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Better Management Practices

Small Scale Fisheries Guideline Series

SEAWEED CULTURE

Gracilaria sp. IN POND

Version 1 | June 2014

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Small Scale Fisheries Guideline Series
SEAWEED CULTURE - Gracilaria sp. IN POND
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ISBN 978-979-1461-37-5

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Publisher	: WWF-Indonesia
Credit	: WWF-Indonesia

Preface

Praise to God Almighty for the completion of Better Management Practices (BMP) of Seaweed Culture Gracilaria sp. in ponds. This BMP is a practical guideline to small-scale seaweed farmers for more responsible and sustainable practice.

The compilation of this BMP went through several processes, e.g.: study literature, field data collection, internal review from WWF-Indonesia aquaculture team, and Focus Group Discussion (FGD) with seaweed culture experts as external reviewers. This BMP is a living document that will be improved based on the development in the field and inputs from stakeholders.

Our sincere thanks to all parties involved in the preparation of this BMP for their support, cooperation, input and correction, namely Directorate General of Aquaculture, Marine and Fisheries Agency Province South Sulawesi, BRPBAP Maros, BBPBAP Jepara, Indonesia Seaweed Commision, Indonesia Seaweed Society, Jasuda, Kospermindo-Asperli, Celebes Seaweed Group, Hasanuddin University, and Muara Rejeki Group-Pekalongan.

We are open to any constructive feedback to improve this document. We apologize for any mistake that you might encounter in the proceeding pages.

June 2014

Editor
WWF-Indonesia

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GLOSSARY

Epiphytes : A plant that grows upon another plant for their life support.

Photosynthesis : A process of using sunlight to convert carbon dioxide and water into carbohydrates by green plants and other organisms.

Geosmin : An earthy-smelling substance produced by microorganism.

Pests : Plants or animal intruders on cultivation.

Daily Growth Rate : The percentage of weight gain per day of cultivation.

Morphology : Form and structure of organisms.

Ice-Ice Disease : A disease condition with characteristic whitening of seaweed's tissues particularly at the base.

Phosphate : Macro essencial nutrients for plants in water or phytoplankton.

Polyculture : A cultivatino that uses multiple crops in the same space.

Variety Selection : seaweed seed selection based on morphology assessment with the highest growth rate.

I. INTRODUCTION

Gracilaria is one of seaweed types producing gelatin or called as agarophytes. Besides Gracilaria, other seaweed gelatin producers are Gelidium, Pterocladia, and Gelidiela. In 2009, the total production of dried agarophytes in Indonesia reached 35,050 tons. Out of the total figure, 81.60% of them (28,600 tons) are used locally, while the remaining is absorbed by international market (Anggadiredja et al., 2011). The highest contribution of raw materials in gelatin production is accounted by gracilaria (>90 %) compard to other agarophytes genus. This is because Gracilaria is cultivated in ponds, while other agarophytes are harvested from naturally growing (wild) seaweed.

Gracilaria sp.

Gracilaria sp. is a red algae (Rhodophyta) genus known locally as sango - sango, rambu kasang, janggut dayung, dongi-dongi, bulung embulung, agar-agar karang, agar-agar jahe, blung sangu, among others. This type of seaweed comes in different varities that come with their own distinct features: Gracilaria confervoides, Gracilaria gigas, Gracilaria lichenoides, Gracilaria crasa, Gracilaria blodgettii, Gracilaria arcuta, Gracilaria taenioides, Gracilaria eucheumoides, etc. Some experts suspect that the graciaria has the most varities compared to its other genuses.

Gracilaria is cultivated either by monoculture or polyculture system with fish or shrimps. Low input and simple technology applied has prompted small-scale farmers to cultivate this commodity.

Several guidelines have been developed to provide practical instructions for farmers to improve the production of Glacilaria. WWF-Indonesia developed this BMP based on common farming practices of Glacilaria culture in Indonesia, especially in South Sulawesi and Central Java, to maintain its sustainability through responsible cultivation.

The development of this BMP is seen to serve as a reference for farmers to maintain the sustainability of Glacilaria cultivation through responsible practices.

II. SEAWEED FARMER GROUP ESTABLISHMENT

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Farmer Group Meeting

To improve the bargaining position of farmers while maintaining the sustainability of Glacilaria cultivation, it is expected that farmers affiliate with formal farmer groups that meet the following criteria:

1. Obtain approval from village officers with the assistance of the local fisheries agency.
2. An ideal farmer group consists of 10-25 members. When the group organization gains ground, the number of members can be increased. Women are encouraged to join as they are entitled to do so.
3. The group is assisted by an extention officer; for example, a field officer at the local fisheries agency.
4. Members should share the same livelihood (e.g., seaweed culture).
5. Hold regular meetings, at least once in two weeks.
6. Election of group leaders must be elected democractically.Groups must have transparent membership scheme and should run its own administrative system. The group leader is expected from the farmers in the group.
7. Have a good leadership.
8. Seek parnterships with related parties.
9. It is suggested that the group is established with concern on nearby location to ease the management.

A GROUP LEADER IS EXPECTED FROM THE FARMER GROUP

IN ESTABLISHING A GROUP AND DECIDING THE NUMBER OF GROUP MEMBER, PLEASE CONSIDER THE EASE OF MANAGEMENT AT SEAWEED CULTURE AREA AND COORDINATION AMONG MEMBERS

The importance of working in groups:

1. Working in groups plays an important role for farmers cultivating Gracilaria. Market wise, they will possess more strength in price-bargaining, as well as gaining efficient operational cost by transporting their produce (a minimum of one container with a weight of 20 tons) to exporters or gelatin manufacturers without the need of a middleman.
2. Group strengthening can be initiated by cooperation between the groups and with non-governmental organizations, governments from village to provincial levels as well as with the private sectors, especially companies.

LEVEL OF GROUPS AND ITS ENDORSEMENT

Beginner group obtains the approval from the head of village and establishes itself with 10 - 25 members.

Pre-intermediate group obtains approval from head of subdistrict. This group is an expansion from beginner groups which have their own rules.

Intermediate group obtains approval from the head of regency. Groups under this category should establish a better business level through an elaborate financial management for its members.

Advance group obtains the authorization from the Governor. Groups under this category should possess rapid growing business and good financial management system for its members and community.

Besides the issuance of a decree to meet the group's legal requirements, the government plays an important role in the groups' development by assigning at least one of extension officer in sub district to assist the group development.

III. PLANNING AND PREPARATION OF SEAWEED CULTURE

A. Planning

- Planning for Gracilaria cultivation is set in group meetings which include location, planting methods, seed provision, and planting calendar adjustment based on group agreement.

- Determination of cultivation location is based on physical, chemical, and biological soil as well as water assesment through testing and/or test plot in the ponds.

- The plan is reviewed every two months or one crop cycle of Glacilaria. Based on the yield and business analysis in one cycle for a year, the feasibility of location for Glacilaria cultivation can be determined.

DETERMINATION OF PLANTING CALENDAR

Determination of the planting calendar is crucial because the growth of Glacilaria is influenced by seasons. Each region has a different calendar based on rainfall and tides, for example, data production in 2009-2011 in Takalar, the growth and production of Glacilaria was very good in March-July, while in August, the production decreased. Determination of planting calendar can be decided by farmers based on the following:

- Record and analyze the data of growth, production, incidence of pest and disease, and environmental condition around the site observed for a year.
- The annual data is compared to the previous year's and serve as the basis to predict next year's planting calendar.
- Information regarding the rain fall and tides for the last two years are very important for seaweed planting. They can be obtained from the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), Research Institute, Aquaculture Institute, or Hydro-oceanographyic of Navy.

B. Preparation of Seaweed Culture

Preparation of location

When determining the location of seaweed cultivation, these are some aspects to be considered:

1. The location of cultivation should meet policies of local government.

   a. The location is chosen in accordance to the designation of the location / land for aquaculture as stipulated in the Coastal and Small Islands Zone Plan (RZWP3K) and or the Spatial Plan (RTRW) of land at city/district or province. The suitability of the cultivation location with designation is intended to avoid conflict with other users such as residential areas, conservation, fishing, tourism, industry, shipping, etc.

   b. If the RZWP3K and RTRW are not available, then it is suggested to report and consult it with local authorities at the village / sub district /district or related offices to be included as a designed aquaculture area when the spatial plan is arranged.

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2. The location for seaweed cultivation should meet technical feasibility criteria based on water quality and accessibility, and access to the cultivation area, as below:

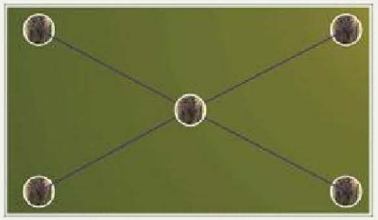
a. Water Quality:

- Located in tidal areas for water exchange through gravity.
- Sand muddy ponds at the bottom.
- The cultivation site is close to freshwater resource to lower the salinity, in order to meet the requirements.
- The location is free from sewage pollution.
- Clear water with transparency between 40-60 cm.
- Salinity between 15-30 ppt and optimal salinity at 20-28 ppt.
- The water temperature should hover between 20-28 °C
- pH ranges between 6-9

Trial of location suitability

At the new location, samples need to be obtained to measure the growth of seaweed and assess the feasibility of the location through biological, chemical, and physical factors. The samples can be taken from Glacilaria stocked in ponds or planted through longline method.

- The sampling at Glacilaria pond can be conducted at five points, as the sketch below:



Samples can be placed in baskets or wrapped by nets. Initial weight is determined, and during harvest, the samples are remeasured. Initial weight and final weight can be used to calculate daily growth rate of seaweed. The average daily growth rate is calculated from daily growth rate for each point.

- The measurement of daily growth rate can be also calculated on seaweed planted through longline. The sampling is conducted with a minimum 5% of total existing clumps of seaweed or weighed the seaweed along with the line.
- The location is considered as feasible if daily growth rate of seaweed reaches at least 4% per day, which is at least 6 times of initial weight of seaweed seed. As reference to determine the growth rate of seaweed, refer to following table:

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Growth (Total final weight from initial seed weight)	Daily Growth Rate (%)
2,4 time	2
3,0 time	2,5
3,8 time	3,0
5 time	3,5
6 time	4,0
7 time	4,5
9 time	5,0
11 time	5,5
13,7 time	6,0
17 time	6,5
21 time	7,0

b. Accessibility

- It is recommended to choose cultivation location which control activities, and security measurement can be conducted easily.
- Sufficient facilities and infrastructure are available on site to facilitate cultivation as well as post harvest handling and marketing the crops.
- The location is expected to be located near the source of good quality seeds. If not available, the seeds can be brought from other areas with special concern on good handling and transportation.

Legal Aspect of Seaweed Culture

Business and scale of cultivation should meet the regulations of the Ministry of Marine Affairs and Fisheries:

a. Based on Minister of Marine Affairs and Fisheries Republic Indonesia Number 49/Permen-KP/2014 regarding fish cultivation businesses, aquaculture enterprises are required to have fisheries business liscenses (Surat Ijin Usaha Perikanan/ SIUP) or have a fisheries business recording mark (Tanda Pencatatan Usaha Pembudidayaan Ikan / TPUPI).

b. Small-scale fisheries enterprises are not required to have SIUP. However, they are to secure TPUPI. Small business maritime aquaculture should meet the regulation of Minister of Marine Affairs and Fisheries Republic Indonesia Number 49/2014 about aquaculture. The following are the requirements:

   The aquaculture uses simple technology

   The culture is in brackish water, including Gracilaria sp with area not more than 5 ha.

c. Fishery Business License (IUP) should be owned by medium-scale up to large-scale of aquaculture enterprises and issued by a Fisheries Agency.

d. According to the regulation of the Minister of Marine Affairs and Fisheries Republic of Indonesia No. 3/2015 on the Delegation of Authority to grant Business Licenses on Fish Farming and Mariculture, in the implementation of one stop integrated service to the Head of Capital Investment Coordinating Board(BKPM), SIUP for aquaculture business requires these following criteria.

   Using foreign capital

   Located within the sea above 12 (twelve) miles measured from the coastline towards open water and islands waters

   Located on land area across provinces
   Using super intensive technology on land and the sea areas above 12 (twelve) sea miles from the coastline towards open water and or island waters

Other regulations related to aquaculture activity in coastal, namely:

Law No. 27/2007 concerning the Management of Coastal Areas and Small Islands bans the conversion of land coastal areas which do not take into account ecological functions and ecosystems.

Law No.31 / 2004 regarding Fishery and Government Regulation No. 60/2007 regarding Conservation of Fishery Resources, which is by participating in conserving ecosystems associated with fishery resources.

Pond Certificate

Farmers should possess a land ownership certificate (Certificate of Property Rights).

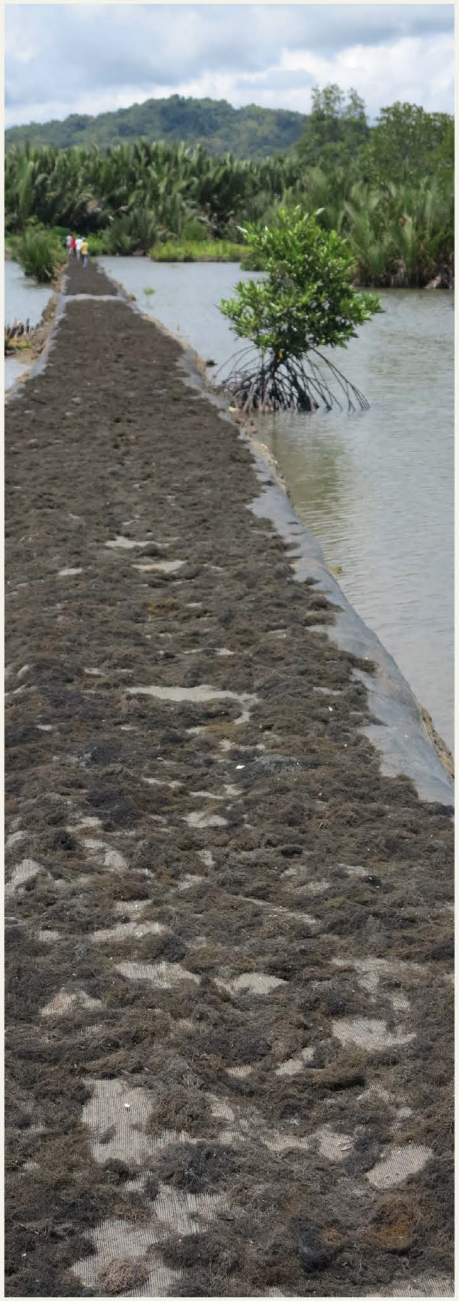
National Standards Related to Aquaculture

Apply the cultivation practice as stipulated under the Better Aquaculture Practice (Cara Budidaya Ikan yang Baik/CBIB) from Diretorate of Aquaculture, including Indonesia's National Standard (Standar Nasional Indonesia /SNI), as standard quality of Milkfish Farming which is recognized nationally.

GET CERTIFICATE

CERTIFICATE CBIG FOR YOUR SEAWEED CULTURE!

Please contact Fisheries Department for futher information.



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IV. SEAWEED CULTURE AND CARE

A. Pond Preparation

a. Ensure the land (aquaculture facility construction) ready for seaweed planting.

- Each pond should have an inlet and outlet for water circulation by gravity to maintain the water quality in the pond.
- If water exchange cannot rely on tide, water pumps can be used.
- The dike should be strong, free from leak, and must be clean. The embankment can be used as a pathway for pond management, and can also function as a Gracilaria dryer.
- The dike's height should go beyond the estimated highest tide level and should not submerge when heavy rain or flood occurs within the area of the pond. In any case of flooding, do these following steps:

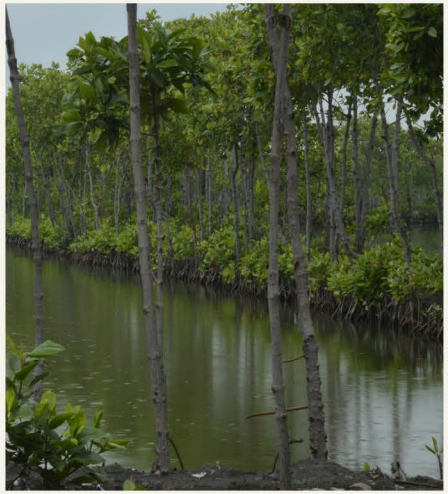
b. Drain the ponds and remove organic matter/ sludge with at least 10 cm.

c. Let the pond dry under the sun for 3-5 days until its soil cracks.

d. Add lime to the ponds to reach a degree of acidity (pH) between 6-9 or about 6-8 for the optimal growth of Gracilaria.
If the degree of acidity is 5, the lime added into pond is 500 kg/ha.

e. Put water into the pond through a filter mounted in the inlet. The depth water for the optimal growth of Gracilaria is 50 cm. However, if the pond uses polyculture method with Milkfish or shrimps, the depth can reach 100 cm.

f. If pests are still found in the pond, apply saponin with 20 ppm.



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Gracilaria Pond

POND DEPTH MANAGEMENT

The pond's depth influences the intensity of sunlight required by Gracilaria for growing and producing gelatin.

During vegetative growth in the first to three weeks, sufficient light is needed to develop the thallus. Therefore, the 0.5 m of depth is very optimal. However, during the fourth-sixth week, the water can be added into the pond until reaching 1.0 m to reduce the sunlight intensity for the optimal development of gelatin.

Upon harvest, the water can be reduced by up to 0.5 m to facilitate the process. However, the water level should not be too shallow because it will increase water temperature,causing Gracilaria become pale or white due to strong sunlight.

B. Seaweed Seed

a. Characteristics of good seeds

Good seeds have several characteristics as below

- Elasticthallus,
- Have many branches,
- The base is bigger than the branch tip,
- The thalus ends are straight,
- Bright colors and fresh smell,
- Free from pests, weeds (epiphytes), or dirt,
- If some part of thallus is cut, it feels brittle,
- No patches
- Uniform seeds

GOOD GRACILARIA SEEDS HAVE HIGH AND STRONG GELATIN

b. Nursery Garden

Building nursery is important to ensure availability of seeds in each region. Preparing seaweed nurseries begins with the selection of varieties which can be done using longline method.

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Variety selection using longline method

SEAWEED NURSERY DEVELOPMENT AND VARIETY SELECTION

The development of seaweed nursery and variety selection is essential to ensure the availability and quality of Gracilaria seeds. Some stages to develop seaweed nursery and select the variety are as follows:

PREPARATION AND SEED PLANTING

- Plug wood or bamboo with a diameter 3-5 cm and 2.0 m long in each of the pegs to stretch the rope spans of Gracilaria seeds. The size of nursery plot depends on the capability to control the nursery and the availability of ponds. Plots of ropes with 50 m x 30 m can fit into 50 lines.
- The distance between lines is about 15-25 cm, with length of line at 30-50 m. Each of the lines can be set 200-300 points of clumps for seed selection.
- The distance between the lines should be all same so that each seed clump has an adequate space to grow, obtaining nutrients from the water.
- Tie the seaweed seeds into rope, then spread out under the water surface at a depth of 10-20 cm.
- The distance between seed clumps is 10-20 cm.
- Seeds that have been tied into line are stretched on one side by tying into pegs of woods or bamboos

MAINTENANCE AND SEED SELECTION

- Clean the seeds from the dirt and observe the growth of Glacilaria every week.
- Change 75% of the pond's water every week to get optimum condition of ponds and keep the depth at least 80 cm in the ponds.
- Mark 10% of Gracilaria clumps in a line which have highest growth rate or quantitatively the biggest or heaviest clumps every week
- Take the clumps that have been marked at the end of week III-IV, the weight of seeds is expected 4-5 times compared to initial planting.

c. Transportation and Seed Handling

- Use seeds from their own culture or seeds from nearby location as these seeds have adapted to the site and only require short transportation (less than 4 hours).
- When transporting the seeds, avoid their exposure to direct sunlight and ensure the seeds are always wet. Use a cover when the sunlight is too hot and perforate the cover for air circulation.
- Keep away the seeds from freshwater. Avoid transporting the seeds when it rains. Use a tarp to cover the seaweed from rainwater.
- When transporting seeds from neighboring ponds, they can be placed into bags or unloaded load into a boat and taken to the pond through a canal. Ensure the seaweeds in the bags are always in moist or wet and good air circulation by making holes in the bags. Do not compress the seaweed in the bags.

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- If the seeds are transported from far, before stocking, the seeds need to be adapted by soaking the seeds into water of the ponds.

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Gracilaria Planting

C. Planting

a. Once the ponds are ready for planting, select good quality of fresh seeds and picking the clumps (thallus) for 5-10 cm from the tip of the Gracilaria clumps.

b. Spread evenly into the pond in the morning or afternoon with a density of 1 ton/ha for initial planting.

POLYCULTURE GRACILARIA WITH MILKFISH AND OR SHRIMPS

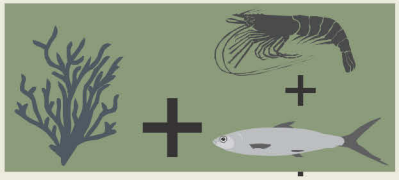
One way to integrate social, economic, and environmental aspects is through cultivating Gracilaria along with milkfish and or shrimps.

Coastal communities who have cultivated milkfish and shripms for a long time but still face a decrease in production can use the polyculture system. This method uses two or more organisms that will be cultured in the same pond to generate optimum social, economic, and environmental benefits.

Gracilaria cultivation can be combined with milkfish or shrimps.

- Gracilaria can function as a biofilter in the ponds for the benefit of the milkfish and/or shrimp
- Milkfish can consume moss attached on Gracilaria, so Gracilaria that are cultivated with milkfish or shrimp will be clean from moss and grow faster.
- Besides the crop from Gracilaria, the milkfish or shrimp crops can be another source of income.

Based on a research conducted by the Institute for Brackishwater Aquaculture (Balai Riset Perikanan Budidaya Air Payau/BRPBAP) Maros, the optimum polyculture in the ponds are as follows:



- Polyculture Gracilaria with milkfish at 1 ha area ideally uses a 2-2 ratio or 2 tons of Gracilaria: 2,000-2,500 of baby milkfish.
- Polyculture Gracilaria, milkfish and shrimps pn 1 ha area is ideal using a ratio of 1.5 tons Gracilaria: 1,000 baby milkfish: 5,000 shrimps.
- Be aware that if the milkfish cultivated is too large, they will eat the Gracilaria; as a result, milkfishes will smell like seaweed (Geosmin). That is why farmers are unlikely to cultivate them. Some solutions for the issues mentioned above are:
  - Shift the milkfish with a size of 3 fingers or 1 kg consisting of 5 fish into pond for milkfish only, or
  - Perform depuration by placing the milkfish which are ready to be harvested into a different pond with running water system and additional artificial feed. Depurationprocess takes 1 week.

D. Care

a. Keep the ponds free from pests and weeds as well as the dirts so that the Gracilaria can grow optimally. The canal and inlet should be maintained to facilitate water exchange.

b. Change the water at least every 3 days during high tide.

c. During dry season, change the water more frequently to avoid high salinity due to evaporation. Meanwhile, during rainy season, keep the water salty not too low through recirculation methods.

d. Monitor salinity, pH, temperature, and turbidity of the ponds regularly every 3 days to ensure water quality is good for optimal growth of Gracilaria.

e. Ensure the water depth during the first 4 weeks of culture is between 30-50 cm for faster growth of branches. During the fifth to seventh week, maintain the water depth into 50-80cm to slow the growth of branches and improve the growth of the contents.

f. Observe Gracilaria development through daily growth rate. If the growth rate is under 3% or if you harvest 3.8 times of wet seaweed compared to the initial weight, then the second planting can be added the seed into 2 tons/ha. But if the daily growth rate is higher than 4% or 6 times of wet seaweed harvesting, then the next planting can be 3-4 tons/ha.

g. If there is cumulation of seaweed, the seaweed needs to level out in order to prevent decay or development of H2S gas in the pond.

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Pembusukan di ujung percabangan karena penumpukan Gracilaria

h. Fertilization is required in certain conditions as mentioned below. However, testing of phosphate and nitrogen level is also needed before fertilization.

- During the first 30 days of Gracilaria culture, if the water is too transparent into bottom, apply NPK fertilizer for 15 kg/ha or phosphate fertilizer (eg. SP36) to help plankton growing, so that it can reduce light penetration.
- The use of phosphate fertilizers should consider pH soil. When the soil has low pH (<5), applying phosphate is less effective.
- Fertilization is applied when daily growth rate of Gracilaria is less than 3%.Apply the fertilizers with high nitrogen content during first four weeks and fertilizer contains phosphate in week 5 to 7.
- Dose of fertilizers is adjusted based on the needs.For example, 10 kg/ha for fertilizer with nitrogen content and 5 kg/ha for phosphate.
- Fertiliztion can be applied by dissolving the fertilizers into water then spread it evenly across the pond.
- Besides anorganic fertilizer, organic fertilizers such as compost and animal manure can also be applied.

WATER QUALITY MANAGEMENT

Water quality management in the pond can be conducted by observing the tides and building a well-constructed pond and canal that's ajudsted to the seawater movement.

The following steps are advised to be done to reach the desired water quality for best Gracilaria growth:

a. Ensure water salinity at range 12-30 ppt by maintaining canal,inlet, and outlet of ponds so that water exchange can flow well.

b. Maintain water pH at range 6.2-8.2 and manage to reach 6.5-8.0 for the optimum growth of Gracilaria.

c. Maintain water temperature at range 18-30oC. Gracilaria grows at an optimal rate within 20 - 25 oC

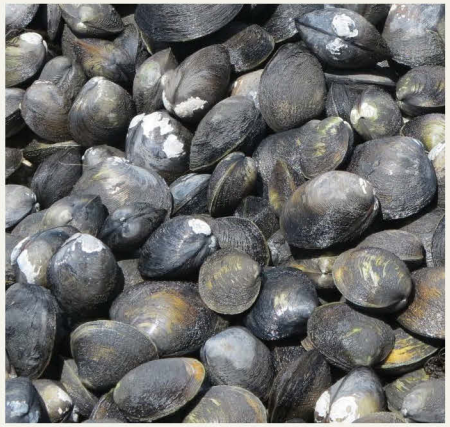
d. Observe the turbidity of water so that Gracilaria at the bottom is still able to obtain sunlight for photosynthesis and optimum growth.

V. . PEST AND DISEASE ON GRACILARIA CULTURE

Pest	Symptom/Cause	Treatment
Mussels or oyster (Limnea glabra) and snails or gastropods	They stick themselves to the thallus and cause the whitening of seaweed. Commonly, this is because of water circulation issue	- Collect the pest manually during pond preparation - Use water filter at inlet and ensure that there is no leaks in the filter -Maintain water quality and regulate water intake and out to the pond regularly
Fish: Rabbit fish, Spotted Scat Fish, Tilapia	Broken of seaweed thallus	- Use water filter at inlet and ensure that there is no leaks in the filter - Apply saponin during pond preparatiom.
Moss: Lumut Sutra (Chaetomorpha)	The moss aticking to seaweed and compete in absorbing nutrients	- Stock milkfish - Increasing water depth
disease	**Symptom/Cause**	**Treatment**
Ice-ice	The seaweed becomes whitish and the thallus is broken due to extreme environment change	- Water replacement / Water circulation

AVOID THE USE OF PESTICIDE FOR PEST ERADICATION BECAUSE WILL AFFECT SEAWEED FERTILITY AND CAUSE ENVIRONMENTAL POLLUTION

One of perticides that is used to eradicate the pests



The mussels that become pest at Gracilaria cultivation

MOSS HANDLING

The rapid growth of mosses like Enteromorpha sp, Chsaetomorpha sp, and Ectocarpus, is a major issue in seaweed cultivation.

The overgrowth of moss will hinder nutrient absorption and sunlight, which leads to the impaired growth of Gracilaria

The presence of moss is also one of the causes of ice due to the competition in nutrient absorption and sunlight intensity at the bottom. To overcome the problem caused by the moss, the following steps can be conducted:

- Manually take the moss out of the pond.
- Increase water depth in the pond.
- Increase daily water recirculation.

VI. HARVEST AND POST HARVEST

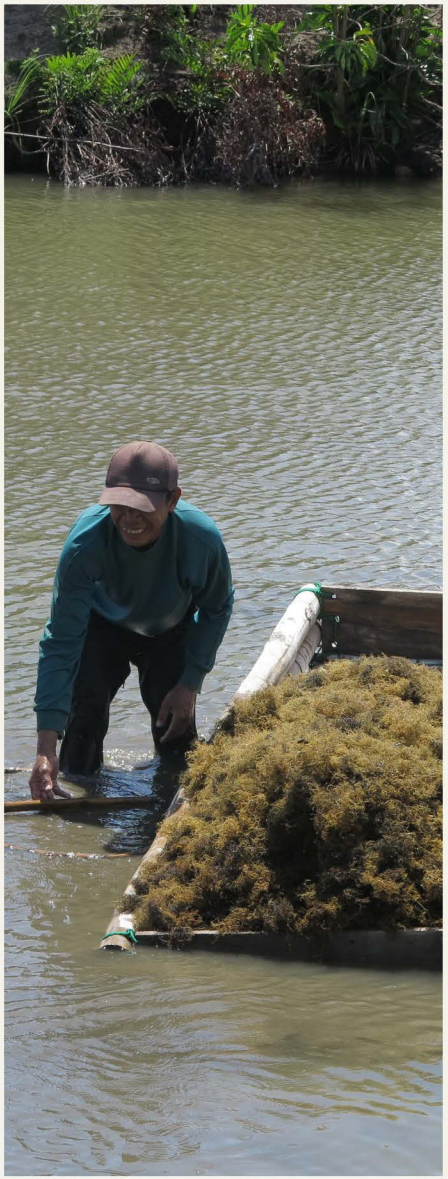
A. Harvest Procedure

a. Harvest is conducted after 45-60 days of seaweed culture to get optimum level and strength of gel.

b. Harvest is carried out by lifting the seaweed from the bottom of ponds and washed with pond water before placed on the boat to be transported on land.

c. Seaweed harvest should be conducted in the morning in order to have sun-drying afterwards.

d. Avoid harvesting in the rain because it would deteriorate seaweed quality.



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Harvesting of Gracilaria in the pond

B. Post Harvest Handling

1. Drying

a. Seaweed can be dried on the dike of ponds or on particular area for drying.

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Gracilaria drying on the dike

b. Assure to dry the seaweed is clean. Place and put a base such as nets, woven bamboo, and other material so that the dried Gracilaria will not have direct contact with land (dike).

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Nets for drying the seaweed

c. Keep the drying area free from cattle.

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Cattle on the drying area

d. During the rain season, the drying area should be covered from the rain. Gracilaria can be arranged with 5-10 cm thick. The wind helps the drying process in this season. It takes about 1.5 – 2 days for them to dry.

e. The drying seaweed needs to be inverted in order to dry completely.

f. To avoid the rain water in the night, the seaweed is rolled and stored to be dried on the next day.

g. When it dries, there will be grains of salt. Clean the grains during the drying process by flicking the nets over. The expecting dryness of Gracilaria at the end of drying is at 13-15%.

h. If the degree of drying seaweed sold on the merchant more than 15% (7-10 tons of wet seaweed for 1 ton drying), then the seller who owns the warehouse will dry the seaweed back for 1-2 days to reach 13-15% dryness (10- 12 tons of wet seaweed for 1 ton of dried seaweed).

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Dried and Clean Gracilaria

i. Dried level (13-15%) is indicated by squeezing dried Gracilaria by hand. If it does not feel sticky and loose, then the level of dryness has met the requirements.

j. The dried gracilaria is separated from the salt content by manual sorting or sieving to eliminate or reduce the dirt and foreign objects. Good quality dried Gracilaria only has 2-4% of foreign matter content.

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Dryness level test of Gracilaria

2. Packing and Storaging

a. Dry Gracilaria can be pressed manually by hand and packed in sacks for each 30-40 kg / sack or packed using a press machine with size 50, 75 and 100 kg of Glacilaria depending on buyer demand.

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Packing using manual press

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Sack from manual packing

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Packing using press machine

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Press machine at closer view

DURING DRYING AND PACKING, AVOID:

- STEPPING ON SEAWEED
- SMOKING OR DISPOSING THE ASH ON SEAWEED
- SPITTING AT THE DRYING AREA

b. Store the gracilaria in a warehouse and ensure the cleanliness and dryness of the warehouse as well as its good air circulation..

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Storing the sacks from manual packing at warehouse

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Storing the gracilaria sacks from packing machine at warehouse

c. Ensure the warehouse roof and ventilation do not leak when it rains and there should be no hole for animals to enter the warehouse.

COOPERATE WITH EXPERIENCED EXPEDITION SERVICE FOR SECURE INTER-ISLAND GRACILARIA SHIPPING

3. Matketing and Transporting

a. Dried Gracilaria could be marketed through local traders and large traders (exporters) or jelly plant. The number or size of the volume is adjusted based on the farmer group capacity.

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Gracilaria shipment to exporter

b. Farmer group can acquire price information directly from potential buyers by requesting price quotation for dry Gracilaria or by contract agreement with buyers.

c. After agreement on price and mode of payment (eg payment in cash, no provision of money), a truck or container of the warehouse or jelly factory can be used to deliver the dried Gracilaria. It should be dry and clean and free of chemicals for export shipments.

d. Cooperation may be established with experienced expedition in export delivery and inter-island shipping.

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Gracilaria shipment using container truck

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VII. SOCIAL ASPECTS ON SEAWEED CULTIVATION

- Under the provisions of ILO and Indonesia's labor regulations, it is prohibited to employ children for labor.
- Also, it is not advised to use coercion at work. Working hours should be based on regulations.
- Avoid discrimination on workers.
- Pay attention to workers's safety aand welfare.
- Workers have the right to organize themselves into community groups, youth clubs, among others.
- Disciplinary action or sanction given to workers who break the rules should be done through a fair mechanism.
- Socio-cultural aspects of the cultivation should be given importance to maintain a good relationship with the community.

VIII. BUSINESS ANALYSIS OF SEAWEED CULTURE

A. Business Analysis of Gracilaria on Monoculture System

Items	Quantity	Price per unit (IDR)	Total (IDR)
1. Saponin (kg)	40	12.000	480.000
2. Purchase of seaweed seed (kg)	1500	1.500	2.250.000
3. Fertilizer (kg)	30	5.000	150.000
4. Lime (kg)	250	500	125.000
5. Pond repairement (packet)	1	500.000	500.000
6. Drying equipment (unit)	1	500.000	500.000
7. Harvest equipment (unit)	1	200.000	200.000
8. Cost for first planting			400.000
9. Maintenance cost			1.200.000
10. Harvest cost			1.000.000
11. Drying and packing cost			1.200.000
12. Other expenses			200.000
13. Pond rent / year			4.000.000
Total Expenditure			**12.205.000**
1. Gracilaria (6 time harvesting/year)	7200	7.000	50.400.000
Total Income			**50.400.000**
Profit			**38.195.000**

Dried Gracilaria price based on the price in South Sulawesi as of May 2014

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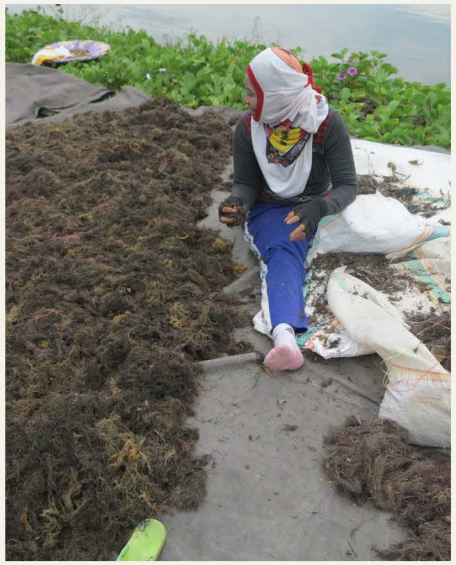
B. Business Analysis of Gracilaria on Polyculture System

Items	Quantity	Price per unit (IDR)	Total (IDR)
1. Saponin (kg)	40	12.000	480.000
2. Purchase of seaweed seed (kg)	1500	1.500	2.250.000
3. Fertilizer (kg)	30	5.000	150.000
4. Lime (kg)	250	500	125.000
5. Pond repair (packet)	1	500.000	500.000
6. Drying equipment (unit)	1	500.000	500.000
7. Harvest equipment (unit)	1	200.000	200.000
8. Milkfish seed (ea) 2 x stocking	3.000		1.050.000
9. Shrimp seed size 3-5 cm (ea) 2 x stoking	10.000		600.000
10. Shrimp feed (kg)	200		1.400.000
11. Cost for first planting			400.000
12. Maintenace cost			6.000.000
13. Harvest cost			1.000.000
14. Drying and Packing Cost			1.200.000
15. Other Expenses			200.000
16. Pond rent / year			4.000.000

Items	Quantity	Price per unit (IDR)	Total (IDR)
Total Expenditure			**20.055.000**
1. Gracilaria (6 times of harvest/year)	7200	7000	50.400.000
2. Milkfish	480	11000	5.280.000
3. Shrimp	200	60000	12.000.000
Total Income			**67.680.000**
Profit			**47.625.000**



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IX. CULTURE ACTIVITY RECORDING

Recording the seaweed conditions and environment variables regularly could help in analyzing the causal relationship between seaweed and environmental conditions.

This will be useful in solving problems related to seaweed cultivation development.

Monitoring the condition of seaweed can be conducted through the use of the following table:

Monitoring Table by Group

Condition	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Dry season												
Rainy season												
Daily average salinity (ppt)												
Daily average temperature (oC)												
Well-growth of seaweed												
Slow -growth of seaweed												
Seaweed affected by ice-ice												
Seaweed attached by Moss												
Predators attack (eg. snail)												
Turbid pond water												

* **Tick on appropriate coloum**

Recording Table by individual farmer

Seed type		**Farmer Name**				.....	
Seed origin		Planting date					
Date of seed purchase		Harvest date					
Shipping duration		Dry duration				..... Hour	
Total seed weight	..... Kg	Gross dry weight				..... Kg	
Growth rate measurement	**Weight (Gram) - Week no...**						
	Seed	**2**	**3**	**4**	**5**	**Harvest**	
Clump at inlet door							
Clump at outlet door							

Data that have been recorded by farmers and groups are regularly analyzed by mentor and later presented to farmers.

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Other Series of Practical Culture Guideline that can be accessed namely:

1. BMP on Seaweed culture for Cottony (Kappaphycus alvarezii), Sacol (Kappaphycus striatum), and Spinosum (Eucheuma denticulatum)
2. BMP on Milkfish (Chanos chanos) at pond
3. BMP on Tiger shrimp farming (Penaeus monodon), Traditional and semi-intensive
4. 4BMP on shrimp farming for Vannamei, Semi intensive ponds with Waste Water Treatment Plant (WWTP).
5. BMP on Catfish Pangasius Culture (Pangasius sp.)
6. Mangrove planting protocol on pond region
7. White snapper cultivation on floating cage system and on pond
8. BMP on Tilapia Cultivation, Floating cage system
9. BMP on Abalon (Haliotis sp.), on Floating cage system
10. BMP on tiger grouper cultivation, Floating cage system
11. BMP on Green Mussle (Perna viridis)

Besides aquaculture practical guidelines, WWF-Indonesia also published other guidelines on Capture Fisheries, Bycatch Fisheries, Marine Tourism, and Marine Protected Area. For further information and electronic version for the guidelines, please visit www.wwf.or.id.

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