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# Economic Returns from Seaweed *(Eucheuma cottonii)* Farming in Bali, Indonesia

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## Abstract

The farming of seaweed is becoming more common in Indonesia. The species known as *Eucheuma cottonii* is the most commonly cultured. There appears, however, to be no estimates of the economic returns from this activity for Indonesia. After providing a brief background on culture technique and marketing aspects, we analyze the investment, cost and revenue data from a 1-ha *E. cottonii* farm in Jungut Batu, Bali. It is estimated that the payback period for this activity on this farm is 7.8 months and that seaweed farming gives an accounting rate of return of 123% and an economic rate of return (IRR) of 153%. Thus *E. cottonii* farming is a potentially attractive investment in Indonesia and more so since it is relatively labor-intensive and does not require significant quantities of processed or imported inputs such as fertilizers, chemicals, fuel and food.

## Introduction

Seaweed is the major non-food fishery item exported from Indonesia. Total export production of seaweed in 1984 was estimated to be 3,061.1 t with a value of US$658,842; by 1988 this had increased to 8,366 t with a value of $2,880,510 (Anon. 1989). In terms of volume, seaweed ranks fourth among Indonesia's fisheries exports following shrimp, tuna and other fish (Table 1).

Due to increasing export demand for seaweed, the Indonesian Government has encouraged seaweed farming in coastal areas (Directorate General of Fisheries 1988). Many coastal rural dwellers in Bali have adopted seaweed culture, but in other coastal rural areas the rate of adoption of this culture is slow. This is partly because Bali has some advantages such as natural seed availability, suitable

Table 1. Indonesia's export of fisheries products by type of commodities, 1984-1987 (in t).

| Commodities | 1984 | 1985 | 1986 | 1987 | Average growth/year (%) | Percentage of total exports |
|---|---|---|---|---|---|---|
| Food items | 66,392 | 72,629 | 92,579 | 122,270 | 13.4 | 87.1 |
| Prawn | 28,025 | 30,980 | 36,101 | 44,267 | 14.0 | 31.1 |
| Tuna/skipjack | 14,702 | 17,889 | 24,236 | 33,995 | 17.5 | 24.2 |
| Other fishes | 8,623 | 9,158 | 10,611 | 18,902 | 15.8 | 13.5 |
| Frog thigh | 2,200 | 2,802 | 3,752 | 3,078 | -2.5 | 2.2 |
| Sea cucumber | 1,318 | 3,123 | 2,362 | 2,517 | 30.6 | 1.8 |
| Jelly fish | 2,556 | 1,875 | 4,762 | 3,372 | -15.1 | 2.4 |
| Crabs | 2,143 | 1,749 | 1,944 | 2,049 | 1.3 | 1.5 |
| Others | 6,823 | 5,053 | 8,811 | 13,730 | 25.4 | 9.8 |
| Nonfood items | 9,303 | 11,868 | 14,866 | 18,108 | 16.7 | 12.9 |
| Ornamental fish | 204 | 235 | 859 | 530 | 61.5 | 0.4 |
| Seaweeds | 3,061 | 5,446 | 7,111 | 9,882 | 34.4 | 7.0 |
| Sea shell | 2,603 | 2,832 | 2,389 | 2,740 | 5.2 | 2.0 |
| Others | 3,435 | 3,355 | 4,507 | 4,956 | 6.0 | 3.5 |
| Total | 75,695 | 84,497 | 107,443 | 140,378 | 13.8 | 100 |
| Total value (FOB US$000) | 248,063 | 259,444 | 374,117 | 475,524 | 18.1 | |

Source: Central Bureau of Statistics, Jakarta, 1987 cited in Directorate General of Fisheries, Jakarta, 1988.

coastal sites, developed transportation and market networks. These attractive conditions are not satisfied in other coastal areas of Indonesia. For example, seaweed farmers in Sibolga, North Sumatra; Seribu Islands, Jakarta and in Kabupaten Barru, South Sulawesi, depend on seed from Bali and market their seaweed through middlemen mostly from Bali.

As yet no estimates appear to have been made of the potential economic return from seaweed farming in Indonesia. Therefore, this paper aims to provide estimates of potential economic returns from *E. cottonii* farming using data obtained from a farm in Bali and analyze the available cost data. Although the data and the results are specific to Bali, the techniques used to evaluate and analyze the data are of general applicability to seaweed farming. Before analyzing the data, background information is given about the species maricultured, the culture technique used and the marketing aspects.

## Species, Culture Technique and Marketing Aspects

Five species of seaweed are of economic importance in Indonesia: *Gracilaria* sp., *Gelidium* sp., *Sargassum* sp., *Eucheuma cottonii* and *Hypnea* sp. *E. cottonii* is the most extensively cultured and the market price of this species is higher than for other seaweed species.

For example, in December 1988, at the farm gate in Bali, the market price of dried *E. cottonii* was Rp. 450/kg (Indonesian currency unit: Rp. 1,715 = US$1), but the price of dried *E. spinosum, Gracilaria* sp. and *Gelidium* sp. was only Rp. 250/kg as one author found from interviews in Bali.

The culture technique most commonly used is the off-bottom monoline system employed by *E. cottonii*-seaweed farmers in Bali because of the suitable nature of coastal sites. Materials required for this technique include wood, bamboo, nylon lines or twine and plastic rafia. Plants are tied along the nylon lines. Propugales are spaced along the nylon line at intervals of 0.2 m or at a planting density of 5 plants·$m^{-1}$. The lines are tied to stakes driven into the bottom of the seafloor. The stakes are spaced at distances of 10 m along the rows which are 0.5 m apart.

The market structure of seaweed in this coastal area (Bali) can be described as one of oligopsony. At the village level, seaweed farmers sell their products to few buyers (collectors and/or middlemen) in dried form. These village collectors collect the seaweeds on the site, and therefore, seaweed farmers do not need to pay transportation costs. Collectors at the village level then sell the seaweed to large traders in Bali and or outside Bali (Jakarta and Ujungpandang). Finally, these large traders of seaweed sell to exporters or directly to overseas buyers in countries such as Denmark, USA and Singapore.

It is worth noting that buyers at the village level are not necessarily agents of any parent company, but have established trading relationships with large traders as well as with other interested international buyers. Trading relationships between village/local traders and seaweed farmers extend beyond the mere sale of seaweed. Village seaweed traders provide a multiplicity of economic services to seaweed farmers such as finance for investment purposes (loans).

In Bali the price of *E. cottonii* at the village level is much the same everywhere and, in 1988, was Rp. 450/kg. Seaweed collectors are able to make a profit because of the higher international market price. In 1988 they were paid $0.35/kg (Rp. 600/kg) for seaweed at export ports in Bali.

In Kabupaten Barru, South Sulawesi and Sibolga, North Sumatra, seaweed farmers are paid low prices compared to Bali ranging between Rp. 250 and 350/kg. There are greater variations in price than in Bali due in part to less competition between seaweed buyers. Furthermore, the lower price may reflect monopsonistic elements, higher transport and transaction costs than on Bali as well as the availability of less information by farmers. As a result, coastal rural dwellers in these areas are not enthusiastic about adopting seaweed farming as an alternative economic activity.

Some possible solutions to these problems could include government intervention and the establishment of a cooperative marketing system among farmers. The establishment of farmers' cooperatives may result in some positive influence on the marketing system, e.g., by establishing minimum prices paid to the farmers for their production and providing market information. Seaweed-farmer cooperatives have only been established in Bali. Perhaps, this is one reason why farmers in Bali obtain a higher price for seaweed.

The risks involved in seaweed farming can be categorized into two kinds, namely, natural risks and risks from non-natural causes. Natural risks arise from variations in biological and environmental conditions. Unusual strong wave action in sandy areas can slow the growth rate of the plants. Animal 'pests' such as fish (*Siganus* sp.) and turtles can damage seaweed. Tropical cyclones or typhoons can destroy the crop and the capital investment. Rain can affect the harvesting schedule, handling and processing of seaweed. To reduce the latter risks, most seaweed farmers in Bali have their own storage facilities. Many also fence their seaweed areas using netting to keep out animal pests. On the economic side, risks may arise from variations in the price of seaweed or costs.

## Analysis and Data Limitations

Many methods can be used to evaluate the economic desirability of business projects. Project evaluation methods include the payback period method, the average rate of return approach and discounting methods. The last set of methods include the net present value (NPV) or discounted cash flows (DCF), the internal rate of return (IRR), and benefit-cost ratio methods (Tisdell 1972; Shang 1981; Gittinger 1982).

The payback period and the average rate of return methods, however, fail to make any allowance for the timing of benefits and costs. For instance, the payback period method simply estimates the speed with which the project repays the original investment. Projects which repay the original investment or outlay in the shortest period of time are preferred. The limitations of this method are that it ignores the flow of returns beyond the payback period and does not take into account the receipt pattern within the payback period. No account is taken of the possibility that some projects involve capital outlays in other than the initial period. Thus this measure ignores much of the time pattern and, indeed, some of the net benefits from projects (Tisdell 1972).

Whilst there is wide acceptance by economists of the use of the NPV criterion for evaluating projects, there are differing views on what rate or rates of discount should be used for calculating NPV (Tisdell 1972; Bradford 1975; Mendelsohn 1981; Pearce and Nash 1981; Gittinger 1982; Mishan 1982). Some argue that because capital should be invested where returns are highest, the appropriate rate of discount is the opportunity cost of capital. Although this is appealing theoretically, it is difficult to apply in practice since the opportunity cost of capital is imperfectly known.

Data presented in this paper are based upon the actual costs and production figures collected through interviews with a 'model' seaweed farmer in Jungut Batu village, Nusa Penida, Bali, in December 1988. He had a 1-ha farm, a size larger than the average farm and was able to provide one of the authors with suitable data. He had also received an award from the Indonesian President for enterprise and he may be, therefore, a more efficient farmer than the average seaweed farmer. The amount of seaweed produced by this farmer was 48 $t \cdot ha^{-1} \cdot year^{-1}$ (dried form). His yield was higher than the average product of 30-40 $t \cdot ha^{-1} \cdot year^{-1}$ suggested in the literature (Chapman and Chapman 1980; Abdul Malik and Rahardjo 1988). Thus, the returns calculated in this paper indicate what can be achieved under above-average management. In addition, the analysis presented in this paper assumes costs and revenue for a farm for 10 years under *static* conditions of farm size and technology.

Taxes are not included in the calculations as the Indonesian tax system is not well organized in rural villages. It seems that products from agriculture, aquaculture or fisheries sold directly by farmers to the buyers are not subject to tax. Furthermore, seaweed farmers do not lease their holding because coastal dwellers in Bali believe that the coastal areas adjoining their village belong to them. This implies that village land regulations (customs) will be a constraint to the entry of non-villagers to this business in Bali. However, there is a coastal rental fee paid annually by seaweed farmers for village contribution.

Since there are no comparative data from small farmers in the area, the results of economic analysis may not be representative of many small farmers in the area. Thus, some caveats apply for this analysis. Nevertheless, the returns presented in this paper are indicative of the potential returns possible from seaweed farming in Indonesia at least for 1-ha seaweed farmers.

## Economic Returns

Several studies on economic returns from seaweed farming have shown that yields from investment in this activity can be high. Padilla and Lampe (1989), for instance, from their study in the Philippines, found that seaweed farming is a high-yielding investment. They calculated the return on investment in the Philippines to be 78% which is way above the opportunity cost of capital. The accounting return is higher for noncorporate farmers since these farmers do not impute costs for their labor contribution to the farm or for their entrepreneurial skills. However, it is not clear how Padilla and Lampe (1989) calculate this return, that is, whether it is the internal rate of economic return or an accounting-type return calculated along the lines used by Shang (1976).

Shang (1976) estimated the rate of return on *Gracilaria* seaweed farming cultivation in Taiwan to be 56%. He claimed that the cost of farming seaweed per unit area is less than the cost of other types of aquaculture. This culture involves labor-intensive production and requires few facilities and little equipment. In addition, seaweed can be harvested in six weeks, whereas milkfish need six to nine months to achieve market size.

In Bali, Indonesia, although seaweed farming has become well established since the early 1980s, little information is available on economic returns from this activity. Fishermen and coastal rural dwellers in Bali began to grow seaweed because of the low yields from fishing operations and because of government prohibition on the collection of corals. Entry into seaweed farming in Bali was encouraged by financial assistance from seaweed purchasers (collectors/middlemen) and readily available markets. As a consequence, seaweed farming is now, for instance, the main economic activity in the coastal village of Jungut Batu, Nusa Penida in Bali.

We calculate the return to the seaweed operations on two bases here, namely, the accounting-type rate of return estimated by Shang (1976) and the IRR. From an economic point of view, the IRR is the more accurate indicator of returns.

In the accounting-type of approach outlined in Table 2, the straight line method of depreciation is used and assets are assumed to have no residual value at the end of their useful life. The application of this method results in a rate of return of 123%. Using Table 2, we can also see that the payback period is extremely short, namely, 0.6 x 13 months equals 7.8 months.

Assuming a planning period of 10 years (an economic horizon at 10 years with assets having no residual value beyond their expected useful life), cash outflows (capital costs and operating costs) and cash inflows (revenue) are indicated in Table 3 for the planning period. A 10-year economic horizon is assumed for the sake of simplicity to accommodate the duration of useful life of some materials (bull hammers and iron bars) used in the activity.

The initial seedling stock is assumed to last the whole 10 years because seaweed can be reproduced vegetatively and farmers can collect new planting material from their harvest. No boat or raft is used on this 'model' farm. Because the farming area is close to the shore, this farmer can plant seaweed and harvest it when the tide is low. Real prices and costs are assumed not to alter throughout the planning period. On this basis, the IRR from seaweed farming as indicated in Table 4 is 153%.

Tables 2, 3 and 4 show that seaweed farming has the potential to give high returns. The yield provides an income of Rp. 19,200,000 in the first year, is more than twice that of annual operating costs and the initial investment can be paid back in less than a year. The rate of return of 123%/ha/year using the method employed by Shang (1976) is way above the opportunity cost of capital in Indonesia (Table 2). But the method used in Table 2 to calculate returns is deficient from an economic viewpoint since returns and costs are not considered as a stream over the life of the project.

By assuming an economic life for a seaweed farming project of 10 years, it is found that the IRR of this activity is 153%. Therefore, the maximum rate of interest which could be paid for funds to invest in this activity and still break even is 153% (Table 4).

It is worth noting that labor is the major operating cost in seaweed farming. It accounts for 60% of total annual expenses. This cost includes labor for seeding, weeding, harvesting and drying. Thus

Table 2. Cost and return analysis for a selected 1-ha seaweed farm *(Eucheuma cottonii)* in Bali, 1988.

| | Cost (Rupiah) | Life (years) |
|---|---|---|
| A. Initial investment (Cash outflows) | | |
| - 20,000 kg seed stock at Rp. 50/kg | 1,000,000 | |
| - 1,000 kg nylon plastic (4 mm) | 4,000,000 | 2 |
| - 100 kg nylon plastic (8 mm) | 400,000 | 2 |
| - 8,000 pcs bamboo at Rp. 200 each | 1,600,000 | 2 |
| - 300 kg rolls plastic at Rp. 1,000/kg | 300,000 | 1 |
| - 2 bull hammers at Rp. 5,000 each | 10,000 | 10 |
| - 1 iron bar at Rp. 3,000 | 3,000 | 10 |
| - 1 knife at Rp. 500 | 500 | 5 |
| - 15 pairs of gum boots at Rp. 5,000 a pair | 75,000 | 1 |
| - 2 pcs mask at Rp. 25,000 | 50,000 | 1 |
| - 15 baskets at Rp. 1,000 | 15,000 | 6 months |
| - 2 scoop nets at Rp. 3,000 | 6,000 | 1 |
| - 100 gunny sacks at Rp. 400 | 40,000 | 6 months |
| - 1 axe at Rp. 4,000 | 4,000 | 5 |
| - 1 wood saw at Rp. 5,000 | 5,000 | 5 |
| - 50-m net at Rp. 2,000/m | 10,000 | 2 |
| - initial set up labor cost, e.g., setting up the bamboo posts | 750,000 | |
| Total initial cash outflows | 8,268,500 | |
| B. Operating costs | | |
| - 15 laborers at Rp. 30,000 for a year | 5,400,000 | |
| - license (including coastal rental fee) | 50,000 | |
| - Depreciation (derived from initial investment) | 3,549,200 | |
| Total production cost | 8,999,200 | |
| C. Cash inflows (there are 6 harvests in a year, 48,000 kg/year at Rp. 400/kg) | 19,200,000 | |
| D. Profit without tax (C - B) | 10,200,800 | |
| E. Profit (C - B) without depreciation | 13,750,000 | |
| F. Payback period (A/E x 13 months) | 7.8 months | |
| G. Rate of return (D/A) | 123% | |

Notes:

- Cost data are based on 1988 price; Rp. 1,715 = US$1.
- Seedlings for subsequent planting are obtained from initial first planting. Thus, it is included in initial capital cost.
- Payback period (see Tisdell 1972) and rate of return method after Shang (1976).

Source: Interviews with seaweed farmers in Jungut Batu, Nusa Penida, Bali, December 1988.

Table 3. Estimates of annual capital and operating costs for a selected 1-ha seaweed farm in Bali, 1988 (unit: x Rp. 10,000).

| Cash outflows | Year 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital costs | | | | | | | | | | | |
| Seed | 100 | - | - | - | - | - | - | - | - | - | - |
| Nylon plastic (4 mm) | 400 | - | - | 400 | - | 400 | - | 400 | - | 400 | - |
| Nylon plastic (8 mm) | 40 | - | - | 40 | - | 40 | - | 40 | - | 40 | - |
| Bamboo | 160 | - | - | 160 | - | 160 | - | 160 | - | 160 | - |
| Net | 1 | - | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Plastic rafia | 30 | - | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Gum boots | 7.5 | - | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Mask | 5 | - | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Basket | 1.5 | 1.5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Scoop net | 0.6 | - | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Gunny sacks | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Bull hammers | 1 | - | - | - | - | - | - | - | - | - | - |
| Iron bar | 0.3 | - | - | - | - | - | - | - | - | - | - |
| Knife | 0.05 | - | - | - | - | - | 0.05 | - | - | - | - |
| Axe | 0.4 | - | - | - | - | - | 0.4 | - | - | - | - |
| Wood saw | 0.5 | - | - | - | - | - | 0.5 | - | - | - | - |
| Costs of tying up seeds and setting up bamboo | 75 | - | - | - | - | - | - | - | - | - | - |
| Total | 826.85 | 5.5 | 54.1 | 655.1 | 54.1 | 655.1 | 55.05 | 655.1 | 54.1 | 655.1 | 54.1 |

Continued

Table 3. Continued.

| Cash outflows | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Operating cost | | | | | | | | | | | |
| Laborer wage | - | 540 | 540 | 540 | 540 | 540 | 540 | 540 | 540 | 540 | 540 |
| License | | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Total | - | 545 | 545 | 545 | 545 | 545 | 545 | 545 | 545 | 545 | 545 |
| Cash inflows | 0 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 | 1,920 |
| Net cash flows (Rp. 1,000) | -8,268.5 | 13,695 | 13,209 | 7,199 | 13,209 | 7,199 | 13,199.5 | 7,199 | 13,209 | 7,199 | 13,209 |

Notes: Assumed economic horizon of seaweed farming is 10 years or cycle of 10 years;
Assumed no change in real annual operating cost;
Assumed no change in real price.

Table 4. Internal rate of return (IRR) calculation for a selected seaweed farm (unit: x Rp. 1,000).

| Year | NI | Discount rate (155%) | PV | Discount rate (150%) | PV |
|---|---|---|---|---|---|
| 0 | -8,268.5 | 1.0000 | -8,268.5 | 1.0000 | -8,268.5 |
| 1 | 13,695 | 0.3921 | 5,369.8 | 0.4000 | 5,478 |
| 2 | 13,209 | 0.1537 | 1,030.2 | 0.1600 | 2,113.4 |
| 3 | 7,199 | 0.0603 | 434.2 | 0.0640 | 460.7 |
| 4 | 13,209 | 0.0236 | 170.3 | 0.0260 | 343.4 |
| 5 | 7,199 | 0.0093 | 66.8 | 0.0100 | 72.0 |
| 6 | 13,199.5 | 0.0036 | 48.0 | 0.0041 | 54.1 |
| 7 | 7,199 | 0.0014 | 10.3 | 0.0016 | 11.5 |
| 8 | 13,209 | 0.0006 | 7.9 | 0.0007 | 9.2 |
| 9 | 7,199 | 0.0002 | 1.6 | 0.0003 | 2.1 |
| 10 | 13,209 | 0.00008 | 1.0 | 0.0001 | 1.4 |
| Total | | | -128.4 | | 277.3 |

IRR = 150 + 5 (277.3/405.7) = 153.42%

Notes: NI = net income; PV = present value of net income stream.
The initial discount rate is found by trial and error which will make the net present worth of the incremental net benefit stream equal to zero (Gittinger 1982).

seaweed farming is relatively labor-intensive and therefore suited to countries such as Indonesia where labor is relatively abundant. For some farmers, labor expenses (actual outlays) are low since they employ their own family members including children. The opportunity cost of their employment may also be low. In addition, seaweed farming requires few commercial inputs and does not need pharmaceuticals, chemicals or supplementary feed to sustain production (Table 2).

The size of small seaweed farms in Jungut Batu varies between 0.05 and 0.25 ha and the average product harvested per month varies between 200 and 1,500 kg/area holding. Small farmers usually do not hire labor in managing their farms. They rely mainly on family labor to reduce labor outlays. Also, they often obtain seedlings free from neighbors or relatives or gather them from natural stocks. The planting of a 0.25-ha farm requires an initial investment of about Rp. 1,000,000 ($580). Funds to meet the initial capital cost are usually obtained from credit institutions, seaweed collectors or through informal financial sources available in rural areas. Small farmers in Jungut Batu village feel that seaweed culture gives good returns and the initial investment can be paid back in less than one year (pers. comm.).

## Conclusion

The 'accounting' rate of return on investment from seaweed farming in Bali for the farm surveyed is 123%/ha/year, which is very high. The IRR of this activity is 153%. This suggests that seaweed farming is a potentially attractive economic investment for coastal rural dwellers in Indonesia. The Indonesian Government should encourage seaweed farming in other coastal areas of Indonesia which are economically and ecologically suited to this type of farming.

However, the above returns must be regarded as above-normal because the farm selected was a model farm with favorable natural conditions. Furthermore, returns have been calculated free of risks. At this stage, we do not have estimates available for risks, but these would no doubt reduce expected returns. A severe cyclone or typhoon in the 10-year period could mean that all capital is lost and might reduce returns to under 100%. Nevertheless, these results support the Padilla and Lampe (1989) contention for the Philippines that the returns to seaweed farming may be high in Southeast Asia.

One may also wonder why the costs of leasing suitable sites is not higher given the attractive level of returns from seaweed farming in Bali. The main reason seems to be that villagers in Bali believe that the seashore areas adjacent to their village belong to their village. Consequently, village chiefs do not determine leasehold allocations on purely economic grounds and by economic competition. This also means that it is difficult or impossible for nonvillagers to obtain rights for seaweed farming in a coastal area adjoining a village. They may be limited to operations on alienated land not being used by villagers.

Some wonder if seaweed farming is likely to be profitable for small farmers. Since small farmers often have surplus labor and are able to gather propugales free, and also sometimes timber and bamboo, they may have some economic advantages compared to large-scale farmers. Furthermore, there appears to be no diseconomies from such scale operations and small growers can often combine seaweed growing with other occupations. The relative non-perishability of seaweed is a particular advantage of seaweed growing compared to many other types of aquaculture.

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