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Better Management Practices

Small Scale Fisheries Guideline Series

TIGER GROUPER CULTURE

FLOATING CAGE SYSTEM

Version 2 | January 2015

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TIGER GROUPER CULTURE–FLOATING CAGE SYSTEM
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PREFACE

Praise God Almighty for the completion of the Better Management Practices (BMP) Tiger Grouper Culture Floating Cage System. This BMP is a second version, served as revision of the BMP published by WWF-Indonesia 2011.

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

Our most sincere thanks to the parties who were involved in the preparation of this BMP for their help, cooperation, input and correction, namely Joint Program TNC-WWF; Marine and Fisheries Agency Berau District; Coastal Fish Seed Production Centre (BBIP) Talisayan Berau District; Kabilahian group-Tanjung Batu, Sapandapat group -Balikukup, and Idaman Bersama group - Teluk Sulaiman in Berau District; University of Hasanuddin Makassar; BRPBAP Maros; ACIAR Makassar; Main Center of Mariculture Development (BBPBL) Lampung; Marine and Fisheries Agency Berau district of East Kalimantan; Marine Aquaculture Development Center (BBL) Lombok and PT. Pura Baruna Lestari Kudus Central Java. We are always welcome to all parties for any constructive feedback for the improvement of this BMP. We also apologize if there are mistakes and short comings in the process of drafting and the content of this BMP.

January 2015

Editor
WWF-Indonesia Fisheries Team

Table of Content

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GLOSSARY

- **Acclimatization** : Process in which an individual organism adjusts to new environment
- **Aeration** : Process in which oxygen added in the water
- **Aerator** : Device that used to add oxygen the water
- **Accessibility** : The degree of ability to access the location and to conduct the activity
- **Antibiotic** : Type of medicines that stop or decelerate the growth of bacteria
- **Alkalinity** : Chemical parameter on the water served as buffer the change of pH which measured base carbonate content
- **Ammonia** : Hazardous gas produced by fish metabolism and organic decomposition
- **Material PE/HD** : Polyethylene/High Density a type of material for plastic component
- **Bacteria** : Microscopic organism, that some can cause disease infection and some other can provide benefit as well
- **Blooming Plankton** : Massive growing plankton and dominating in the water
- **Cool Box** : Storage to maintain temperature
- **Dissolved Oxygen (DO)** : The amount of oxygen that is dissolved in water
- **Exploitation** : The use of natural resources to fulfill human needs
- **FCR** : Feed Conversion Ratio / The amount of feed proportion given towards the growth of fish weight
- **Phosphate** : Macro important nutrient for plants
- **Genetics** : Characteristics of living organism that derived from parents
- **GMO** : Genetically Modified Organism/Organism in which the genetic material from genetic engineering
- **Hatchery** : Facility where fish eggs are hatched under artificial condition
- **Juvenile** : Fish that morphologically resembles the adult but sexually immature
- **Vaccine** : Agent that used to stimulate antibody and improve immunity to fight one or several type of disease

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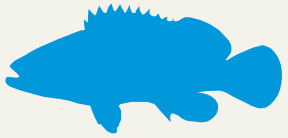
I. INTRODUCTION

Grouper is an important commodity in the Indonesian , which has a bright prospect market, both for domestics and for export. High demand for grouper commodities has led to the over exploitation on fishing. Over fishing using non environmental friendly practices, for example by using explosives or poison, can threaten the environment. Therefore, grouper culture was developed as an alternative to overcome it.



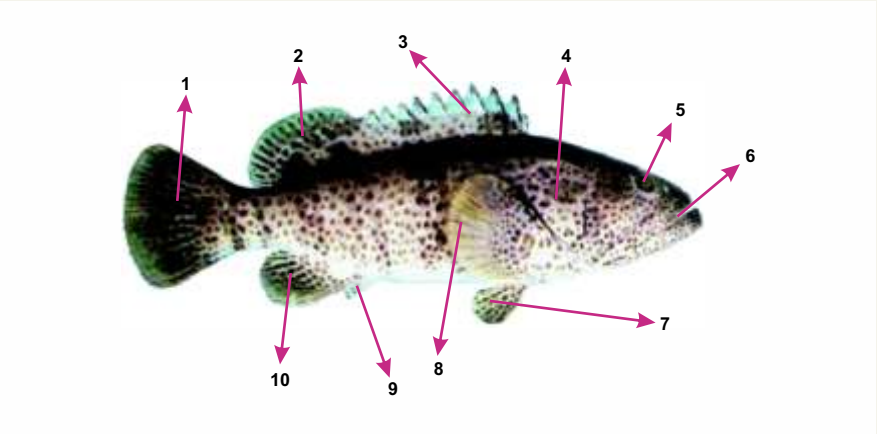
In the 1990's, cultivation of grouper in floating net was developed to meet the demand of grouper. Groupers are successfully cultivated in Indonesia such as orange spotted grouper, humpback grouper (*Chromileptes altivelis*), coral trout grouper, tiger grouper, giant grouper, marbled grouper and hybrid grouper i.e cantang grouper (a cross-bred from tiger grouper and giant grouper).

Grouper culture in floating cage has provided positive impact economically on increasing the income of fish farmers. However, the development of grouper culture in floating cage should be conducted properly and responsibly to prevent negative impacts on the aquatic environment, such as:

1. The increased number of trash fish used as feed which is dominated by other type of juvenile fish which can lead the pressure for other fish juvenile exploitation.
2. Accumulation of organic matter derived from feed residue can cause water enrichment
3. Potency on decreasing the carrying capacity of the aquatic environment surrounding the location
4. Potential conflict for social and land utilization.

Responsible grouper farming practices are not only considering technical and ecological principles, but also ecological principle. WWF-Indonesia initiates to create a guideline of Better Management Practices (BMP) Tiger Grouper Culture on Floating Cage to support the development of grouper aquaculture in a responsible manner by integrating the three principles above.

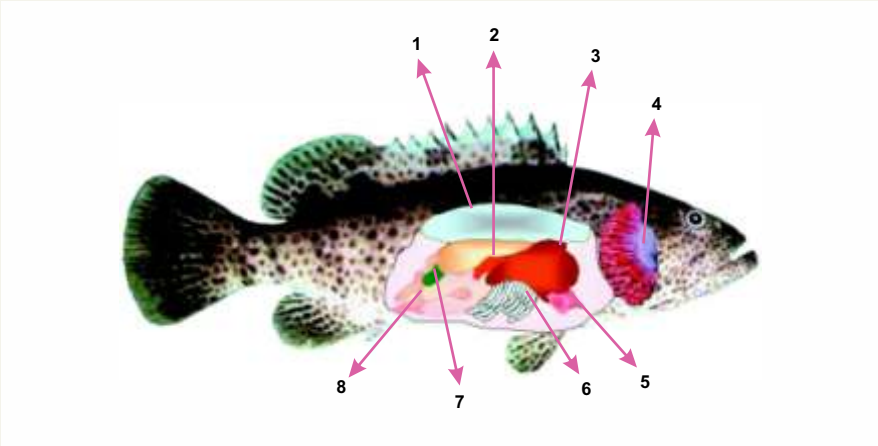
- ***Fish Anatomy – External Anatomy***



Remark :

1. *Caudal Fin*
2. *Dorsal Fin*
3. *Dorsal Fin spines*
4. *Operculum (Gill Cover*
5. *Eyes*
6. *Mouth*
7. *Pelvic Fin*
8. *Pectoral Fin*
9. *Anus*
10. *Anal Fin*

- ***Fish Anatomy – Internal Anatomy***



Remark :

1. *Air bladder*
2. *Spleen*
3. *Liver*
4. *Gills*
5. *Heart*
6. *Appendix*
7. *Gallbladder*
8. *Intestine*

II. GROUPER FARMER GROUP

- The established groups get approval from the local government (Village / Sub-Village / Sub-District), and supervision from the Marine and Fisheries Agency (DKP) or other relevant local agencies.
- Ideal number of grouper farmer group is 10 people, both men and women, and assisted by extension officer, for example, extension field officer (PPL) of fisheries from local agency.
- Grouper farmer group is suggested to meet regularly every two weeks, facilitated by extension field officer to discuss aquaculture activities, constraints and solutions in the field. In addition to that, meetings may be held if there are some issues or other urgent purposes such as disease outbreak or extreme weather conditions.

it is suggested to establish cooperation forum between farmer groups within the region and between regions. .

- Cooperation forum should conduct regular meetings at least once in three months.
- Benefits joined in a group :

a. Reduce the failure risk, improve the success of the harvest.
b. Increases the bargaining power for grouper farmers in the provision of means of production and product sales in the market.
c. Mediate conflicts that may occur among members of the group, as well as with other parties.

III. PLANNING AND PREPARATION OF THE CULTURE

A. PLANNING

To be able to execute farming activities in a certain area, environmental condition; market demand and seed availability must be considered.

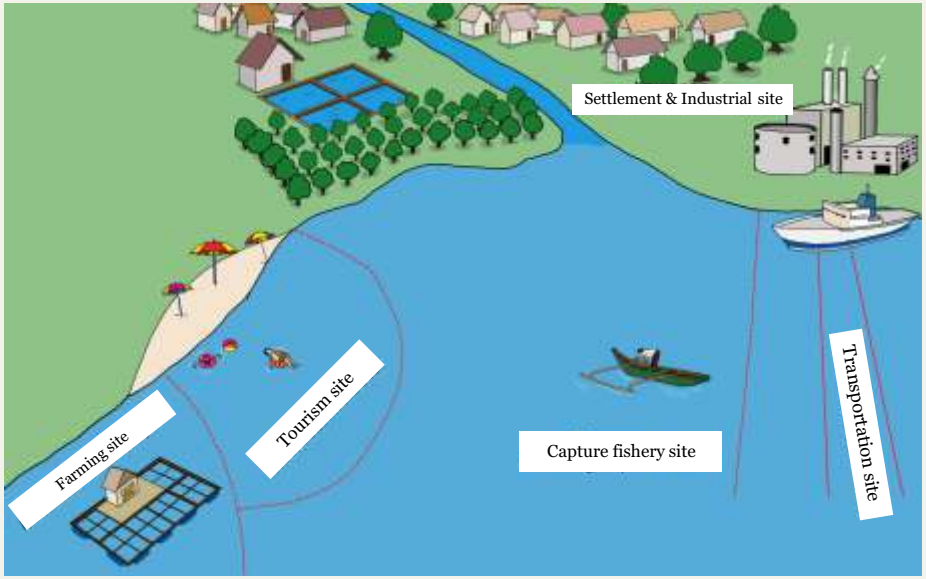
This is important to avoid the failure of aquaculture due to unfavorable environmental conditions. For example, in May - September huge waves often occur in Berau-East Kalimantan. Therefore, to avoid the risk of failure, the cage can be moved to a safe location around the bay during those months.

Good planning will lead to maximal business profits.

B. PREPARATION

The culture should meet with the applicable rules / policies

1. ***The location for culture should comply with the applicable rules / policies***
   - The location is chosen in accordance with 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) to land at city/district or province. The suitability of the cultivation location with designation is intended to avoid conflicts with other uses such as residential areas, conservation, fishing, tourism, industry, shipping, etc.



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

2. ***The business and scale of cultivation should obey with regulation of Ministry of Maritime and Fisheries Affairs*, they are:**
   - Aquaculture enterprises are required to have fisheries business licenses (Surat Ijin Usaha Perikanan/ SIUP) or have an aquaculture business recording mark (Tanda Pencatatan Usaha Pembudidayaan Ikan / TPUPI) based on the Regulation of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia Number 49 / PERMEN-KP / 2014 regarding Fish cultivation businesses.
   - SIUP should be owned by medium-scale up to large-scale of aquaculture enterprises and issued by related Fisheries Agencies.
   - Small-scale aquaculture enterprises are not required to have SIUP, but should have TPUPI. Based on the regulation of Ministry of Marine Affairs and Fisheries, Republic of Indonesia Number 49/2014 regarding to aquaculture, grow-out farming activities are considered in the small scale business if:
     - ***The aquaculture uses low technology***
     - ***The area for aquaculture is not more than 2 Ha.***
   - According to regulation of the Minister of Marine Affairs and Fisheries Republic of Indonesia No. 3/2015 about 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 for aquaculture business with the 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 coastline towards open water and or islands waters

     The licenses are issued by the Investment Coordinating Board (Badan Koordinasi Penanaman Modal /BKPM) based on the recommendation from the Minister of Marine Affairs and Fisheries.

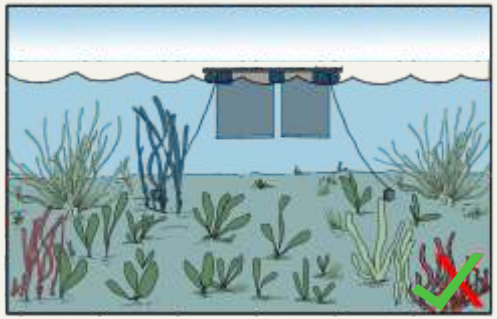
3. **Other regulations related to aquaculture in coastal activity , namely:**
   - Law No. 27/2007 and its amendment, law No. 1/2014 concerning the Management of Coastal Areas and Small Islands, which is a ban on conversion of land or ecosystems in the aquaculture region or zone which does not take into account the sustainability of the ecological functions of coastal and small islands
   - Law No.31 / 2004 regarding Fishery and Government Regulation No. 60/2007 regarding Conservation of Fishery Resources, which is by participating in conserving mangrove ecosystems, seagrass beds, coral reefs, and other ecosystems associated with fishery resources.

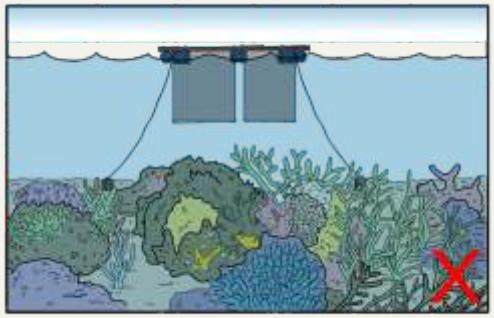
2. Feasibility location for grouper farming based on the type of location, water quality, and access to farming areas, e.g.: :

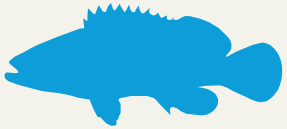
a. Type of Location

i. The area is sheltered from huge waves and strong winds throughout the year.

ii. The area has a sloping topography with sand-bottom. Area covered by healthy live coral and sea grass beds should be avoided for culture.







b. Water Quality

The water quality in physics

i. Water transparency is more than 5 m.

ii. Current velocity smoothly at speeds ranging from 0.1 to 0.3 m / sec and current direction which not rotate.

iii. Free from pollution, especially oil pollution and heavy metals such as lead (Pb), mercury (Hg) and copper (Cu).

iv. Differences between high tide and low tide preferably 1-2 m.

v. A minimum water depth of 7 m.

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Measurement of water transparency using secchi disk

Water Quality in Chemical aspects

NO	PARAMETER	UNIT	STANDARD QUALITY
1	Temperature	°C	27 - 30
2	Salinity	ppt	27 - 34
3	pH		7 - 8.5
4	DO	ppm	≥ 5
5	Nitrite (NO_2^-)	ppm	< 0.05
6	Nitrate (NO_3^-)	ppm	< 0.008
7	Total Ammonia - N	ppm	< 0.3
8	Phospate	ppm	< 0.015
9	Total Organic Matter	ppm	< 50
10	Alkalinity	ppm	>100

MAXSIMUM DAILY TEMPERATURE FLUCTUATION IS 3^0C

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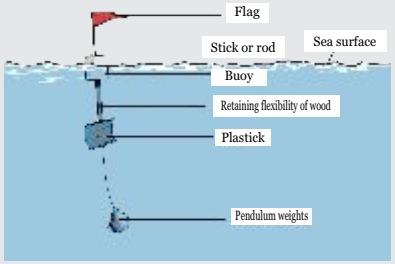
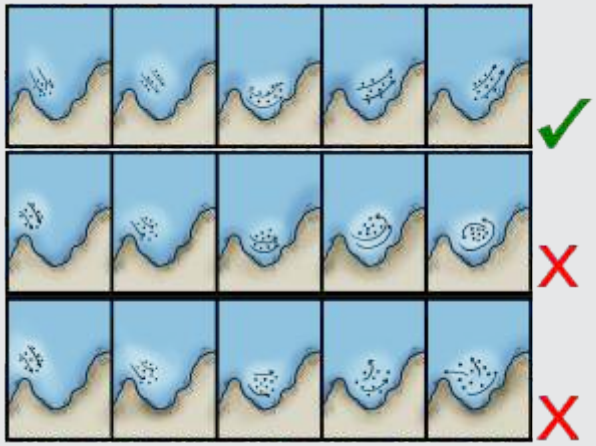
"DROUGE" METHOD FOR PROPER SITE SELECTION OF FLOATING CAGE SYSTEM



- Place a small buoy with a flag as a sign
- Tie a rope along the 1/3-1/2 of water depth to the buoy
- Tie a ballast weight to the end of the rope

- Place 8-12 small buoys to the water simultaneous and wait ± 15-20 minutes
- Observe the direction of the buoys
- If the buoys spread toward the same group, then the circulation indicates the location corresponding to floating cage
- If the buoys gather, it indicates the flow of water rotates (not recommended area for floating cage)
- If the buoys spread on scattered direction, then it indicate that the water flow is not stable, there is potential in the central swell (bottom) waters. This location is not recommended for KJA



c. Accessibility

i. The area is easily accessed by vehicles through land or sea.

ii. Transportation facilities and infrastructure are available.

iii. Close to feed source and labor and also good security conditions.

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IV. FACILITY AND INFRASTRUCTURE OF FLOATING CAGE

Floating cage is a series framework for cage floating to place nets as container of cultivation

Parts of floating cage

a. Raft

Raft is a frame which is equipped with floats as place to bond or tie the waring-net and nets.

- Frame material of the floating cage is made of solid wood 6 x 12 cm or board width of 20 cm and 2 cm thick or HDPE or bamboo or PVC.
- Raft with size 8 x 8 m is divided into four squares with the size 3 x 3 m / square. If the beam with size 7 x 14 x 800 cm, board thickness 3 -4 cm, length 400 cm served as foothold. Other alternative for frame is using bamboos.

b. Floating

- Materials made of drum polyethylene (PE) volume of 200 liters, arranged with a distance of 0.5 m.

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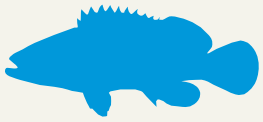
- The number of drums per unit is based on the number of desired box/squares
- If the frame is made of HDPE, the drums do not need to be used

c. Anchor and anchor rope

- Material: concrete blocks, iron anchors, concrete
- The anchors with weigh 40 – 75 kg are tied at each corner of the raft using anchor rope made of PE diameter of 2-4 cm. 4 pieces iron anchors are needed for one raft.
- Anchor rope that used has length 3 times of the depth of the waters (about 18-20 m) so the raft is not drifted.

d. Waring/hapa-nets

Waring-net is the material used to make the bags of fish farming in the early stage of nursery. Waring-net is made of black PE with the mesh size of 4 mm. The shape of waring pockets is a square or cube with a size of 1 x 1 x 1.5 m or 1 x 3 x 1.5 m.

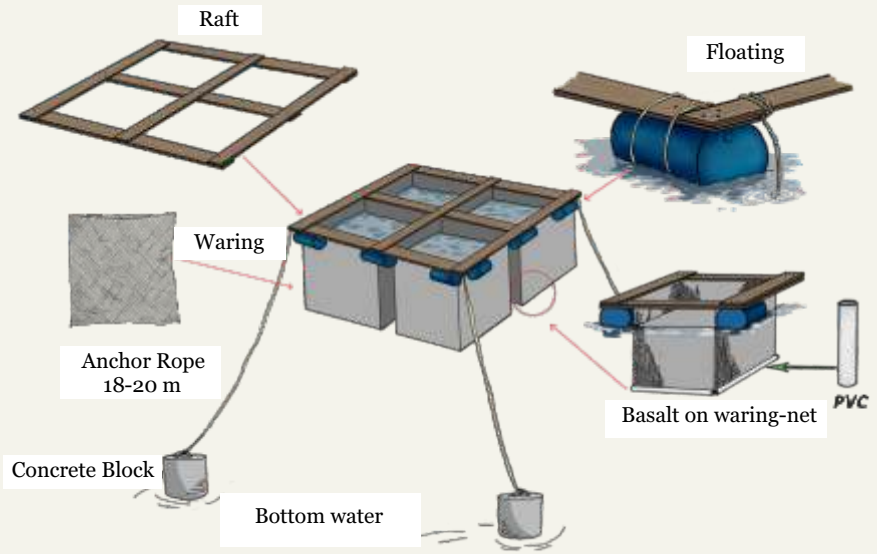


e. Nets

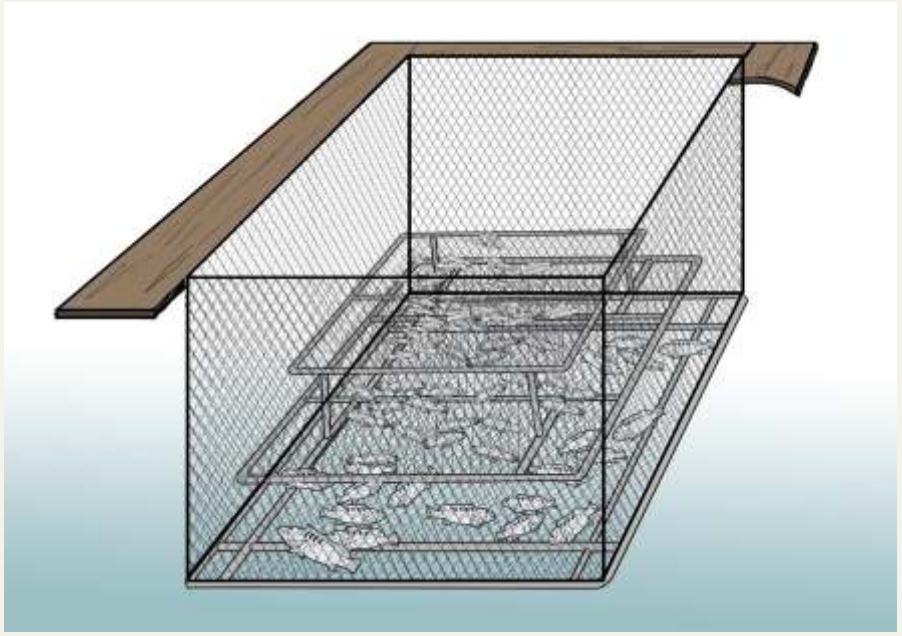
- Net is material to create a place for fish cultivation and having larger mesh than waring-net.
- The type of nets used is made of PE.
- The nets for grow out are bag-shaped nets with size 3 x 3 x 4 m and mesh sizes from 1.25 to 1.5 inches.
- The size of the nets yarn used for grow out is D19.
- The depth of the nets in the cages is 4 m with ballast rectangular PVC pipe which has been filled with mixture of cement in it.

Tabel 2. *Mesh size of nets adjusted with fish size*

NO	MESH SIZE (CM)	FISH SIZE (CM)
1	0.7 – 1.5	5 – 10
2	1.5 – 3.8	10 - 15
3	3.8 – 5.0	>15



IN ORDER TO IMPROVE EFFICIENCY IN THE USE OF CAGE FASILITIES, PARTICULARLY FOR GROUPER CULTIVATION IT CAN BE DEVELOPED CAGES BASED STOREY.
THE FRAME FOR STOREY NET CAN USE PVC.
THE USE OF STOREY NET CAN INCREASE STOCKING DENSITY



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f. The number and size of the guard house are based on the needs. Guard house and warehouse can be built with a size of 1.5 x 2 m. The material used is wood as basic material and asbestos for the roof. Roofs can also use other materials (besides asbestos) that are lightweight and strong.

The house can also be used as a resting place for workers and storage facilities as well as feed storage. If the keeper / owner liveclose to the cage, then the guard house can be omitted in unit cage.

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g. In addition to these parts, operational equipment of cage also requires other equipment such as scissors, brushes, baskets, plastic containers (for grading), aerator, scales, cool box (for feed store), dustpan, boats or ships, cleaning nets (eg net sprayers and water pumps) and immersion container.

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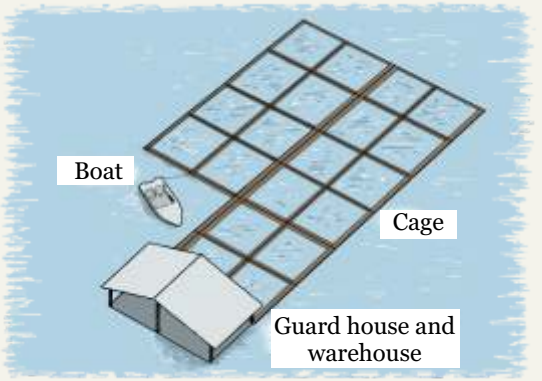
THE CAGE INFRASTRUCTURE

a. Transportation access
b. Communication access
c. Electricity
d. Freshwater resource
e. Feed source



V. GROUPER SEED

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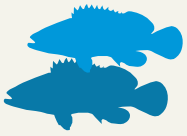
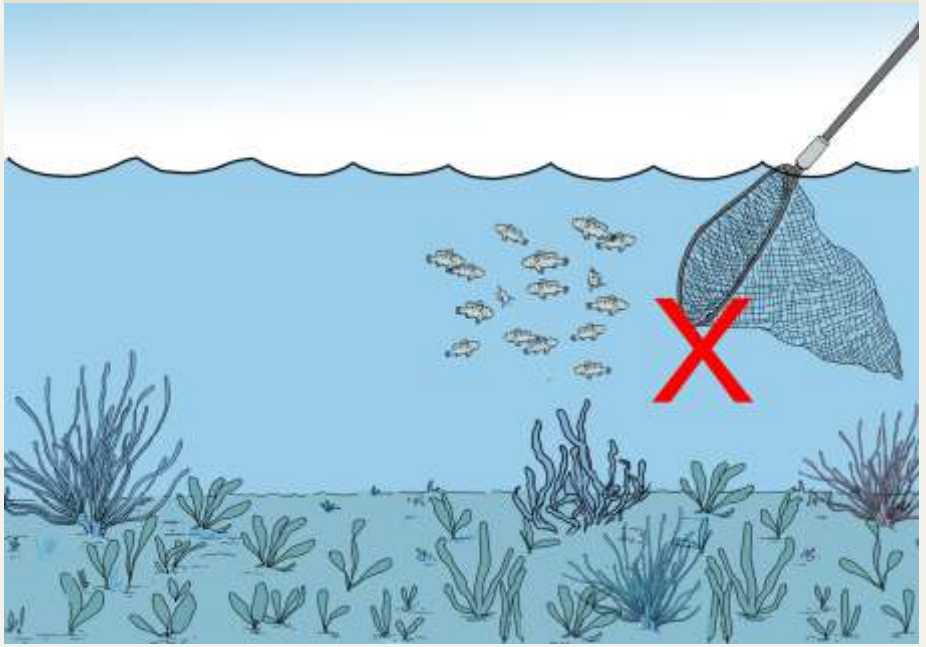
A. CRITERIA FOR GOOD SEED GROUPER :

- Having a uniform size
- Seed size 8 - 10 cm (8 - 20 g)
- Fish seed has brownish color and bright
- Swimming actively against the flow and in group
- No deformity / complete limbs
- Responsive to feed, shock and light
- Not dwarf
- Free from diseases like VNN and Iridovirus. Prioritizing the seeds that have been getting treatment vaccine (Vibrio, VNN, Iridovirus)
- Pass the stress test well by using freshwater or 200 ppm formalin
- The seeds are not from:
  - Catch from sea
  - Genetic Modified Organism (GMO)
  - Hybridization

PRIORITIZE SEEDS THAT HAVE GOT TREATMENT OF VACCINES (VIBRIO, VNN, IRIDOVIRUS)



DO NOT USE THE SEEDS FROM THE CATCH IN THE SEA



B. HARVEST, PACKING, AND SEED TRANSPORTATION

1. Harvest grouper seeds in *Hatchery*

- Check the seeds to be purchased prior to harvest.
- Make sure the seeds have fasted for at least one day prior to harvesting. The objective of this fasting is that the seeds do not spend a lot of metabolic waste (ammonia) during transport.

i. Reduce the volume of water in the tub of seed up to 5-10 cm.

ii. Harvest the seed entirely by using scope net carefully.

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Decreasing in the water volume of seed tub

iii. Collect the seeds harvested and place them in the reservoir tank carefully , and then calculated in accordance with the number to be purchased.

2. Packing and Seed Transportation

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i. Packing the seeds using double plastic bags made from PE with a size of 50 x 80 cm and a thickness of 0.6 mm.

ii. The density of seeds per bag is tailored to the size of the seed as shown in the table below.

Tabel 3. *Density of seed grouper a bag for maximum of 15 hours the transport*

SIZE (CM)	NUMBER OF SEED PER BAG (EACH)
2-3	200
4-5	75
6-7	50
8-9	40
10-11	35
11-12	30
13-14	25
15-16	20

iii. Comparison between water and oxygen is 1: 3, or fill the bag with sterile sea water about 10-12 l and leave the remaining part of bag for oxygen.

iv. Place the bags into a clean styrofoam box.

v. Keep the temperature of the water in packaging in the range of 22-25 °C by providing ice 0.5 kg / box in a plastic bag wrapped in newspaper.

vi. Cover and paste the styrofoam.

vii. Manage the seed arrived on the cage site in the morning or afternoon so that the seed can be stocked right away.

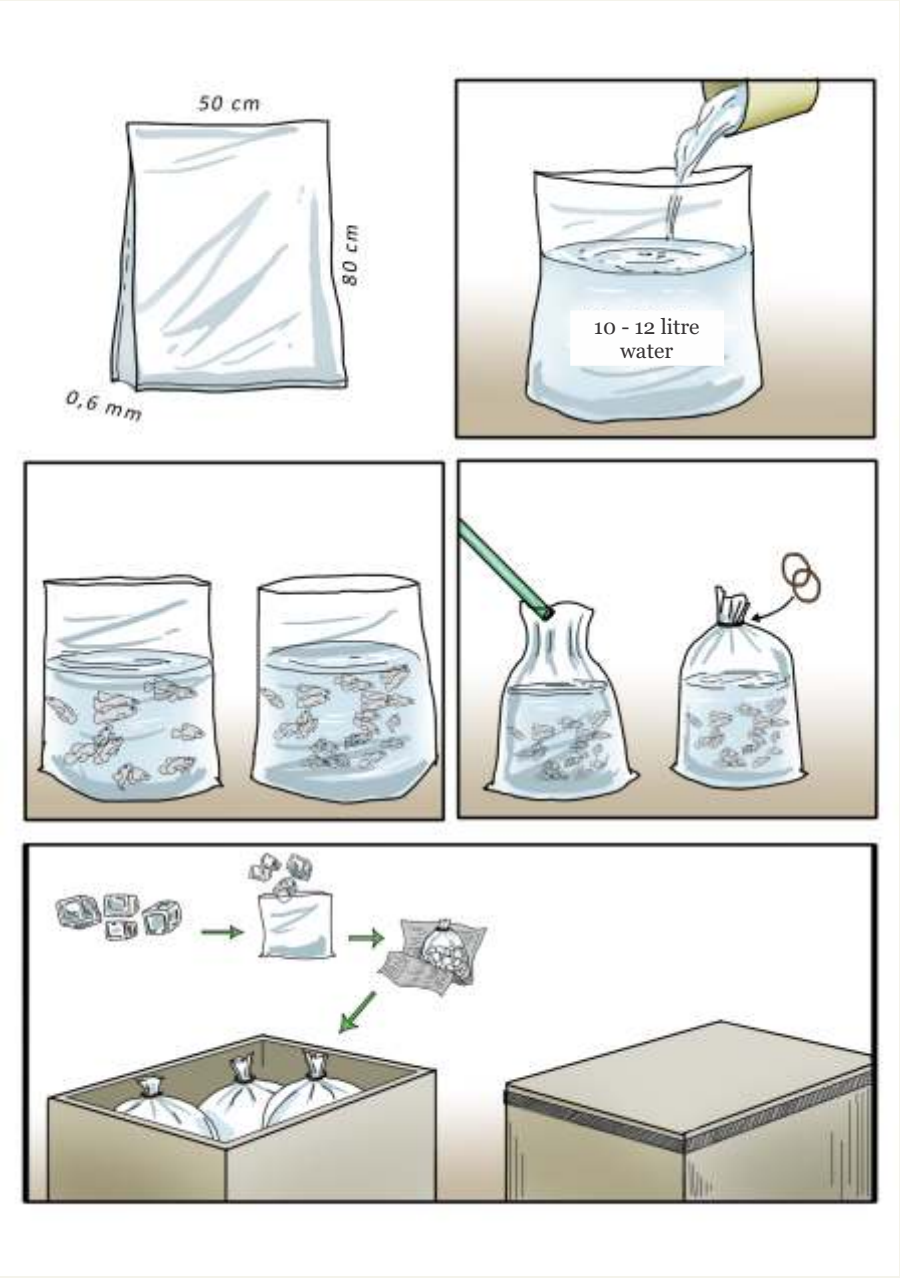
viii. Closed transportation in packing can be used for carriage.

ix. If the transportation takes more than 16 hours, do repacking .

x. Transportation can also use a pickup by using aeration or pure oxygen which is sufficient for close range transporting.

xi. Permit from quarantine must be obtained for inter-island shipping. Permits can be submitted two days before the transport of seeds carried out.

To reduce ammonia levels during transportation it can be added 10 -15 active carbon granules or 5 g / packing



3. Seed Stocking

One of the keys to success in grouper culture is successful in seed stocking. Successful stocking is characterized by well acclimatized process.

i. Place the packing bags into the cage to equalize the water temperature between the water inside packing bags and temperature outside the bags.

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ii. Open the strap of the bags and filled sea water slowly, in small amount into the bags until water temperature in the bags approaching the water temperature in the cages.

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iii. Tilting the mouth of the bag and let the fish seeds go out by themselves. Once the temperature in the bag is same with the temperature of the sea water, the seeds can also be poured into the basket. Seeds in a basket can be selected to anticipate if there are seeds that are not uniform in size or get sick due to the transport.

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iv. Stock the seeds in the morning or in the afternoon.

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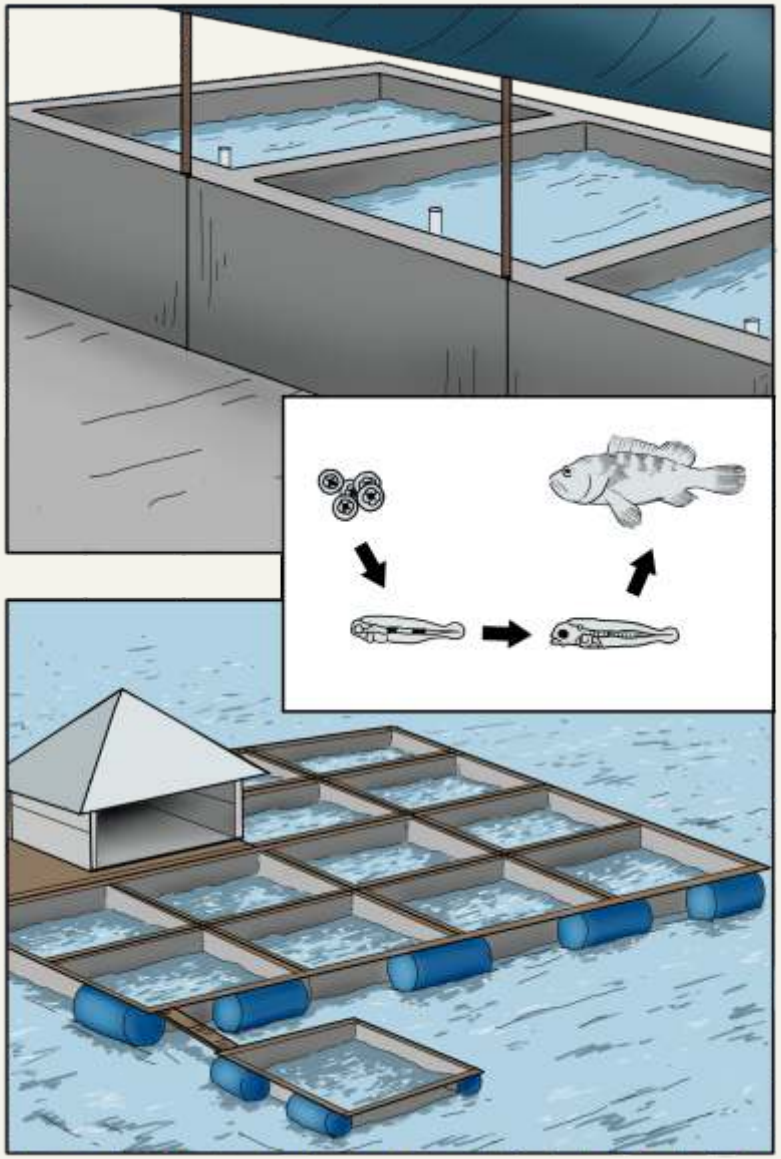
4. Nursery

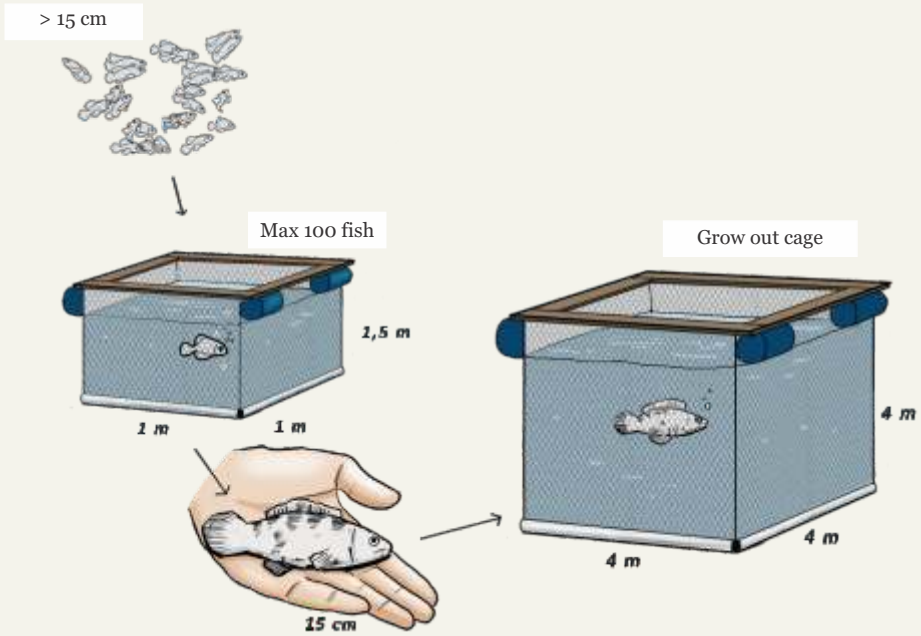
i. If the size of grouper seed is still less than 15 cm, it is necessary to place them in nursery using a tub in the hatchery and waring-nets in cage.



Logging only seeds in the tub and KJA

ii. Maximum stocking density in nursery is 100 individuals (seed size 7-8 cm) in net cage size of 1 x 1 x 1.5 m. When the seeds are larger than 10 cm, the maximum stocking density in the nursery 75 individuals/unit.

iii. After reaching the size of 15 cm, the fish seed was transferred to grow out cage with maximum stocking density is 500 individuals in net cage with the size of 3x3x3 m 4x4x4 m. The density of fish in the net is gradually lowered (by grading), so that the number when harvest in is 300 fish for each cage.



VI. FEED

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A. TYPE OF FEED

Two types of feed that used for grouper aquaculture, namely:

- Fresh trash fish is type of feed from fresh fish or frozen fish. The fish that commonly used such as Slender mackerel scad (Layang), Comon ponyfish (Petek), Trevallies (Selar), Yellow Goatfish (Kuniran), Tilapia (Mujair), etc.
- Pellet feed is type of feed manufactured by factory with its formulation adjusted to saltwater fish. The composition of proper nutrition in the feed is useful to meet energy requirement and mold flesh for fish cultivation. Levels of protein for starter feed (up to 15 cm) of at least 48 % and 45 % minimal for grow out fish
  The type of feed used is a slow sinking pellet.

The availability of pellet feed is more stable than the fresh trash fish because it is not influenced by the seasons

B. FEEDING PRACTICE

- Trash fish that used as feed should be fresh. The fresh fish is cleaned and the head and entrails disposed. Size of feed is based on fish mouth opening.

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- Fresh fish can be stored for a maximum of three days in the refrigerator or keep within ice in a tight container, so that the freshness of the fish can be maintained.
- Avoid storage along with drugs and other harmful chemicals.
- Feed is given in a relatively same place.
- Feeding is given until the fish is full. Feed is given in small amount until the fish stop eating. Feeding dose is provided on the table below.

FRESH TRASH FISH FEED

FISH WEIGHT (GR)	DAILY FEED (% FISH BIOMASS)	FREQUENCY (TIMES)
5-10	15-20	4-6
10-50	10-15	2-3
50-100	8-10	1-2
150-300	6-8	1
300-600	4-6	1

PELLET FEED

FISH WEIGHT (GR)	DAILY FEED (% FISH BIOMASS)	FREQUENCY (TIMES)
5-20	2-4	2-3
20-100	1.5-2	2
100-200	1.2-1.5	1-2
200-300	1-2	1
>300	0.8-1	1

FOOD CONVERSION RATE (FCR)

TRASH FRESH FISH	PELLET FEED
6-8	2-3

- Every afternoon of the remaining feeding is cleared.
- At the next feeding schedules, if the fish do not respond the feed, it indicates that the fish was still full, so the feed does not need to be given.

- Feeding practice can combine both the pellet feed and trash fresh fish interchangeably. Pellet feed is given earlier before trash fresh fish given.
- For small fish (<10 cm), it is suggested to give pellet.
- Vitamin C and multivitamin at a dose of 3-5 g / kg of feed are given every week.

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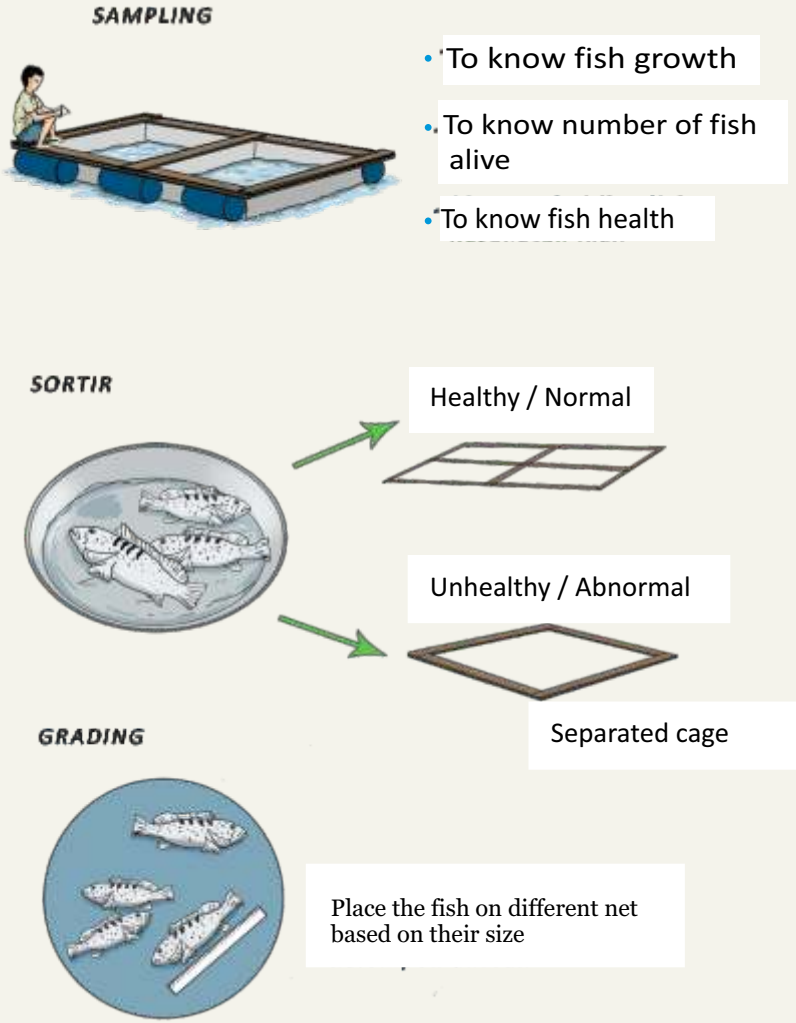
VII. FISH CULTURE AND CAGE MAINTENANCE

A. SAMPLING, SORTING AND GRADING



Sampling

Fish sampling is conducted to determine the growth of fish, the number of fish survive and fish health monitoring.

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Sorting

Sorting is conducted to separate between healthy fish and non-healthy fish.

Grading

Grading is conducted to select the fish based on the size.

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- Grading, sorting and sampling can be conducted at the same time. Those activities can be also combined with change the nets.
- Grading can be conducted every 2-4 weeks depend on the size of fish.
- Fish selected by grading is placed separately based on group size.
- When grading, unhealthy fish is quarantined in a special plots for treatment, while the defective fish is placed in separate plots to be sold to the local market or for personal consumption.
- Along with grading activities, fish growth measurement are also carried out by taking 10 random fish each group to be measured the weight and the length.
- For fish that have weigh more than 200 g, the sampling size of the fish can be conducted every 1-2 months.
- In grading and sorting activities, it is suggested to use scoop with smaller mesh size made from smooth material so it does not hurt the fish.
- Grading and sorting should be conducted in good weather conditions such as in the morning or afternoon.
- Data sampling, sorting and grading of fish, are recorded in the monitoring format (attached).

B. WATER QUALITYMONITORING

- Water quality monitoring should be conducted regularly. Measurements of temperature, salinity, dissolved oxygen and pH can be done once a week.

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- In extreme weather conditions, the measurement of water quality parameters can be conducted every day.
- Other water quality parameters such as nitrite and plankton abundance was observed in case of suspicious things that occur in fish.
- The important thing to note is the daily weather changes, as well as current and wave conditions.
- Results of water quality and weather observations are recorded well and complete in monitoring format.

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C. CAGE MAINTENANCE

- Nets should be replaced every 1-2 weeks or depend on the site water conditions. Replacement nets intended to smooth the flow of water and reduce the risk of pests and diseases.

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- Dirty nets are dried 5-7 days (until completely dried) and cleared of most and animal attached. Once the nets are clean, they can be used as a replacement nets.

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- Check nets every day, if there is damage, repaired immediately.

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- Examine and repair facilities of cages every time after harvesting.

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CLEAN NETS WILL EXPEDITE WATER CIRCULATION AND REDUCE THE RISK OF PEST AND DISEASE

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B. FISH DISEASE PREVENTION

- Vaccinate the fish on a regular basis in accordance with the recommended dosage.
- Provide sufficient feed to meet fish's nutritional requirement.
- Provide vitamins, especially vitamin C to boost immunity so that the fish are resistant to disease. The dose is 3-5 g / kg of feed.
- Soak the grouper with freshwater periodically to break the chains of parasites that attach to the fish. Soaking is conducted for 5-10 minutes during grading. Use sufficient aeration so that the fish are not stressed during the soaking. The treatment is only for healthy fish.

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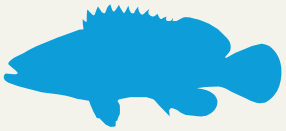
- Keep clean the nets and the cultivation environment so that no food remains which can attract destroyer fish nets.
- Monitor and control fish health periodically to the lab to ask help from a technician / extension workers.
- If fish dead, take the fish and dip in 10% formalin solution, then buried on the ground.
  Do not discard dead fish into the sea or use a dead fish as fish feed.



"DISEASE PREVENTION IS THE BEST WAY TO KEEP FISH HEALTHY."

C. FISH HANDLING PROCESS FOR FISH WHICH DISEASE / PARASITES INFECTED

- Unhealthy fish is separated on the net.
- Soak in freshwater with aeration for 5-10 minutes..
- If after soaking fish behavior returned to normal, fish can be put into the cage. If it does not recover then quarantine the fish and treat the fish according to symptoms.

D. HEALTH PROBLEMS CAUSED BY BLOOMING PLANKTON OR POLLUTION

Blooming plankton such as *Noctiluca*, *Cochlodinium* etc and water pollution can lead to fish health problems due to lack of oxygen and poisoning.

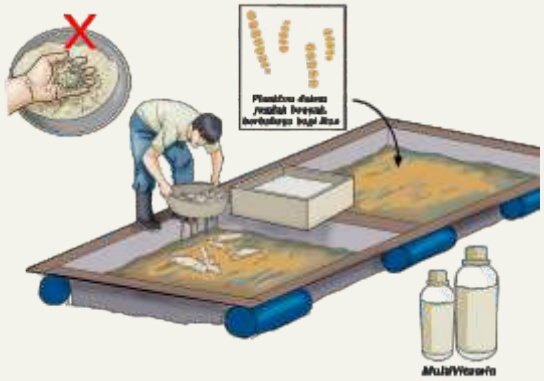
© BBPBL-Lampung

© BBPBL-Lampung

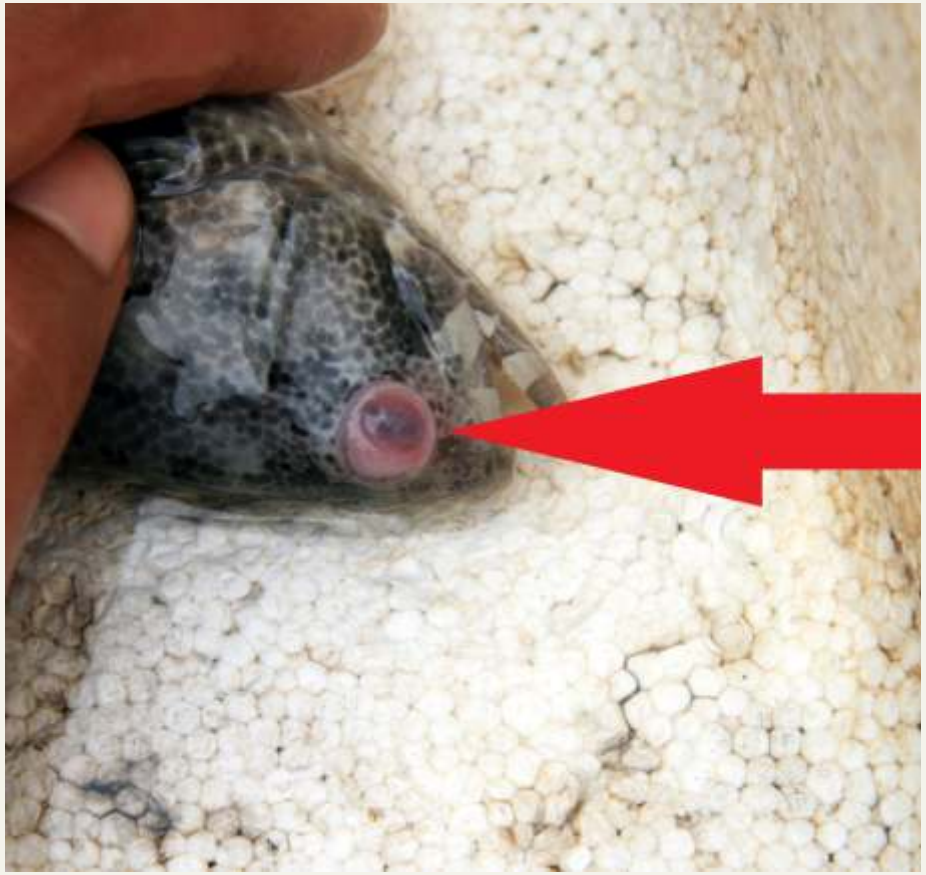
Blooming plankton Cochlodinium occurred in Hurun Bay, Lampung, 2012 caused fish in cages death.

If it is found symptoms of unhealthy fish due to blooming of plankton, then some action:

- Fast the fish for some time,
- Shift the fish to another location with good water quality,
- Provide a multivitamin to boost the immune system of fish.



VIII. PEST AND DISEASE ON GROUPER



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MAIN CAUSES OF FISH DISEASE:

- Extreme weather change.
- Particularly water polluted by heavy metals.
- Drastic parameter changes in water quality, particularly temperature and DO.
- Pathogens infection (parasites, bacteria, virus).
- Low quality seeds.
- Poor handling, such as too high stocking density, Insufficient feed in terms of both quality and quantity.

A. SYMPTOMS OF UNHEALTHY FISH:

- Decrease appetite .
- Inactive swim and apart from group.
- The color of the fish turn dark / pale (symptoms of stress fish).
- There are wounds on the body tissue.
- Irregular swimming, floating, upside down, circling and loss of balance.
- Rubbed the body on the nets
- Redness at around the mouth, gill cover, the base of the fins and fin surfaces.

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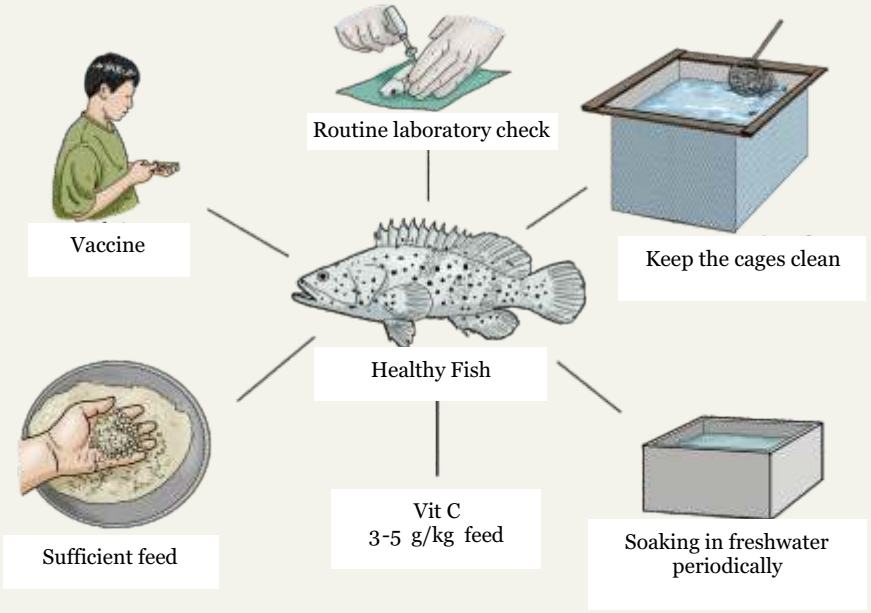
- Body shape is not normal.
- Slow growth.
- Fish is weak and stay at the bottom.

B. FISH DISEASE PREVENTION



E. TYPE OF DISEASE AND THE TREATMENT NEEDED

NO	CAUSE OF INFECTION	ORGAN ATTACKED	SYMPTOMS	TREATMENT
1	Parasite: A. Flatworms a. Flatworms at gills: - *Haliotrema* - *Diplectanum* - *Pseudorhabdosynochus*	- Gills	- Gills look pale - Fish swim unstable on the surface of water - Colour of tissue become white - Decreasing appetite - Occurred problem in breathing - High mortality rate or mass death	- Soaking the fish into freshwater for five minutes with two repetitions or - Soaking can also use H_2O_2 with a dose of 150 ppm for 30 minutes. (technical guideline from BBRPBL Gondol) - For Isopoda: Take isopoda manually. If there are wounds followed by secondary infections (bacteria), treatment is conducted by immersion the acriflavin concentration of 5-10 ppm for 10 minutes. If the fish has not recovered yet, the treatment can be repeated every two days until the fish recover.
	b. Flatworms at skin: - *Benedenia* - *Neobenedenia*	-Surface of fish tissue - Eyes	- inactive swimming - Rubbed the tissue into nets - Eye swelling - Wounds into skin - Blind - Secondary infection by bacteria - High mortality rate or mass death	
	B. Crustacean a. Kopepoda - *Caligus*	-Surface of tissue - Gills	- The surface of tissue is not smooth - The fish swim slowly approaching the water surface - Decreasing appetite - Fish become weak when get strong attack - Skin and muscle corroded - Secondary infection by bacteria - High mortality rate or mass death	**Instruction for using acrivlafin :** **For Fish>10 individuals** • Prepare 2 buckets volume @ 80 litre • Fill them with freshwater • Add 15 g acriflavin into one of the bucket **For Fish<10 individuals** • Prepare a bottle volume 500 ml • Fill the bottle with freshwater and 10 g acriflavin • Spray on fish infected pests
	b. Isopoda	- Gills - Surface of tissue	- Decreasing appetite - The fish rubbed the tissue into the nets - Breathing problem - Mortality occurred	

NO	CAUSE OF INFECTION	ORGAN ATTACKED	SYMPTOMS	TREATMENT
	C. Protozoa a. Dinoflagellata - *Amyloodinium*	-Gills - Tissue surface	- The fish gather in water surface or close to aeration - Gills look pale, - The color of the tissue surface becomes dark - Gills and skin damaged - High mortality or mass death occurred	
	b. Ciliates - *Cryptocaryon irritans* - *Trichodina* - *Brooklynella*	- Tissue surface - Eyes	- White spots appeared on the skin - Fish rubbed the tissue into the nets - Mucus production increased - Respiratory problems - Secondary infection by bacteria - Mass mortality if there is not any treatment	
2	Bakteria - *Vibrio* sp. - *Tenacibaculum maritimum* - *Streptococcus* sp. - *Pasteurellosis* - *Flexibacter*	- Heart - Spleen - Kidney	- Decreasing appetite - Fish becomes weak - Decay in fins - Eyes bulging and fluid accumulated in abdomen	- Using recommended antibiotic or natural antibiotics such as: garlic and betel leaves
3	Virus - VNN (*Viral Nervous Necrosis Virus*) - Iridovirus	- Brain - Eyes - Gills - Spleen and other internal organ	- Tissue's color becomes dark - Fish stay at the bottom - Disrupted balance swimming (Fish swim spinning) - Hemorrhagic (bleeding) at the base of the operculum and swim bladder - No sign of injury on the exterior of the tissue	- Test the seed that will be used, so the seed does not contain this virus

IX. HARVEST

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- Harvest can be conducted when the fish has reached the size 500 - 1200 g / each, or meet market demand.
- Fish that have economic value is fish that are not defective.
- It is recommended that farmers check the weighing scales to prevent fraud.

A. HARVEST FOR LIVE FISH PRODUCTS

- Fish have been fasted for 1-2 days before harvesting to avoid vomiting during transportation.

  Prepare nets / temporary tank to collect the crop.

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- Harvest the fish by lifting the nets slowly then keep stay close to the surface about 10 minutes. Nets then divided into two parts using bamboo or wood for easily collecting.

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- Fish collected from the net using a scope net / basket and placed in shelters nets. Placed the fish according to size.
- The fish was weighed and transferred to a carrier vessel to be brought to the buyers or placed in temporary tank on the land.

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B. HARVEST FOR FRESH FISH PRODUCTS

- Harvest for fresh fish products is relatively similar to harvest for live fish products.
- Fish is slaughtered by placing the live fish into a container that consist of ice (temperature less than 4 °C). Fish that have been slaughtered are placed into a box in which has been provided ice. The fish then taken to the mainland.

X. SOCIAL ASPECT OF GROUPER FARMING BUSINESS

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- Do not use child labors who are still of school age as stated in ILO clause and labor regulations in Indonesia.
- No coercion on working and must pay attention to working hour according to regulations and no discrimination against fellow workers.
- Pay attention to the safety and welfare of workers.
- Workers should have right for be association or organization, such as community groups, youth clubs, community organizations, and others.
- Disciplinary actions or sanctions given to employees who break the agreed rules, should be through a clear mechanism and align with the employment agreement.
- Prioritizing local workforce to reduce potential conflicts.

XI. GROUPER FARMING BUSINESS ANALYSIS

A. INVESTMENT COST FOR GROUPER

NO	DESCRIPTION	QUANTITY	UNIT	AMOUNT (Rp)	TOTAL (Rp)
1	Floating cage (1 unit guard house)	4	Unit	-	35,000,000
2	Nets during culture & substitute nets (Nets PE 3 x 3 x 3 m)	18	Each	800,000	14,400,000
3	Motor boat 5 PK	1	Unit	7,500,000	7,500,000
4	Oxygen tube	1	Each	1,000,000	1,000,000
5	Aerator AC- DC	1	Each	2,000,000	2,000,000
6	Generator 5 KVA	1	Unit	8,000,000	8,000,000
7	Water pump	1	Each	1,000,000	1,000,000
8	Cable installation and lighting	1	Packet	2,500,000	2,500,000
9	Work equipment	1	Packet	2,000,000	2,000,000
				TOTAL	73,400,000

B. OPERATIONAL COST:

1. **Fixed Cost** ,
   One cycle of tiger grouper cultivation takes 10 months. Assuming the cage will last for 5 years:

1	Depreciation 20 %/year	Rp 13,650,000
2	Maintenance (5 % investment)/year	Rp 3,412,500
3	Permit (2 % investment)/year	Rp 1,365,000
	Total	Rp 18,427,500

2. Operational cost for one cycle of tiger grouper cultivation:

NO	DESCRIPTION	QUANTITY	UNIT	AMOUNT (Rp)	TOTAL (Rp)
1	Seed with size 7 cm	8,000	Ekor	7,000	56,000,000
2	Pellet Feed : Target SR Production Initial stocking FCR Feed need	 70 8,000 1.8 5,040	 % Ekor Kg	 15,000	 75,600,000
3	Vitamin and drugs	1	Packet	1,000,000	1,000,000
4	Fuel : Gasoline	7,000	Litre	6,500	45,500,000
5	Miscellaneous cost				1,000,000
6	Supervisor Salary 1 person	10	Month	850,000	85,000,000
7	Technicians 3 persons	10	Month	2,500,000	25,000,000
					211,600,000

3. Calculation of income from tiger grouper culture

NO	DESCRIPTION	TOTAL (Rp)
1	Revenue (5,600 individuals x 0.5 kg x Rp. 90,000)	Rp 252,000,000
2	Fixed Cost	Rp 18,427,500
3	Variable Cost	Rp 211,600,000
5	Income margin	Rp 21,972,500
6	Income tax	Rp 3,295,875
7	Net Income	Rp 18,676,625

XII. RECORDING AND ENVIRONMENT MONITORING

Recording

Recording is the main support in the success of farming. Good record-keeping will ease to analyze a case. For example when there is disease outbreak, the available data can be analyzed the cause and effect associated with environmental conditions.

Recording also allows the preventive actions to reduce crop failure.

Recording can be performed alternately by the group members.

THE RECORDS ARE KEPT FOR ATLEAST **2 YEARS AFTER HARVESTING.**

Keep recording and documentation of the entire cultivation process from preparation to harvest, namely:

- The amount of feed used, both the total amount and amount of usage per each cage.
- Fish growth.
- The number of fish that die each plot every day.
- Water quality that consist of salinity, pH, DO, temperature, total ammonia, total nitrogen and phosphate.
- The type and abundance of plankton around the cages, a minimum of 1-2 times /year at the height of the dry and rainy season.
- Weather conditions, especially in extreme weather conditions such as storms, rain too often, or heat.

Sample of daily form table:

GROUPER CULTURE DAILY RECORD

Farmer name: **Cycle Year:** **fish Type:**

DATE	DOC (DAY)	NO. CAGE	NUMBER OF INITIAL STOCKING (INDIVIDUAL)	NUMBER OF MORTALITY (INDIVIDUAL)	DAILY FEED (KG)	AVERAGE WEIGH (G)	WATER QUALITY				TREATMENT	REMARK
							TEMPERATURE	SALINITY	DO	pH		

Note

Monitoring environment can be conducted in integrated between groups with related offices / agencies.

Environment Monitoring

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Attention to the environment around the cages is very important to maintain the nature. A bad environment will directly affect the success of aquaculture, especially through sea water which is a place for fish to live

Things that need to be concerned during environment monitoring are:

- Monitoring the condition of coral reefs and sea grass beds with line transect survey method and or quadrant permanent transects that conducted before, middle and after one cycle of cultivation.
- Monitoring of fish and other biota around the cage with the visual method, at least once, twice a year.
- Monitoring observation points are at a radius of 5-10 m and 50 m from the cages and located at 4 wind direction, or at least two points in the direction of the alternating current.

HEALTHY ENVIRONMENT WILL ENSURE THE SUSTAINABILITY BUSINESS AQUACULTURE

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3. Tiger shrimp aquaculture (*Penaeus monodon*), Traditional Fishpond and Semi-Intensive
4. Vannamei Shrimp Aquaculture, Semi-Intensive with Wastewater Treatment Installation
5. Mangrove cultivation in traditional shrimp pond and other type of shrimp pond
6. Milkfish Aquaculture (*Chanoschanos*), in Environmental Friendly Fishpond
7. Tilapia Fish Aquaculture in Cage with Floating Net System
8. Abalone Culture (*Haliotis* sp.)
9. BMP of Catfish Pangasius Culture (*Pangasius* sp.)
10. White Perch Aquaculture (*Lates calcarifer,* Bloch) in Floating Net
11. Green Mussel Culture (*Perna viridis*)

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

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