital elements. That is why today seaweed is considered to be the food supplement for the 21st century, containing proteins, lipids, polysaccharides, minerals, trace elements, vitamins, and enzymes (Goulart, 1989). It is also served in the dishes by some airlines in the air. Even diabetic patients may consume seaweed (Johansen *et al.*, 1988).

Seaweeds are valuable sources of bio-chemicals and pharmaceuticals. Though seaweed has been considered a delicious food in the upper class dishes in many eastern and western countries, but its value as medicinal raw material for some incurable diseases is on the rise now in many countries (Knanzawa, 1992). Seaweed has long been applied and recognized widely as alternate medicines side by side a delicious food item in Japan, China, Thailand and Korea. It is also an ingredient for cosmetics industries and is used as an animal feed additive, and for freshwater treatment (Wang and Chiang, 1994). Seaweeds are also commonly used as decorative plants in salt water aquaria (Williams, 1990).

Seaweed farming is highly developed in many countries such as: Japan, China, Korea, Taiwan, the Philippines, Malaysia, Indonesia and Thailand (Ohno, 2004). Some 221 species of commercially important seaweeds are found in south-east Asia. Of these, about 145 species are used for food and 110 species for phycocolloid (i.e., agar) production (Rudolph, 2000). According to FAO (2003), the estimated amount of global seaweed production is 6 million tons per annum value of which is around 5 billion US dollar (FAO, 2003). The contribution of cultured seaweeds is 15% of total global aquaculture volume or nearly 5% of total volume of world fisheries production. East and south-east Asian countries contribute almost 99% cultured production, with half of the production (3 million tons) is supplied by China.

Bangladesh has a coastal zone of 480 km coastline and 25,000 km^2 of coastal area with a huge population, supporting a variety of land use practices. This coastal area with sandy and muddy beaches, estuaries and mangrove swamps provide substrate and habitats for various seaweeds cultivation (Mahmood *et al.*, 1997). The coastal belt of Bangladesh extends over 76 upazilas (i.e., sub-districts), where large numbers of people depend for their livelihood on fishing, fishery exploitation and other associated activities (Feroze-Ahmed, 1997). However, the seaweed industry in Bangladesh

is an initial stage and it is not widespread due to socio-economic and technological constraints. People in Bangladesh are still not aware of the seaweed potential. With this view, a study on potential of seaweed cultivation in Bangladesh with its constraints was conducted.

MATERIALS AND METHODS

Study area: The area for the study was southeast and southwest Bangladesh mainly Cox's Bazar, Chittagong, Noakhali and Bagerhat districts. Geographically these areas have been identified as the most important and promising areas for seaweed cultivation, because of the availability of coastal areas, favourable resources for seaweed cultivation, climatic conditions, cheap and abundant labour. Therefore these coastal districts were selected for the study.

Methodology: The study was undertaken for six months from July to December 2004. A survey involving participatory approach, qualitative and quantitative data were collected using following methods:

1. Secondary data collection: Data about seaweed cultivation, its potentials and constraints were collected from published and unpublished documents, relevant government and non-government organizations, research institutes and universities.

2. Primary data collection: Primary data were gathered by field surveys. This information was also used to confirm the secondary data. A combination of the following survey techniques were used for primary data collection:

a) Participatory rural appraisal (PRA): PRA is a group of methods to collect information in a participatory fashion from rural communities (Chambers, 1992). The advantages of PRA over other methods is that it allows wider participation of the community, the information collected is likely to be more accurate. For this study, PRA tool such as focus group discussion (FGD) was conducted with fishermen and coastal communities in the southeast and southwest part of Bangladesh. FGD was conducted to get an overview of present condition of seaweed farming in Bangladesh, its potential and constraints. FGD sessions were held on front of village shops, under the big trees, fishermen's houses and school premises wherever there are spontaneous gatherings and where participants can sit, feel comfortable and are easily observed. A total of 50 FGD sessions were conducted where each group size of FGD was 6 to 12 persons (i.e., average 9). Around 450 people (9 x 50) were conducted through this process.

b) Cross-check interviews: Cross-check interviews were conducted with key informants such as school teachers, local leaders, District and *Upazila* Fisheries Officers, seaweed researchers from different universities and research organisations, and relevant NGO workers. Where information was contradictory further assessment was carried out.

RESULTS AND DISCUSSION

Present status of seaweed industry: In Bangladesh, seaweeds have been traditionally utilized as human food by the tribal people. In recent years, few Chinese restaurants are often used seaweeds as fresh salads, cooked vegetables, fish curry and meat dishes. Seaweed is also an ingredient for bio-chemicals, pharmaceuticals and cosmetics industries in Bangladesh.

There is no regular seaweed industry in Bangladesh. Some local collection of seaweed can occur for two to three months from November to January in the year. There is good growth of the edible green, red and brown seaweeds in the Sunbarbans mangrove forests, on the pneumatophores. Defying the government ban, the poor people in St. Martin Island used to collect seaweed in a limited scale for their livelihood during April-May season which are being exported to Myanmar, China and Singapore.

In Bangladesh, seaweed having immense medicinal vales and delicious food also has the export potentials as seafood to fetch substantial foreign exchange. But the government of Bangladesh has banned its harvesting for export and other purposes for protecting ecological balance and marine biodiversity. However, seaweed experts noted that besides coastal areas, some species of the green seaweed could be produced in other areas suitable in a bigger way for both export and domestic consumption purposes without harming the environment.

A few people are involved in seaweed cultivation in the southeast and southwest coast of Bangladesh. Introduction of seaweed culture at areas suitable for their cultivation through familiarizing the poor farmers with cost-effective technology could open up a new avenue for expanding seaweed industry in the country. The methods of cultivation of seaweeds using indigenous materials like bamboo and rope. The main culture methods involve either vegetative propagation using fragments from mother plants or by different kinds of spores such as zoospores, monospores, tetraspores and carpospores. Fragments of adult plants, juvenile plants, sporelines or spores are seeded onto ropes or other substrata and the plants grown to maturity in the sea.

Bangladesh is rich with 133 species of seaweed and eight of them are commercially important (Table 1). These could be produced commercially in a large scale. Seaweed has great value in providing low-cost, wholesome nutrition and therapeutic protection. Bangladesh should therefore promote the cultivation and consumption of seaweed among their people.

Table 1 Commercially important seaweeds in Bangladesh

SL No.	Genus	Species	Type
1	*Caulerpa*	*Caulerpa racemosa*	Green Seaweed
2	*Enteromorpha*	*Enteromorpha sp*	Green Seaweed
3	*Gelidiella*	*Gelidiella tenuissima*	Red Seaweed
4	*Gelidium*	*Gelidium pusillum*	Red Seaweed
5	*Halymenia*	*Halymenia discoidea*	Red Seaweed
6	*Hypnea*	*Hypnea pannosa*	Red Seaweed
7	*Hydroclathrus*	*Hydroclathrus clathratus*	Brown Seaweed
8	*Sargassum*	*Sargassum sp*	Brown Seaweed

Source: Survey data (2004)

Potentials of seaweed cultivation: The demand for seaweed industry of Bangladesh is great but the present production from natural habits is very low. Survey revealed that vast seaweed resources along the coastal belts of Bangladesh. Abundant seaweed resources are present on the inter-tidal and sub-tidal regions. These resources have great potential for the development of seaweed-based industries of Bangladesh. In addition, conservation of natural seaweeds beds is one of the important advantages of seaweed culture in Bangladesh. As seaweed cultivation requires low inputs, and provides good returns and can employ many people, therefore seaweed culture could be a good industry for coastal communities in Bangladesh. According to the survey, the seaweed could be cultivated in the suitable areas stretching from Cox's Bazar to Sundarbans.

Besides good export potentials, introduction of seaweed culture in the country's coastal areas could be an alternative option for the people's source of income. Many edible seaweed species are available on the coast. Attempts should be made to develop products suitable for the Bangladeshi palate and to popularize the same amongst the public. In Bangladesh, where thousands of the people live along the coastal zone, people can use seaweed as one of the vital sources of good nutrition. Since it can be easily dried and preserved well, seaweed can be easily transported inland to places where people suffer from thyroid problems due to a lack of iodine. The efforts in seaweed cultivation and its utilization through product and process development could help in meeting the food and nutritional security of Bangladeshi population as well as augmenting value of total fisheries export.

According to the seaweed experts, green seaweeds could be suitable to culture in Bangladesh. The green seaweed such as *Caulerpa racemosa* and *Enteromorpha* sp. rich with protein, amino acids, vitamins and minerals have multiple uses like as fodder, fertilizer, human food, industrial and pharmaceutical raw materials. They contain compounds that help reduce high blood pressure, cholesterol, and prevent strokes (Anhalt, 2003). Seaweeds have effective remedial power against rheumatism, diarrhea and checking growth of tumors (Table 2). It contains enough calcium, protein, phosphorus and good cholesterol that helps erase diseases in human body (Ohno and Triet, 1997).

In south-east Asia, the seaweed culture is mostly emphasized on green seaweeds. Cultivation of *Caulerpa* sp. has recently been developed in many south-east Asian countries. The green seaweed *Caulerpa* sp. grows commonly in tropical marine waters. People have used this seaweed as food for many years. It is reported to be edible, to have antibacterial, antifungal and antitumor properties, and to be used to treat high blood pressure and goiter (Hanisak, 1998). It also strengthens the immune system and helps maintain psycho-emotional equilibrium by increasing physical resistance to stress. Therefore *Caulerpa* sp. seaweed culture could be emphasized in Bangladesh.

More than one million people are exposed to goiter and related diseases in Bangladesh. Through iodine deficiency alone, people suffer severe mental and thyroid problems. Most seaweed contain more iodine than sea water and are a much better alternative than iodized salt or drugs in regulating the production of thyroid hormone. Besides iodine, seaweed is a perfect source of calcium, phosphorus, iron, sodium, potassium, magnesium, sulphur, copper, zinc, cobalt and iodine. The content of calcium in seaweed is not only up to 10 times higher than that in cow's milk but is also much easier for the body to assimilate. Pregnant and lactating women, as well as malnourished children, should thus consume some seaweed daily to ensure that they get enough of the element that is found in the greatest quantity in human bodies (Leyman, 2002). From the above point of view, seaweed should be cultured in Bangladesh for providing nutritional food to the women, children as well as men.

Table 2 Power of seaweeds

In Bangladesh seaweeds could be used as:
• Source of food
• Source of income and livelihoods of the poor
• Export earner
• Stabiliser and/or emulsifier for many food products, such as chocolate.
• Additive in instant food drinks
• Emulsifier, to bind certain foods together and give them a smooth consistency.
• Medicinal ingredients
• Natural latex creaming and thickening for rubber.
• Adhesive for paper bags and gummed tapes.
• Coating for food packages and milk containers, ceramic glazes, leather finishes, and emulsions.
• Additives in the preparation of fertiliser and pesticides.
• Ingredient for bio-chemicals, pharmaceuticals and cosmetics industries.

However, successful development of seaweed industry not only requires appropriate natural environmental conditions and the availability of workable technical methods but also receptive and supportive social and economic conditions (Tisdell, 1999). On the economic side, needs, markets, availability of suitable resources and appropriate systems of property rights are seen as important. Significant social influences are security of property, types of social mechanisms used for resources allocation and determination of resource use, the legal system, the political system, tastes, and social values.

Social and economic issues influence the development of seaweed cultivation and need to be taken into account in fostering and planning it. Even if biological, technological and environmental conditions are favourable for the development of seaweed production, it may fail if social and economic factors are unfavourable. The development of seaweed cultivation calls for a holistic approach accounting for all of the factors indicated in Figure 1. Such issues are equally important for the successful development of seaweed culture in Bangladesh.

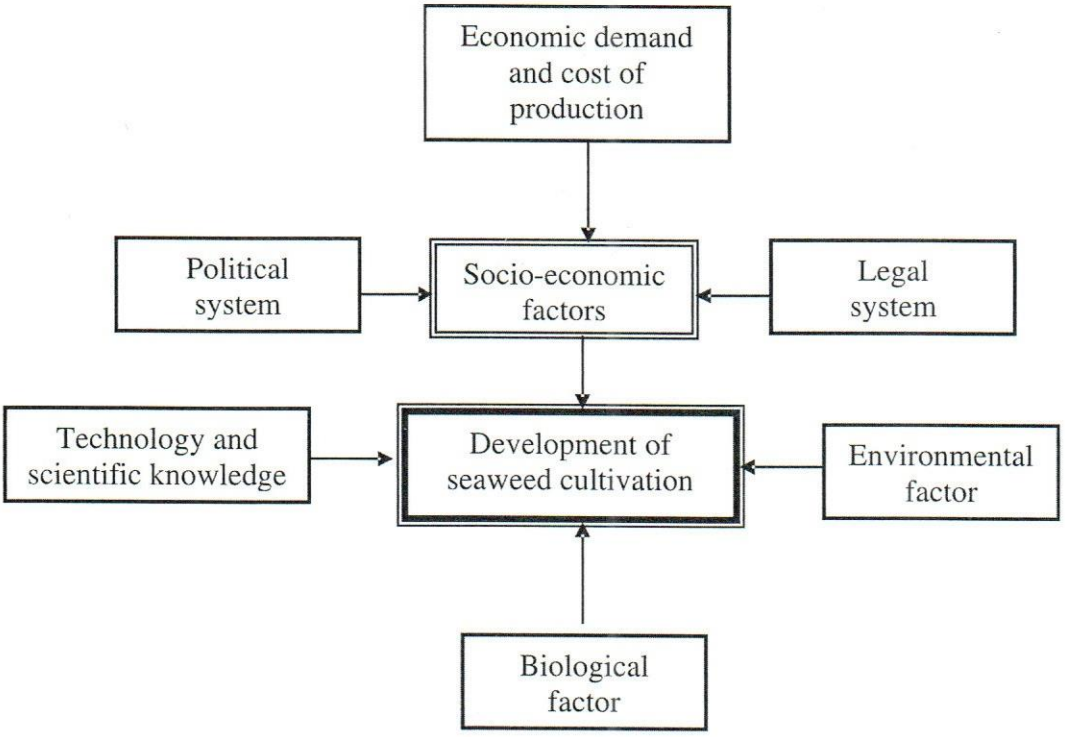

Fig.1 Factors influence on the development of seaweed cultivation

The development of seaweed cultivation is also market-driven. If demand is low and natural resources are adequate, artificial cultivation is unnecessary. As demand increases, however, attempts may be made to increase production using resource management techniques. Improvements can be made to harvesting methods and artificial habitats, competing species can be removed and cleared areas seeded.

Seaweed could easily be a new item on the country's limited export basket and would contribute greatly in reducing poverty and persistent unemployment problem. At present, Japan, Korea, Philippines, China, India and Taiwan have been producing the seaweed commercially (Sahood *et al.*, 2002). On the other hand, USA, Japan, Singapore and some European countries are importing seaweed and Bangladesh could explore the markets.

Constraints: The major problems in the seaweed industry of Bangladesh include lack of information on seaweed cultivation, lack of technology, socio-economic constraints and shortage of skilled manpower for wild seaweed harvesting. Large-scale commercial seaweed culture is required experienced manpower. One reason why Bangladesh has not, so far, given importance to seaweed cultivation could be the absence of experienced

cultivators. The south-east Asian countries have skilled cultivators, whose services could be made available to Bangladeshi cultivators through training programmes and demonstrations. Most of the south-east Asian countries have successfully produced a few hundred thousand tons of seaweed a year. There is no reason why Bangladesh should not follow suit.

CONCLUSION

Despite the great potential of seaweed culture, no attempts to grow seaweed have been made in Bangladesh so far. Efforts are needed to increase production through improving harvesting techniques, creation of artificial habitats and seeding of suitable coastal areas. The technology for the cultivation of different commercially important seed stocks and their improvements should be developed through research. In addition, extensive surveys need to be conducted to identify suitable sites for large-scale seaweed culture. Culture of high value seaweeds should be aimed for, as part of integrated coastal and national development programme. Seaweed polyculture in association with mollusk, prawn, shrimp, mud crab and fishes seems to have good prospects to increase harvest and profits. Seaweeds with shrimp farming in coastal areas can help to treat the effluent water. More technologically sophisticated extraction plants with easy access to markets and marketing organizations need to be established nearby cultivation areas to utilize the resources efficiently with greater profits.

ACKNOWLEDGEMENTS

The research was funded by the DFID Aquaculture and Fish Genetics Research Programme (AFGRP-DFID, UK). The author is grateful to Professor James F. Muir, Institute of Aquaculture, University of Stirling, UK and Manager of the AFGRP, for his valuable suggestions and continuous support throughout the study period.

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