

Introduction

The term eastern Indonesia denotes nine provinces that are rather left behind in their economic development compared with the provinces in western Indonesia. These provinces are West Nusa Tenggara, East Nusa Tenggara, East Timor, South Sulawesi, Central Sulawesi, Southeast Sulawesi, North Sulawesi, Maluku and Irian Jaya. They include almost half of the total Indonesian waters, and produce about 50% of national fisheries products. Although Bali Province is not part of eastern Indonesia, we will include this island in our discussion because this island is closely related to eastern Indonesia and is a good example of successful seaweed cultivation.

The first record of seaweed usage was in 1750, reported by Dutch officer G.E. Rumphius*. For the insular people of Indonesia, the term economic seaweed may have two meanings: (1) any kind of seaweed that can be sold as a vegetable or as material for making local agar; (2) red seaweed, which is especially harvested and dried before being sold to the phycocolloid factories or their agents. We will focus the discussion on the second meaning, i.e., seaweed which can be used as materials for producing carrageenan and agar.

In the 1950s, Indonesia was the largest seaweed producing country in the world, but since the 1960s this position has been taken over by the Philippines. In

the early 1970s, seaweed culture was introduced in Indonesia. Since then seaweed production grew rapidly. From the 1970s until the mid-1980s, when the market price of seaweed was very good (ca. Rp.1,000/kg dry weight (d.w.)), seaweed culture became a good economic activity, not only for export but also for domestic

is required for this activity except a small wooden canoe and home-made goggles.

In the late 1970s in Bali, an attempt was made to transplant a new species, *K. alvarezii*, which was imported from the Philippines. This effort was successful; large quantities have been exported and distributed to other places for seaweed culture. Recently, *K. alvarezii* and *K. striatum* are the favored seaweeds collected and planted by fishers because their market demand and price are relatively high and stable. There is another carrageenophyte species which is not as profitable, *Hypnea* sp., which produces kappa-type carrageenan. Its occurrence is seasonal; in Southeast

Maluku we found it very abundant in the intertidal zone in October and November.

In Indonesian waters, seaweeds that produce agar belong to families Gelidiaceae and Gracilariaceae. The common species are *Gelidiella acerosa*, *Gelidium latifolium*, *Gracilaria euchemoides*, *Gracilaria heteroclada*, *Gracilaria fastigiata*, *Gracilaria tenuistipitata*, *Gracilaria firma*, *Gracilaria coronopifolia*. The first two species prefer to grow on hard substrate with high salinity and strong current, while the *Gracilaria* grows better in rather low salinity and weak current. *Gracilaria* can frequently be found in front of mangrove forests. Reports on harvesting *Gelidiella acerosa* and *Gelidium latifolium* in eastern Indonesia are rare, but on the south coast of Java both species are harvested regularly. No effort has been made to cultivate them.

The possible reason is that their size is small, less than

Economic Seaweed Resources and Their Management in Eastern Indonesia

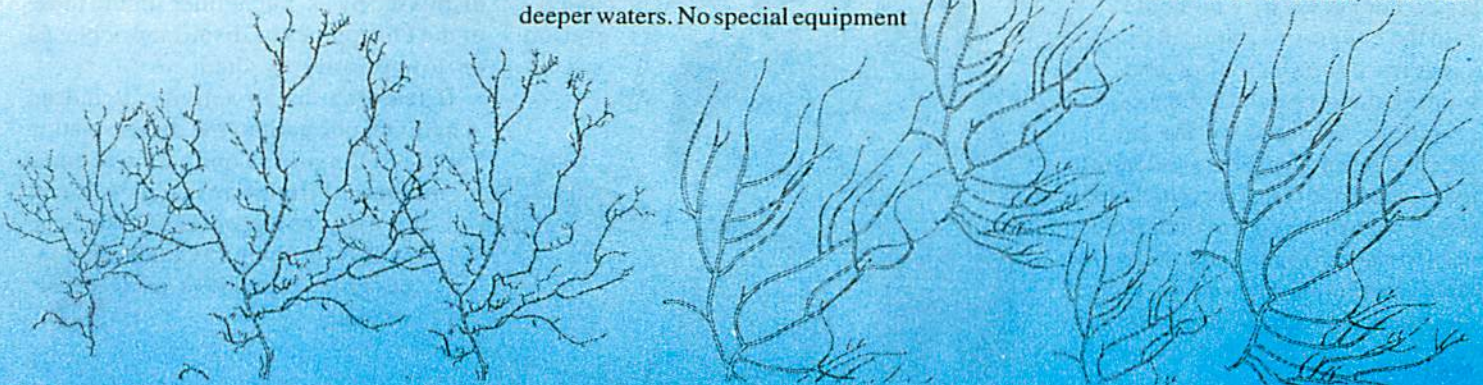
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markets. The lowest seaweed price in remote places was about Rp.100 - 150/kg d.w. In recent years the seaweed price in harbor cities is about Rp.450 - 600/kg d.w.

The Resources

Most carrageenophyte species explored in eastern Indonesia belong to the genera *Kappaphycus* and *Euchema*, comprising such species as *K. striatum*, *K. cottonii*, *K. edule*, and *K. denticulatum*. The *Kappaphycus* produces kappa-type carrageenan and *E. denticulatum* produces iota-type carrageenan. These species are endemic in eastern Indonesian waters. They can be found mostly in the coral reef intertidal zone, down to 3-5 m depth, but it is quite frequent that these species are found in deeper waters. The fishers mostly collect them in the intertidal zone, but when the seaweeds become scarce, they collect them in the deeper waters. No special equipment

*Rumphius, G.E. 1750. Het Amboinisch Kruid Boek. Herbarium Amboinense. Amsterdam. Amstelaedami 6:256. Pls. 1-90.





Harvesting *Gracilaria* sp. in ponds. Takalar, South Sulawesi.

10 cm high, and they are difficult to grow on artificial substrates. Members of *Gracilaria* are more common in eastern Indonesia. There are many other species of *Gracilaria* found in these waters, but they are considered less profitable.

There are two types of seaweed cultivation, i.e., open and closed cultivation. The first takes place in open beaches or lagoons where there is no barrier between cultivated seaweed and open sea. This type is suitable to cultivate carrageenophytes and there are many methods to plant the seaweed, such as floating raft, off bottom rope, hanging rope on stakes, and floating ropes. The second type is enclosed ponds where the cultivated seaweed is protected against open sea conditions. This type is only recommended for cultivating *Gracilaria*. The center for this cultivation type in eastern Indonesia is in South Sulawesi.

Production

Seaweed production areas in eastern Indonesia can be divided into two categories: areas where seaweed production mostly comes from natural harvest (e.g.,

Maluku and Irian Jaya Provinces); and areas where most production comes from cultivation (e.g., South Sulawesi, Southeast Sulawesi and West Nusa Tenggara Provinces plus Bali Province). Some production data are presented in Table 1.

Historically, seaweed production in

eastern Indonesia began in Maluku Province. The backbone of the seaweed trade in this province was traditional insular fishers who used to sail to the remote islands and bring the products to Ujung Pandang (in South Sulawesi) and Surabaya (in East Java). Seaweed cultivation was established in Galo-Galo Island (near Morotai Island) of North Maluku District. The cultivation was successful and involved whole villages, but in late 1991, when the price fell drastically (from Rp.800 to Rp.400/kg d.w.), cultivation collapsed.

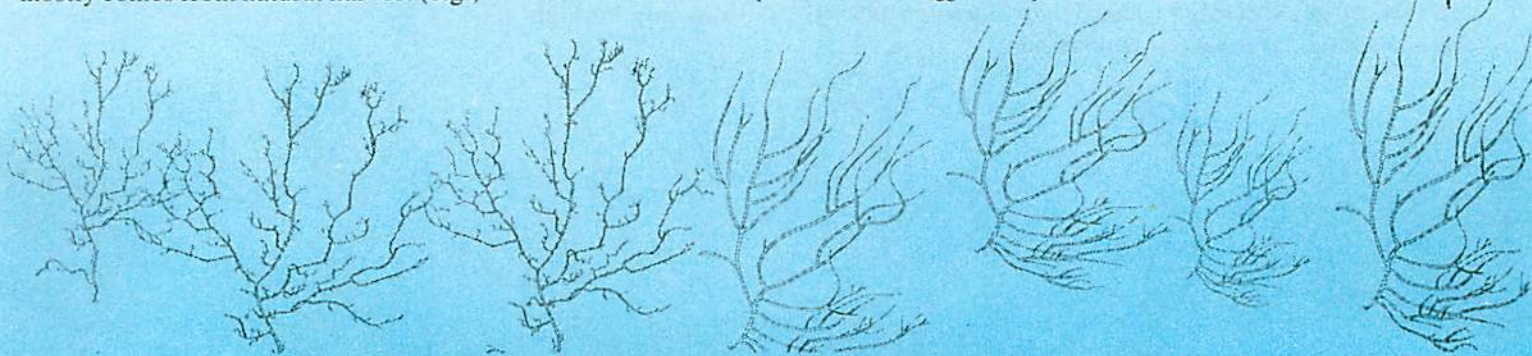
Biak is one of centers of seaweed production in Irian Jaya Province. Seaweed trade in this district was reported only once, in 1979. Since then until the early 1990s, seaweed was neglected as a potential marine product. In 1989, the Cendrawasih Coastal Area Development Project introduced seaweed culture in Nusi Island. The activity ran smoothly but since then the villagers prefer natural harvesting than cultivation. Even though the production is low, the seaweed price in Biak is relatively stable (i.e., Rp.400 - 550/kg d.w.). There is a good network between the villagers, district cooperative and the main trader in Ujung Pandang.

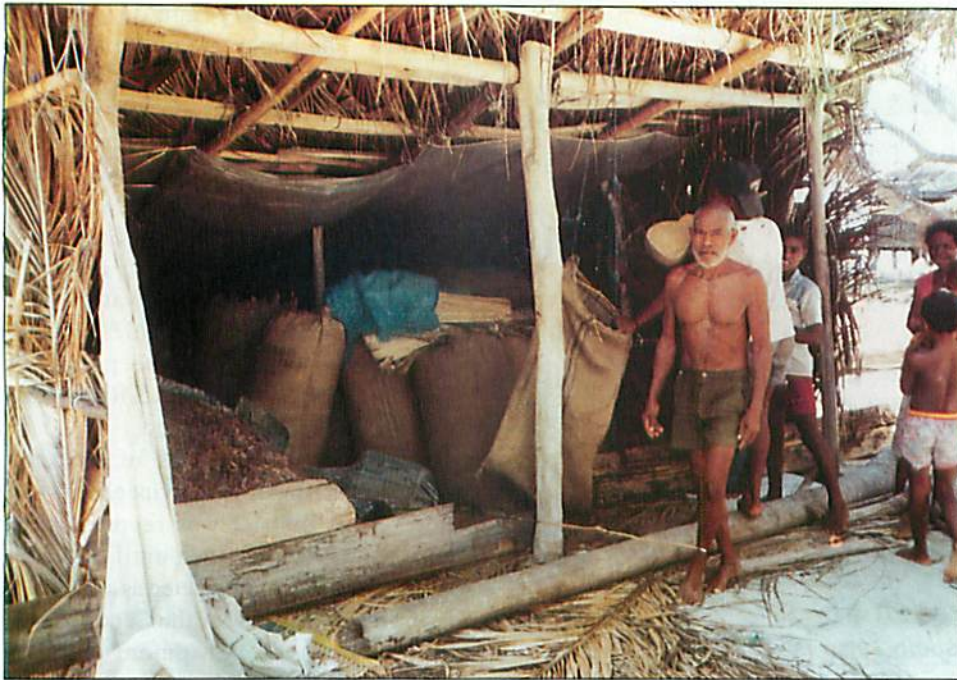
Table 1. Seaweed production (in tonnes) in some places of eastern Indonesia.

Year	South Sulawesi ¹	Maluku ¹	Biak ²	Bali ¹
1979	-	-	5.50	-
1980	-	6,6380.60	-	-
1981	-	6,341.00	-	-
1982	-	6,347.70	-	54.00
1983	332.40	-	-	370.00
1984	306.90	-	-	1,536.00
1985	327.40	6,932.00	-	57,002.00
1986	329.80	6,967.10	-	66,776.80
1987	357.00	1,783.00	-	73,899.40
1988	611.20	1,651.00	-	78,593.70
1989	898.90	2,526.70	-	78,228.80
1990	1,164.80	2,764.60	11.54	97,272.50
1991	887.30	2,157.60	28.24	81,810.30
1992	638.80	1,778.50	35.40	90,261.40

¹ Sources: Annual Statistical Reports of Fishery Products, Directorate of Fishery, Dept. of Agriculture of South Sulawesi, Maluku and Bali Provinces.

² Sources: Biak District Cooperative of Mina Sanggami Sarey, Biak and Commercial Office of Biak District.





A simple seaweed warehouse in Nusi Island, Biak. The seaweed is collected from natural stock.

South Sulawesi and Bali Provinces are successful examples of seaweed cultivation. The production in both provinces is already independent of natural harvests. South Sulawesi is both a center for seaweed cultivation and a center for seaweed trade.

Management of Seaweed Resources

Management of seaweed production involves at least five factors, i.e., the potential of the resources, the price, the location, transportation and human resources. By considering these factors, we found that the marine culture concept is not always appropriate and applicable for every place. The success of seaweed culture in Maluku and Irian Jaya Provinces is influenced very much by the fifth factor, which is not only the availability of human power but especially their motivation and attitude. Here we give examples how the fishers adjust their system in managing the resources.

Natural harvesting has two characteristics: 1) the harvest continuous

throughout the year but occurs in limited periods; and 2) production is more unpredictable and the influence of nature is dominant. Most harvesting of natural seaweed in Maluku and Irian Jaya does not follow even traditional management to keep the stock more productive. The harvesting pattern depends very much on the market price of seaweed: when the price is low the desire of villagers to collect seaweed is decreased; when the market price goes up, the villagers collect seaweed more intensively. Thus, there are two drawbacks for seaweed management. First, overharvesting the natural resources; second, the raw materials produced by fishers become poor in quality. The second drawback is very common. When the fishers seek high production targets, they pack the materials with high water content and add hard materials (broken coral) or sand into the packages.

In Maluku Province and adjacent areas, a traditional regulation is used to limit and distribute equitably the marine production. This regulation, which is known as "sasi", is valid only for high-

priced animal products such as many kind of fishes, trochus, giant clam, and sea cucumber. Since seaweed price occupies the lowest rank amongst the price of marine resources, this regulation is not effective. In remote islands, "sasi" is very difficult to enforce. Furthermore, for fishers, collecting seaweed is the last alternative of their daily activities because the trade still depends on visiting traders, while the seaweed price is never enough to cover the real operational costs. In fact, the labor effort is never calculated. Therefore, to develop seaweed culture in remote islands is very difficult and the villagers prefer to focus their economic activities on catching fish.

In the places where seaweed price is more stable, market demand is predictable and transportation is good, seaweed cultivation can be developed very well. South Sulawesi, Southeast Sulawesi and Bali are examples.

Prospects

The potential for increased production of seaweeds in Indonesia is high because 1) there is a large area for cultivation and natural harvesting; 2) world demand seems to be increasing; and 3) national demand is increasing - five years ago there were four processors; now there are eight. The demand is due to rapid developments in the domestic cosmetic, pharmaceutical, food and textile industries.

Indonesia has the largest insular tropical waters in the world. Exploration for a seaweed inventory in this country is still lacking and its large expanse provides many chances to find new species or strains which could be useful in phycocolloid industries.



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