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ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

SEVENTEENTH REGIONAL TECHNICAL MEETING ON FISHERIES

(Noumea, New Caledonia, 5 - 9 August 1985)

EUCHEUMA SEAWEED FARMING IN KIRIBATI

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Ministry of Natural Resource Development  
Kiribati

SUMMARY

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SUMMARY

Eucheuma seaweed, source of carrageenan gel which is utilised in the food, pharmaceutical and cosmetic industries, is being farmed commercially on Tarawa atoll in Kiribati, Central Pacific. Some 1600 hectares in the eleven lagoon atolls within Kiribati have been assessed by the Fisheries Division as suitable for this activity and families are now being encouraged to set-up their own seaweed farms. Using a method of horizontally positioned lines, 200 gram Eucheuma seedlings will grow effectively to between one and two kg in ten weeks, enabling a one tenth of a hectare outer island family farm to produce 4.1 tonnes of dried seaweed per year, of AUD \$1558 income value. With first year construction and running costs of \$179 a reasonably productive family might earn a net \$27 per week. A possible four month reduced and seasonal growing period, under investigation, may reduce this average net production of 39 to 26 t/h/yr. Washed, redried and compacted, the raw dried Eucheuma is being purchased locally at \$0.38/kg. Present production since June 1985 in Tarawa is rising at two tonnes per month, and it is estimated that with 50 small farms on each of five islands 1025 tonnes would be produced per year.

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### Introduction

1. The tropical seaweed Eucheuma is a source of the phycocolloid gel Carrageenan, utilised in the food, pharmaceutical and cosmetic production industries. Large scale production of this seaweed is limited to the Philippines where in 1979 15,000 tonnes of farmed dried E.cottonii was produced and exported to the USA, Denmark and France.
2. In 1980 a pilot project to develop Eucheuma seaweed farming in Kiribati was started on Christmas Island by Fisheries Division. On establishing a farming technique that could be profitably employed by I-Kiribati people, the project was transferred in 1982 to the main Kiribati chain of 17 atolls. Here on seven of the eleven lagoon islands during 1983 trial plots of E.striatum (E.cottonii type) were set-up around the lagoon peripheries to identify suitable locations.
3. The shallow lagoon atolls in Kiribati running north to south astride the equator at 175°E are typically circular in shape with thin strips of land on the east; reefs border the lagoons and keep them open to the west. Introduced Eucheuma will grow in areas where the seawater is recently oceanic in origin, circulating or agitated through tidal or wind driven motions, where wave action is non-destructive. From the 1983 study supported by the Overseas Development Administration of the UK, some 1600 hectares of potentially farmable reef and lagoon areas were identified that could produce a minimum of 26 tonnes of dried seaweed per hectare per year. Such farmed production would give an Outer Island I-Kiribati family approximately a net weekly income of \$17 by farming approximately one-tenth of a hectare.

### Farming Method

4. Eucheuma like all seaweeds absorbs nutrients and growth requirements from surrounding seawater through the thallus (body) surface, and only utilises a 'root' system for attachment to substrates. Furthermore Eucheuma can be broken up into small pieces and each will grow to 'maturity'. These two characteristics make the farming of Eucheuma possible whereby hand-size (200 gram) seedlings attached with plastic rafia twine to a horizontally positioned fishing line will grow in the right aquatic conditions to harvestable size (one to two kg.) in eight to twelve weeks.
5. A productive farm therefore consists of perhaps 300 lines of 82 kg-test nylon monofilament in seven metre lengths staked-out between mangrove (Rhizophora sp.) or Guettarda speciosa (I-Kiribati: Te Uri) posts, occupying approximately 1000 square metres of shallow sublittoral. By planting thirty lines per week over the (average) ten week growing period, and following a regular harvesting/replanting schedule, a continuous weekly income can be extracted from the farm. But many variations on the theme are possible to fit the often spontaneous and variable monetary needs of the subsistent outer-islander.
6. The fresh harvest is taken ashore after the best growing tips (10 to 20% of the harvest) have been selected for replanting. Dried for a week on 4 x 2 metre drying racks constructed from Saronshade stretched out over chainsawed coconut timber frames, the (raw) seaweed at 10% of it's fresh weight is ready for sale.

A Farmer's Costs, Production and Income

7. Table one shows a farm's capital costs expended during the first 10 weeks of construction, amounting to between AUD\$136 for a 300 line farm to \$192 for a 500 line farm. These costs increase to \$214 and \$323 respectively if imported timber is substituted for chainsawed coconut timber. Approximate replacement times for the tarpaulin is per year, the nylon every three years and the locally cut mangrove stakes every nine months.

	1050 sq.m		1750 sq.m	
	Quantity	Cost	Quantity	Cost
1. Nylon Monofilament 82kg test	2280m	53.81	3800m	89.68
2. Sledgehammer	1	21.88	1	21.88
3. Tarpaulin	1	25.00	1	25.00
4. Locally cut mangrove stakes	360	-	600	-
5. Drying racks				
a/		Costs		
Salonshade 4m		7.20		
3x2 Radiata Pine 15.2m		23.56		
Baton 15.2m		3.50		
PRICE PER RACK	34.26			
	3	102.78	5	171.30
b/				
Salonshade 4m		7.20		
Coconut timber chainsawed		1.00		
PRICE PER RACK	8.20			
	3	(24.60)	5	(41.00)
6. 5% contingencies		10.17		15.39
7. TOTAL CAPITAL COST		<u>213.64</u>		<u>323.25</u>
8. Total Capital Cost, substituting coconut timber		135.46		192.95

Table One - Capital costs for 1050 and 1750 sq.m farms

8. Running costs amount to \$43 and \$71 per year for plastic rafia twine-"tie-tie", for 300 and 500 line farms respectively.
9. Combined, these costs are \$3.44 and \$5.06 per week (over the first year).
10. With a conservative per plant fresh weight after 10 weeks growth of 1kg. and a seedling size of 0.2kg., a thirty line weekly harvest would produce 79kg. raw dried *Eucheuma* for sale. Per annum with constant growth rates throughout the year 4.1 raw tonnes would be produced from a 300 line farm, equivalent to a net raw production rate of 39 tonnes per hectare per year (a 500 line farm would yield 6.8t/yr).

11. In certain farming situations for example areas of South Tarawa a seasonality effect has been observed and is presently being quantified. Here due to some growth-limiting factor (nutrient linked?) in the lagoon environment, growth rates slow and the counter-productive effects of grazing and epiphytic attack (especially Ceramium sp.) become highly significant, around July and August. Untouched by the farmer, recovery is slow and the reduced (sometimes negligible) production can last an estimated four months; but methods of raising production and reducing the period by bringing in healthy seed material and educating farmers on weeding-out sick, infectious plants are being investigated.
12. At worst four months of reduced growth would bring annual production rates down to 2.7 t for a 300 line farm (4.6 for 500 lines).
13. The farmer selling his raw dried Eucheuma at A\$430 per tonne (based on export market prices) on Tarawa and \$380 per tonne on the Outer Islands would receive from a 300 line farm a yearly gross income of \$1763 on Tarawa and \$1558 on the Outer Islands, with no seasonal variations in growth. Per week and after costs this net income is equivalent to \$31 on Tarawa and \$27 on the Outer Islands. Seasonally limited growth might reduce this 1050 sq.m farm production to 2.7 t/yr which would enable gross incomes of \$1161 on Tarawa and \$1026 on the Outer Islands: \$19 and \$17 net per week.
14. In a higher incentive situation a farmer with an increased farming area of 1750 sq.m or 500 lines could increase this net weekly income to \$51 on Tarawa and \$45 on the Outer Islands with no seasonality. Four months of low growth would reduce these net incomes to \$33 and \$29 per week respectively.
15. These figures demonstrate the viability of seaweed farming as an income generating activity where even on an isolated island with a small Eucheuma farm and only two thirds of the year being productive, profit can still be gained at \$17 per week averaged over the year. In full time employment with the Outer Island Councils, who represent virtually the only source of employment besides copra, a labourer might earn \$12.50 to \$17.50 per week depending on which island he lives on. But the opportunity of ever working for the council as a labourer is extremely slim.

#### Production and Income Potential for Kiribati

16. Based on present studies, Eucheuma could be farmed on up to ten lagoon islands in the Kiribati chain, and as already mentioned some 1600 hectares of potentially farmable sublittoral has been identified.
17. Table two demonstrates the Potential Production quantities of raw dried Eucheuma for Kiribati per annum, for two farm sizes, with and without seasonality.

No. of farms per island	Farm Area	No Seasonality			Seasonality		
		Islands 1	5	10	1	5	10
20	1750	136	680	1360	92	460	920
	1050	82	410	820	54	270	540
50	1750	340	1700	3400	230	1150	2300
	1050	205	1025	2050	135	675	1350
100	1750	680	3400	6800	460	2300	4600
	1050	410	2050	4100	270	1350	2700

Table Two - Potential Eucheuma Production Tonnage on 1, 5 and 10  
Islands in Kiribati

18. Thus with 50 small farms (1050 sq.m) in operation throughout the year on each of five islands some 1025 tonnes of raw Eucheuma could be produced per year.
19. Once purchased in a raw (dried for a week) state the seaweed is washed in fresh water by the buyer, at present Fisheries Division, to remove salt and foreign matter, and then dried again to yield at 5% of the original fresh weight a wash dried product. This product would then be hydraulically baled and trucked or shipped (from the Outer Islands) to port Betio ready for export, valued FOB Betio at approximately A\$1000 per tonne. The wash dried seaweed can be sold CIF Boston and Denmark at about US\$1600/t.
20. The production quantities can therefore be converted into export and income potentials, where the tonnage exported, due to washing, is half the production tonnages in table two. For example, at FOB Betio A\$1000/t value (\$810/t FOB Outer Islands), the potential earnings for Kiribati for 100 farms on each of five islands without seasonality could be expected to be over \$1.5 million.
21. With 250 small farms (approximately 26 hectares) in operation on five islands, producing 1025 tonnes of raw dried E. striatum per year, A\$512,500 in foreign earnings could be expected. Yet with ten islands and sufficient farming area available for 100 farms on each island, an annual production of 6800 t could result, valued FOB at \$3,400,000 per year.

#### Markets, Export Freight and Compaction Prior to Export

22. Companies in five countries, at present purchasing E. cottonii from the Philippines, have expressed interest in buying wash dried Eucheuma seaweed from Kiribati.

23. CIF prices are based on the carrageenan yields from the seaweed in conjunction with moisture, sand and salt levels in the final product. Raw dried seaweed, the major product of the Philippines E. cottonii industry gives a 15% (kappa) carrageenan yield on extraction, valued FOB Cebu City at US\$300/t, plus Philippines to Denmark freight costs of US\$100/t. Wash dried E. striatum (Cottonii) can give carrageenan yields of 50 to 60%, resulting in a 3 to 4 fold increase in the CIF price: US\$1200 to \$1600 per tonne. But to produce such yields moisture contents should be down to around 10% and the less salt the better. Harsh quality controls and rigorous washing methods are therefore required to produce a high quality wash dried product to gain these top CIF prices. Kiribati has difficulty in exporting raw-dried Eucheuma with the high cost of export freight, and in order to maintain a high quality of product it is imperative that the local buyer purchases raw-dried and then washes the seaweed as opposed to the farmer producing wash dried seaweed for sale.
24. Export freight rates from Kiribati to such places as the East Coast USA and Denmark are extremely expensive and almost prohibitory. Compaction of the wash dried product is thus imperative to reduce shipping costs. Compaction trials so far in Kiribati have been restricted to the use of a manual wool press producing 0.6 cbm bales of a maximum 200 kg weight: a 3cbm/tonne ratio. Such compaction is insufficient, and for viability in exporting to the USA and Europe this ratio must approach 1.5 cbm/tonne, which it is estimated can be achieved using a hydraulic press. An extensive search is therefore under way to identify the supplier of a suitable press, but this is proving to be a difficult matter.
25. Total export freight, handling and insurance costs in shipping LCL to Denmark and the USA with transshipment in Australia, amount to US\$490 per tonne occupying 1.5 cbm (A\$605/t). Internal freight, handling and insurance costs from the Outer Islands to Tarawa is another A\$190 per tonne. These costs can probably be reduced as guaranteed export tonnages increase, commodity rates can be negotiated and containers (12 to 16 t @) are used.
26. Undoubtedly a Pacific Basin market for example New Zealand or Japan would be more stable in the future, but the present CIF prices from the USA and Europe still offer greater profitability, providing the compaction problem can be solved.
27. Information from the 1983 FAO Study on the World Seaweed Industry and Trade, suggests that according to Philippine processors and exporters the supply and demand situation of E. cottonii is balanced. But buyers from the USA and Denmark are presently cooperating in an intensive search for alternative raw material producers.
28. With the appearance on the carrageenan market of a cheaper semi-refined product, increased utilisation of carrageenan may well result, which over time may cause an increase in demand for the raw material. The present market for refined carrageenan is expanding at about 5% per annum (FAO, 1983).

Commercialisation in Kiribati

29. During 1985 over forty farmers have been introduced on South Tarawa to the lagoon farming of Eucheuma. Expansion has had to take place slowly, governed by availability of seed material and the social acceptance of this income generating activity. Those with high initiative and incentive have easily managed to construct farms of 300 lines and slowly others are following. A suitable punt has now been trialed by the Fisheries Division Boad Shed, but private sector expansion is limited through lack of funds, recently poor and expensive timber supplies.
30. Production has now risen to half a raw dried tonne per week, giving a promising average \$20 income per week to the producing farmers. Other farmers are still involved in construction, and others still have come up against the "July-August" reduction in growth. The 40 farms should soon be producing 3 tonnes per week.
31. It is intended to use Tarawa as the industry's testing ground, where full support can be given to assessing and developing all aspects of the project. But full benefit of the income earning potential of the project will be on the Outer Islands. Activities on the three islands of Butaritari, Abemama and Beru are being stepped up under the Fisheries Division Extension Programme; an initial group of independent farmers have recently been introduced on Butaritari, to be expanded to twenty-five in September, with a possible trial shipment to Tarawa by the end of 1985.

Financial Support for the Project

32. Financial and advisory support for the Seaweed Project in Kiribati has been given by the European Economic Community, the Governments of New Zealand and the United Kingdom. Technical advisory services are also being sought from Japan. The EEC under Lome II has provided A\$13,113 towards the purchasing of farming materials. New Zealand during 1984 donated A\$17,724 for drying racks, the compacting machine and establishment of a purchasing fund; in 1985 this support has been extended to a further A\$48,000 for workshed construction on the Outer Islands and in-assistance of budgetary requirements.
  33. The Kiribati Government has assisted in the provision of project staff, buildings, boats and the objective of striving towards economic independence.
  34. The project under the overall programme and supervision from the Fisheries Division is run by T.C. appointment provided by ODA of U.K. and counter-parts from the Division.
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