Journal of Applied Phycology **105**: 105–109, 1996.

Economics of cultivating *Kappaphycus alvarezii* using the fixed-bottom line and hanging-long line methods in Panagatan Cays, Caluya, Antique, Philippines

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Received 11 August 1995; revised 18 March 1996; accepted 21 March 1996

Key words: economics, fixed-bottom, hanging long line, *Kappaphycus*

Abstract

A socio-economic survey was conducted among the *Kappaphycus alvarezii* planters of Panagatan Cay, Caluya, Antique, Philippines to determine some social information, farming practices and cost and returns of farming the seaweed. Cultivation is dominated by brown and green morphotypes using the fixed-bottom and hanging-long line methods. Approximately 9.3 t d. wt ha^{-1} and 7.2 t d. wt ha^{-1} is produced from fixed-bottom and hanging-long lines methods, respectively, after 60–90 days of culture. The former method requires a working capital and total investment of P7490 and P1870, respectively, compared to the hanging-long line which requires P8455 and P25464, respectively (US$ 1 = P26). A higher total revenue (P139500), net income ((P187895), and return of investment 1002%), but a shorter pay back period (0.10 years) were obtained in fixed-bottom than in hanging-long line. A lower total expenses were incurred in fixed-bottom (P21354) than in hanging-long line (P24566). The farming of *K. alvarezii* in this area has brought tremendous economic impact to the marginal fishermen.

Introduction

The introduction of *Kappaphycus* and *Eucheuma* farming in the Philippines in the mid '60s began in southern Mindanao (Doty, 1973; Parker, 1974; Doty & Alvarez, 1975, 1981) and spread to the Visayas (Lim & Porse, 1981; Laite & Ricohermoso, 1981; Posadas, 1988; Samonte et al., 1993) and Luzon (V.B. Alvarez, pers. comm.). It has undergone several modifications (Posadas, 1988; Trono, 1992; Samonte et al., 1993) and has transformed the life of several marginal fishermen (Smith & Pestano-Smith 1980; Alih, 1990).

The first literature (Samonte et al., 1993) on *Kappaphycus* farming in Western Visayas, Philippines, mentioned the production and economic efficiency of bottom line and raft monoline techniques at four cultivation sites on Antique and one in the Guimaras. There are several islands in Western Visayas with shallow reef flats with potential for *Kappaphycus* farming. Panagatan Cays is a shallow reef flat approximately 1300 ha surrounding three small islands. It is endowed with a wide seagrass bed and natural stock of *Eucheuma* (Kraft, 1972), *Haliotis* (Capinpin et al., 1994), *Tridacna, Trochus* and milkfish fry. The aim of the present study was to examine the socio-economic status of seaweed planters, production and economic efficiency of fixed-bottom and hanging-long line techniques of farming *Kappaphycus* in Panagatan Cays, Antique, Philippines.

Materials and methods

Forty-three *Kappaphycus* planters were interviewed using a structured questionnaire during the planting month (November) and harvest month (May) of the year. The respondens represented 72% of the total seaweed planters in the three islands. Responses were coded and expressed in frequency and % distribution. Information was gathered on: (1) personal data – age, civil status, residence, highest education attained, number of dependents, major livelihood, and minor

Table 1. Investiment requirements for *Kappaphycus* farming (ha^{-1} yr^{-1}) in Panagatan. (US$ 1 = P26 as of January 1996)

Item		Fixed-bottom			Hanging-long line		
		Value	Economic life	Depreciation	Value	Economic life	Depreciation
A.	Capital Investments						
	Non-motorized banca	2500	5	500	2500	5	500
	Bamboo-raft	1000	3	333	1000	3	333
	Monoline	7500	5	1500	9920	5	1984
	Post	260	2	130	224	2	112
	Float	0			3365	3	1122
	Total	11260		2463	17009		4051
B.	Working Capital	7490			8455		
C.	Total Investment	18750			25464		

livelihood; (2) farming practices – size of area, cultivated morphotype, planting method, period of cultivation, frequency of harvest, frequency of cultivation, and production; (3) economics – total investment, production cost, income $crop^{-1}$, return on investment and pay back year; (4) economic impact of seaweed farming.

Results

Social information

The planter's age ranges between 16 and 76 years. Planting is dominated by males, though the whole family is involved in this activity. A family consisted of 2–7 children whose ages ranged from 2–16 years. The majority of the seaweed planters were formerly farmers or fishermen in their original places of residence, who had shifted to this kind of livelihood after two years of seaweed planting. Except for two who are professionals, none of the seaweed planters had finished primary education. The two professionals have the biggest planting area and highest production.

Technical information

Cultivation

Planters use one or a combination of morphotypes (brown, green, red and pale violet) of *Kappaphycus*; however, farming is dominated by the brown and green morphotypes. Both the monofilament (#110) and polyethylene rope (#7) are used as ropes in fixed-bottom and hanging-long farming. The latter method is brought nearer to the water surface at constant depth and kept buoyant with styrofoam floaters. 'Seedlings' are tied to the rope with plastic strips (tie-tie) at a distance of 30–40 cm. The rope ranges from 4 to 7 m long and kept taut at both ends with a stake driven to the bottom. The distance between two ropes is 1 m.

One farming area ranges from 280–17500 m^{-2} or an average of 3500 m^{-2} $farmer^{-1}$ at an average stocking density of 0.5 kg m^{-2}. The first 'seedling' in this area came from nearby islands (Cagayancillo and Cuyo) six years ago. Since then, the area was able to sustain 'seedlings' for their farming purposes. The first forty-five days of culture is mainly for 'seedling' expansion puposes. After this period, it takes another 60–90 day growing period before the seaweed is harvestable. Cultivation in this area is year-round, and the average production is higher in fixed-bottom (9.3 t d. wt ha^{-1} $crop^{-1}$) than in hanging-long line (7.2 t d. wt ha^{-1} $crop^{-1}$) with three crops $year^{-1}$. Approximately 16.5 ha of the total reef flat is planted with *K. alvarezii*.

Marketing outlet

All dried seaweeds are sold to a 'stacker'. There are five traders who are outsiders but each has a trader in the area. The farm gate price in November 1993 was P4.50 kg^{-1} but it increased to P7 in May 1994 which further increased to P11–13 kg^{-1} to this date. A stacker usually gets P0.50–P1 kg^{-1} as compensation from the trader who ships the seaweed either to Cebu or Manila for processing or export.

Table 2. Cost and returns (Phil. Peso, ha^{-1} yr^{-1}) of *Kappaphycus* farming in Panagatan (US$ 1 = P26 as of January 1996)

	Fixed-bottom	Hanging-long line
FIRST CROP		
Production, dry (kg)	9300	7150
Revenues (P7.50 kg^{-1})	69750	63625
Less: Operating Expenses		
Cash:		
Seedlings, kg (fresh, P1 kg^{-1})	4900	5800
Labor: Installation (P15 m^{-1} $line^{-1}$, 1 pers)	1300	1120
Tying (P0.30 5 m^{-1} $line^{-1}$, 1 pers)	390	335
Materials: Plastic strip (Tie-tie)	900	1200
Sub-total	7490	8455
Non-cash:		
Family Labor (harvesting)	1800	1800
Depreciation	821	1350
Sub-total	2621	3150
SECOND & THIRD CROPS		
Revenues	139500	107250
Less: Operating expenses		
Cash:		
Seedlings, kg (fresh, P1 kg^{-1})	0	0
Labor: Installation (P1 5 m^{-1} $line^{-1}$, 1 pers)	2600	2240
Tying (P0.30 5 m^{-1} $line^{-1}$, 1 pers)	780	670
Materials: Tie-tie	1800	2400
Sub-total	5180	5310
Non-cash expenses:		
Family labor (harvesting)	3600	3600
Depreciation	2463	4051
Sub-totaal	6063	7651
Total Expenses	21354	24566
Net Income	187896	136309
Return on Investment (%)	1002	535
Payback period (year)	0.10	0.19

Economic analysis

The comparative investment on a per hectare basis of the two culture methods of *Kappaphycus* farming in Panagatan is higher in the hanging-long line (P25464) (US$ 1 = P26) than in the fixed-bottom method (P18750) (Table 1). This is due to the need for more monoline ropes and floats as well as higher working capital requirements (P8455) compared to fixed-bottom (P7490). In like manner, the total expenses for hanging-long line is higher (P24566) than in fixed-bottom line (P21354). However, a higher net income (P187896) is derived from fixed-bottom line than in hanging-long line (P136309). Consequently, a much higher return of investment (%) is obtained in fixed-bottom line (1002) than in hanging-long line (535). A shorter pay back period of 0.10 years (Table 2) is also computed in the fixed-bottom line.

Discussion

The average production obtained from fixed-bottom line method (27.9 t ha^{-1} yr^{-1}) reported in the present study is higher than those reported by Alih (1990) in Tawi-Tawi (5 t ha^{-1} yr^{-1}) and Samonte et al. (1993) in other parts of Western Visayas (5.8 t ha^{-1} yr^{-1}). The increased production in Panagatan Cays could be explained by site fertility to support a smaller density, which requires less plant respiration but higher photosynthetic rate with a corresponding greater carbon fixation (Gerard, 1984, 1986). Approximately 1/3 of the total reef area is planted with *Kappaphycus*.

Earlier reports on the commercial farming of *Kappaphycus* and *Eucheuma* in the Philippines involved fixed off-bottom (Lim & Porse, 1981; Posadas, 1988; Alih, 1990; Llana, 1991; Trono, 1992) and floating raft methods (Samonte et al., 1993; Trono, 1992). The results of the present study reveal another method of cultivating *K. alvarezii*, the hanging-long line. Planters adapted this planting technique with the objective of controlling or reducing grazing by sea urchins, synaptids and juvenile siganids. However, the results show that lower production was obtained compared with the fixed-bottom line. This can be attributed to the technique used in the former. A decreased growth rate of *Eucheuma* grown near-surface constant-depth was observed after the second two weeks of fast growth (Doty, 1971). The organic nitrogen content of the thalli grown just under the surface declines in a parallel fashion (Doty, 1973). Production could be increased in a balanced light intensity, water quality and water motion. Information on the ecological aspects of seaweed farming is thus significant among marginal fishermen. The hanging-long line is more effective than the fixed-bottom technique for 'seedling' source purposes, but the latter is more efficient for biomass production purposes. It is therefore more productive to culture the seaweed for the first 30–45 days using the hanging-long line and shift to the fixed-bottom until the seaweeds are harvestable. This will expose the seaweeds to the rise and fall of the tide with a concomitant balanced light intensity. A source of 'seedlings' for farming is not a problem in this area, unlike the neighboring islands (Samonte et al., 1993), because there is year-round cultivation of *Kappaphycus*.

Seaweed farming in Panagatan Cays is perceived by the planters as a better source of livelihood than fishing, which is only done for home consumption. Income derived from seaweed farming showed an increased purchasing power of the basic needs (food, shelter, education) and recreational needs. An improvement in the standard of living among the planters has been demonstrated through the purchase of refrigerators, TV sets, karaoke, video cassette players, radio cassettes, and sail or motorized boats. Electrification of the island six years after the introduction of seaweed farming is a strong indication that there is progress in this area.

Acknowledgements

The senior author is pleased to acknowledge the travel support of the Chile Embassy in the Philippines through Consul Eleodoro Pempelfort, Mr Arturo Rocha, Executive Vice President, CF Sharp & Co. Inc., and Mr VB Alvarez for her attendance to the 15th International Seaweed Symposium in Valdivia, Chile.

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