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Advances in seaweed aquaculture among Pacific Island countries

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Abstract

Recent developments in the seaweed aquaculture industries of Pacific islands are reviewed from the perspective of technical, production, geographic, marketing, species-diversification, socio-economic and institutional-support advances. Successful commercial aquaculture of seaweeds in the Pacific island region is presently based on two species, *Kappaphycus alvarezii* in Kiribati, Fiji and Solomon Islands, and *Cladosiphon* sp. in Tonga. It is possible that other candidate species could be considered for aquaculture for food (e.g. *Caulerpa racemosa* or *Meristotheca procumbens*) or extraction of agar (*Gracilaria*), although further research on the technical feasibility of aquaculture methods to produce sufficient tonnage, and particularly on their marketing, is needed. While the Pacific island region may be environmentally ideal for seaweed aquaculture, the limitations of distance from main centres and distance from markets, vulnerability to world price fluctuations, and socio-economic issues, make it unlikely that the Pacific Island region will ever rival the scale of Asian seaweed production. Regional seaweed farming can nevertheless make a useful contribution to supplement other sources of income, and can be an important economic boost for isolated outer islands where few alternative income-generating opportunities exist.

Introduction

The "Pacific Islands region" for the purposes of this paper comprises those countries and territories that are members of the Secretariat for the Pacific Community (SPC) and include the Federated States of Micronesia (Yap, Chuuk, Pohnpei and Kosrae), the Northern Mariana Islands, Marshall Islands, Nauru, Palau, Kiribati, Papua New Guinea (PNG), Solomon Islands, Vanuatu, New Caledonia, Fiji, American Samoa, Samoa, the Cook Islands, French Polynesia, Niue, Pitcairn, Tokelau, Tonga, Tuvalu, and Wallis and Futuna. Uwate et al. (1984) and Adams et al. (2001) have published reviews of aquaculture activities in the Pacific Islands region, and South and Pickering (2006) includes mention of the main seaweed aquaculture activities. Currently there are two species which provide a basis for commercial aquaculture; the red seaweed *Kappaphycus* Doty, and the brown seaweed *Cladosiphon* sp. The latter is known to occur naturally in Tonga and in New Caledonia; all cultured stocks of *Kappaphycus*, however, originated from outside the region.

Kappaphycus farming has been strongly promoted in the Pacific region because it requires a low level of technology and investment, can be operated at the family level, has relatively little environmental impact, does not require refrigeration or high-tech post-harvest processing within the country, and is normally compatible with traditional fishing and other subsistence uses of the inshore environment. It is a potential source of income and employment in rural areas with few other income-generating opportunities, and in particular is an activity that can provide income for women.

South (1993) reviewed the farming of *Kappaphycus* in the Pacific Islands up until the early 1990's, and reviews since then include Ask (2003), Ask et al. (2003c), Luxton and Luxton (1999), Luxton (2003), Pickering (2003) and South and Pickering (2006).

Various difficulties affecting the initial attempts to cultivate *Kappaphycus* in the 1980's (e.g. Tonga, Solomon Islands, Federated States of Micronesia and Tuvalu) led to the activity being abandoned in most of these countries (South, 1993).

Early results in Fiji proved encouraging, and this led to the establishment of an industry with total production of 684.4 t between 1985 and 1990 and highest yearly production of 277 t in 1987, however for a range of reasons reviewed by Ask et al., (2003c), Luxton (2003) and South and Pickering (2006) production ceased in 1993. A re-vitalization of the Fiji industry from 1997 onwards is also reviewed by Ask et al. (2003c). Annual seaweed production under this new initiative rose to 419 t by 2000, but levels have not reached the projections forecast by Ask et al. (2003c) and production is now declining. Feedback from farmers during 2003 indicated a loss of enthusiasm due to long delays in payments for seaweed produced; in some cases as long as 6 months (Pickering et al., 2003).

Seaweed production in the region has been both greatest and most consistent in Kiribati (Why, 1987; Uan, 1990; South, 1993; JICA, 1996). Commercial *Kappaphycus* cultivation commenced in the mid 1980's initially in the Gilbert Group, and later returned to the Line and Phoenix Groups where the early trials had taken place (JICA, 1996). In 1991 the commercial farming and marketing activities were handed over to the 100% government-owned Atoll Seaweed Co. Ltd. Production in recent years has been greatly dominated by a single atoll, Tabuaeran (Fanning Island) in the Line Islands, which has oceanographic conditions suited to rapid plant growth, and no copra industry owing to aged palms.

This paper reviews recent developments that might be considered "advances" in seaweed aquaculture among the countries and territories of the Pacific Islands region, including not only "technical advances" but also "production", geographic", "marketing", "species-diversification", "socio-economic" and "institutional support" advances.

Technical advances

The Pacific Islands' *Kappaphycus* industry has its origins in the Philippines and uses similar methods (McHugh & Philipson, 1989; Adams & Foscarini, 1990), so there is little to report from the Pacific region that could be considered as substantive "advances" in cultivation technology compared with Asian practices. Three principal farming methods have been tried in the South Pacific: off-bottom (fixed monofilament lines between posts driven into the substratum); floating rafts; and floating long-lines (Prakash & Foscarini, 1990; Ask 1999). Commercial cultivation in Fiji, Kiribati and Solomon Island is nowadays almost entirely by the off-bottom method. Kiribati also uses net cages for seed-stock farms, to protect plants from fish grazing.

Recently there has been a resurgence of interest in the raft method of cultivation in Solomon Islands, to reduce grazing by fish. Rafts are relatively easy to move around, to find locations where fish grazers are less abundant; placing rafts in depths of at least 5–10 m often gives good results (Alex Meloty pers. comm.). Another theoretical advantage of rafts is that a wider choice of farm sites becomes possible, because seabed type and water depth are no longer site-selection issues. In Kiribati trials of PVC-pipe rafts are now being carried out in the Gilbert Group on Abaiang and Nuotaea atolls, especially in areas where water flow is lacking (Ienimoa Kiatoa, pers. comm.). The disadvantage of rafts is that they require more labour and materials to set up (in Kiribati, even bamboo would need to be imported). In terms of their advantages, grazing by fishes on Pacific Island farms occurs at levels that can be tolerated for the most part, and there is currently no shortage of suitable reef space for off-bottom culture. The ultimate test of whether or not rafts are an improvement over off-bottom cultivation will lie in the proportion of farmers that willingly adopt this method of cultivation.

A recent advance in Asian cultivation technology is the Made Loop, described by Ask et al. (2003a) as a simple, low-tech and rapid way of attaching and harvesting seaweed plants on lines. These lines take longer to make than raffia tie-ties but are said to last longer. Furthermore, harvest is quicker, material cost is no higher, and seaweed quality is higher since less stray tie-tie material tangles in extraction machinery. Information about the Made Loop was incorporated into Pacific Island regional training materials, and most seaweed project officers in Fiji and Solomon Islands now know about it. Farmers in Fiji, however, are almost entirely using the raffia tie-tie method because Government provides farm materials to farmers and has made a multi-thousand-dollar investment in a special imported UV-resistant raffia tie-tie material which is still available in bulk quantities. Solomon Islands farmers tried out the Made Loop method after demonstration at SPC-funded training workshops held in November 2002, and many in Rarumana and Waghena are now using this method. It has not yet been tried in Kiribati as they only recently heard about it.