Livelihood Options for Coastal Communities

Volume II

IIRR

SMISLE

Livelihood options for coastal communities

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The International Institute of Rural Reconstruction is a non-profit, non-government organization that aims to improve the quality of lives of the rural poor in developing countries through rural reconstruction: a sustainable, integrated, people-centered development strategy generated through practical field experiences.

SMISLE

European Union

The Small Islands Agricultural Support Services Programme is a special project of the Government of the Philippines supported by a grant from the European Union. Implemented by the Department of Agriculture, SMISLE covers the islands of Guimaras, Biliran, Bantayan and Camotes (Cebu) and Pres. Carlos P. Garcia (Bohol). It aims to assist the communities on these islands to initiate and sustain increases in output from farming and fishing, thus enabling them to raise their incomes and generate cash surpluses.

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This book is a joint production between the Small Islands Agricultural Support Services Programme (SMISLE) and the International Institute of Rural Reconstruction.

Foreword

The success of the first volume of **Livelihood Options for Coastal Communities** has led to the demand for this second volume, which is a compilation of small-scale technologies aimed at improving the income and quality of life among coastal communities. It should be used as an addition to the first volume which was published in 1995, also as a joint publication between IIRR and SMISLE.

The aim of the publication is to focus on new technologies that have developed since the first volume was published. All of the appropriate technologies featured in this book are used mainly throughout the Philippines as well as areas of South East Asia.

By producing this book, SMISLE and IIRR continue their practice of people-centered development. This publication marks another joint commitment to share skills, techniques and new and alternative technologies to improve awareness of community resources and provide tested and proven field technologies. This 'learning-sharing' function has been encouraged by SMISLE and IIRR as part of their participatory approach to the development and sustainability of small communities.

Most of the livelihood options featured in this publication had been implemented and proven to profit coastal families in the Philippines. It is our hope that these livelihoods would also benefit more families and communities and help them uplift their standard of living while at the same time being conscious of the protection and conservation of the coastal zones.

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Introduction

Coastal areas throughout the world have been placed under an enormous amount of pressure from human activities, the increasing population and economic pressures for basic survival needs. This has resulted in the continuing deterioration of coastal environments.

In the Philippines alone, the marine waters are five times greater than its land area. Its territorial waters total 220 million hectares, 26.6 million of which are considered coastal. Small coastal communities throughout the Philippines face the problem of over-use and abuse of their natural coastal surroundings, therefore increasing the need for new and alternative technologies to generate income.

Despite efforts by NGOs and awareness groups thoughout the country, destructive fishing methods, such as cyanide and blast fishing, continue to be used. Other methods, such as using nets with small mesh sizes, have also contributed to the depletion of natural marine resources. These methods, though seen as necessary by many fisherfolks for food and income, have a long-term detrimental impact on communities.

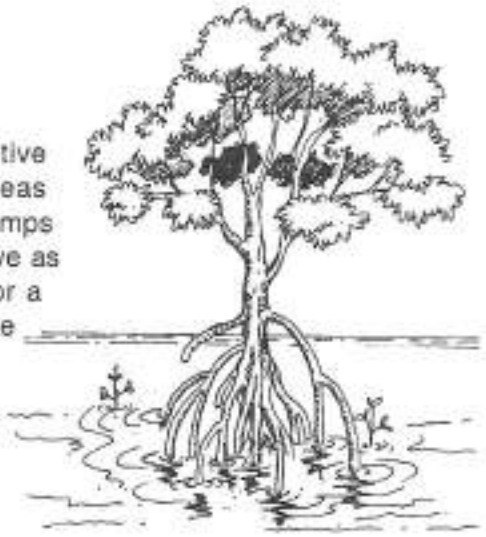
In addition to this, tourism also poses a threat to the country's marine resources. The government has actively promoted tourism in an effort to gain more financial security at the expense of natural marine resources and coastal livelihood endeavors. To counteract this, many NGOs are beginning to make communities increasingly aware of ecotourism activities which respect natural resource supplies and provide alternative livelihood options. However, there is still a lot of work to do to make the benefits of ecotourism clear to both the government and communities.

Among all these threats, the work of NGOs, trainers and extension workers continues. The most important part of their work is to make communities aware of the income generation opportunities surrounding them. However, awareness does not focus solely on identifying previously untapped resources, but includes preparing and training a community for managing an environmentally sustainable economic venture. The role of trainers and extension workers includes making people aware of the advantages and disadvantages of available technologies on communities, families and individuals.

This publication - **Livelihood Options for Coastal Communities: Volume II** - will be of great help to trainers and extension workers in information dissemination and technology transfer.

Aquaculture

Mangrove gardening



Mangrove areas are highly productive marine support systems. These areas provide shelter for crabs, finfish, shrimps and other marine life. They also serve as breeding and spawning grounds for a variety of fish species. All these marine organisms are harvested by man for food and income generation. In addition, mangroves are sources of fuelwood and sturdy construction materials.

The destructive effects of strong winds and waves on coastal communities are abated by mangrove areas which also prevent scouring and serve as silt catchment. Birds find shelter and food in mangrove areas. Their droppings as well as the decomposing mangrove biomass enrich the marine soil and nourish other marine flora.

Many mangrove areas in the Philippines have been destroyed due to overexploitation and conversion into other uses, most notably fish culture on ponds. Mangrove gardening, however, has been gaining acceptance among many coastal communities because of its socio-economic benefits.

A mangrove garden is a small-scale plantation similar to a backyard garden. Mangroves:

- protect houses situated along the shore against scouring of the shoreline;
- serve as buffers against strong winds and waves;
- provide breeding and spawning grounds for economically important fish species;
- provide economic gain as a livelihood option; and
- provide a rich source of construction material, fuelfood and fish food.

Mangrove gardening has been successfully tried on a household basis in Campamanog and Villa Milagrosa, Pres. Carlos P. Garcia, Bohol. About 15 households were able to establish mangrove gardens with an aggregate area of 6 ha.

Securing stewardship for a mangrove garden

Before planning for a mangrove garden, landusers must get a certificate or community forest stewardship. To apply for stewardship:

1. Get prior clearance from the Environment and Natural Resources Council of the municipality;
2. File an application with the CENRO and submit it to the PENRO together with the following documents:
   - a completed application form;
   - the Constitution and By-laws and Articles of Incorporation, when applicable;
   - a copy of the Certificate of Registration from the Securities and Exchange Commission (SEC) or any registering agency;
   - sketch map of the applied area;
   - list of association/community members; and
   - Indicative Development Plan.

Applicants can only apply for land which is exclusively occupied by them. This includes hunting and burial grounds in the case of indigenous cultural communities and other potential areas for community projects. The terms and conditions of the stewardship is explained to applicants in their native dialect. Indigenous cultural communities entering into a stewardship agreement will not waive their ancestral land rights inside and outside the covered area.

Responsibilities of applicants

Applicants are expected to:

- participate in project area delineation and parcellary survey;
- develop at least 20 percent of the land to tree farming of suitable species;
- protect and conserve the forest growth within the project area;
- preserve monuments and boundary landmarks within the project area;
- prevent and suppress fires in the project and adjacent areas;
- protect and preserve trees or other vegetation within 20 m strips along rivers and streams;
- refrain from cutting and harvesting naturally growing trees within adjacent areas; and
- refrain from transferring or assigning their allocated land or any portion of it without prior approval from the DENR.

Transferring stewardship rights

Applicants can only transfer stewardship rights if it is approved by the DENR Secretary and if the original steward:

- dies or is incapacitated;
- transfers residence to outside the area; or
- changes vocations and ceases to be the actual tiller of the land.

The applicants must nominate their heir. If they do not nominate anyone, their children or next-of-kin decide among themselves who will continue the stewardship of the land.

Who is considered next-of-kin?

The spouse and children are considered next-of-kin. If this is not applicable, the parents, brothers or sisters are the next-of-kin.

Planning for a mangrove garden

Location

The proposed plantation site should be sheltered from the general direction of strong winds and waves.

History

Know the history of the site such as previous mangrove cover, prevalent species and peak monsoon months. These pieces of information will help decide what species to plant, when to plant, etc.

Depth

Select shallow areas so the propagules will not be totally submerged during high tide. As observed in Campamanog and Villa Milagrosa, submerged propagules have less chances of

survival. Likewise, do not select an area seldom reached by seawater during high tide or low tide.

Presence of barnacles

Barnacles are a menace to mangrove plantations. Their presence can be detected on rocks, trees and stumps. Scrape them off manually if they are found on existing vegetation and peripheral outcroppings.

Steps in mangrove gardening

1. Selecting the species to plant

There are 47 species of mangroves and associated plant species. Not all of them, however, can adapt to the conditions in your mangrove area. To ensure adaptability, determine the species common in your area or immediate locality. Also ascertain the species which might have been prevalent in your chosen site in the past but was overexploited to its lowest population in the area.

2. Determining the number of propagules needed

Use the following formula to determine the number of propagules needed for a specified area and the planting distance:

$$\text{Number of propagules} = \left[\frac{\text{Length}}{\text{Interval}} + 1\right] \times \left[\frac{\text{Width}}{\text{Interval}} + 1\right]$$

An area of about 10 m² will need 55 propagules if planting distance is 0.5 m between rows and between hills, and 33 propagules if planting distance is 1 m between rows and 0.5 m between hills.

The households of Campamanog and Villa Milagrosa followed a planting distance of 1 m x 1 m. They, however, left an unplanted area of about 5 m wide between two gardens to serve as a passage towards the open sea and a place to moor their motorized boats.

3. Collecting the propagules

Collect mature propagules from the nearest possible source. A mature propagule has a brown crown. Rings appear between its stalk and bulb. Uproot any propagules that have just started to establish themselves on the area just below the mother tree.

4. Transporting the propagules

Plant the propagules right away. If they need transporting to the planting site which is far from the source, sprinkle them occasionally with seawater during transport. Do not expose them to the sun for a long period of time. You can also immerse the propagules in seawater for 3-4 days while waiting for the schedule of planting. This method eliminates insect pests that attack the propagules.

5. Planting

Make a layout of your garden during low tide. Do not plant during the annual monsoon. Drive the pointed base of the propagule into the marked spot in the soil. If the soil is compact, make a hole first and insert the propagule into it. Follow a planting distance of at least 0.5 m between rows and between hills.

Maintenance

Visit your garden regularly. Remove any debris, flotsam or entanglements. If possible, construct a fence around your garden to keep off any debris and pollution. Recycle old nets for this purpose. As all shoreline areas belong to the State, do not forget to secure a mangrove stewardship contract from the Department of Environment and Natural Resources (DENR) to protect any rights you have over your mangrove garden.

Harvesting is possible if the necessary harvesting permits have been secured from the DENR field office.

Once the trees mature, practice selective pruning. **Do not cut mangroves**; a law was passed (Proclamation No. 2152) in 1981

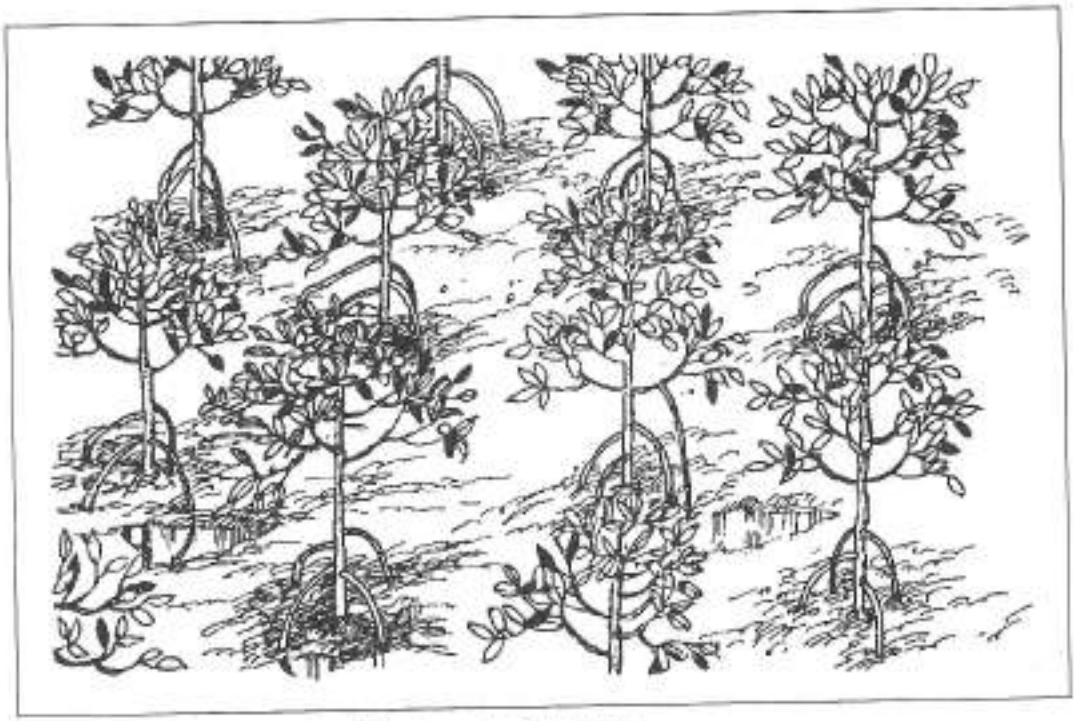
forbidding any cutting of mangroves. Leave the leaves and twigs in the garden to rot and nourish the soil. Sun-dry the harvested wood for several days for construction purposes if necessary. If sold as fuelwood, cut it into several pieces of uniform length.

Sustainability

Before embarking on a mangrove garden project, a household must first fully appreciate the roles played by mangroves in:

- restoring the original shoreline claimed by the sea due to the destruction of the natural mangrove area;
- protecting their houses from winds and waves during storms; and
- establishing a natural habitat for the different marine resources made scarce due to the loss of the original mangrove cover.

Most significantly, a mangrove garden must also be viewed as both a direct and indirect source of income.



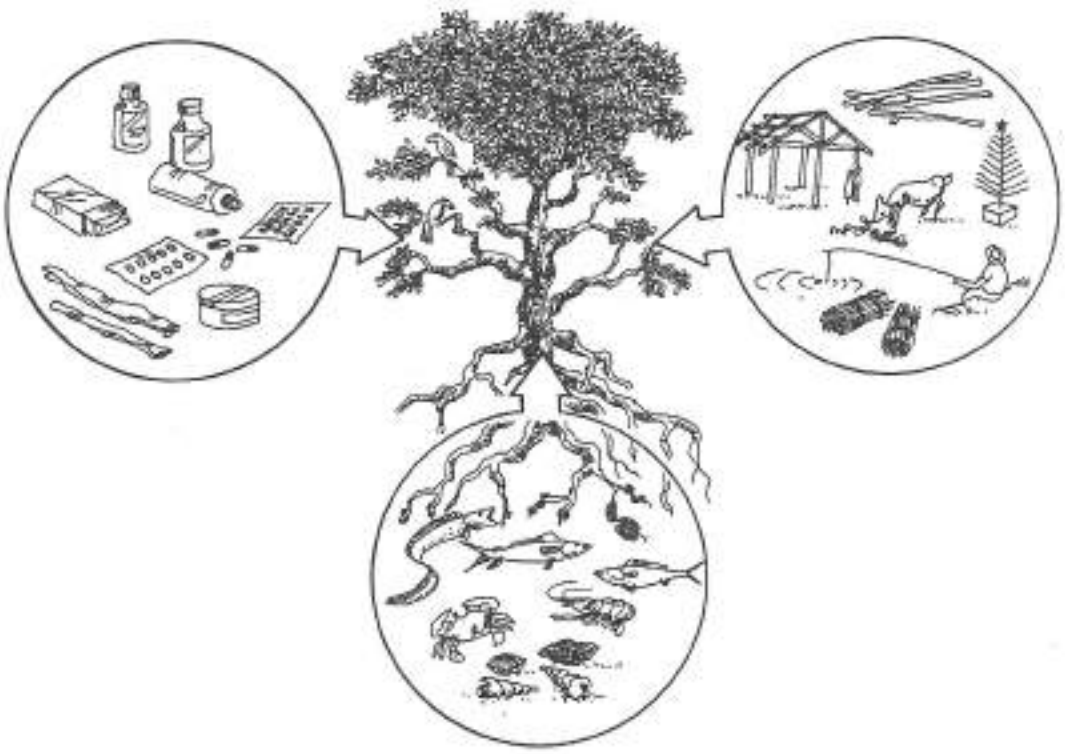
Portion of a mangrove garden following a planting layout

Most common mangrove tree species in the Philippines

Scientific name*	Common name**	No. of seedlings/ propagules needed per hectare**	Planting distance in one hectare** (row x hill) (m x m)	Maturity period (planting to harvesting of wood)**(Years)
Sonneratia alba	*Pagatpat*	10,000	1 x 1	10
Avicennia marina	*Bungalon*	10,000	1 x 1	10
Rhizophora stylosa	*Bakauan-bankau*	10,000	1 x 1	10
Rhizophora mucronata	*Bakauan-babae*	10,000	1 x 1	10
Rhizophora apiculata	*Bakauan-lalaki*	10,000	1 x 1	10

Source: * *Field Guide to the Identification of Some Mangrove Plant Species in the Philippines (DENR - ERDS Region 7, 1996)*

** *Ecosystems Research and Development Service, Department of Environment and Natural Resources, Central Visayas Regional Office*



Values of magrove trees

Cost and return analysis

Establishing and maintaining a one hectare mangrove plantation (0.5 m spacing)

Expenses			
Site preparation			
Labor cost	12 days x ₱100 per day		1,200.00
Materials	400 poles @ ₱5 each		2,000.00
Planting			
Propagules			8,000.00
Labor			31,688.00
Year 1		13,688.00	
Year 2		9,000.00	
Year 3		4,500.00	
Year 4		2,250.00	
Year 5		2,250.00	
Propagules for replanting	12,000 pcs @₱ 0.2/pc		2,400.00
	Total		**₱ 45,288.00**

Production of propagules can be an added income in developing *bakauan* plantations considering the following:

Income @ P0.20 per propagule

Age of plantation	No. of propagules per tree
5-7	5
8-10	10
11-20	220

Source: Sustainable Livelihood Options for the Philippines: An information kit, 1997

At the end of the 20th year, a hectare of *bakauan-bangkau* could produce 16,000 pieces of posts 14-16 cm in diameter and 10 m long. These can be sold at ₱200.00 per piece for a gross income of ₱3,200,000.00. Harvesting and marketing cost for this is estimated at ₱2,240,000.00 per ha. Therefore, the projected net income after a 20-year period is ₱960,000.00.

Prepared by Edgardo Dellin and Armi Aragones, SMISLE

Mudcrab pen culture in mangroves

Over the years, commercial production of mudcrab *(Scylla* spp.) has been undertaken only in bamboo- or net-fenced brackishwater ponds. Its feasibility was proven through a series of verification trials conducted in commercial ponds by SEAFDEC/AQD researchers and is now practiced elsewhere in the country.

Of late, the introduction of using net enclosure to grow mudcrabs in mangroves or tidal zone offers a bright prospect in aquasilviculture. Using mangroves as a natural resource paves the way for creating livelihood among the fisherfolk in the coastal areas. While this method is not very popular in the Philippines as it has only recently been introduced, the same has been carried out for quite some time in Indonesia, Malaysia, Vietnam and China successfully. The advantages of this livelihood option include low investment cost, easy construction, easy operation and it is environmentally-friendly.

Site selection

Mangrove areas should have a sufficient supply of marine or brackishwater throughout the year. Water depth at high tide should range between 0.8 to 1.0 m. Salinity should range between 10 to 30 ppt and temperature between 25 to 30°C. The site must be free from any source of pollution, protected from environmental hazards such as typhoons, flood, erosion and from vandals and poachers.

Materials

- 6 rolls of green polyethelene (PE) net, 1-2 cm mesh size and 2 mm twine diameter
- 2 rolls of plastic sheets
- 30 pieces of bamboo (10-15 m) for structural framework (horizontal bracing)
- Wooden posts, 3-4 m long (vertical post)

Installation of net enclosure

The design for a 4,000 sq m (50 m x 80 m) net enclosure used in the Philippines is shown on the next page.

Constructing a pen

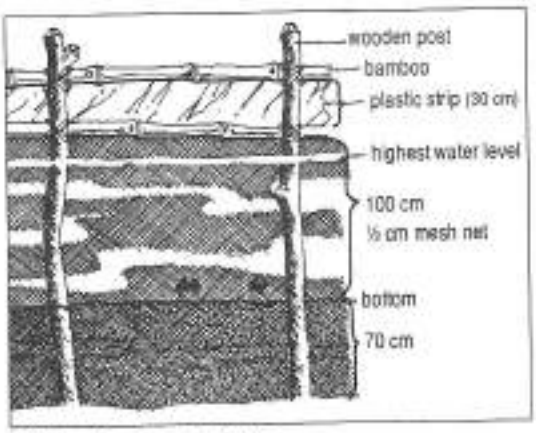
1. Design the enclosure with a shape that varies from square, rectangular, etc. depending on the contour and vegetation of the area. The area should cover 0.2-1.0 ha of water during high tide.

2. Install a net enclosure (polynet 1-2 cm mesh size) using bamboo or wooden posts as a structural framework. The upper end of the net should extend not less than 30 cm above the waterline during the highest high tide level.

3. Along the top edge of the net enclosure, install a plastic strip/sheet of about 50 cm to prevent mudcrabs from climbing over the top. Embed the lower end of the net about 50-70 cm along the base of the enclosure.

4. Drg ditches/puddle trenches (*libaong*) at a depth of about 20-40 cm representing at least 20 to 30 percent of the total area of the enclosure. These are intended to hold water in the enclosed area during the lowest tide for the crabs to withdraw and take refuge. Avoid cutting the main roots of the mangroves during digging.

5. Install catwalks around or perpendicular to the enclosure for ease in feeding and monitoring the stocks during high tide.

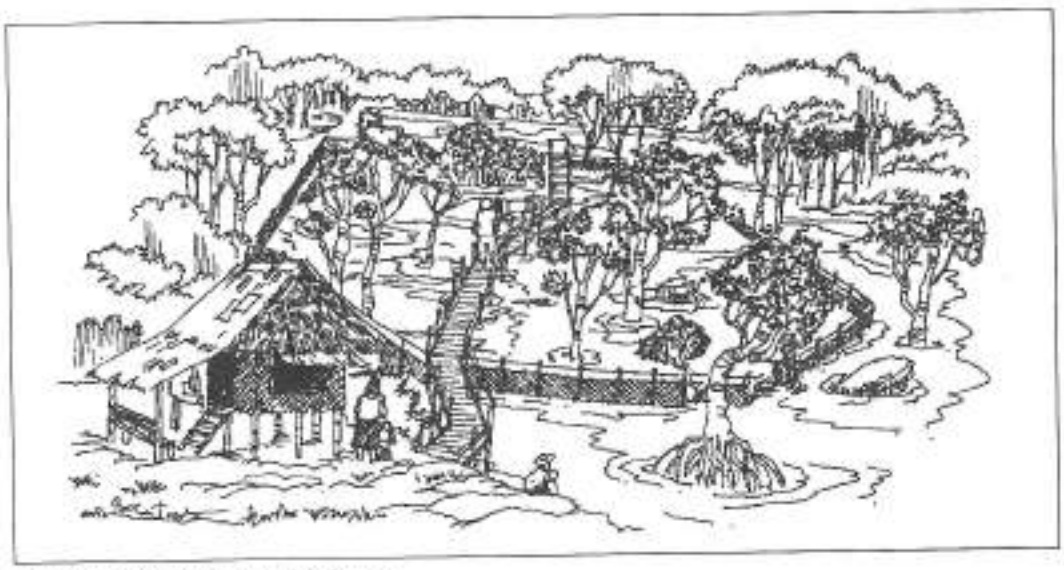


Detail of a net enclosure

Rearing operation

Transporting mudcrab juveniles for grow-out culture

Mudcrab juveniles for stocking are normally placed in bamboo wicket baskets (*bakag/kaing*) or in plastic/pandan (*bayong*) bags during transport. Normally, a pandan bag can carry about 150 to 200 pcs of 20-50 g of juveniles.


Design for 4,000 sq m mudcrab pen

Place fresh mangrove leaves inside the basket or bag to reduce the temperature, serve as a cushion and prevent juveniles from fighting each other. Do not cut or remove the chelipeds or pincers of young juveniles below 30 g so they are protected from stress or infection, which could cause mortality.

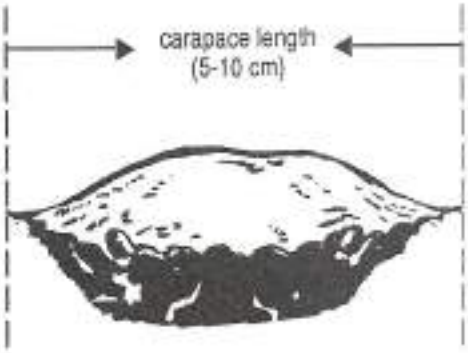
However, juveniles weighing more than 30 g must have their pincers tied using strips of soaked coconut sheath (*suwak*) or plastic straw. Sprinkling them with brackishwater during transport or storage keeps them alive and active.

Stocking and acclimatization

Before stocking, ensure that the enclosure is cleared of debris, unwanted species and predators. Check nets all around for possible holes or scouring.

Stock monosize mudcrab juveniles weighing 30-50 g per piece or measuring 5-10 cm (carapace length) at the recommended rate of 5,000-10,000 per ha.

Stocking must be done in early morning or late afternoon when the temperature is cool and the tidal water is available.



Before releasing the juveniles, place them inside plastic basins and sprinkle with seawater until they are completely submerged for about ½ hour. Make sure that crabs have adopted to the pen water temperature and salinity before releasing them.

During stocking, tilt the basin and allow crabs to crawl out freely. Cut the ties on pincers before releasing the crabs.

Feeds and feeding

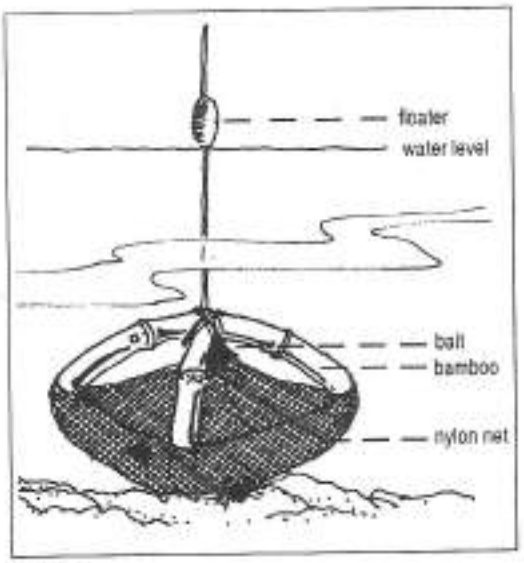
Feeds comprise 40-60 percent of the total cost of production. Chopped trash fish, animal hides or entrails, mussel meat and snails (golden apple snail) are cheap and effective locally available feeds for mudcrab culture.

Broadcast feeds evenly everyday, using half the total feed in the morning between 6-8 a.m. and the other half in the afternoon between 4-6 p.m.

Feeding rate is at 10 percent of the average body weight per day. Reduce the feed by 1 percent and adjust monthly down to 5 percent up to the end of the culture period.

Stock sampling

Take a stock sample every 30 days, using *bintol* or bamboo traps, to determine the growth and feed requirement. Take 30-50 crab samples and measure their increase in body weight and carapace size.



Bintol

Pen management

Monitor the crabs for feed consumption, swimming behavior, presence of berried female crabs, etc. Inspect enclosures daily for destructive debris, scouring and torn nets where stocks could possibly escape. Secure them against possible poachers by making routine inspections of the area, especially during the night.

Harvesting

Partial harvesting is done when mudcrabs reach marketable size of 200 g and above. This could start, at the earliest, after 45 to 60 culture days.

Handpick the crabs during low tide and/or by catching them using baited traps like *bintol* during high tide. Fat crabs are detected by pressing the abdomen. The presence of gonads (orange mass called *aligue*) indicates fat female crabs. Fat male crabs have massive pincers.

Total harvest may be done after 4-6 months of culture. Tie the pincers of newly-harvested crabs using plastic straw or *suwak* before transporting them to market.

Mudcrabs sold in restaurants are 250 g and above. Prices vary with markets and seasons.

Marketing

In all cases, mudcrabs are marketed live. In the Philippines, female crabs with mature gonads are relatively expensive. Mudcrabs are sold in the market year-round, but generally, those found in the domestic markets are grouped in mixed sizes and are smaller than exportable crab. Usually during the Christmas season, the price is relatively high because of the increased demand.

The major markets for the Philippine mudcrab are Taiwan, Hongkong, Guam, Japan and the USA. Other markets include Singapore, Brunei, Germany, Korea and neighboring countries. Taiwan has been the biggest buyer of mudcrab from the Philippines. The trading pattern of mudcrab industry throughout the Asian region involves a series of intermediaries between the fishfarmer/supplier and the local consumers or exporters.

Cost and return analysis

Technical Information

Project location:	Manalo Multi-purpose Cooperative, Manalo, Puerto Princesa, Palawan
Total area:	4,000 m²
Initial stock:	2,040 pieces
Size at stocking:	9 - 22 g/crablet
Method of harvest:	Partial starting from 2nd to 5th month, total in the 6th month
Survival rate:	1,734 pcs or 85%
ABW:	275 g
Yield:	477 kg
FCR:	1:5
Croppings/year:	2

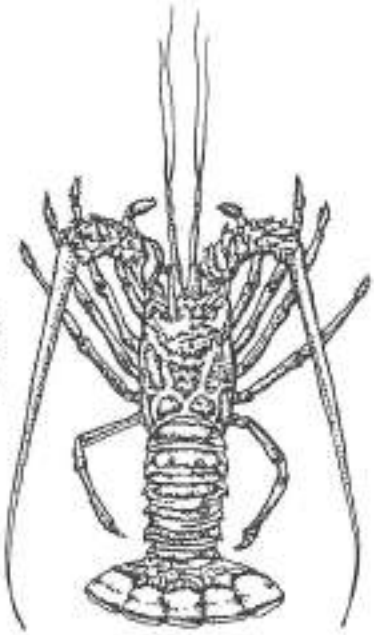
Investment requirement

Pen construction		
Nylon nets	5 rolls	₱ 8,000.00
Bamboos for horizontal bracing	25 pcs	750.00
Wooden posts	4 m in length, 130 pcs @ 30/pc	3,900.00
Memofilament #150 mm	5 kg@₱120/kg	600.00
Plastic sheet #5	2 rolls	4,000.00
Labor		33,900.00
Canal excavation for fence		5,500.00
Fencing		26,000.00
Backfilling		2,400.00
	Total investment requirement	**₱ 85,050.00**

COSTS		
Labor		
Feeder		₱ 7,500.00
Caretaker		3,000.00
Predator eradication of undrainable areas		
Hydrated lime		600.00
Ammonum sulfate		400.00
Materials		
Crab juveniles	₱8/pc	32,640.00
Trash fish	2,425 kg x 2 @ ₱7/kg	33,950.00
Maintenance and repairs		500.00
Transportation		1,000.00
Depreciation		17,010.00
Contigencies		500.00
	Total costs	**₱ 97,100.00**
Returns	477 kg x 2 x ₱170/kg	**₱ 162,180.00**
Net return		**65,080.00**
Return on investment		**.76**
Payback period		**18 months**

Prepared by Dan Baliao and Miguel de los Santos, SEAFDEC/AQD

Lobster culture



Lobsters (*Family Homaridae*) command a higher price than other crustacean species such as shrimps and crabs. The common spiny lobsters are in demand both in the local and export markets because of their delicate flesh. They are bought live and only whenever each weighs between 500 g - 1 kg.

The spiny lobster has a hard shell, stalked eyes, four pairs of legs and a pair of antennae below the eyes. Unlike the common species, spiny lobsters do not have large claws. However, they have a pair of handlike appendages used to hold food. In Guimaras, Philippines, the most common species are the ornate tropical rock lobster or tiger lobster *(Panulirus ornatus)*; green lobster (*Jasus verreauxi*) and the Southern rock lobster or *pulahan* (*Jasus novaehollandiae)*.

Fisherfolks gather lobsters from reefs at shallow depths at night using kerosene-fueled lamps (*lampara*) and pole nets or gill nets. During the day, lobsters are speared or caught by air compressors. Fisherfolks from Guimaras harvest tropical rock lobsters from wild stock. During the peak season, they could harvest about 50-80 kg per week valued at P800.00 per kg.

Lobster are successfully cultured in Zamboanga and Guimaras, Philippines.

Lobster culture in pens

Lobster culture has been done in cages, concrete ponds and seafarm pens in Singapore, Thailand, Australia and recently in the southern Philippines. The most conventional design is the cubical pen measuring at least 5 m x 5 m x 4-6 m and made of a synthetic net (3-cm mesh), framed by wood or bamboo, and strengthened at the corners by big poles.

Selecting a lobster pen site

Note the following parameters in selecting a good site for the lobster pen:

Location	Marine waters away from rivers and creeks and free from domestic, industrial and agricultural wastes and other environmental hazards.
Substrate	Sandy and rocky, with corals and patches of seagrass.
Water quality	Clear, with considerable amount of plankton and other food organisms; salinity not less than 30 ppt.
Water current	10-35 cm/sec; minimum of moderate current exchange; free from strong waves such as those resulting from typhoons.
Water depth	Not less than 1 m during the lowest low tide (neap tide) and not more than 6 m during high tide.
Availability of species	Presence of indigenous species to help solve the shortage of juvenile stock.
Security	As lobsters command a very high price, they become easy prey to thieves. The site selected must be within a community where peace and order is not a problem.
Government restriction	Inquire from the Local Government Unit (LGU) for the necessary permit for culturing lobsters.

Constructing the pen

1. Layout

Using bamboo poles or stakes, mark the corners of an area measuring 5 m x 5 m. Drive the main post into these points.

2. Staking

Bamboo, *ipil-ipil* and *bakawan* are good staking materials.

a. sharpen the ends of the stakes and drive them 2-3 ft deep into the laid out area.

b. leave enough length to attach the net and 1-2 ft gap between stakes.

c. strengthen the hold of the stakes by attaching onto them a pole or piece of wood horizontal to the base at a height of 2-3 ft.

d. repeat the process every 2-3 ft above the last level depending on the desired height of the pen and the point for strengthening the whole structure.

3. Installing the screen

Inside the pen, dig a 1 ft deep canal around the perimeter to bury the bottom part of the net and prevent burrowing species from escaping. At least two persons are needed to install the screen, one inside the pen and the other outside it. From the inside, secure the net onto the wall framework with bamboo strips tied vertically onto the horizontal bars with nylon twine (80 lbs).

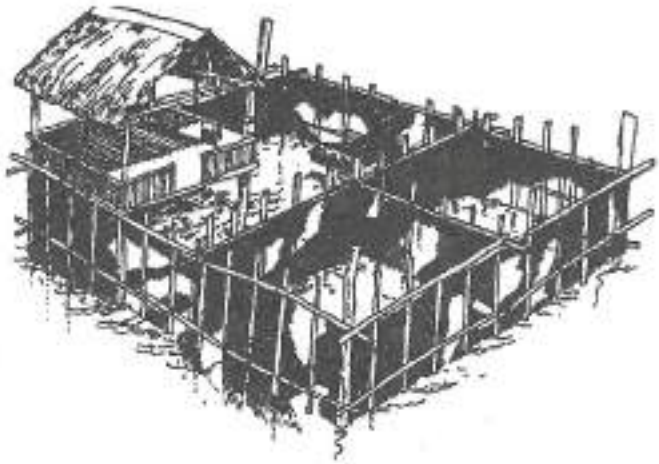
4. Dividing the pen into compartments

Divide the pen into three compartments:

- rearing area (15 m^2);
- transition area (6 m^2); and
- nursery area (4 m^2).

Follow the process for layout, staking and installing the screen mentioned earlier. Use nets

Layout of a lobster culture pen



Basic framework of a lobster culture pen

of larger mesh or bamboo strips to secure an additional compartment of at least 2 m² for the molting stock.

5. Constructing the caretaker's shed

In one corner of the site, construct a shed for the caretaker and for the harvested stock before the latter is transported to the market. Use local roofing materials such as *nipa* or *cogon*.

Sourcing for juvenile stocks

Only very few areas in the Philippines are identified as having a natural population of lobster. In Guimaras, spawning of lobsters peaks in October. Young lobsters are found in the coral reef areas during low tide. Lobsters are difficult to catch because of their small size, spiny body and swift movement. Local fisherfolks sell the juvenile at ₱10 each if they weigh less than 200 g. Those weighing more than 200 g are considered of marketable size and priced by the kg.

Maintaining the pen and managing the stock

Stocking density

Select stocks that weigh at least 200-300 g each. Lobsters are carnivorous, thus, select fingerlings of the same size. Stock the pen during high tide by gently droping the fingerlings into the water. Do not mix healthy juveniles with those that are molting or have just molted. The following stocking densities are recommended for the different compartments:

- rearing area - 150 pieces;
- nursery area - 160 pieces; and
- transition area - 150 pieces.

Sanitation and protection

One month after constructing the pen, remove any fouling organism, crabs or flotsam which can damage the net. Clean the net at least twice a month. Using coconut husk or nylon scrub, remove barnacles and other debris to allow water movement inside the pen. Install

kerosene-fueled lamps along the perimeter to warn fisherfolks of the presence of the enclosure, especially at night.

Shelter for the stock

Arrange old tires, bamboo tubes or rock piles inside the pen to provide shelter for the lobsters. Use coconut fronds to filter out too much sunlight.

Feeding the stock

Feed the stock twice a day (early morning and late afternoon) at 15-20 percent of the aggregate body weight of the stock. Some fisherfolks from coastal communities in Guimaras (La Paz, Sabang and Pandaraonan) have been using sea urchins, trashfish like rays and sharks, and other animal-based feed with good results. Monitor the growth of the lobsters at least twice a month to determine feed requirement and for record purposes.

Monitoring

Keep a record of activities and financial concerns to determine the status of the project.

Harvesting

Harvest the lobster six months after the first stocking. Oversized lobster weighing 1.5-2 kg are rarely bought. Harvest those that weigh at least 1 kg each. Do not harvest the lobsters that have just molted because they cannot withstand stress during transport.

Survival is high at 90 percent for lobsters that weigh at least 250 g. Harvesting can be done as early as four months and as late as seven months. Always keep a weighing scale to determine the weight of the lobsters.

Succeeding harvests can be done every month thereafter. The ideal time for harvesting is between 6am to 8am, or when the weather is particularly cloudy. Do not harvest when it rains because lobsters die when exposed to freshwater.

Buyers prefer live lobsters, therefore, lobsters must be handled with utmost care. Wear a pair of goggles or a snorkel while harvesting by hand or harvest using a scoop net. Always use a box (at least 2 ft^3) made of plastic weave or netting, partially buoyed by bamboo tubes, styrofoam or any other floater to keep the harvested lobster in the water while the collection is ongoing.

Marketing

Contact buyers before harvesting. Deliver the live harvest immediately to avoid stress. Wrap the lobsters in paper or cloth pre-soaked in seawater and place them inside styrofoam boxes.

Sustainability

A lobster pen operator must source for lobster juveniles and feeds to sustain this livelihood activity.

Cost and return analysis

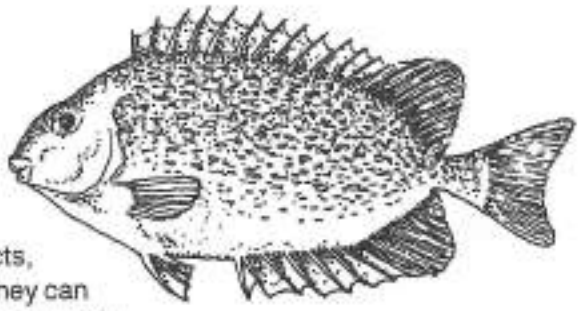
Assumptions: 20% mortality rate and 80% of total stock harvested after 6-10 months

Fixed assets		
Pen		**₱ 5,000.00**
Production expenses		
Materials		
Synthetic net	60 m x ₱75/m	4,500.00
Lobster fingerlings	460 pieces (42 kg) x ₱400/kg	16,800.00
Trash fish	4.6 kg/day x 190 days x ₱10/kg	8,740.00
	Subtotal	**₱ 30,040.00**
Labor		
Cleaning the pen	10 days x ₱120/day	1,200.00
Feeding operations	6 days x ₱120/day	720.00
Harvesting operation	1 day x ₱120/day	120.00
Caretaker's salary	10 months x ₱ 1,200.00/month	12,000.00
	Subtotal	**₱ 14,040.00**
Other expenses		
Transportation	414 kg x ₱21.25 (2.5% of the market price)	8,797.50
Harvesting and transport materials (styrofoam boxes, paper and cloth)		10,000.00
Depreciation		2,500.00
	Subtotal	**₱21,297.50**
Total expenses		**₱ 65,377.50**
Summary		
Gross income	414 kg x ₱ 850/kg (market price)	₱ 351,900.00
Total cost		₱ 65,377.50
	Net income	**₱ 286,522.50**

$$\text{ROI} = \frac{286{,}522.50}{5{,}000} = 57.3$$

Prepared by Leonidas Tan, SMISLE

Siganid culture in fixed pens

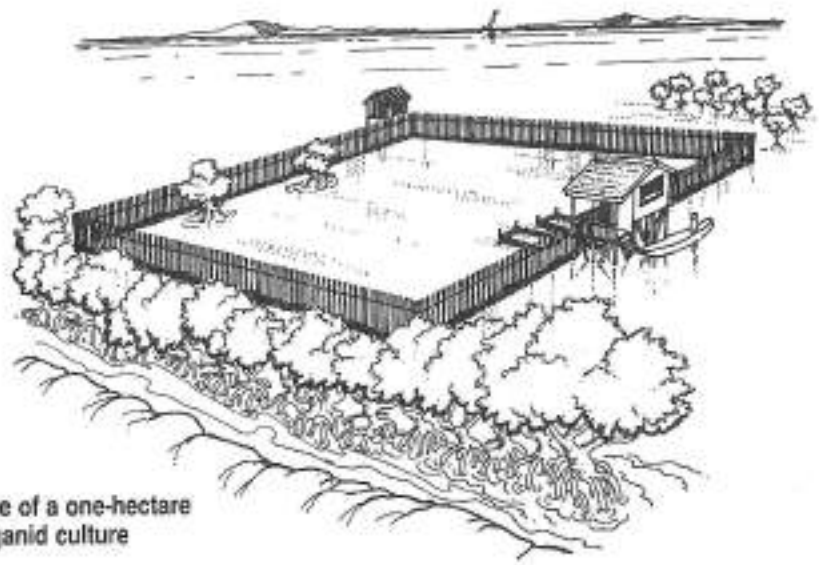


Siganid (*Siganus* spp.) is a high-valued fish species with consistent market demand. Unlike groupers which have territorial instincts, *siganids* are gregarious, so they can be raised in an enclosed environment without causing any stress through overcrowding. *Siganids* are herbivorous, and nibble on algae which attach to seagrass. They thrive on reef areas where seagrass abound.

Selecting the site

The site selected for implementing *siganid* culture project must have:

- an abundant supply of *siganid* fingerlings in the site and vicinity. *Siganid* fingerlings are abundant in Palawan, Panay, Guimaras, Baurayan Island and Pangasinan;
- natural feedstuff available such as seagrass;
- the presence of a naturally occuring tidepool, i.e., the area is always submerged in water at least 1 m deep during low tide, and with sandy-to-muddy or clayey-to-muddy substrate; and
- protection from strong water currents and winds, i.e., the site is preferably a cove or an inlet.



Perspective of a one-hectare pen for siganid culture

Constructing the pen

Enclose a 1 ha area with a fence made of bamboo strips and nylon nets. Make sure that its highest level is at least 1 m higher than the water mark at highest high tide. Use a fine-mesh net reinforced on the outer side with a polyethylene net.

Collecting the fry and fingerlings

Collect *siganid* fingerlings using a beach seine about 100-200 m long and with fine mesh (*baring*). Launch the net into the water during high tide. Secure both ends of the net to a tree, post or peg on the beach. Collect the fry/fingerlings during low tide when they can be trapped in the remaining water bordered by the fine-mesh net. Scoop and pour them onto a pail.

Nursery operation

Nursery operation is necessary for fry 1-2 cm in length. Construct a *hapa* (similar to inverted mosquito net) inside the pen. At least 2 *hapa* are recommended. Net mesh size is 0.5 cm and the stocking density is 600-1,000 fry/m^3.

Stocking

A 1 ha pen can accommodate 50,000 fingerlings. Determine the appropriate number of fingerlings needed by first weighing a fingerling sample and counting the number of fingerlings in the same sample. Stock the pen with as many samples as needed. This procedure should be done quickly to avoid stress on fish.

Feeds and feeding

Siganids require a full feeding regime using either commercial or alternative feed, e.g., trash fish, seaweeds, rice bran. The Daily Feed Requirement (DFR) is 3-5 percent of the average body weight per day. To compute the DFR:

1. Weigh several samples of average-size *siganid*, each sample containing about 20-30 pieces.
2. Divide the total weight by the number of samples.
3. Divide the quotient by the actual number of pieces per sample to get the average body weight.
4. Multiply the average body weight by 5 percent or 3 percent to get the daily requirement for alternative or commercial feed, respectively.
5. Multiply the DFR by the estimated number of fish in the pen to determine the total amount of feed required per day.

Feed the fish twice a day — early morning and late afternoon — with the feeds equally divided. When using alternative feed, the ratio of seaweeds/rice bran to fishmeal should be 7:3.

Health and maintainance

Look for early signs of disease, e.g., loss of appetite, abnormal swimming behavior, etc. Consult the fish health staff of the Department of Agriculture/Bureau of Fisheries and Aquatic Resources (DA/BFAR) Regional Offices for disease diagnosis, prevention and treatment. DA/BFAR helps the aquaculture industry in fish health management throughout the country.

Harvesting

Siganids reach marketable size of about 10-11 pieces/kg in 3-5 months. For easy harvesting, place a seine net (mesh size: 12 mm) on one side on the pen and pull it slowly towards the opposite side. Scoop the fish using hand nets. Place them in styrofoam boxes with ice at a ratio of 1 kg of ice per 4 kg of fish. Transport the fish to the market within 24 hours.

Sustainability

This livelihood activity can be sustained by an organized community whose members commit themselves to manage and maintain the fish pen. They must keep tab of its physical structure, the growth of the fish, and feed requirement.

Like any other fishery production activities, *siganid* culture is extractive in nature. Establish a marine park and fish sanctuary nearby to ensure sustainability.

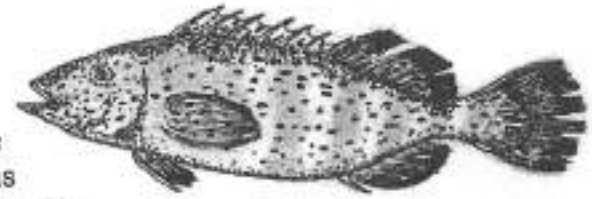
Cost and return analysis

Assumptions: 10% mortality of the 50,000 fingerlings; annual production of 4,000 kg of fish priced at ₱30/kg

Fixed assets		
Fishpen		29,056
P.E. net #200 (31m x 100m)	8 rolls x ₱ 3,632/roll	1,680
Barrier net #7 (2.5m x 400m)	1 roll x ₱ 1,680/roll	3,600
Nylon rope (1in x 200m)	3 rolls x ₱ 1,200/roll	600
Nylon thread #6	4 kg x ₱ 150/kg	750
Nylon monoline #150	5 kg x ₱ 150/kg	30,000
Bamboo poles	1,500 pieces x ₱ 20/piece	3,600
Labor	30 days x ₱ 120/day	12,000
Constructions	12 months x ₱ 1,000 per month	2,500
Banca	1 unit x ₱ 2,500/unit	5,000
Farmhouse	1 unit x ₱ 5,000/unit	
	Subtotal	**₱ 88,786**
Operating expenses		
Supplies/materials		5,000
Siganid fingerlings	50,000 pieces x ₱ 0.10/piece	28,000
Feeds	8,000 kg x ₱ 3.50/kg	2,000
Fine-mesh net	1 bundle x ₱ 2,000/bundle	1,500
Sinkers	20 pieces x ₱ 75/piece	200
Floaters	2 bundles x ₱ 100/bundle	4,000
Styrofoam box (35-kg capacity)	20 pieces x ₱ 200/piece	1,000
Pail	10 pieces x ₱ 100/piece	
	Subtotal	**₱ 41,700**
Maintenance cost		₱ 27,000
Depreciation (10% of fixed asset)		₱ 8,878.60
	Total operating expenses	**₱ 77,578.60**
Annual gross income	4,000 kg x ₱30/kg	₱ 120,000.00
Less total cost		₱ 77,578.60
Annual net income		**₱ 42,421.40**

Prepared by Paolo Cobrado, SMISLE

Grouper culture in floating cages



Grouper (*Epinephelus* spp.), locally known as *lapu-lapu*, has been cultured in cages and to some extent in ponds in Southeast Asia for more than a decade. It is one of the most expensive fish species and is valued for the excellent texture and flavor of its flesh, as well as its great potential in aquaculture. The demand for grouper in the international market is fast growing particularly in Hongkong, Japan and Singapore. Its export price is expected to increase in the near future.

Locally, grouper culture in cages has had considerable success in Pres. Carlos P. Garcia, Bohol. The Sto. Rosario Fishermen's Association of this municipality has established market links with buyers based in nearby Cebu City. The Cagay Multi-purpose Cooperative in Roxas City has also had success in grouper culture. Grouper culture could therefore become another significant earner for the country.

Species identification for commercially cultured groupers

There are about 40 species of groupers distributed in tropical waters and 2 species are currently popularly cultured commercially. These are:

Epinephelus coioides

(Common name: Orange-spotted grouper)

Distinguishing characteristics:

- light yellowish-brown dorsal body color
- shaded to whitish on the side and belly
- numerous brownish orange or brownish-yellow spots unevenly scattered on head, body and fins
- chin or underside of head and belly whitish or creamy white without any spots

Epinephelus malabaricus

(Common name: Black-spotted grouper)

Distinguishing characteristics:

- body color is light brown on the upper part of the body, belly and ventral side light grey
- body with 5 distinct broad dark brown oblique bars which tend to bifurcate ventrally
- head and body with numerous small well-separated blackish spots especially on chin
- fins scattered with small black spots

Source of stock

At present, supply of grouper fry for commercial cage/pond production still depends on the wild. However, institutes like SEAFDEC/AQD and other progressive finfish hatchery operators are refining their broodstock and seed production techniques. In due time, these hatcheries will be able to supply fry and fingerlings.

Grouper fry are collected in nominal quantities using various devices, e.g., scare-lines or brush piles. The size of fry varies from 1-9 cm and is usually collected by fish traps from coastal waters near mangrove areas. In the Philippines, the major sources of grouper fry are in the provinces of Pangasinan, Cavite, Mindoro, Quezon, Masbate, Bulacan, Cagayan, South Cotabato and Negros Occidental.

Site selection

The site should:

- be in calm water, e.g., sheltered lagoons, coves, inlets, bay, behind an island or a river mouth. This is to avoid damage caused by strong winds, waves and currents
- have salinity ranging between 30 - 34 ppt
- have water depth not less than 3 m during lowest low tide
- have good water exchange to maintain good water quality
- be relatively free from any source of pollution (industrial, agricultural and domestic) and protected from any environmental hazards such as typhoons, floods, erosions, etc. It must be accessible and preferably secured from vandals and poachers.

Cage specification

A floating cage module is usually composed of 4-12 compartments supported by a framework.

Consider the following when constructing a floating cage:

Cage frame

Made of bamboo and durable enough to withstand stress caused by wave action and increased weight during culture operation.

Classification of grouper seedstock for pond and net cages

	Body length (cm)	Body weight (g)	Price (P/pc)
1. Fry	1-2	1-3	6-8
2. Fry 1	3-4	4-5	8-10
3. Fry 2	5-7	6-9	15-20
4. Fry 3	8-9	10-13	25-30
5. XL	10-12	15-24	45-60
6. Undersize	13-20	30-160	55-75
7. Good size	30-70	400-700	260-260

Cage dimension

5m x 5m x 3m or 3m x 3m x 3m

Water column

Maintain at 2.5 m.

Sinkers

Use small concrete blocks as sinkers suspended by ropes, placed at the bottom of the 4 corners of the cage for rigging.

Catwalks

Attach lumber measuring 1 in x 6 in (cross section) and 6 m in length to the framework.

Floaters

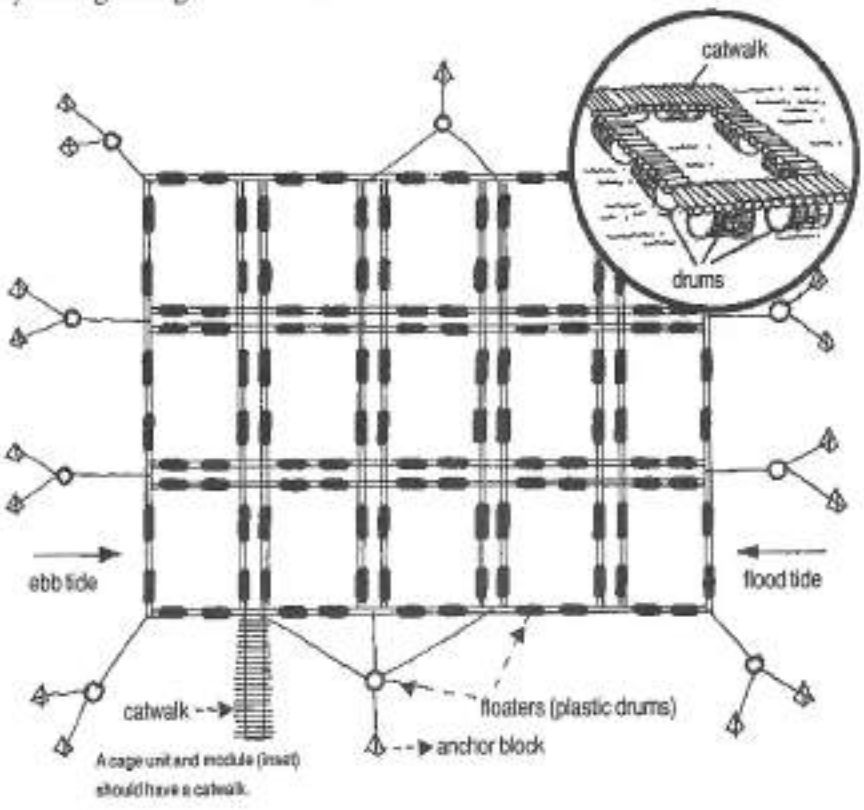
Use plastic drums as floaters on each side of the cage between the bamboo pipes. Tie the drum to the cage frame using a rope 5 mm in diameter to stop the drum from drifting, especially during strong wave action.

Cage netting

- nursery cage; "B" net (0.5 to 1 cm mesh size; knotless)
- production cage; "PE" net (2 - 5 cm mesh size)

Nets are fabricated like an inverted mosquito net (*hapa*). Each cage is supported with polyethylene rope (5 mm diameter) inserted along the sewed borders of the net and held using a clove hitch with overhand knot.

Each cage should have double-layered nets to avoid loss of stock due to tearing and other mechanical damages.



Netcage module layout and anchor block positioning

Anchor

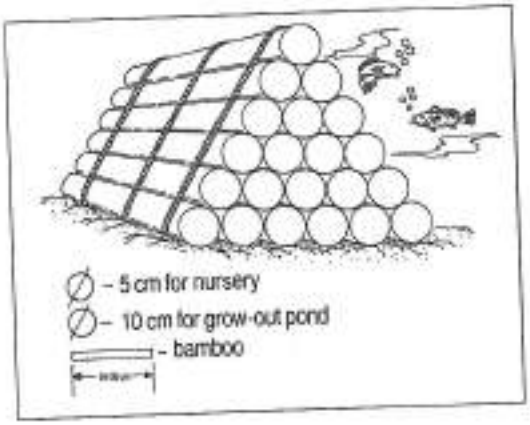
The rope length from the floater to the anchor should be the same as the water depth at high spring tide. The raft structure needs 14 concrete blocks (0.5 - 1 ton each) with 8 placed at the ebb end (ebb tide being stronger than flood tide), 4 at the flood end and 2 in the mid-section.

Generally, the weight of the anchor should be twice the weight of the entire floating cage module.

Shelter

Groupers need a place to hide, unlike other fish.

To provide a place for groupers to hide, use sawed-off bamboos, 5 cm in diameter and 15 cm in length (for nursery cages) and 10 cm in diameter and 30 cm in length (for grow-out cages) tied in triangular bundles and suspended in strategic areas inside the net cage.



Shelters for groupers

Nursery cage operation

Use a nursery cage for fry 2 - 10 cm long.

Stocking rate: 60-100 fish per cubic meter

Feeds include mysid shrimps and/or finely chopped trash fish given at the rate of 10 percent of the average body weight per day. Divide the feeds equally and give 2-4 times each day.

Install a 50-watt incandescent lamp (hover type) inside the cages, about 0.5 m above the water line, at night to attract live food such as mysids, copepods and other smaller fishes.

Grow-out cage operation

Use a grow-out cage for stock sizes of more than 10-15 cm in total length.

Stocking rate: 30-60 fish per cubic meter. Give trash fish at a rate of 5 percent of the average body weight per day. Divide the feeds equally and give twice a day.

Monitoring

- Take a few samples of the stock every 15 days to determine feed requirement and growth rate of grouper stock. Scoop out 10-15 samples and measure the weight and length of each sample.
- Inspect nets for tears.
- Clean/remove dirt, debris and fouling organism attached to the nets.
- Repair or replace damaged nets.

Sort or grade the stock in nursery cages every week to avoid cannibalism.

Health management

It is generally recognized that many diseases in fish culture are often associated with stress. Stressed fish can easily be infected with disease-causing agents and this affects growth. The following tips may minimize stress on fish and prevent disease outbreaks:

1. Observe any unusual swimming behavior of the fish, especially during dawn and late afternoon. Fish gasping for air usually indicates low levels of dissolved oxygen. Should this happen, thin-out stocks by transferring some of them into another compartment.

2. Weak fish, i.e., individuals refusing to "school" with other fish, and those observed as losing balance while swimming, should be separated from healthy stocks immediately. Stocks found to have sudden loss of appetite and with red "spot-like" wounds on the skin and fins are likely to have a bacterial infection. Use Povidone-iodine, commercially known as "Betadine solution," at 15 parts per million for 5-10 minutes for 3 alternate days, as an affective treatment for bacterial infection. Methylene blue can also be used by swabbing. Transfer treated fish to a new compartment.

3. Maintain a distance of 1 m between compartments to ensure easy and continuous water flow and maintain ideal water quality for the fish.

General rules

1. Avoid overstocking. Always follow the suggested stocking rate.
2. Do not overfeed nor underfeed the stocks during the culture period.
3. Maintain good water quality.
4. Handle stocks gently to avoid physical damage.
5. Dispose of dead fish properly.

Harvesting

Starve the fish 24 hours before harvesting. Harvest depends on the demand of the local and export market.

Postharvest

Scoop live marketable size grouper (400 g and up) from the cages. Hold grouper temporarily inside the conditioning tank and provide aeration for about 1-2 hours. Adjust water temperature gradually to 18°C by adding packed ice. Place 3-5 fish inside an oxygenated double-sheet plastic bag, with water at 3-5 cm or at least covering the nostrils of the fish. Place crushed ice on top of the plastic bags to maintain the water coolness during transport.

Place plastic bags inside the square styrofoam box (30 cm x 30 cm x 20 cm) with a carton cover having a tag "live fish" and then ready for transport.

Before transporting harvested stocks, a "freshwater dip", or a short bath in freshwater for 2-10 minutes is advisable. The dip will decrease parasite infection and lessen the incidence of disease and mortality during transport.

Important considerations in grouper cage culture

There are some important considerations for converting grouper cage culture into a highly profitable business undertaking, namely:

- survival and growth rates;
- adequate and cheap supply of raw meat, i.e., trashfish and mollusk meat;
- quantity/quality of seedstocks; and
- marketing.

Actual nursery operations in SEAFDEC/AQD reveal that survival rate of 79 percent from tiny to extra large can be achieved. This is about 20 percent higher than the rate used in the profitability analysis on the next page. Proper care of the fry can then reduce the operating cost significantly.

Ensure an abundant and cheap supply of trash fish as this constitutes the biggest chunk in operating expenses. A higher price for these feeds will reduce the project's profitability significantly.

One of the most important considerations before venturing into grouper culture is the availability of buyers or exporters to purchase the groupers produced by ex-farms and sell to the live-fish local and export markets. The high price of live grouper is due to its being a delicacy to Chinese communities all over the world. Contract stable buyers or exporters who can cater to these markets so that the targeted selling price of ₱280.00/kg of live fish is achieved.

Sustainability

Intense activity of this livelihood in a certain area will compromise the environment, thereby deteriorating the water quality. To ensure optimum environmental conditions for cage culture, observe proper placement of cages or "zoning". Some municipal governments have designated areas for cage culture. You can request permits from the local government units (LGUs) implementing zoning programs in their area. Furthermore, you can also request technical assistance from the Department of Agriculture/Bureau of Fisheries and Aquatic Resources (DA/BFAR) offices to help identify and evaluate ideal areas for cage culture.

Cost and return analysis (8-month period)

Technical information

Nursery of tiny to XL

Initial stocking:	4,500 pcs
Size at stocking:	2-3 cm tiny
Size of cage:	3 m x 3 m x 2m
Culture period:	4 months
Survival rate:	60%, 2,700 pcs (10-12 cm)

Grow-out of XL to marketable size

Size at stocking:	10-12 cm
Stocking rate:	250/cage
Survival rate:	95% (2,565 pcs x 430)
Culture period:	4 months
Size at harvest:	450 g up

Investment requirement		
Cages and hut		₱ 28,000.00
Work area		129,300.00
Sales	1154 kg @ ₱280/kg	₱ 323,120.00
Costs		
Tiny	4,500 x ₱10	P45,000.00
Feeds	₱40 worth of trash fish to produce a 500 g fish	91,314.00
Wages	1 laborer (feeder) @ P2,000/month	16,000.00
Depreciation		31,460.00
Maintenance and repairs		3,000.00
Contigencies	@ ₱500/month	4,000.00
Marketing expenses	@5% of sales	16,156.00
	Total costs	**₱ 206,930.00**
Net income		**₱ 116,190.00**
Return on investment		**0.74**
Payback period		**16.25 months**

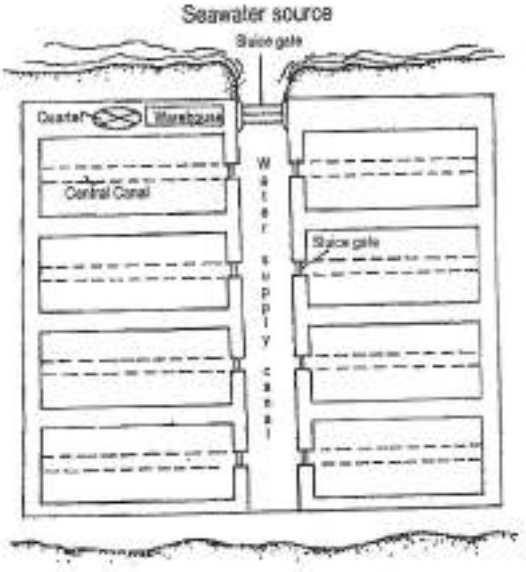
Prepared by Dan Baliao and Miguel delos Santos, SEAFDEC/AQD

Semi-intensive milkfish culture in brackish water ponds

Semi-intensive milkfish culture can be adopted for pond owners with the technical capability and the appropriate pond conditions and support facilities. In addition to this technique, the sustainability and the environmental impact of this scheme must be taken into serious consideration. Cooperatives should also source for possible financial support along with conducting training courses for technicians.

Pond design

A grow-out pond can be square or rectangular constructed in series with independent supply/drain gate/canal system ranging in size between 1 - 2 ha. Sluice gates can be made of wood or concrete. The pond bottom must be leveled flat but inclined towards the gate for easy water management and stock harvesting. Other necessary facilities include the chilling tank, harvesting shed, *bodega* and caretaker's hut.



Design of a semi-intensive pond for milkfish

Pond preparation

Milkfish thrive on natural food such as *lab-lab*, *lumot* and plankton grown by fishfarmers using known techniques. Comparatively, *lab-lab* excels other food types when it comes to raising milkfish. *Lab-lab* is a local term for benthic algal community consisting of yellowish-greenish minute plants and animals forming a mat on the pond bottom. They are sometimes detached and float in clumps or patches.

You can grow *lab-lab* by:

1. Draining the pond completely and allowing it to dry for about 1-2 weeks until the soil cracks. Prolonged drying is not advisable as it makes the soil hard and powdery.

2. Eradicating unwanted species by using organic pesticides such as tobacco dusts and/or a combination of ammonium sulphate fertilizer and lime. When using tobacco dust, spread it over the moist bottom at 300-400 kg/ha and allow it to stand for about a week.

   Prepare a mixture of hydrated lime and ammonium sulphate fertilizer (21-0-0) at a ratio of 5:1 and broadcast it on wet areas of pond bottom during a sunny day. The mixture releases heat and ammonia which effectively kills unwanted species in the pond.

3. Applying chicken manure at 2 tons per ha. Flood to a depth barely covering the pond bottom and broadcast urea (45-0-0) at 15 kg/ha, 2-3 days later to speed up the breakdown of chicken manure.

4. Increasing the water depth gradually over a period of 1-1½ months, 3-5 cm each time until the stocking depth of 30-40 cm is reached. An abrupt increase in water depth will cause *lab-lab* to detach and float. Install fine-meshed screens (*bastidor* or *lumpot*) at the gates to prevent the re-entry of wild species or the possible escape of stock.

To bolster *lab-lab* growth, apply inorganic fertilizer (16-20-0 or 18-46-0) at 50kg/ha, respectively, every 12-15 days.

Eradication of snails

The two most common snail pests called *suso* and *bagungon* belong to the genera *Cerithadae* and *Telescopium*, respectively. These pests destroy *lab-lab* mat and compete with *bangus* for *lab-lab*. Use alternative molluscicide, like tobacco dust, applied at 300-400 kg/ha. or collect the snails by sweeping or handpicking and burn them with rice straw.

Grow-out operation

Transfer of fingerlings and stocking

As soon as the ponds are ready for stocking, buy fingerlings (80-100 grammers) from nearby suppliers or catch them from the adjacent stunting pond. Maintain a stunting pond to ensure an adequate supply of fingerlings for year-round operation.

Fingerlings are normally held in *hapa* nets a few hours before stocking. Position the *hapa* near the mouth of the gate where there is flowing water. Slowly drag the *hapa* through the supply canal to the rearing pond where they will be stocked.

For longer distances, place the fingerlings inside oxygenated plastic bags. Stocking should be done during the cooler part of the day. Slowly release the fingerlings to the ponds at the density of 5,000 fingerlings per ha per crop.

Count the fingerlings to prevent under-or overstocking.

Management

When *lab-lab* starts to deteriorate or get overgrazed, increase the water level to 80 or 100 cm. Apply inorganic fertilizer (16-20-0) at 50 kg/ha every 1-2 weeks. Provide formulated diets daily at 5 percent of the average body weight per day. In a designated area, broadcast or use a feeding machine to condition the fish to eat feed pellets for about a week.

Water management can either be tidal or with the aid of a water pump. Tidal management should follow the lunar periodicity.

After stocking, maintain the optimum water condition for both the fish and the natural food. When using *lab-lab* as food base, apply fertilizer (16-20-0) at the rate of 50 kg/ha divided into small doses and applied every 12-15 days.

Coincide fertilization during spring tide cycles. Replenish about one third of the pond water before every fertilizer application. In hot months, increase the frequency of flooding to compensate for evaporation. Keep the depth at about 40-50 cm. During rainy months, drain the uppermost freshwater layer in the water column to prevent a sudden drop in salinity.

In the middle or towards the end of the culture period, *lab-lab* may be prematurely depleted because of overgrazing, poor water conditions or persistent inclement weather. Provide artificial feed at a rate of about 5 percent of the average body weight per day, using commercial feed. A weekly feed conditioning is necessary to determine the attractability of the feed. Efficient feeds should be used. Unattractive feeds not only result in poor health of the milkfish, but also pollute the pond environment.

Abnormal occurences may, at times, be experienced, such as the fish appearing to gasp at the surface or fish swimming in circles. These are indications of stress associated with insufficient dissolved oxygen.

Replenish water at the first opportunity. The water should be splashed onto a piece of wood to add oxygen. Extreme problems occur during mass fish kills especially in the morning of a very calm and windless day. If the tide is favorable, particularly during spring tide cycle, admit water immediately. If this is not possible, allow the water from an adjoining pond to flow so that water is agitated. Use pumps in such an emergency.

Anticipate adverse weather conditions. Sudden rain or thunderstorms during a hot day may present dangers as well as sudden changes in water temperature which may also result in some fish kills. Observe extra precaution to minimize the possibility of dike wash-out, flooding and the like.

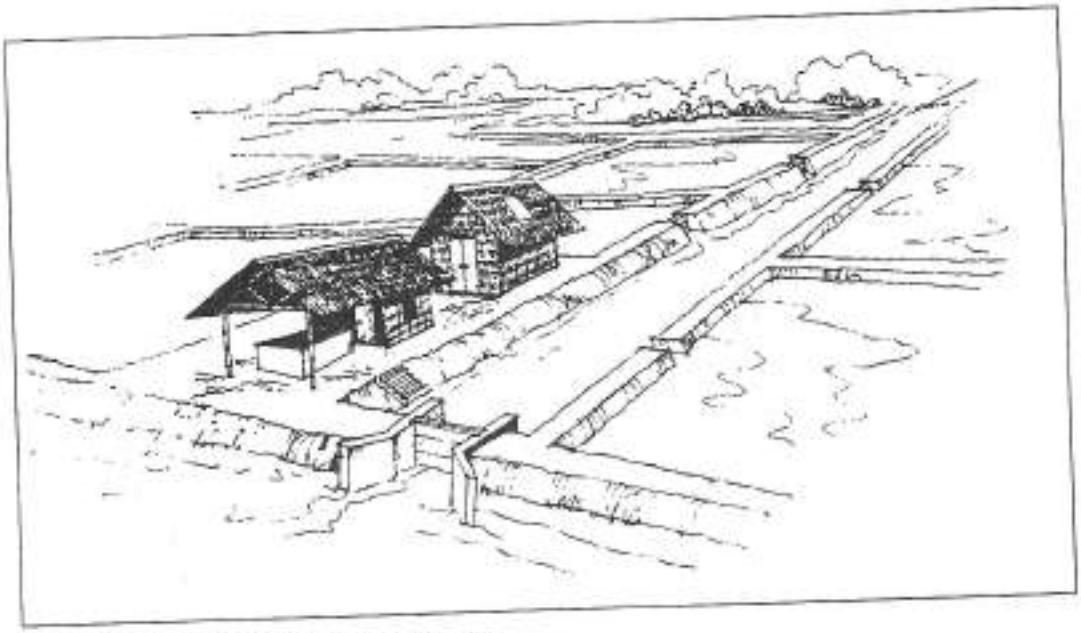
Harvest and postharvest

To obtain the highest profit, culture period should be about 60 days for cost effeciency. Yield is up to 2-2.5 tons/ha per crop, equivalent to 6-7.5 tons/ha per year for 3 croppings. The most common and undisputed technique of harvesting milkfish is the *pasulang* method or inducing the fish to swim against the water current. Gather the fish in the catching pond or canal during spring tide cycle and use drag seines to collect them.

Scoop, wash and stun the fish in chilling tanks or boxes. The latter should contain a 1:1 weight ratio of ice to fish to bring down the temperature of the fish to about 4 °C in two hours.

Total harvest is done manually by collecting or picking the remaining fish from the pond bottom. Sort pre-chilled fish according to quality (size, freshness, etc.) and pack them in wooden and/or metal boxes, metal tubs *(bañeras)*, basket *(kaing)* or styrofoam boxes filled with ice ready for transport to fish landings.

Harvested bangus may be sold fresh, dried, smoked, deboned, pickled or sent to a cannery for processing.



Perspective of a semi-intensive pond for milkfish

Cost and return analysis

Technical information

Stocking rate:	5,000/ha	Yield/crop:	2.1 tons
Size at stocking:	80-100 g	Yield@3 crops:	6.3 tons
Size at harvest:	400-500 g	Price:	₱60.00/kg
Survival rate:	95%	Gross income/crop:	₱126,000.00
Days of culture:	60	Gross income/year:	₱378,000.00
FCR:	1.1	Value of one hectare pond:	₱200,000.00

Operating expenses (per annum)	Qty	Price/unit (P)	Total value
Fingerlings*	15,000	4.00	60,000.00
Organic fertilizer			
Chicken manure	6 tons	1.00	6,000.00
Inorganic fertilizer			
16-20-0	450 kg	9.00	4,050.00
46-0-0	150 kg	10.00	1,500.00
Pesticides			
Lime	150 kg	5.00	750.00
21-0-0	30 kg	7.00	210.00
Labor			
Pond preparation	30 days	120	3,600.00
Caretaker	1 person for 12 months	4,000.00	48,000.00
Harvesting	9 days	120	1,080.00
Feed (FCR=1.1)	6,930 kilos	16	110,880.00
Contingencies			5,000.00
Depreciation			40,000.00
	Total		**281,070.00**
Gross income per year			**376,000.00**
Net income			**96,930.00**
Return on investment			**0.48**
Payback period			**2.06 years or 25 months**

** Fingerlings bought from outside or raised in the farm would cost almost the same, although raising fingerlings within the farm would ensure the fishfarmer of sustained supply for stocking and less dependency on external supplier.*

Prepared by Dan Baliao and Miguel delos Santos, SEAFDEC/AQD

Capture fisheries

Indigenous traps for fry and fingerlings

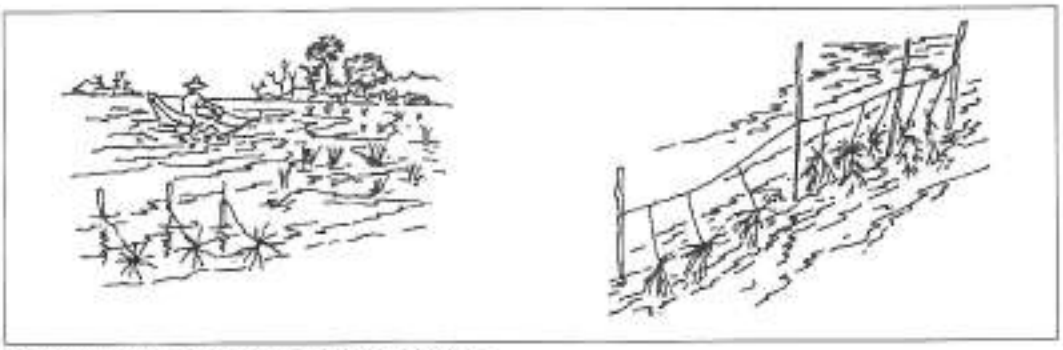
For sustainable culture fishing, there must be a continuous and abundant supply of fry and fingerlings. The present methods of collecting fry and fingerlings involve filtration by mobile or stationary gear. Bottom topography, wind and water current patterns and tidal fluctuations in the fry grounds are the most important considerations in designing and constructing gear. The behavior of the fry and fingerlings determines the collection methods employed in specific areas.

Higher fry catches are achieved by operating the appropriate gear at appropriate times and localities. The methods and gear described here are currently used for milkfish and shrimp fry, with some exclusively used for the latter. *Siganid* and seabass fry can also be collected in some of these gears. The *siganid* fry fishery in Pangasinan, Philippines employs several specialized gear.

Stationary gear

Lures

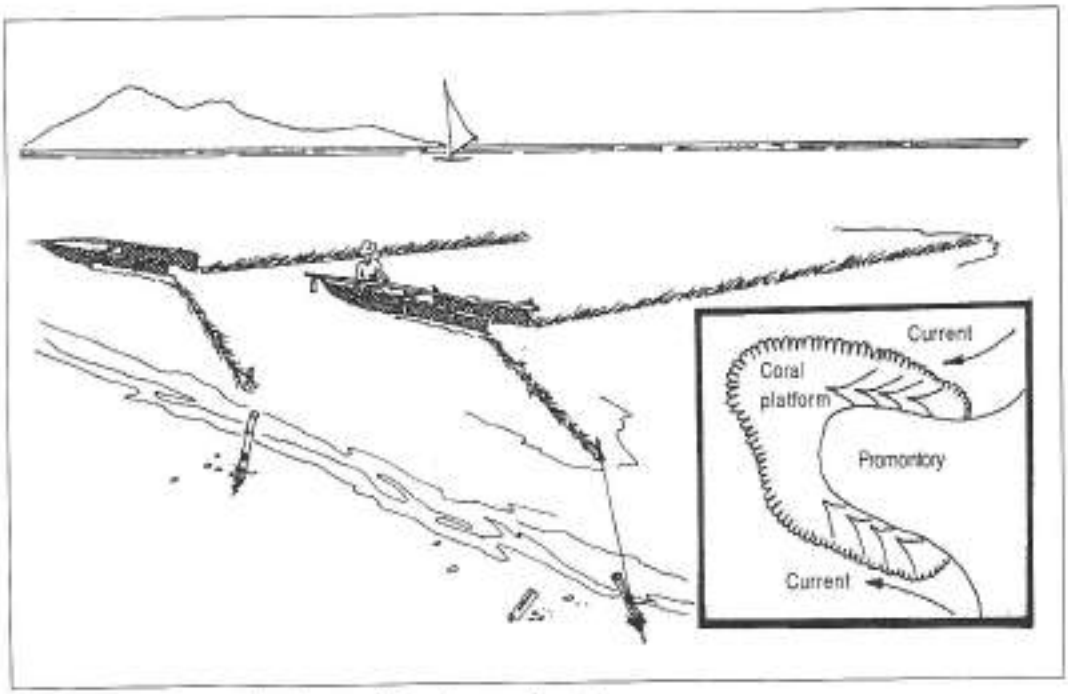
Bonbon and *pagungpong* are traps made of bundles of twigs, grass or coconut leaves that are set in shallow brackishwater mangrove areas and used by shrimp fry as substrates for attachment. The fry are shaken off these lures into scoop nets and other collecting gear. Lures have been used to a limited extent for seabass fry in mangrove areas. Bundles of grass attached to bamboo floats are used to collect *Siganus vermiculatus* fry from shore waters.



Fry lures made of bundles of grass and twigs

Floating tidal set net

Tangab-baka is set along coastal promontories with shallow coralline platforms. It consists of long wings fixed in place and a catching chamber made of a frame and bagnet. The chamber is set in place during flood and high tides, but removed when not in use. Several units of this gear can be used along the same stretch of beach, one in front of the other, all facing the same direction. The gear uses mainly longshore currents.



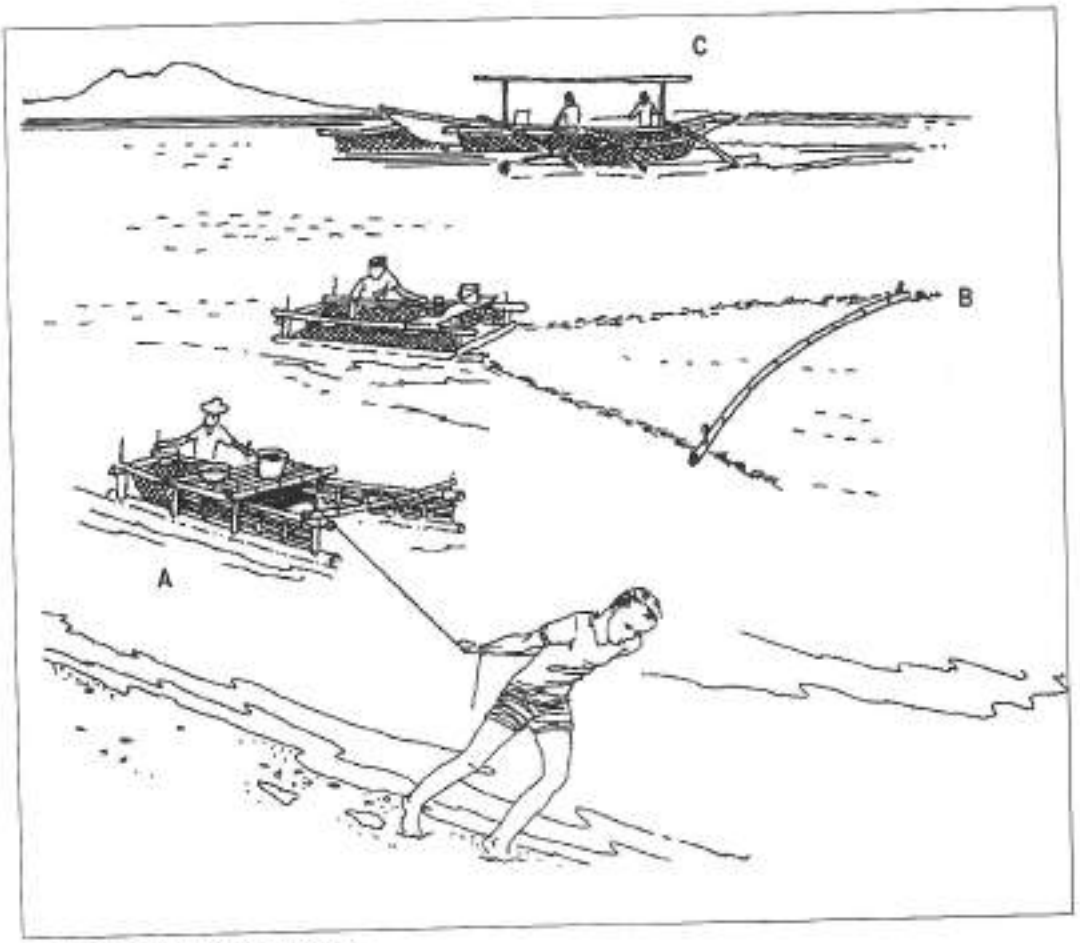
Floating tidal net set, showing position of operation at a promontory (Lipata Point, Panay Island, Philippines)

Mobile gear

Fry sweeper

A lightweight fry sweeper without the rigid frame is attached to one or both sides of the boat and operated some distance offshore. There are modifications on the fry sweeper:

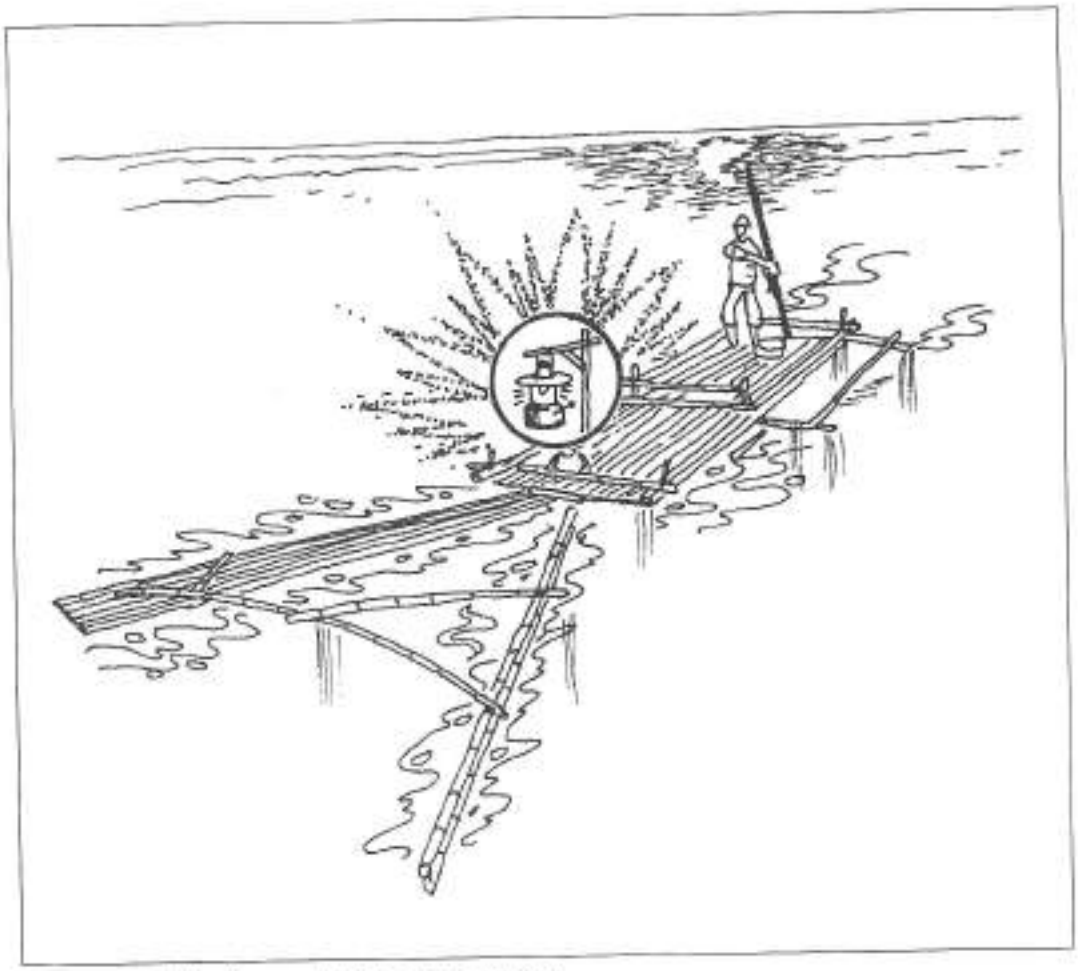
A: the enlarged frame with a person dragging and another pushing it
B: with long wings made of coconut leaves
C: the motorized sweeper operated from the boat offshore.



Modifications of the fry sweeper

D: fry sweeper with raft.

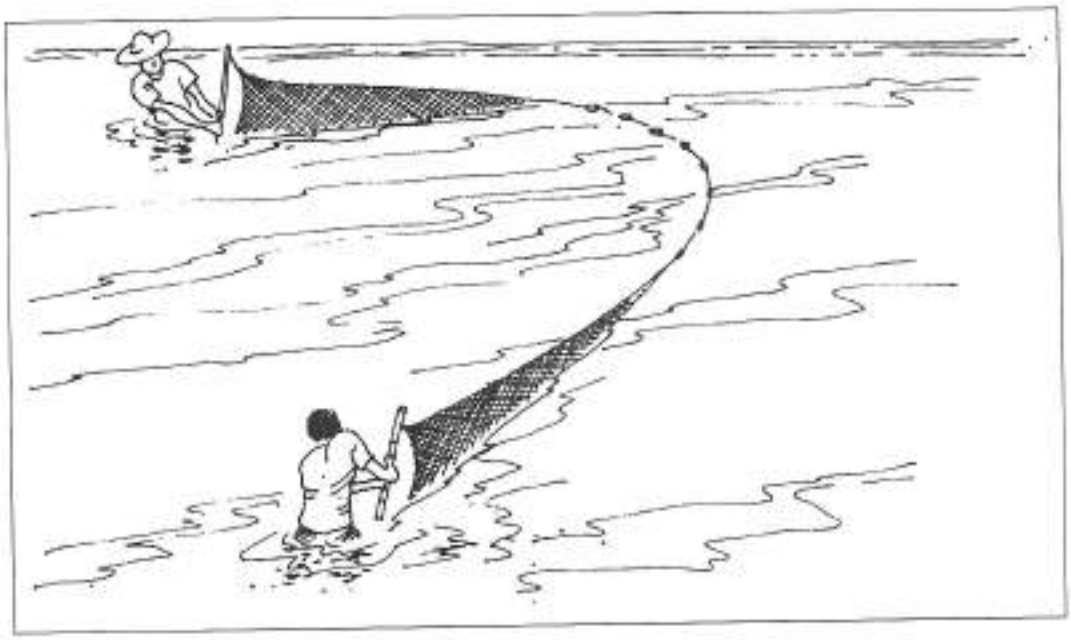
The fry sweeper with raft is an enlarged sweeper with long wings attached to a raft and is operated some distance from the shore often at night with a lamp. It is driven by a person with a long bamboo pole or sometimes with an outbound engine. This gear may also be operated like a tidal set net.



Fry sweeper with raft operated with a lamp at night

Towed bagnet

This is a long conical net also called a *sayot*. It is attached to bamboo poles and dragged along the shore. The narrow end is bunched and tied with a string during operation and later untied to release the collected fry into a plastic bag. Bamboo floaters may be attached to the wings to facilitate operation. This gear may be operated like a tidal set net.



Towed bagnet with conical end secured with a string

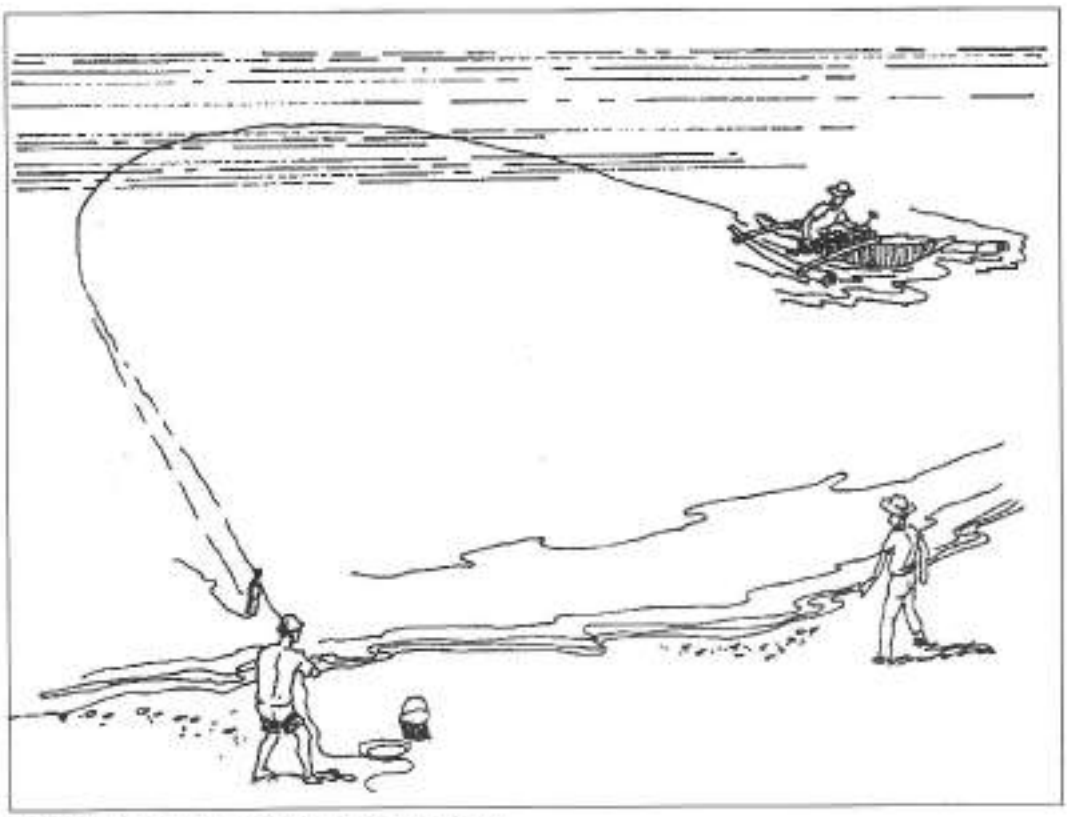
Double-stick seine

This is a traditional seine, locally known as sagyap. It is 3-7 m net with bamboo poles at both ends, dragged by two persons along the shore or river banks. It has been variously modified in response to prevailing topography, weather and economic conditions.

Operating the double-stick seine

Fry beach seine

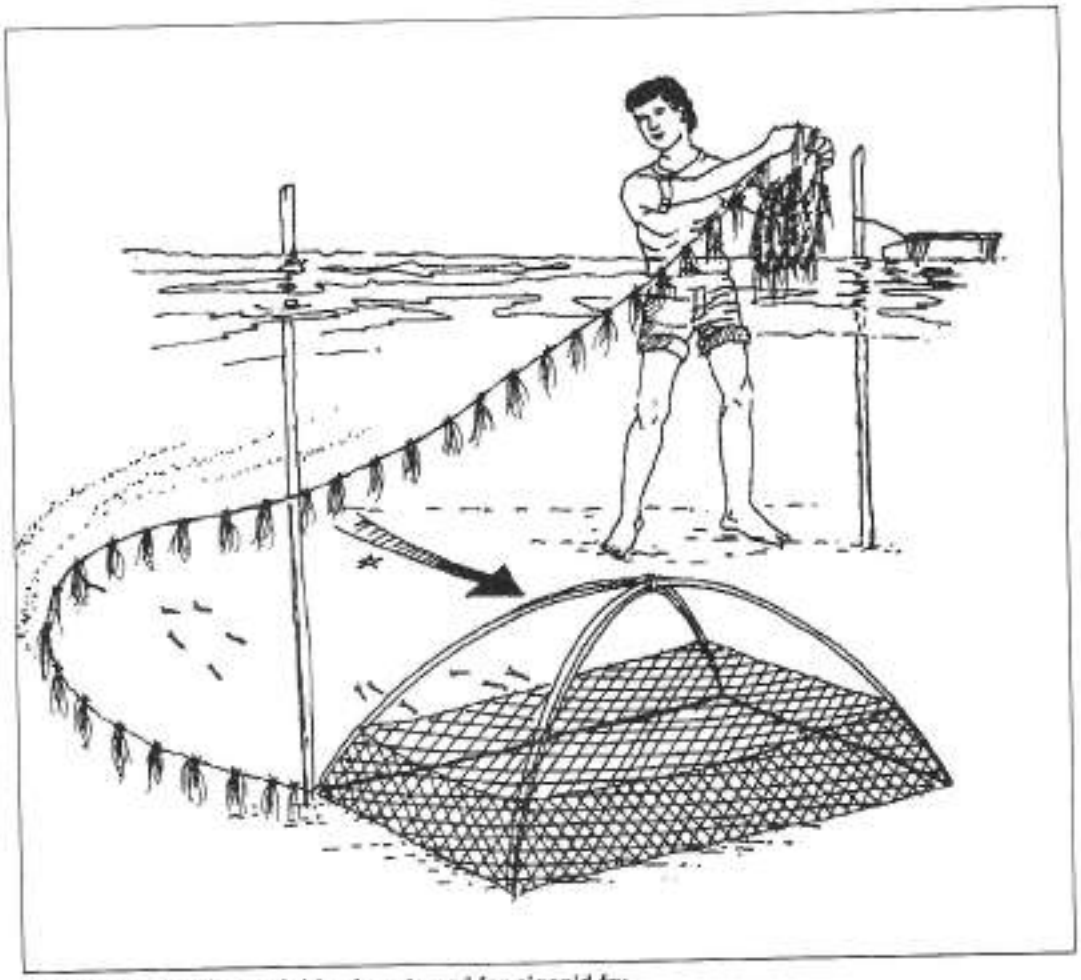
This is a much longer *sagyap* called *taktak* and is operated like a beach seine. One person stays on the shore holding one end of the towline, while another takes a boat out and casts the net 50 - 100 m offshore; the net is then pulled back to shore. A similar beach seine with a conical bagnet called *karukod* is operated in seagrass beds in Pangasinan to collect *siganid* fry.



Fry beach seine cast offshore and pulled back

Encircling scare-line and drive-in nets

The scare-line or *kalaskas* is made of coconut leaves, grass or plastic strips attached to a rope and is used to drive the fry into shallower water or into a trap. A floating scare-line is used to encircle milkfish fry in shallow areas; this method is commonly used in Indonesia. Lead sinkers are attached to scare-lines used for prawn and siganid fry. The fry are caught by scoop nets or by pre-set traps.



Encircling scare-line and drive-in net used for siganid fry

Types of fry and fingerling traps used in the Philippines

Traps	Province/Region (description of area)	Species caught/ trapped	Cost/unit gear (P)	Frequency of catch	No. of persons needed to operate/unit	Advantages	Disadvantages/ Constraints
Stationary gear 1. Lures for fry *(bonbon/ pagungpong)*	Iloilo, Antique, Capiz, Bicol, Negros, Bohol, Zambales, La Union	Shrimp/prawn Siganid Seabass	Only recycled materials are used	Several times/day	1	Cheap materials Selective in catch	Easily worn out/ destroyed
2. Floating tidal set net for fry	Iloilo, Bicol, Bohol, Antique, Quezon	Various species but specifically milkfish, siganid and shrimp	1,500-2,000	Daily/seasonal	1-2	Can be operated during high and low tide, even during bad weather	Limited catch and non-selective
Mobile gear 1. Fry sweeper a. enlarged frame	Quezon, Iloilo, Bicol, Bohol, Antique, Zambales	Milkfish Seabass Snapper Grouper	600-800	Several times during peak season	2	Less expensive Cheaper materials (most commonly used nowadays) Less manpower	Covers short distances Non-selective, hence would kill other fry
b. long wings	Quezon, Iloilo, Bicol, Bohol, Antique, Zambales	Milkfish Seabass Snapper	600-800	Several times during peak season	1	Wider scope of fry and collection	Needs more bamboo, Needs *banca* Laborious Non-selective
c. motorized sweeper	Quezon, Iloilo, Bicol, Pangasinan, Bohol, Antique	Milkfish Seabass Snapper	8,000 to 9,000	Several times during peak season	2	Faster to operate Covers long distances	More expensive Fry gets stressed Non-selective Needs more manpower
d. fry sweeper with *banca*	Bicol, Iloilo, Antique, Pangasinan, Bohol, Zambales	Milkfish fry Seabass Siganid Snapper	1,000-1,500	Seasonal during season	1-2	Can cover a deeper and wider area	Costly if equiped with engine Needs additional manpower Non-selective

Traps	Province/Region (description of area)	Species caught/ trapped	Cost/unit gear (P)	Frequency of catch	No. of persons needed to operate/unit	Advantages	Disadvantages/ Constraints
Mobile gear							
2. Towed bagnet *(sayot)* for fingerlings	Bohol, Bicol, Pangasinan, Quezon	Milkfish fry Siganid Snapper Mullet	3,000	Several times during peak season	2	Less manpower	Non-selective Limited to shallow areas only
3. Double-stick seine *(sayot)* for fry	Iloilo, Bohol, Bicol, Quezon, Pangasinan, Antique	Milkfish Mullet Snapper Seabass	600-800	Several times during peak season	2	Less manpower	--
4. Fry beach seine *(laktak)*	commonly used in Pangasinan	Milkfish Mullet	3,000-4,000	During low tide only	2	Can be used in deeper and wider areas	More expensive Needs more manpower Non-selective
5. Encircling scare-line and drive-in nets *(kalaskas)* for fingerlings	Iloilo, Bicol, Quezon, Bohol, Pangasinan, Antique	Milkfish Prawn Siganid	500 for line/ rope, lead sinker, plastic strips	3-5 times per day	1	Selective Less manpower Cheap materials	More site-specific

Fish capture using fishpots

A fishpot or *bubo* is a trap designed to catch larger fish and leave the young free. *Bubo* is recommended only in protected areas such as fish sanctuaries or where coral reefs and seagrass abound. *Bubo* fishing has been successful in Luyongbaybay, Doong Islet, off Bantayan, Cebu in the Philippines where the community established a marine park and fish sanctuary. The marginal fisherfolks in this island community have experienced increases in revenue from fishing while minimizing pressure on the natural fish population. To achieve this, they placed fishpot modules beyond the perimeter of the marine park. The average daily fish catch per fisherfolk doubled from 1.4 kg using other methods, to 3 kg using *bubo*. This encouraging development increased the fisherfolk's commitment to sustain the protection of their marine resource, particularly against destructive and illegal fishing activities.

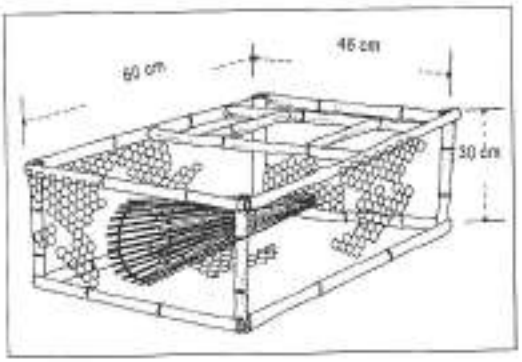
Making the *bubo*

There are several types of *bubo*. The most common is the box type, which needs the following materials:

- hexagonal chicken wire with mesh size of 0.75 in.;
- bamboo strips;
- nylon twine or wire; and
- 50 m of rope.

1. Cut the chicken wire into the desired size and make it into a box with the following dimensions.
   - length — 60 cm
   - width — 46 cm
   - height — 30 cm
2. Strengthen the sides and corners of the box with bamboo strips.
3. On one side of the box, make an inlet that tapers inside with the following measurements:
   - circumference of opening — 50 cm;
   - diameter of opening — 15 cm; and
   - length — 40 cm.

Detail of the *bubo* inlet



A box type *bubo*

4. On the top side of the box, cut out an opening through which the fish caught shall be harvested. Provide this opening with a bamboo pin as lock.

5. Make at least 25 fishpots to complete a module. Tie the fishpots together to a 50 m rope. Assemble as many modules as practicable for your surroundings.

Operation

Fishpots made of wire do not need any anchor or weight to stay in place. Provide each fishpot with trash fish as bait. Submerge the fishpot modules in shallow reef areas (@10-20 m deep) where large carnivorous species such as groupers are attracted to the bait. After 48 hours or when convenient, recover the modules and harvest the trapped fish. In Doong Islet, the fisherfolks observed that even without baits, fish still get trapped inside their fishpots. Their high catch has been considered one of the beneficial effects of the marine park and fish sanctuary they established earlier in the area.

Sustainability

Bubo fishing is an extractive activity. To offset its effects, the fishing community should set aside at least 10 ha for a marine park and fish sanctuary where fish species can mate and spawn. No fishing activity should be allowed in the marine park. *Bubo* and hook-and-line fishing in the fish sanctuary may be allowed by the organization maintaining and protecting the area. The *Bantay Dagat* team of the community must also be strengthened. This seaborne patrol group organized by the local government unit enforces fishery laws and ordinances, particularly those outlawing the use of illegal fishing methods. Usually composed of members of the local police force and citizen volunteers, the team also arrests those encroaching on municipal waters, especially big-time fishers.

Launching a module of fishpots

Cost and return analysis

Example: 1 module = 25 fishpots catching 500 g per fishpot for an average of 180 days per year (fixed asset valued at P32,000.00)

Expenses		
Cost of supplies and materials		
25 fishpots at 160.75 each		₱ 4,018.75
Labor cost		281.25
Supervision		37.50
Deployment and harvesting		6,750.00
Depreciation		6,400.00
	Total	**₱ 17,487.50**
Income		
25 fishpots/day x .5 kg/fishpot x 180 days x ₱80/kg		**₱ 180,000.00**
Net income		**₱ 162,512.50**
Return on investment		**5.18**
Payback period		**2.4 months or 72 calendar days**

Prepared by Paolo Cobrado, SMISLE

Land-based activities

Tree nursery establishment

Some Filipinos have established nurseries to propagate and sell planting materials as a means of generating family income. This is due to the ever increasing need for seedlings to rehabilitate the country's denuded forest areas and the lure of profit from selling high-valued fruits of perennial trees. The success of this kind of livelihood largely depends on the quality of seedlings produced by the nursery.

Selecting the site

In selecting a site for your nursery, consider the following requirements:

Suitability of agroclimatic conditions to species propagated

Tree seedlings thrive best on clay-loam soil with at least 30 cm of topsoil, neutral or near-neutral pH, and high organic matter. The best climate for fruit and forest species is characterized by an even distribution of rainfall throughout the year.

Accessibility to all-weather roads

Tree seedlings are grown in containers which are bulky when transported, so the nursery should be located near a road.

Good drainage

Select an area that is flat to slightly sloping (up to 10 percent) where water can be drained towards one direction.

Availability of water source

As most seedlings need protection from the sun and rain by a shed house, they need water all the time even during the wet months.

Portion of area shaded by trees

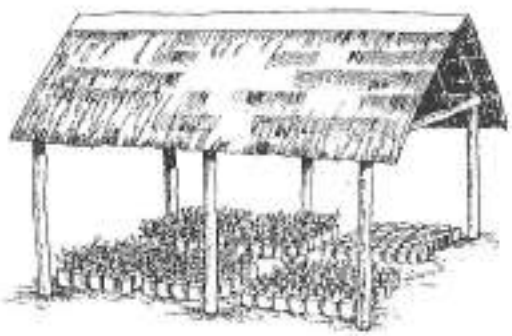
Expose grown seedlings to sunlight as they adjust to actual field conditions. Full sunlight, however, is detrimental to most young seedlings, so a nursery must have a portion shaded from direct sunlight.

Putting up the nursery

1. Mark at least 350 m² (10 m x 35 m) on the area of your choice.
2. Clear it of bushes, grass, stones and other debris.
3. Fence the area if there are stray animals in the vicinity.
4. Mark the spots for or make layouts of the following nursery components:
   - gate;
   - business office;
   - storage room;
   - caretaker's quarters;

- shed house (at least 25 m^2 for every 100,000 seedlings produced annually);
- seedbeds;
- faucet or any water source;
- open but shaded area; and
- an area for future expansion.

Use locally available materials such as bamboo, coco lumber and nipa thatches to construct the shed house and other structures.



A low-cost shed house for a tree nursery

Tree propagation techniques

Asexual propagation

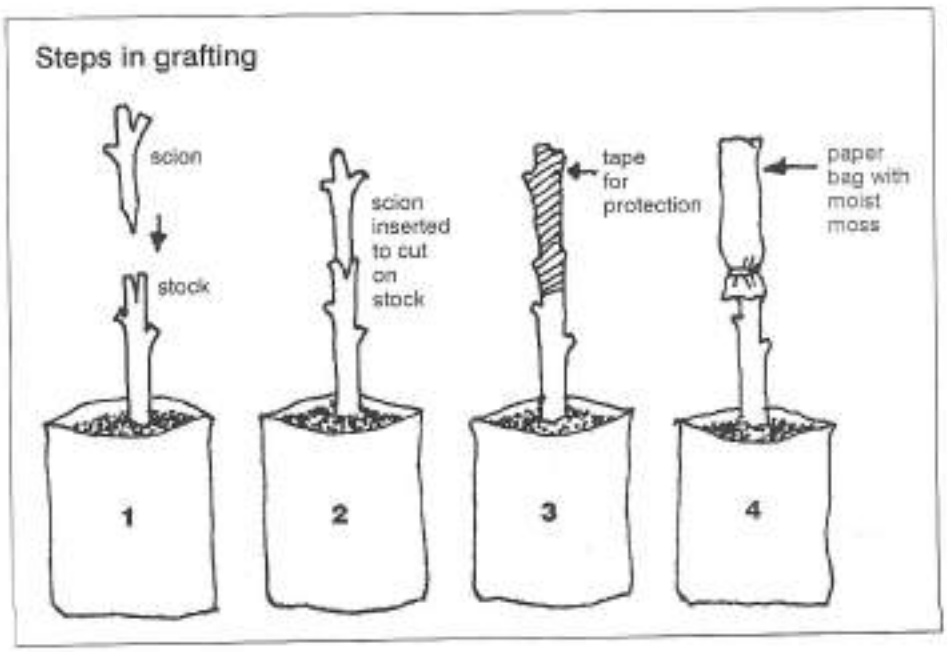
Mango and citrus go through a long juvenile or nonfruiting period from 6-8 years. Therefore, they are propagated through asexual means, the most common of which is grafting. A plant grown from a seed can bypass the juvenile stage by replacing its vegetative portion with that from a mature plant.

Procure sources of scions from outside if there are no mature plants available.

Sexual propagation

Forest trees such as gmelina, mahogany and acacia, and some fruit trees are propagated by seed which results from the exchange of genetic materials of parent plants through cross pollination. Fruit trees resulting from this method are not identical to their parents. In most cases, propagation of fruit trees by this method is not desirable.

For trees propagated by this method, select seeds taken from fruits of vigorous and healthy plants, and those that are of the right size and moisture content.



Treating the seeds

Most seeds of perennial trees do not germinate readily. Induce seed germination through any of the following methods:

1. Soak the seeds in tap water;
2. Wrap the hard-coated seeds with cloth and immerse them in hot water;
3. Reduce the thickness of the seed coat by physically breaking or scraping it; or
4. Soak hard-coated seeds in scarifying chemicals like sulfuric acid.

Preparing the growing medium

For your potting soil, prepare a fine or sieved mixture of topsoil and sandy loam (3 parts), compost (3 parts), and river sand (1 part).

Prepare slightly elevated (5-10 cm) seedbeds at least 1 m wide, with a 40-cm-wide path in between.

For fine seeds, prepare seedboxes of appropriate size (at least 30 cm x 35 cm x 10 cm). To drain excess water, drill holes on the bottom of the boxes before filling them with soil. For elevation, attach wooden legs to the boxes. Place the seedboxes in a shaded area, with the legs standing on water-filled cans to prevent ants from attacking the seeds.

Sowing the seeds

If seedlings will be potted, phase your sowing over 6-8 weeks at weekly interval. Do not sow all the seeds at the same time.

For seedbeds, follow a planting distance of 15-20 cm between rows and 5-10 cm between seeds for large seeds, and 10-15 cm between rows for medium-size seeds. Sow the seeds in a furrow or in holes and cover them with soil.

Broadcasting fine seeds in a seedbox

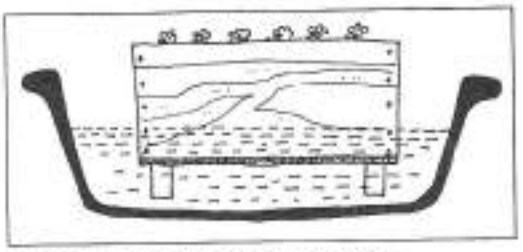
For seedboxes, broadcast the fine seeds evenly on the surface of the soil. Apply a thin layer of fine sand over them. Cover the seedbox with newsprint paper as mulch. Allow the seedlings to sprout through the paper. Before broadcasting very fine seeds, mix them first with ash from wood shavings or very fine sand at 200 g of filler per g of seeds.

If viability of the seeds reaches 50-75 percent, sow them direcly in polyethylene pots at one seed per pot. As much as possible, use biodegradable materials instead of plastic pots.

Caring for the seedlings

Seedlings need protection from rapid evaporation of soil moisture, intense heat, strong wind and the impact of raindrops. To protect the seedlings, cover the seedbeds, seedboxes or pots with organic debris such as rice hull, rice straw, chopped grass, compost, decomposed sawdust, chopped bark of trees, banana leaves and wood shavings. Use fine sand or finely chopped organic debris for small seeds, e.g., calamansi.

Water the seedlings by flooding, furrow irrigation, sprinkling or installing perforated pipes along the seedbeds. Use any of these methods which you find appropriate and economical. Water the seeds in the morning and mid-afternoon. To water the seeds sown on a seedbox, submerge the lower part of the box in water until the soil becomes moist.



Watering the seedlings in a seedbox

Protect the seedlings from direct sunlight and heavy rain. Use a plastic sheet (gauge 0.003 - 0.004) attached to a frame. Enhance the structure with coconut or *buri* fronds.

Transplanting the seedlings

When the first lateral roots appear, lift the seedlings carefully from the seedbed or seedbox with the use of a trowel. Transplant them in containers filled with soil.

Caring for the transplanted seedlings

Arrange the potted seedlings in rows in a shaded area. Avoid dense spacing which reduces air circulation and exposure to sunlight. Water the seedlings as often as necessary depending on their size and stage of development, i.e., small quantity at frequent intervals for small seedlings, and sufficient amount at less intervals for larger seedlings. Gradually expose them to full sunlight by removing the shade materials one by one over a number of days.

Cultivate the area between rows of seedlings to remove weeds and loosen the soil for aeration and water absorption. Remove diseased seedlings or those attacked by insects and other pests.

Sustainability

Anyone embarking on a project such as tree nursery establishment must have sufficient knowledge on proper nursery and management practices to impart to the other members of the household. They must also have steady access to sources of seeds and the ability to link the business with groups or individuals who need seedlings for specific projects.

Cost and return analysis

Example: One year operation

Tree species	No. of grafted seedlings procured	No. of seedlings produced per kg of seeds sown	Total amount of seeds sown (kg)	Estimated no. of seedlings procured	Total no. of seedlings produced less 15% mortality
Acacia mangium		3,000	5	15,000	12,750
Gmelina		3,000	10	30,000	25,500
Mahogany		3,000	10	30,000	25,500
Jackfruit	300				255
Calamansi	300				255
Mango	300				255
Total	**900**	**9,000**	**25**	**75,000**	**64,515**

FIXED ASSET		
Shed house		₱ 5,000.00
	Subtotal	**₱ 5,000.00**
EXPENSES		
Tools and materials		
Plastic sheet	30 m² x ₱18/m²	₱ 540.00
Polyethylene bags	50 kg x ₱100/kg	5,000.00
Seedboxes	10 pieces x ₱50/piece	500.00
Scarifying chemicals	5 bottles x ₱80/bottle	400.00
Hand trowel	2 pieces x ₱150/piece	300.00
Garden shears	2 pairs x ₱200/pair	400.00
Spade	1 piece x ₱150/piece	150.00
Sterilizing drum	1 piece x ₱500/piece	500.00
Forked hoe	1 piece x ₱250/piece	250.00
	Subtotal	**₱ 8,040.00**
Planting materials		
Seeds		
Acacia mangium	5 kg x ₱3,500/kg	₱ 17,500.00
Gmelina	10 kg x ₱100/kg	1,000.00
Mahogany	10 kg x ₱300/kg	3,000.00
	Subtotal	**₱ 21,500.00**
Grafted seedlings		
Jackfruit	300 pieces x ₱20/piece	₱ 6,000.00
Calamansi	300 pieces x ₱20/piece	6,000.00
Mango	300 pieces x ₱25/piece	7,500.00
	Subtotal	**₱ 19,500.00**
Labor		
Clearing	21 days x ₱120 per day	₱ 2,520.00
Fencing	42 days x ₱120 per day	5,040.00
Maintenance	1,728 days x ₱120 per day	207,360.00
	Subtotal	**₱ 214,920.00**
Transport of planting materials		₱ 900.00
	Subtotal	**₱ 900.00**
Total expenses (grafted seedlings from outside)		**₱ 264,860.00**
Total expenses (grafted seedlings produced in nursery)		**₱ 245,360.00**

Summary of income and return on investment

Gross income		
Seedlings*	63,750 pieces x ₱5/piece	₱ 318,750.00
Grafted jackfruit	255 pieces x ₱30/piece	7,650.00
Grafted calamansi	255 pieces x ₱30/piece	7,650.00
Grafted mango	255 pieces x ₱35/piece	8,925.00
	Total	**₱ 342,975.00**

Net income (Grafted seedlings bought from outside)	**₱ 78,115.00**
Net income (Grafted seedlings produced in nursery)	**₱ 97,615.00**
Return on investment (Grafted seedlings bought from outside)	**16**
Return on investment (Grafted seedlings produced in nursery)	**20**

** Acacia, gmelina and mahogany*

Prepared by Christopher Tan and Reigh Monreal, SMISLE

Backyard vegetable production

One of the most important reasons for vegetables production is the high nutrition value of the produce. In addition to the nutritional aspect are the economic advantages gained from backyard vegetable production. Vegetable production can be done in addition to fishery livelihoods, therefore increasing the income generation options for a community. A combination of fish and vegetables for meals also provides a more balanced diet.

Rural people in many parts of the world have always used their backyards to grow food. In the coastal areas in the Philippines, backyard vegetable production is a profitable livelihood.

This paper encourages vegetable production in all parts of the country, especially the provinces that place a lower priority on vegetable production. This situation results in expensive vegetable prices in the local markets.

For example, most of the vegetables sold in the small islands in the Visayas Region of the Philippines come from the bigger islands of the country. Many provinces in Central and Eastern Visayas get their vegetables from Cebu City which also receives regular supplies from the islands of Luzon and Mindanao and a few other vegetable producing areas in the Visayas. In Western Visayas, Iloilo City is the main trading center for vegetables which are sold in the neighboring provinces, including Guimaras.

Small-scale production

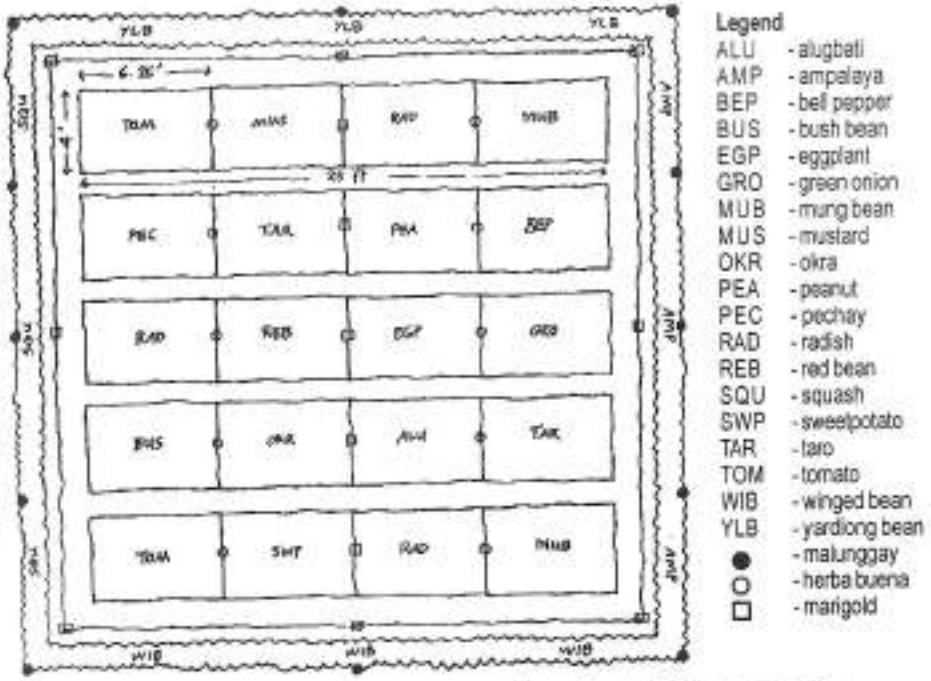
A household can maintain an area of at least 500 ft² (46.45 m²) for vegetable production following these recommendations:

Recommended vegetable species for small-scale backyard production

Leaf vegetables	Fruit vegetables	Root vegetables	Legumes	Others
mustard pechay *alugbati** green onion sweetpotato (tops) *malunggay***	tomato eggplant bell pepper okra *ampalaya** squash	radish *gabi**	mung bean red bean bush bean *sitaw** winged bean peanut	*tanglad** herba buena marigold
* local spinach ** horseradish	*bitter gourd	*taro	*yardlong bean	*lemon grass

Multiple cropping

Plant more than one type of vegetable to provide variety to your household and to the local market. This will also improve the nutritional status of consumers. Multiple cropping maximizes the farmer's time spent on gardening without being overburdened, especially with crops that have different harvest periods. Some vegetables, such as *malunggay* and *alugbati*, do not need replanting.



Legend

ALU	- alugbati
AMP	- ampalaya
BEP	- bell pepper
BUS	- bush bean
EGP	- eggplant
GRO	- green onion
MUB	- mung bean
MUS	- mustard
OKR	- okra
PEA	- peanut
PEC	- pechay
RAD	- radish
REB	- red bean
SQU	- squash
SWP	- sweetpotato
TAR	- taro
TOM	- tomato
WIB	- winged bean
YLB	- yardlong bean
●	- malunggay
○	- herba buena
□	- marigold

Layout of a small-scale backyard vegetable garden (500 ft² or 46.45 m²)

Land preparation

Plow the field until the soil becomes pulverized. A big household may use hand implements to do the job. Remove stones and other debris. Replace poor soil with compost. Crops such as tomato, pechay, pepper and eggplant are sensitive to too much water. For these species, prepare raised beds with drainage canals around them.

Planting density

The table above shows the planting density for each recommended vegetable type.

Crop rotation

Do not plant the same crop on the same plot after every turnover. Exceptions can be made on *malunggay* and, for a certain period, *alugbati*. To improve soil conditions, plant legumes on the plots previously planted with other vegetables to minimize nutrient depletion and control insect pests and diseases.

Chemical-free practices

Use pesticides only when there are pest outbreaks. Practice hand weeding and observe sanitation in the garden. Plant insect-repelling species such as *herba buena* and marigold along the plot borders. Use commercial fertilizer only on extremely poor soil. Apply manure and compost regularly. To improve soil condition and clean up the environment, incorporate the biodegradable debris left after every harvest into the soil. To some extent, these practices abate the effects of pesticide toxicity among vegetable consumers.

Recommended planting distances and seed requirements for vegetables

Species	Planting distance	No. of hills per plot	Amount of seed required per planting (gram)
Mustard	25" x 25"	30	20
Pechay	25" x 25"	30	20
Alugbati	25" between rows	150	150 (pieces)
Green onion	20" x 20"	50	850 (pieces)
Sweetpotato	25" between rows	150	150 (pieces)
Malunggay	12 cuttings along perimeter	12	12 (pieces)
Tomato	30" x 30"	18	20
Eggplant	35" x 35"	15	20
Bell pepper	30" x 30"	18	20
Okra	35" x 35"	15	20
Ampalaya	50" x 50" along perimeter	15	50
Squash	50" x 50" along perimeter	15	50
Radish	25" between rows	drilled	100
Gabi	35" x 35"	15	30 (pieces)
Mung bean	30" between rows	drilled	400
Red bean	30" x 30"	18	200
Bush bean	30" x 30"	18	30
Sitaw	30" x 30" along perimeter	30	50
Winged bean	50" x 50" along perimeter	15	50
Peanut	30" x 30"	18	400

Sustainability

For every crop, reserve a number of mature plants or an amount of seed harvested as planting materials. The gross income is expected to increase in subsequent croppings as labor requirement decreases and sources of planting materials are sustained.

This livelihood activity can be further sustained when the farmer possesses complementary skills on vegetable seed production, seedbed preparation, compost making and farm record keeping. The farmer must also be updated on the current prices of vegetables to get the best price for produce.

An improved marketing system, which includes market links, is vital in sustaining small-scale vegetable production. Organizations of vegetable growers must also be strengthened to serve as a marketing arm for surplus products.

A farmer must be skilled in seed production to prepare for some subsequent cropping and to reduce overhead costs and sustain production.

Some useful information on some vegetable crops grown in the Philippines

Crop	Planting months	Best planting month	Depth of sowing (cm)	Age of transplanting (weeks)	Spacing H x R (cm)	Maturity (days)
Ampalaya	Any month	1 Oct-1 May	3	-	100 x 100	70 - 80
Broccoli	1 Oct-15 Jan	1 Oct-15 Jan	1	4 - 5	30 x 33	55 - 70
Brush snap beans	1 Aug-15 Dec	1 Aug-15 Dec	2.5	2.5	15 x 33	50 - 55
Bush sitaw	Any month	1 Oct-1 June	2.5	-	15 x 33	50
Carrot	1 Sept-1 Nov	1 Sept-1 Nov	Until covered	-	4 x 25	90
Cucumber	1 Feb-15 Apr	1 Feb-15 Apr	2.5	-	30 x 65	45
Eggplant	Any month	1 Oct-1 June	1	4.5	50 x 60	50 - 60
Green onion	Any month	1 Oct-1 June	-	-	5 x 10	45 - 55
Hot pepper	Any month	1 Oct-1 June	1	4.5	40 x 50	70 - 90
Leaf lettuce	1 Aug-1 Feb	1 Aug-1 Feb	Until covered	3 - 4	20 x 25	30
Okra	Any month	1 Nov-1 March	2.5	-	30 x 70	50 - 60
Patola	Any month	1 Oct-1 May	3	-	100 x 100	75 - 85
Pechay	Any month	1 Oct-1 June	1	-	Dense	25 - 30
Pole snap beans	1 Aug-15 Dec	1 Aug-15 Dec	2.5	-	30 x 70	50
Pole sitaw	Any month	1 Oct-1 June	2.5	-	30 x 70	55
Radish	1 Sept-15 Jan	1 Oct-1 May	1.5	-	15 x 30	60
Squash	Any month	1 Oct-1 May	2.5	-	100 x 150	75 - 90
Sweet corn	Any month	1 Oct-1 June	2.5	-	35 x 70	70
Sweet pepper	1 Sept-1 Jan	1 Sept-1 Jan	1	4 - 5	35 x 70	70 - 90
Tomato	1 Oct-15 Apr	1 Oct-15 Apr	1	4 - 5	50 x 60	60 - 70
Upland kangkong	Any month	Any month	2	4 - 5	50 x 10	25 - 30
Upo	Any month	1 Oct-1 May	2.5	-	100 x 100	75 - 85

Source: Nornita Ignacio and Thomas Westermann, 1996 (unpublished)

Consider the following information in vegetable seed production:

Indices for harvesting the fruit for seed extraction

Beans	Beans are ready for harvest as soon as 90 percent of the pods have turned yellow or pale yellow. Pods do not mature at the same time so they must be harvested only when they mature. Do not leave the dry pods in the field to prevent shattering during sunny days and rotting or sprouting within the pods during rainy days.
Tomato	Harvest the fruit only when fully ripe, i.e., when it is all red in color.
Eggplant	Fruits are fully matured when skin turns bright. Ripe fruits are bright yellow or purple depending on the variety.
Bell pepper	Harvest the fruits only when they turn bright red.
Ampalaya	When the fruit becomes shiny and changes its color from dark green to yellowish green or yellow, it is ready for harvest. Usually, the fruits are harvested four months after germination.

Extracting the seeds

Beans	Remove the seeds by splitting the dry pods manually.
Tomato and *ampalaya*	Cut the fully ripe fruit into half and crush it to remove the seeds. Place the seeds in plastic or glass containers. Allow the seeds to ferment for 1-2 days, then wash them thoroughly before sun-drying.
Eggplant	Roll the fruit with your palm to soften the flesh. Cut the fruit lengthwise and remove the seeds in water. Drain the water from the basin, collect the seeds and air-dry them.
Bell pepper and squash	Cut open the fruit with a knife, remove the seeds manually, then wash them.

Drying the seeds

Air-dry the seeds for 1-2 days. Sun-dry for a whole day under full sunlight or until they attain a moisture content of about 8-12 percent.

Packaging and storing the seeds

Before keeping the seeds, make sure they are dry to prevent deterioration. Place the seeds in labelled paper packets or envelopes and store them in air-tight containers such as glass jars.

Packing and storing the seeds in an air-tight container

Provide desiccants like powdered charcoal to prevent early deterioration. Store the jars in a cool and dry place. Seed quality of fruit vegetables such as bell pepper and squash improves if the fruits are stored in a cool and dry place for a period of 2 - 3 weeks after harvest. Paper pouches, plastic bags or sacks are not good packaging materials because they absorb moisture that hastens seed deterioration.

Seed testing

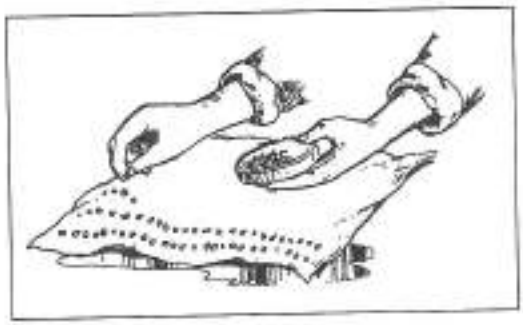
Seed testing is done to determine seed germination percentage and viability, evaluate seed quality and determine the quantity of seeds needed per unit of planting area.

To determine the seed germination percentage:

- use either ragdoll, dish germination, or seedbox methods.
- regardless of method used, count 400 seeds from your stock and group them by the hundred.

Ragdoll method

Spread the 100 seeds evenly on a moist rag. Using a stick at one end of the rag, roll the rag and secure it onto the stick. Repeat the procedure for the remaining seeds.



Ragdoll method

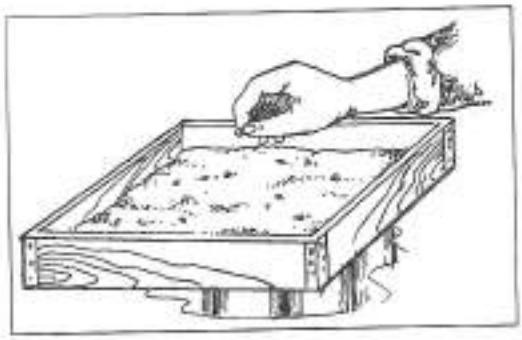
Dish germination method

Cover the bottom of the dish or deep saucer with moist filter paper or about four layers of bathroom tissue. Spread 100 seeds evenly on the dish or saucer. Repeat the process for the remaining seeds.

Dish germination method

Seedbox method

Prepare four small boxes filled with sterilized soil. Sow 100 seeds in rows in each box, cover them lightly with soil and water the seedbox thoroughly.



Seedbox method

For all the methods used, always keep the germination medium moist to prevent seed dehydration by regular watering. After 3 - 7 days from sowing, count the seeds that germinated and calculate for the germination percentage using the following formula:

$$\text{Germination percentage} = \frac{\text{Number of seeds that germinated}}{\text{Number of seeds sown}} \times 100$$

Cost and return analysis

A multi-crop backyard vegetable garden of at least 500 ft² (46.45 m²) has the following requirements for the first cropping:

Unskilled labor		
Seedbed preparation	4 hours x ₱15 per hour	60.00
Collection of fencing materials and compost/manure	1 day x ₱120 per day	120.00
Plot preparation	3 days x ₱120 per day	360.00
Care of seedlings on seedbed	20 hours x ₱15 per hour	300.00
Care of plants	120 hours x ₱15 per hour	1,800.00
Preparation of compost	1 day x ₱120 per day	120.00
	Subtotal	***₱2,760.00***
Planting materials		
Mustard	0.02 kg x ₱1,000/kg	₱ 20.00
Pechay	0.02 kg x ₱380/kg	7.60
Alugbati	150 cuttings x ₱0.10/cutting	15.00
Green onion	0.85 kg x ₱30/kg	25.50
Sweetpotato	150 cuttings x ₱0.10/cutting	15.00
Malunggay	12 cuttings x ₱2/cutting	24.00
Tomato	0.02 kg x ₱2,400/kg	48.00
Eggplant	0.02 kg x ₱3,000/kg	60.00
Bell pepper	0.02 kg x ₱3,500/kg	70.00
Okra	0.02 kg x ₱300/kg	6.00
Ampalaya	0.05 kg x ₱1,800/kg	90.00
Squash	0.05 kg x ₱1,280/kg	64.00
Radish	0.10 kg x ₱280/kg	28.00
Gabi	30 corms x ₱0.50/corm	15.00
Mung bean	0.40 kg x ₱50/kg	20.00
Red bean	0.20 kg x ₱50/kg	10.00
Bush bean	0.03 kg x ₱260/kg	7.80
Sitaw	0.05 kg x ₱300/kg	15.00
Winged bean	0.05 kg x ₱280/kg	14.00
Peanut	0.60 kg x ₱60/kg	36.00
	Subtotal	**₱ 590.90**
	Total cost	**₱3,350.90**

Income

Species	Annual production (kg)	Selling price (₱/kg)	Gross Revenue (₱)
Mustard	24	25	600.00
Pechay	24	25	600.00
Alugbati	32	25	800.00
Green onion	3.75	100	375.00
Sweetpotato	24	8	192.00
Malunggay	320 (stalks)	1.00/5 stalks	64.00
Tomato	27	12	324.00
Eggplant	45	25	1,125.00
Bell pepper	10.8	30	324.00
Okra	22.5	25	562.50
Ampalaya	33.75	25	843.75
Squash	120	20	2,400.00
Radish	72	25	1,800.00
Gabi	60	10	600.00
Mung bean	3.6	35	126.00
Red bean	2.7	30	81.00
Bush bean	8.1	12	97.20
Sitaw	18	30	540.00
Winged bean	7.5	12	90.00
Peanut	7.2	40	288.00
		Total	₱11,832.45
Gross Income			₱ 11,832.45
Total Cost			₱ 3,350.90
Net Income			₱ 8,481.55

A 100 sq m multi-crop vegetable production area will give a farmer an annual income of approximately ₱ 18,259.42 as computed using the following equations:

$$500\ ft^2 \times \frac{0.8361\ m^2}{9\ ft^2} = 46.45\ m^2$$

$$\frac{₱\ 8,481.55}{46.45\ m^2} = \frac{X}{100\ m^2}$$

$$= ₱\ 18,259.42/100m^2$$

Prepared by Charry Galia and Reigh Monreal, SMISLE; and Elizabeth Briones, VISCA

Annex

Fingerling and fry transport

Transporting fingerlings and fry is seen as an extension in capturing and culturing fish. Fingerling and fry transport can be an extra source of income for a community if they are not available nearby. During transport, handle the fingerlings and fry delicately to avoid stress that may lead to infection and death.

General practice

Do not feed fry or fingerlings for at least 24 hours before transporting. Place them in containers with clean water of similar salinity and temperature. Count the fry visually in small lots. Add freshwater to reduce the salinity to 12-20 ppt (this is 1-2 parts freshwater to 2 parts seawater) when transporting milkfish and seabass, but not when transporting siganid and prawn.

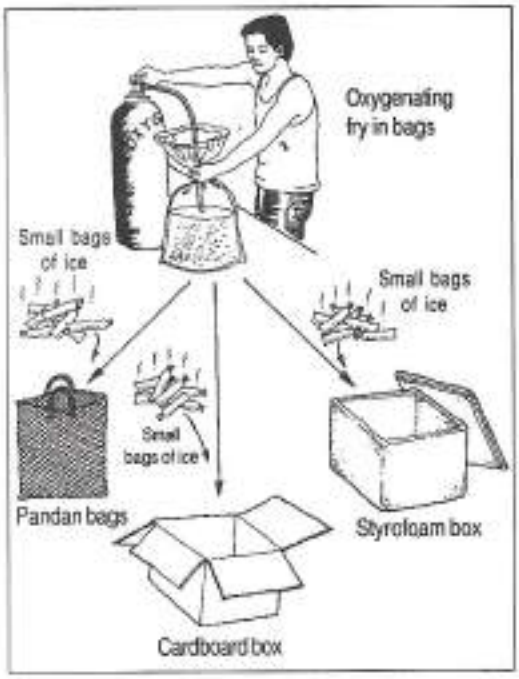
Water temperature

Leave the water temperature at ambient (26-30°C) if the number and/or size of fry is small and the transport time does not exceed six hours. At higher stocking densities, bigger fry sizes and longer transport times, reduce the temperature to 20-22°C by placing the transport medium into small plastic bags to reduce the metabolic rate therefore reducing the oxygen intake. Place the ice wrapped in newspaper on top of the plastic bags of fry to maintain low temperature during transport.

To lower the water temperature, place the transport medium in a small plastic bag of ice. Using bags prevents salinity reduction. Ensure the temperature does not drop below 20°C.

Pour the desired number (see table) of fry into double plastic bags. Place oxygen into the bags at a volume equal to or twice that of the water in the bag.

Place the plastic bags inside pandan bags in case of land transport or in cardboard and styrofoam boxes for air shipment or long duration transport.



Alternative transport methods

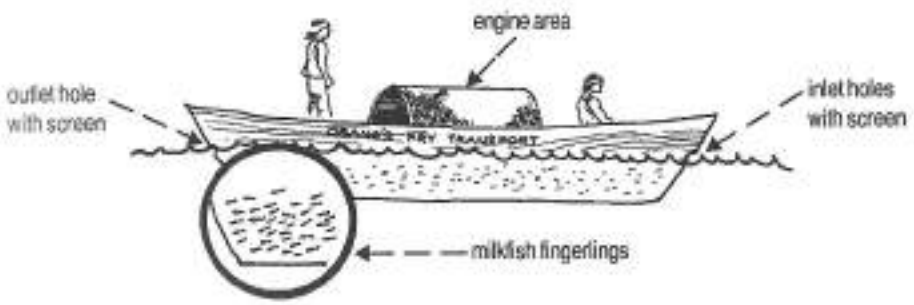
Live-fish boat *(pettiya)* is another method of transporting milkfish fingerlings. The boat has a flat bottom serving as the fingerling compartment with 1-3 inlet holes at the front part for water to enter. Another hole at the rear part of the boat serves as a water outlet. A water pump is used to change the water in the compartment. When passing through muddy or polluted waters, the holes are plugged and the pump recirculates the water inside. This method is practiced when transporting fry or fingerlings from Bulacan to Laguna. For juvenile shrimp, the cylindrical floating cage used for storage may also be used for transport over water and towed to its destination.

Causes of mortality during transport

1. Physical injuries
2. Overcrowding
3. Oxygen depletion due to leaking plastic bags, transport delays, decomposition of debris or high bacterial count of transport water
4. Thermal stress due to high (30°C) or low (20°C) temperatures
5. Accumulation of toxic waste products, like ammonia, in the water

Ways of reducing mortality during transport

1. Acclimatize the fry to lower salinity before transport. However, the salinity of the transport water should not be higher or lower by 5 ppt than that of the pond where the fry/ fingerlings will be stocked. This applies to milkfish, siganid, seabass, shrimp and tilapia but not grouper.
2. Do not feed the fry for at least 24 hours before transportation.
3. Transport only healthy fry.
4. Allow the fry to recover from handling stress for at least 12 hours before and after transportation. This will not decrease their resistance to subsequent stress.
5. When water temperature needs lowering, it should be done gradually, approximately 1°C every 10 minutes, and should not go lower than 20°C.
6. Avoid unnecessary fry handling and transfer. The stocking density in one transport bag should not exceed the stocking capacity of the subsequent container.



Transport practices for fry and fingerlings of crustaceans and finfishes

Conditions	SHRIMP		MILKFISH		SEABASS	
	Fry (1.2-2.0 cm)	Juveniles (2.0-5.0 cm)	Fry (1.0-1.6 cm)	Juveniles (3.0-5.0 cm)	Fry (0.2-1.5 cm)	Juveniles (2.0-8.0 cm)
Container	Plastic bag in pandan bag Plastic bag in styrofoam box (low temperature)	Plastic bag in pandan bag Plastic bag in styrofoam box, floating cylindrical cage	Plastic bag in pandan bag Plastic bag in styrofoam box (low temperature)	Plastic bag in pandan bag Plastic bag in styrofoam box live-fish boat	Plastic bag in pandan bag Plastic bag in styrofoam box	Plastic bag in pandan bag Plastic bag in styrofoam box
Water volume (liters)	2.5-10	5-10 Depends on the size of cage	4-10	10-15 6,000-8,000	5-10	5-10
Salinity (ppt)	20-32	10-25 Depends on river salinity	12-22	10-35 2-10 Depends on the salinity along the way	10-30	5-30
Stocking rate (no./container)	800-1,000 1,500-5,000	200-600 600-1,500 500-800	4,000-6,000 6,000-8,000	200-500 500-1,500 50,000-120,000	1,000-2,000	200-500
Transport time (hr)	2-6 6-10	2-6 6-10	2-6 6-12 1-2	3-5 6-8	2-6 6-8 4-5	2-6 6-8
Mortality (%)	2-5	2-5 negligible	2-6	1-10 0.5-2	1-10	1-10

Transport practices .. continuation

Conditions	SIGANID	CRAB	GROUPER	
	Juveniles (2.0-5.0 cm)	Juveniles (10-20 g)	Tiny (1.0-2.0 cm)	Juveniles (2.0-8.0)
Container	Plastic bag in pandan bag	50 cm x 60 cm box Either hard carton or plywood, pandan bag with fresh fronds of mangrove trees	Oxygenated, double Plastic bag inside pandan bag or hard box	Oxygenated, double Plastic bag inside pandan bag or hard box
Water volume (liters)	5-10	bring brackishwater which can be used to moisten and sprinkle the crabs during travel/storage	4-5	4-5
Salinity (ppt)	5-30	10-25	18-30	18-30
Stocking rate (no./container)	200-500	150-200 pcs	200-250 pcs	100-150 pcs
Transport time (hr)	2-6	7-8	10-12	10-12
Mortality (%)	1-10	negligible	negligible	negligible

Prepared by SEAFDEC Aquaculture Department

Glossary

A

Abaca coir	Abaca fiber.
Algae	Singular organisms to large colonies of kelp. Colors range from the blue-green algae to yellow, green, brown and red organisms. A good number of species are edible.

B

Bay	A part of the sea extending landwards.
Brackishwater	Diluted sea water, most often with a salt content ranging from 0.5-20 parts per thousand.
Brine solution	A mixture of salt and water.

C

Coconut coir	Fiber of coconut husk
Coral reefs	Tropical, shallow water ecosystem which rank as among the most biologically productive and diverse of all natural ecosystems. The term 'reef' refers to the population of stony corals which continue to build on products of their own making. Reefs are not entirely made up of corals. Several species of red algae also grow heavily calcified encrustations which bind the reef framework together.

E

Estuary	The area near the mouth of the river where seawater and freshwater meet.

F

Floater	A device used to facilitate floating.
Fry	The young or brood of fishes and other organisms.

G

Gravid	Heavy with young; pregnant

I

Ice-ice	A disease which can wipe out entire agricultural crops. An early sign is the slow growth rate accompanied by paling and loss of gloss of the plants (aging effect). Roughening of the surface of the branches follows. The disease is thought to be due to adverse ecological conditions, such as light intensities, low nutrient availability, water temperature and low water movement.

L

Leeward	Towards the sheltered side; opposite to that against which the wind blows

M

Mangrove	An individual or a whole forest of salt-tolerant tree species found along tropical coasts. They are valued economically for the fuelwood, pharaceutical properties and construction materials. Mangroves serve as feeding, spawning and breeding grounds for many commercially important species.

P

Parts per thousand (ppt)	Unit used in referring to the amount of dissolved inorganic minerals (salts) in seawater.
Phytoplankton	Tiny plants that drift into the sea.
Polyculture	Culture of more than one species.

R

Red tide	Discoloration of seawater due to a large population of some phytoplankton species, often fatal to many forms of marine life.
Return on investment	The ratio of income to capital invested in a business.

S

Seagrass	A marine flowering plant, a few species of which are similar to terrestrial grasses in appearance. There are 16 species in the Philippines. Seagrasses are valuable ecosytems because they serve as an additional buffer against strong water movements. Seagrass beds also function as feeding, spawning and breeding grounds for economically significant species.
Sinker	A device used to allow sinking.