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THE SEAWEED INDUSTRY IN FIJI WITH SPECIFIC REFERENCE TO EUCHEUMA (RHODOPHYTA).

Vina Ram
Institute of Marine Resources
University of the South Pacific
SUVA, FIJI.

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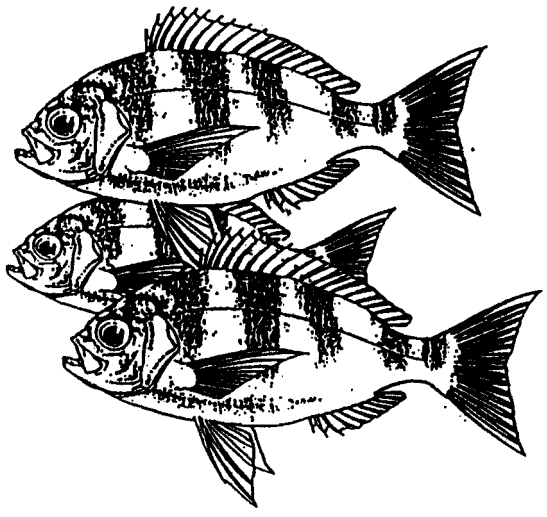

THE SEAWEED INDUSTRY IN FIJI, WITH SPECIFIC REFERENCE TO EUCHEUMA (RHODOPHYTA).

by

Vina Ram
Institute of Marine Resources
University of the South Pacific
SUVA, FIJI.

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CONTENTS

Introduction	1
Seaweed Culture - General	2
Cultivation of Eucheuma	3
Producers and Processors	4
Eucheuma farming in Fiji	5
Production	8
Cost of Production and Income	9
Marketing	10
Supply, Demand and Prices	12
Institutional Support	13
Observation Study	14
-Kiuva and Kaba villages.	
Conclusion	16
References	17
Acknowledgements	19

INTRODUCTION

Modern aquaculture in the South Pacific Islands is only a recent development, with most of it still being at the experimental or pilot project stage. The island countries with extended reef, lagoon and mangrove areas provide sheltered grounds for a wide a range of the aquaculture development, but have lacked local expertise and the necessary capital. However, with foreign financial and technical assistance, the islands have progressed well in growing of some marine and freshwater species by aquacultural techniques such as Tilapia, Milkfish, Grass carp, Pearl Oysters and freshwater prawns.

Seaweed culture, particularly of Eucheuma has also shown successful results in several islands of the Pacific. Eucheuma cultivation is favoured not only because it requires a low level of technology and investment, but also it is less destructive to the environment. It is now regarded as an important source of income and employment in the rural areas by the island governments.

This report attempts to present an overview of the Eucheuma seaweed industry in Fiji. Analysis of the industry has been limited in some areas because of lack of data. Nevertheless, the report provides some background information on the status of the industry through interviews, documentary surveys and fact - finding studies.

SEAWEED CULTURE - GENERAL

Seaweeds belong to the algae, which have four main sub-groups, each distinguished by the pre-dominant colouring pigment in their cells. They are Cyanophyta (blue-green), Chlorophyta (green), Rhodophyta (Red),and Phaeophyta (brown). Some of the brown, green and red marine algae are of economic value and are either cultured or harvested from the natural stock. Eucheuma which belongs to the group of red algae has been widely cultured in S.E. Asia over the last 30 years, and now it has been introduced in the South Pacific as well, with the initial seed stock from the Philippines.

Seaweeds have long been utilized as food by coastal communities in Asia. Commercial culture of Porphyra, commonly known as "nori" in Japan, dates back to some 200 years ago in Japan and China (Trono, 1986)

Records on culture of other species are all fairly recent, such as culture of Laminaria in China started in 1927 and Eucheuma gelatinae in the Hainan Islands in 1960. Gracilaria verrucosa was cultivated in the late 1950's and early 1960's in Guangdong Province.

Starting in about 1900 substantial industries began to develop, based on the use of seaweeds as sources of extracted chemicals (Moss & Doty 1987). The utilization of seaweeds can be classified into 3 categories -

(i) As raw material for the manufacture of colloids: agar, alginate, carrageenan and furcellaran.

(ii) As food for direct human consumption.

(iii) As raw material for the production of animal feed and fertilizer

The production of industrially useful seaweeds from wild harvests have been declining and as a result the supply has become unreliable and of low quality. Thus culture methods are favoured by these growing industries as demand for seaweeds extracts increase.

"..... with the expected increase in the usage of seaweeds and seaweed products brought about by the recent advances in production technologies and the development of new lines of products utilizing seaweed gel, a growth rate of 20 to 30% per year is now projected (Moss 1978, Doty 1982). The significant increases in the production of raw dried seaweeds during the past 10 years seems to support this contention". in : (Trono, Jr. 1986:2).

The most dynamic sector of the seaweed industry is the manufacturing of colloids, which have a variety of commercial applications ranging from air fresheners and textiles to pharamaceuticals and processed foods. A colloid is a non-crystalline substance with very large molecules. The three major types of seaweed colloids are agar, alginates and carrageenan.

Agar is mostly used in foodstuffs to form jellies; alginates have properties of thickening and forming gels. Bacause of their water - retentive, gelling, emulsifying and stablising properties, alginates have several applications in food and other industries.

Carrageenan also has the ability to thicken solutions and to form gels, thus is used as a stabilizer and gelatinising agent in food and other industries.

On the other hand the seaweed industry, despite having a history of thousands of years and a contribution in some way to almost every aspect of modern life, remains among the more remote and least understood of the world's marine based industries today. This is because of its complex characteristics with regard to biology, technical aspects of processing and marketing, which is controlled by only a few large manufacturers.

CULTIVATION OF EUCHEUMA

Culture of seaweeds particularly Eucheuma for carrageenan has also become a high priority means of rural development among the South Pacific Islands, after initial trials of technically successful operations.

The extended marine coastlines and wide coastal shelves of the islands in the region provide a suitable environment for seaweed growth. The coral reefs and lagoons characterised by slow to moderately strong currents and sandy and coralline bottoms provide ideal habitats for seaweed production. Besides, its production requires a low level of technology and investment, which is appropriate to the islands.

Eucheuma was first introduced to Kiribati at Christmas Island in the Northern Line Islands in 1977. The project was terminated in 1981 due to high wave action in the lagoon. In 1982/83 a comprehensive survey of possible sites and growth trials was carried out under the United Kingdom Overseas Development assistance programme.

By 1989 there were 230 family farms located in Tarawa and the Gilbert Group. (Philipson & McHugh, 1989: 147). The other regional islands cultivating Eucheuma are Fiji, Tonga, Solomons and The Federated States of Micronesia.

The method of cultivation of Eucheuma has gone through several changes: from the raft method or floating to fixed off-bottom, tubular net and to the monoline method. (Trono, 1986 : 19). The monoline method is the most extensively used as it has a lower labour cost and results in a higher productivity compared to other methods.

In Fiji, the most widely used method is the monoline method. The Seaweed (South Pacific) Company had introduced the raft method which produces a faster growth rate because seaweeds are cultivated closer to the water surface.

Sites for Eucheuma cultivation should be selected carefully. Areas which are about 60 cm to 90 cm deep at low tide, with coarse sand to coralline substrate and subject to a moderate water current have been found to support Eucheuma. Water movement in general favours the growth of Eucheuma by facilitating rapid nutrient absorption. It also prevents extreme fluctuations in other ecological factors e.g. temperature, salinity, pH, dissolved gases, etc. which can adversely affect the growth of plants.

The plants are ready to be harvested when they weigh about one kilogram or more. The maintenance of the farm consists of weeding, repairing the support system, replacing lost plants and removal of benthic grazers. Drying is an important post-harvest activity which affects the quality of the product. The harvested crop is spread uniformly on a drying platform usually to dry under natural sunlight. The seaweeds are regularly turned over to facilitate complete sun-drying. The dried material is packed in nylon bags and stored in a dry area before shipment.

PRODUCERS AND PROCESSORS

The cultivation of Eucheuma seaweed for carrageenan extraction is currently dominated by the Philippines, followed by Indonesia and China.

China has several advantages over other countries in terms of its aquaculture experience by having ideal grounds for Eucheuma cultivation, and lower economic costs and wage rates. As a result, the development of the Eucheuma industry in China can pose a significant threat to the viability of other existing and potential Eucheuma producers (Phillipson & McHugh, 1989:149)

In terms of processing Eucheuma into carrageenan, it is interesting to note that until recently processors were limited to developed countries. Marine Colloids, a subsidiary of FMC Corporation has been the sole domestic producers of carrageenan in the USA.

The second largest processor, Satia is based in France. There are two companies in Denmark, Litex A/s and Genu (A/s Kobenhavns Pektin fabrik) which together manufacture about 30 percent of the world production. (Phillipson & McHugh, 1989 : 150).

The other recent processors are in the Philippines, South Korea, Indonesia, Japan and China. Like Coast Biologicals Ltd, Seaweed (South Pacific) also had plans to set up a semi-refined carrageenan (SRC) plant in Fiji if the domestic production had reached the minimum target of 600 mt p.a. This would have helped to reduce not only freight costs but also in storage of carrageenan, possibly by holding back stock for favourable prices. Also this would have eased the marketing problems of other South Pacific Islands.

In general a carrageenan extraction plant must process at least a few tonnes of dried seaweeds annually in order to be economical. It would be difficult for some Islands in the Pacific to operate their own plants. Also there is a need for a large capacity of fresh water supply for processing, which is another limiting factor in some of the Islands in the region.

However, since the growth rate in the carrageenan market is at 5% (McHugh : Philipson, 1989: 150) it is important that production levels be monitored as the growth in the region seems faster than 5%. Any over-production would lead to instant reductions in price.

EUCHEUMA FARMING IN FIJI

Eucheuma was first introduced in Fiji in 1976 at Bua in Vanua Levu, but was destroyed by a Cyclone in 1980. It was re-introduced from Tonga in 1984.

In 1984, the Commonwealth Fund for Technical Cooperation (CFTC) carried out trial operations in Fiji using technical assistance from Coast Biologicals (NZ) Ltd and with support of the Fiji Fisheries Division. The initial seed-stock was obtained from Tonga and grown in Tavua, Rakiraki and Verata in Tailevu.

Two major species of Eucheuma are "cottonii" which produces kappa carrageenan and "spinosum" which produces Iota carrageenan which is the most widely used carrageenan in chemical extracts. In Fiji. E. alvarezii which is "cottonii" type is most widely grown.

The success of the trial operations encouraged the New Zealand Company to assist in the development of the seaweed farming industry in Fiji in collaboration with the Fiji Fisheries Division and the Fiji Development Bank. The Coast Biologicals Company provided loans to interested farmers on Western Viti Levu to set up the industry. 11 out of 35 farms established in 1985 were in Rakiraki and Tavua areas. 30mt of dried seaweed was produced by the 35 farms.

The first commercial scale production started in 1986 in Tavua, Rakiraki and Kaba/Kiuva/Rewa areas. Farm sizes ranged from 200 lines to 1000 lines with the exception of one farmer in Kaba who had 7000 lines. [1] Each block consisted of 80 lines with 10 lines used as replacement stock. By the end of 1986, there were 160 farms and production had increased to 200 mt with 173 mt being exported.

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[1] "A 800 line farm occupies o.41 Ha. of sea area." : Chief Fisheries Officer, Fisheries Department.

By 1987, the seaweed industry was steadily progressing. Farms were also established in Moturiki, Ovalau, Bua, Batiki, Vanuabalavu, Fulaga and Ogea. By the end of 1987, the number of farms increased to 240 with 217 metric tonnes of seaweed being exported.

Coast Biologicals (NZ) Ltd had plans to expand its operations and establish a SRC-processing plant in Fiji once the target production of 600 mt was reached (Jayant Prakash, Fisheries Division pers. comm.).

However, as a result of the 2 military coups in Fiji in 1987 which consequently lead to trade bans in New Zealand, banks refusal to give overdraft to farmers, and the effect of Cyclone Bola in early 1988 which destroyed nearly 50% of the crop, Coast Biologicals (NZ) Ltd pulled out its operations in July 1988.

As a result, not only was there a market problem but the assistance programme provided by Coast Biologicals was also removed. The Coast Biological Company had given loans and equipment to farmers and deducted payment from their seaweed income.

The Fisheries Division therefore took control from mid 1988 until end of 1989. It requested the NZ government to assist farmers to continue production. The New Zealand government therefore granted financial assistance which was used to pay deposits for farmers to borrow from the Fiji Development Bank.

New Zealand aid funds were also used to establish a revolving fund by the Fisheries Division to buy and sell seaweeds to the National Marketing Authority after the withdrawal of Coast Biologicals.

The Fisheries Division continued to assist the farmers to market their seaweeds through the National Marketing Authority until the end of 1989.

A further assistance of NZ $50,000 to revive the seaweed industry was given by the New Zealand government in 1989. Table 2. shows the level of support by the New Zealand government over the years. The Australian and the USA governments have also given assistance in order to develop the seaweed industry.

Out of the grant of $50,000 for the 1989 - 90 period, $20,000 was left over at the end of 1990 which has been carried forward to the current year as part of the revolving fund to assist in buying the seaweed from the farmers.

Table 2. New Zealand Government Assistance to Fiji Seaweed Farming

Year	Amount ($N.Z.)
1985-86	67 000
1987-88	70 000
1989-90	50 000

Source: The Fiji Times
17 March 1989

By mid 1990 there were about 100 farms with the average size ranging from 320 to 480 lines, which is about a half acre plot. [2] (Jayant Prakash, Fisheries Division; pers.comm.) In early 1991, the number of farms remained about the same. (Pers. Comm. Fisheries Division S. Mario).

From the beginning of 1990, seaweed marketing had been carried out by a joint-venture company called the Seaweed (South Pacific) [S(SP)]. The joint-venture has local private shareholding of 30% and the rest is Australian, New Zealand and American private investment. Seaweed (South Pacific) had a mutual agreement with the farmers to supply seaweeds and in turn the S(SP) helped farmers with marketing, technical assistance and provided free planting materials. The Fisheries Division during this period acted as an advisory body to the seaweed farming business. The S(SP) planned to cultivate their own farms and had 5Ha already under cultivation at Nanuca which is about 50 km East of Savusavu. It had further plans to start a SRC processing plant in Lautoka once the supply became steady. During the start of its operations S (SP) was quite optimistic and had employed about 40 people on its farms.

Production from S (SP) farms was about 54 mt by the end of June 1990. Part of the reason for S (SP) withdrawal was also because it cost more than half of its cultivation due to bad weather conditions. After the withdrawal of S(SP), the Fisheries Division approached the National Marketing Authority (NMA) to take over marketing of seaweeds. NMA has since bought seaweeds from the farmers but is still negotiating with FMC Litex for market to sell the seaweeds already in store.

In the mean time, preliminary negotiations are underway for establishment of another private joint-venture Company with local and foreign participation called Oceania Trading to market Seaweeds. It is likely that Oceania Trading will focus on the Indonesian market (S. Mario, Fisheries Division, pers. comm.)

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[2] 1/2acre = 0.205 Ha

PRODUCTION

Eucheuma is a fast growing seaweed. In Fiji harvesting occurs between 8 - 10 weeks which gives about 4 - 5 harvests per year. Because Eucheuma is a fast growing crop, it is easy to recover production after destruction by cyclones, unlike other long term crops like coconuts, cocoa, coffee, etc.

Seed stock cuttings are retained from the previous harvest and are tied to nylon lines (approx. 10m long) stretched between 2 stakes embedded in the sand. The best areas for cultivation are shallow, (knee deep at low - tide) sandy, back - reef flats.

The Fisheries Department also has a 0.25 Ha. Seed Stock farm in Kaba whereby it assists new farmers in the supply of seeds.

A farm size of one Ha when planted with 800 lines would yield about 20 mt of dried seaweed per year. (Chief Fisheries Officer; Fisheries Division:). Upon harvesting, the weed is sun dried on racks usually constructed along the coastal areas. Table 3 below shows the Seaweed production in volume and value in Fijian dollars.

Table 3: Fiji Seaweed Production 1985 - 1989

Year	1985	1986	1987	1988	1989	1990
mt.	30	173.41	216.89	60.30	80.34	87.41
F$000	N/A	135.29	136.87	21.11	40.21	N/A
Av. Price/mt.	N/A	$780	$631	$350	$500	N/A

N/A : Not available
Source : Fisheries Division Annual Reports 1985 - 1989.

Trends in the volume of production indicate an increase up to 1987, a decline in 1988, and a slight increase in 1989.

The decline in production in 1988 has been a result of destruction of crops by Cyclone Bola and the loss of interest in production by the withdrawal of Coast Biologicals. However, production is likely to increase if there are no adverse weather conditions and if a market and continued assistance to farmers is secured.

Of the 87.41 tonnes of Seaweeds produced last year, 42 mt were from Kiuva and the rest from Moturiki and Savusavu. Production is currently confined to these 3 areas. In the first quarter of 1991, production was estimated at 10mt. with 4 mt. in Kiuva, 4mt. in Savusavu and 2mt. in Moturiki. (S. Mario, Fisheries Division, Pers. Comm).

COST OF PRODUCTION AND INCOME

The economics of seaweed farming in terms of returns to farmers is difficult to determine because of lack of statistical data and the high level of Government support to the industry at this stage. However, with the data available it is interesting to compare the returns and farm costs of farmers in the Philippines and Fiji.

Philippines data are based on projections of Marine Colloids (Philippines) Inc. of a small household farmer of half ha. plot (Veloso, 1987; Philipson & McHugh, 1989) whereas the Fiji data are based on the Fisheries Division Handbook on Eucheuma, and discussion with Fiji seaweed officer Jayant Prakash (14 May, 1990). Farms in Fiji are run by family concerns and are almost half the size of family farms in Philippines.

Philippines

A half ha. plot based on 5 harvests per year is taken into account which produces about 9.3 mt of dried seaweeds. The price of seaweed is taken to be at US $0.185/kg or P.3.7/kg (1987). This gives a net income of P. 16695 [3] or US $835.

The gross return to the farmer is P.26295 or US $1314 which on a weekly basis, would give a return of US $25.00. Labour costs are given as P.9611. * (McHugh & Philipson, 1989 : 154 - 155).

Fiji

Production has been calculated on the number of lines per farm. According to the Fisheries Division report, a one acre farm is planted with 800 lines. However, the average size of family farms ranges from 300 - 400 lines which is about half acre or 0.205 ha. plots.

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[3] P = Pesos

For comparison a 320 line farm is used which is the most common size of plot and for which data are available.

There are 4 harvests per year. 10 lines per day are harvested in a 4 day week. Therefore 40 lines harvested each week which give about 120 kg of dry seaweed. [Foscarini & Prakash, 1990 : 31]. Total production from 320 lines farm is about 6.24 mt. Price of dried seaweed is taken as: (1990-1991 price)

F$0.50 /kg ~ US$0.33.

so 120kg x F$0.50 = F$60.00 ~ US$39.60

or F$3120 ~ US$2059.20 per year.

For the sake of comparison, with Filipino farmers if 1987 prices were used which was F$0.55/kg and farm size increased to 1/2 ha, then the income of F$3432; multiplied by 2 for a 1/2 ha. would be F$6864 p.a. Prior to May 1987, this would be almost equivalent to US $6864. With the effect of devaluation of Fiji currency, it would come to US$4530.[4]

The cost of setting up a farm according to Fisheries Division estimates is $185.40 or if bush poles and other cheaper materials are used then it can cost as little as $81.50. The fixed cost for tools is estimated at $128.50. However, a lot of raw materials such as ropes, ties and strings have been supplied free of charge. Some tools have also been given free or under subsidized prices.

Although the analysis may not be sufficient, it is evident that farmers in Fiji have a far better return than Filipino farmers partly because of the high level of government support and assistance. In Fiji a lot of the financial assistance is through aid funds in order to develop the industry, whereas the Phillipines Seaweed Industry dates back to over 30 years.

MARKETING

In 1985, the trial production was exported to New Zealand by Coast Biological Officers who visited the farming areas and purchased seaweeds direct from farmers. The seaweed was graded in relation to the moisture content as given below in Table 4.

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[4] Note: (May) 1987 : Exchange rate F$1 ~ US$1.

Table 4. Seaweed Grading and Prices

Grade	Price/kg	Moisture Content	Price/mt
1	$0.55	less than 20%	$550
2	$0.45	20% - 25%	$450
3	$0.35	26% - 35%	$350

Source: Fisheries Division, Jayant Prakash, (pers.comm)

If the average price per tonne from the export value of production in Table 2 and farm-gate price of say Grade 1 of $550/t paid by Coast Biological is compared, it is evident that farmers received a low price. In 1986, the mark-up price for grade 1 was 42% and in 1987 it was 15%. The initial high mark-up could be argued by Coast Biologicals as a result of high transportation and other setting up costs.

After the withdrawal of Coast Biologicals in mid 1988 prices fell to $350 per tonne. Fiji Fisheries Division took over the marketing in order to assist farmers already in production. Fisheries Division bought seaweeds from the farmers at a flat rate of $0.45 per kg and sold to the National Marketing Authority who then exported the seaweeds to Copenhagen, in Denmark. The Fisheries Division therefore paid at a rate of $450 per mt to farmers but the export price was $350 per tonne, indicating that farmers may have been subsidised.

Marine Colloids (Denmark) has given technical assistance to the South Pacific Islands seaweed farmers by providing a seaweed expert to assist in workshop training for the farmers in November 1989.

In 1989, the seaweed price increased to $500 per tonne and production also increased by 33% over the previous year.

The National Marketing Authority (NMA) had an advantage with regard to overhead costs as it already had the established infrastructure. The Fisheries Division collected seaweeds from the farmers and transported them to the National Marketing Authority centres.

From the beginning of 1990, the marketing of seaweeds had been taken over by a private joint-venture called the Seaweed South Pacific S(SP) which purchased seaweeds directly from farmers for export.

Collection centres were located in Lautoka, Kiuva, Nanuca, Moturiki, Kasavu and Lami where farmers had to bring their seaweeds to be collected by the S(SP) and Fisheries Officers.

However, S(SP) pulled out of marketing operations in July 1990 because of financial difficulties. As a result, marketing again has been taken over by the NMA. Since August 1990, NMA has been purchasing seaweeds from the farmers in order to assist those already in production.

By April, this year, NMA has been negotiating for markets with 54 mt. already in store of which 33 mt. has been production of the first quarter of 1991.

The seaweed price in 1990 remained stable at US $500 per mt. with a forecast for a decline in 1991 to about US$400 per mt.

According to the Fisheries Department, the price paid to farmers is also likely to drop from a flat rate of $0.50 per kg to $0.35 per kg as a result of a drop in the world market price.

With the price fluctuations, Fisheries Department has plans to establish a price stabilisation scheme to stabilise the price paid to farmers in order to assist farmers to continue production.

Another difficulty faced by farmers after the withdrawal of S(SP) is the increased costs of transportation and packaging as farmers now have to make their own provision to supply dried and baled seaweeds to the marketing Centres.

Although the Copenhagen Litex is one of the larger world markets, farmers may have to bear high transport costs and face competition with other suppliers such as Philippines, Indonesia and China. Exports from Fiji are comparatively small, having no influence on the price.

One of the aims of the S(SP) was to diversify its markets, possibly by looking for markets closer to Fiji or having easy access and where preferential trade arrangements could be made. Although the government still hopes to achieve such aims either with NMA or through private marketing, there is no guarantee at the moment as the Seaweed market is still fairly unstable.

SUPPLY, DEMAND AND PRICES

Stanley (1987) forecasts an annual compound growth rate of 2.2% for carrageenan use (SRC 4.0%), while other observations consider a growth of 5% :(Philipson & McHugh, 1989 : 150).

Increase in demand for carrageenan is heavily dependent on new and more profitable applications in the processed food market. Further, carrageenan in general may also face competition by its substitutes such as carboxy-methyl cellulose.

On the other hand, E. cottonii, the species adopted by most South Pacific Islands produces kappa carrageenan which has the most widespread use. However, E. cottonii is also produced in Philippines and Indonesia which are the largest producers. It is therefore important to take into account that the type of carrageenan produced in the South Pacific may face direct competition with producers from Philippines and Indonesia.

Price analysis of Pacific Eucheuma by Philipson & McHugh (1989) indicates that marketing Eucheuma to either the USA or Europe would not be economical because of high freight costs. "With freight rates from the Central Pacific to the US or Europe at around US$400/t, the CIF payment made by the purchaser would be insufficient even to pay the ocean freight and there would be no return to the shipper/grower". (Philipson & McHugh, 1989 : 152).

However, Eucheuma has already been exported to Denmark from Fiji for the last 3 years. Prices per tonne are shown in Table 3. which declined when the market changed from Coast Biologicals to Copenhagen Litex, with World prices also dropping during that period.

In 1988, prices fell down to $350/mt but increased by 30% to $500/mt in 1989 and had remained stable in 1990 with a forecast for a reduction in price to $400/mt. in 1991.

It is interesting to note that given the high freight cost, Eucheuma is still being imported from Fiji and the South Pacific by the European market in Copenhagen. Part of the reason could be with the increase in demand for carrageenan in the domestic market for Philippines, Indonesia and other South East Asian countries. Since carrageenan is now processed and used in the food industries in these countries, their exports to Europe may decline in the near future. Thus, to minimise risk for large industries like in Denmark, it is important to diversify its market to the Pacific.

Most of the Eucheuma growing countries in the S.E. Asian region also have unstable socio-political status, thus there is always a risk in depending on limited markets by large processors.

INSTITUTIONAL SUPPORT

Besides providing technical assistance, the Fisheries Division also helps farmers to set up farms and supply subsidised planting materials and gear. Initially, a lot of support was aid funded thus some farmers received planting materials without any cost at all. Through its technical and extension staff, the Division also assists farmers in negotiations with the marketing company.

The Fisheries Division also helps to transport seaweeds from outer islands. Loans from the Fiji Development Bank are also facilitated by the Fisheries Division. Farmers have to pay an initial deposit of 33% and get 2/3 financed by loan at 8% interest rate.

OBSERVATION STUDIES

Seaweed Farming in Kiuva

Kiuva village located on the east coast of Viti Levu in Tailevu has a population of about 300. 28 out of the 50 households in Kiuva are seaweed farmers. This is the sixth year of cultivation of seaweed by the villages in the area.

The government through New Zealand aid has not only assisted the village in setting up the seaweed farming but also in community projects such as construction of the seawall and community hall. The New Zealand government has also donated 12 fibreglass motorized punts to assist farmers in transportation, and built a storage house for storing dried seaweeds. Kiuva is also a seaweed collection centre.

At the beginning of the 1990, seaweed was already bought by the Seaweed South Pacific for which the villagers were paid $0.50 for grade 1 and $0.45 for grade 2 and 3. The S(SP) visited the village once every fortnight to purchase dried seaweeds.

After the withdrawal of S(SP), marketing has been taken over by NMA, however, the farmers have to bear the transportation costs.

From recent observations, although Kiuva still remains the major seaweed growing area, farmers are increasingly opting for other part-time sources of income such as fishing and agriculture.

The Seaweed farmers in the village are also aware of the fluctuations in the market price and the immediate decline in price from $0.50 per kg to $0.35 per kg which is another disincentive for them to expand operations.

Farming in the village is done on an individual household basis. Since villagers have customary rights over the use of the sea up to the barrier reef, there are no problems of seeking permission to establish seaweed farms and to catch fish at the moment.

The village otherwise is quite well endowed in terms of natural resources for economic exploitation. There is an extensive area of mangrove, reef flat and lagoon. The village basically carries out subsistence fishing to supply for immediate consumption. However, some fish is also sold if ice is bought from Fisheries Office in Wainibokasi prior to a fishing trip.

The villagers claim that fish resources are plentiful but there are problems of marketing as fishermen have to travel too far to purchase ice and supply fish to the market which leads to high transportation costs.

Prior to the seaweed project, about three quarters of the village households were engaged in rice cultivation, as the village owns extensive land suitable for rice cultivation. Rice cultivation is now carried out on a part-time basis on a small scale level.

Coconuts were previously grown for copra production but now, it is used for self-consumption in the village.

Seaweed cultivation had attracted a lot of villagers because of the low investment cost; besides there has been considerable government assistance in terms of setting up the farms. The free construction of a big community hall, supply of free punts, drying sheds and storage facility has also been a motivator for a lot of the villagers to engage in seaweed production.

The infrastructure of seaweed farming is well developed in the village, with most farmers owning motorized punts and having access to drying racks and storage facilities.

The work on seaweed farms is not labour intensive as it only requires routine checks during the growing stages. This gives farmers time to attend to other subsistence activities such as fishing and gardening.

From personal observations in the village, the income from seaweed seemed to have had some impact in that there was some improvement in the living conditions such as housing and the quality of food consumed. The villages had cash savings to purchase other food items from the village store to supplement their diet.

The two major problems faced by seaweed farmers are marketing and destruction of crops by adverse weather conditions such as cyclones and strong winds.

The tendency in Kiuva so far has been reliance towards seaweed farming as a major source of income, however to have a sustained development in the village, the people also need to diversify into alternative activities. The vast areas of land could be used for rice and agricultural production and fishing could also be seen as a possibility.

Seaweed farming in Kaba

Dromuna village is situated at the end of Kaba point on the east coast of Viti Levu, not far from Kiuva. The village was one of the first to engage in commercial cultivation of seaweed in 1986 with start of 5 farms. At the end of 1989, only one farm was in operation.

The reasons for loss of interest by villagers are several, some of which relate to destruction by cyclones, farms being located too far from the village and the loss of market to Coast Biologicals which provided the initial support.

The punts used in the seaweed project are now used as a means of transport and for fishing.

According to informal discussions with the villagers, they preferred fishing to seaweed farming as fishing provided a ready cash income whenever the need arose.

The village has a fishing Cooperative which purchases fish from fishermen and supplies ice to them. Thus, once there is sufficient catch, it is marketed to Nausori or Suva.

Attempts are being made by the Fisheries Division to revive the seaweed farming in the area as a subsidiary source of income.

CONCLUSION

Marketing is an important determinant in the success of any industry. The seaweed market in general is rather unstable where there are periods of over supply and sudden bursts of great demand, partly relating to new uses of the extract products.

Experience in South East Asian seaweed producing countries such as Philippines and Indonesia has already shown that marketing of seaweeds is further complicated by the practice adopted by buyers and agents who usually obtain their annual requirements needs from farmers at the early part of the year which pushes the prices up during that period. Once their targets are fulfiled, they abruptly withdraw from the market.

The early year high prices leads farmers to increase production, but by the time new crops are available, prices usually fall with large supply. Sometimes, this situation leads the farmers to neglect their farms and concentrate on other sources of income. Consequently, this leads to a lower output and often of a poorer quality. This fall in supply again pushes prices up and the cycle repeats.

This trend in South East Asia should be seen as a lesson for Fiji and other South Pacific Islands as marketing in the Islands is very much based on a similar pattern.

Looking at the Eucheuma seaweed industry in Fiji, production of seaweed has been a technically successful venture for aquaculture: Seaweed farming so far has provided an important source of income for many coastal villagers. Several sites have been identified as potential grounds for Eucheuma production. However, the marketing of Eucheuma has had major set-backs for the industry, which are difficult to overcome by local efforts as yet.

On the other hand Seaweed farming in Fiji has also become popular because of the low level of technology and investment required, besides a considerable level of government support is also available.

Seaweed takes only a short time to grow. Thus even if destroyed by cyclones, it is easy to revive compared to fish farming. The technology for fish aquaculture is also very expensive and specialised compared to seaweeds.

The development of a semi - refined processing plant within the South Pacific region would probably help to stabilise the industry in terms of marketing.

Since the islands with their sheltered lagoon and reef areas are considered as good potential grounds for aquaculture development, diversification into other types of seaweeds probably with lower volume and higher value commodities should be experimented with, to avoid the risk of monocultural production.

Presently, as according to the case studies, there are no immediate problems with regard to use of the sea as people having customary Fishing rights in an area are also entitled to carry out aquaculture activities according to the village traditional regulations. However, as these activities develop further with the development of aquaculture technology the ownership of customary fishing rights would be inadequate to regulate, manage and develop aquaculture activities such as seaweed farming.

With the possibility of the different commercial seaweed commodities grown and exchanged there would be a need for definate codification of boundaries to avoid conflict with the resource owners and investors as it would become a fundamental issue to establishment of the industry.

Finally, since Eucheuma has been successfully grown in Fiji and further according to investigations by the Fisheries Division, there are extensive potential areas for further cultivation, it is important that some sort of economics of Eucheuma cultivation focussing on potential markets, price forecasts and marketing trends be done before mounting on to further expansion into its production.

Also, it would be difficult to regain confidence and support of farmers already in production if the current marketing problems continue. It may have further implications on other types of commercial seaweed cultivation in future even if growth results indicate success.

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