Livelihood Options for Coastal Communities (IIRR, 1995, 77 p.)

Livelihood options for coastal communities

IIRR

The International Institute of Rural Reconstruction is a nonprofit, 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.

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Aknowledgement

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Preface

The Small Island Agricultural Support Services (SMISLE) programme is a joint project of the Government of the Philippines and the European Union, working towards accelerating development on several small islands in the Visayas. Many small island communities face the problem of over-utilization of their local marine resource. The pressure on the marine resource can be alternative sources of income. In order to present local fisher communities with ideas as to alternative sources of income, SMISLE itself requires information on alternative livelihood options. For this reason, SMISLE is pleased to be able to join with the International Institute of Rural Reconstruction to publish this book.

We hope that the book stimulates broader interest in the topic. We envisage a second edition sometime in the future which present a broader range of livelihood alternatives, with greater detail, and with reports of actual case studies. The case studies should record the successes, and the failures, of communities in establishing alternative enterprises.

SMISLE also hopes that the joint publication of "Livelihood Options for Coastal Communities" is the start of a deepening relationship with IIRR. SMISLE shares IIRR's people orientation to development. We are interested in developing a network of development organizations practicing participative, community-based development. This network can provide a wealth of experience, and offer recommendations as to skills, techniques, training modules, extension programs and development processes which have been tested and proven in a variety of field situations.

With the network and the second edition of "Livelihood Options" in mind, we welcome contact, comments, ideas and articles from our development partners.

Foreword

This publication is a compilation of small-scale, appropriate technologies aimed to provide and improve livelihood opportunities for coastal communities in the Philippines. Although several of the ideas presented in the material may be of relevance to any coastal areas of the world, especially Southeast Asia, it was purposely designed for use in the Philippines.

The bulk of the ideas presented in this book was the direct outcome of a series of site visits to several coastal areas of the Philippines, namely: Sulu, Basilan, Tawi-Tawi and Negros Occidental. The financial support to IIRR to cover the initial set of site visits which led to this publication came from the United Nations Children's Fund (UNICEF) country program in the Philippines.

Mr. Severino "dun" Ubungen, a short-term consultant to IIRR, contributed most of the first draft text after compiling an initial inventory of various livelihood options which were actually being practiced by coastal households in the areas that were visited. He then subjected this initial list to a review and prioritization (including other livelihood specialists from IIRR) in order to arrive at the final list of topics to be included in the book.

Subsequent content editing was primarily provided by the IIRR coastal areas specialist, Ms. Dolores "Donie" Diamante, who revised and improved the first draft text and provided detailed information that supplemented Mr. Ubungen's early drafts.

We hope that this initial listing of livelihood technologies, which are of special relevance to coastal communities and fisherfolk households, will prompt other institutions at all levels (research, government, NGO, community) to further pursue the search for livelihood options for the rural poor coastal communities of the world.

Introduction

Throughout the world, coastal areas are under increasing pressure from human activities and burgeoning populations. An estimated two billion of the world's population depend on marine resources for protein, settlement and income. In developing countries, more than half of the population is in coastal zones. This effectively exacts tremendous demands on the coasts for food and other economic purposes. The ensuing scenario depicts a significant deterioration of the coastal environment.

The Philippines is no exception to this reality. The country's 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. Add these to the coastal land areas in the more than 7,000 islands of the Philippines and one can approximate the natural resources available to its people. However, the high rate of population growth— estimated at 2.4 percent from 1980-1990—and the practically unmanaged economic activities typical of developing nations have contributed greatly to the poor state of the Philippines' marine resources.

Destructive fishing methods, such as cyanide and blast fishing, and the use of nets with very small mesh sizes have been widely practiced for the past several years in response to a growing need for food and income. Unfortunately, these methods are quite deadly in their efficiency; for they facilitate greater harvest not only of needed resources but also of unwanted species, e.g., juveniles. If allowed to grow to maturity, these juveniles will provide future needs. Destructive fishing likewise inflicts a lot of damage to the surrounding areas to the detriment of valuable resources.

Similary, tourism—in spite of its advantages—poses a threat to the country's marine resources. The government, in its effort to push the nation to economic security, actively promoted tourism. However, the country is not quite prepared to adequately address the industry's potential negative impacts, such as unchecked collection of corals, illegal trade of endangered species, etc.

To date, coral reefs with excellent growth cover approximate only five percent. Vital mangrove areas throughout the country have shrunk to less than one percent of its area in the 1920s. Not suprisingly, fish yield data show that Philippine capture fisheries suffer from considerable overexploitation.

The Philippines' archipelagic nature is such that 80 percent of its provinces are surrounded by the sea and 65 percent of the towns are considered coastal. With the increasing threats of overexploitation, overpopulation and a worsening poverty situation, coastal resources management becomes imperative.

An integral part of coastal resources management is the provision of access to livelihood opportunities that help reduce pressure on coastal resources by utilizing previously untapped resources. However, the implementation of any technology requires not only technical training but preparing the community as well. Potential users should be duly informed of the advantages and disadvantages of the technology, in view of its economic impacts and current environmental conditions.

This publication—Livelihood Options for Coastal Communities—arose from perceived existing problems in Philippine coastal areas, particularly in Sulu, Basilan and TawiTawi. The aim of this book is to provide access to various livelihood activities feasible in the said areas. An IIRR study has yielded insights into the nature of the coastal resources-related concerns. The present work summarizes the necessary information gathered during the year of study in the three provinces mentioned earlier.

This book will hopefully be useful for teachers and extension workers engaged in information dissemination and technology transfer in coastal communities.

Water-based activities

Aquaculture

Eucheuma farming

Eucheuma is a red seaweed that is endemic in Philippine waters. When dried, a substance called carageenan may be extracted from the seaweed. Carageenan has a wide variety of uses for products (food preparations, pharmaceutical industries and pet foods) that need gelling, suspending, binding, thickening, emulsifying and water-holding properties.

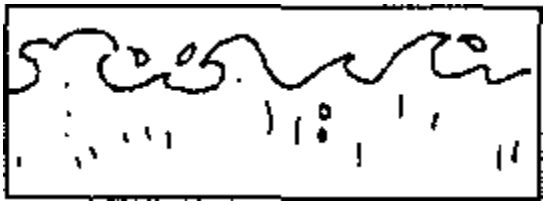
Commercial seaweed farming first began in the Philippines in 1972 in Sulu, Tawi-Tawi and Zamboanga. The rapid development of the Eucheuma industry has made it the country's third ranking fishery export. In 1986, about 50,000 mt, with an estimated worth of P840 million, were exported to Europe, the USA and Japan (Aquabusiness Weekly, June 2-9, 1989).

Eucheuma

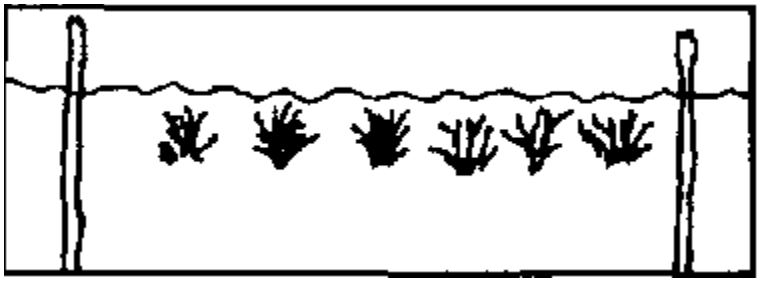
Conditions for seaweed farming

Favorable

Where other organisms grow



Moderate water current

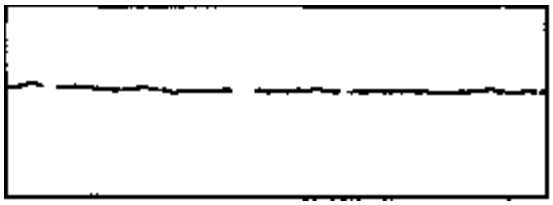


Where Eucheuma will not be exposed to air during the lowest low tide

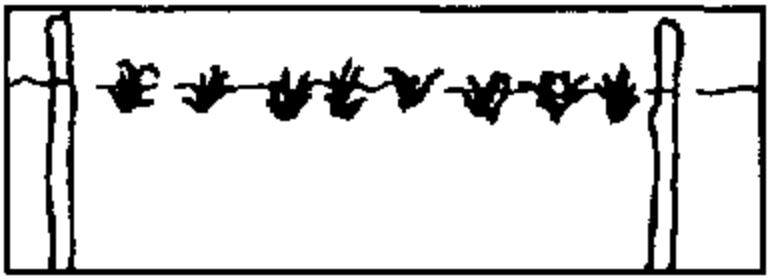
- Over firm substrates
- Salinity ranges from 25 to 35 parts per thousand.
- Temperature of about 25°C

Unfavorable

Where area is relatively devoid of other organisms



Still water or rough water



Eucheuma is exposed to air.

- Soft bottom
- Beyond the range
- Extreme temperatures

At present, there are about 60,000 families engaged in seaweed farming. The two most commonly grown are the Eucheuma cotonii and E. spinosum. They are locally known as tambalang or gozo.

Eucheuma favors moderate water current. It is, therefore, best cultured in protected coves, bays or coral flats. The seawater should also have a salinity range of 25-35 ppt and a temperature of about 25°C. The best time for planting is just after the rainy season.

Among current methods of farming Eucheuma, the bottom monoline method is the best, due to lower material and labor costs and it is easy to maintain. For the bottom monoline method, depth is quite important. During low tides, depth should be about 0.5-1.0 m; while during high tides, the water should not be more than 2.0-3.0 m deep.

It is also important to note whether the site has had a history of the ice-ice disease. If so, it may not be wise to farm in the area for the probability of an outbreak is greater.

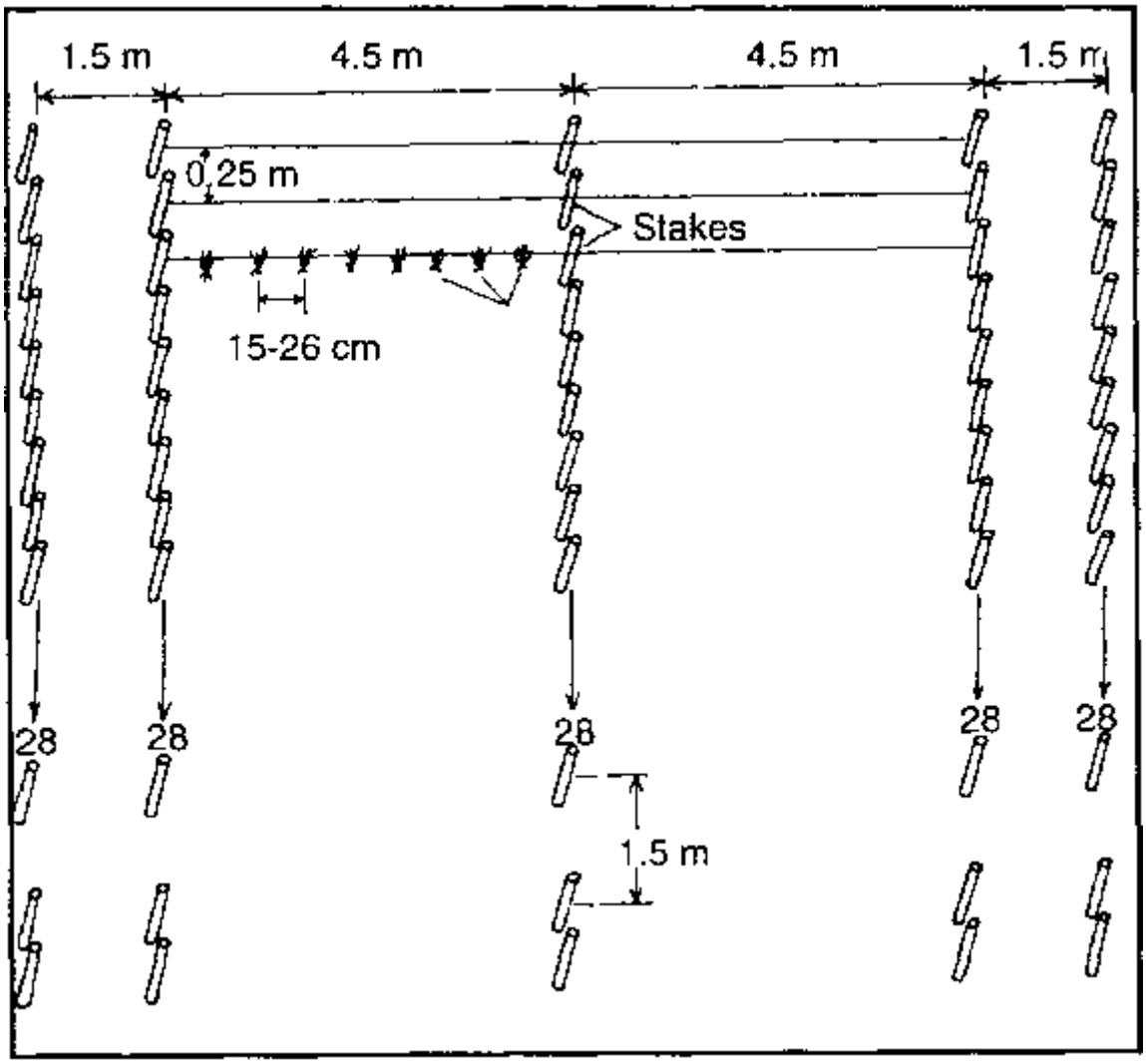
Culture

1. Clear the area of other seaweeds, seagrasses, stones, starfish and sea urchins.

2. Construct the farm support system.

Make holes on the substrate by driving down an iron bar with a sledge hammer. Place a 1.50 m wooden stake in each hole and drive it down with the sledge hammer. Arrange the wooden stakes in rows at 1.0 m intervals and make the distance between two posts in one row at 10.0 m.

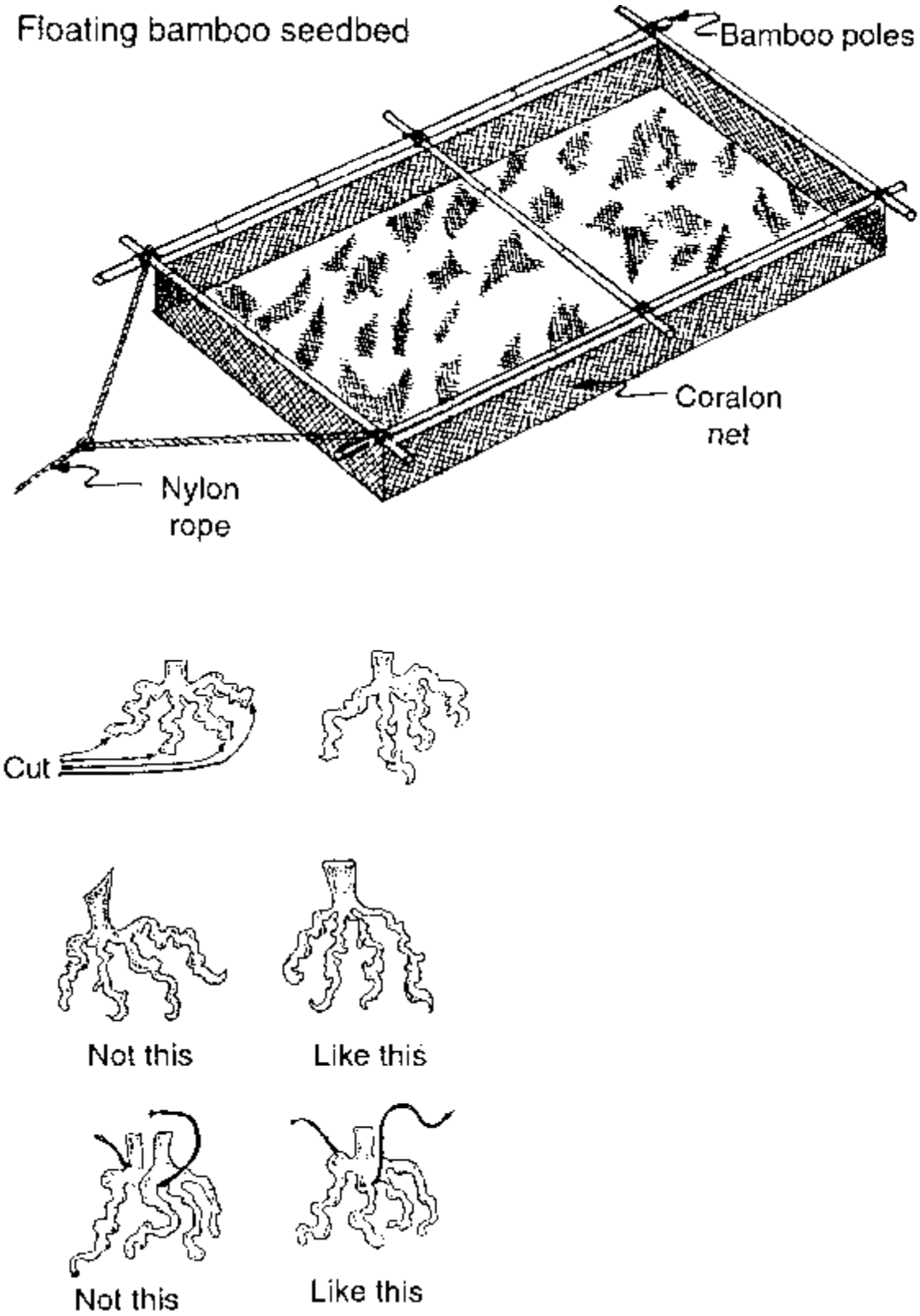
Tie the 11.0 m long monofilament line securely to the stakes at each end of the row. Distance of the monoline from the ground is 0.30-0.50 m.



Lay-out for bottom monoline method

Adapted from: Trono, G.C., Jr. and E.T.Ganzon-Fortes. 1989. Ang Paglinang ng Eucheuma (Eucheuma farming). Seaweed Information Center (SICEN), Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines. Through a grant from the International Development Research Centre (IDRC) of Canada.

If currents are strong, put up an additional row of stakes, placed in the middle of the original rows. This provides greater support to the line. The distance of the additional stakes along the row depends on the strength of the local current. The shorter the distance between rows, the stronger the support system.



Floating bamboo seedbed

3. Procure the appropriate seedplants or propagules from the nearest source. Get seedplants which are mature and free from diseases. Transport the propagules with the use of a wooden boat filled with water, so that the seedplants are submerged continuosly during transport. Excessive exposure to sunlight and air will weaken or frill seedplants that are not submerged in water. Transporting can also be done with floating bamboo with coralon net sidings.

4. Cut the seed pieces in the l let position (not slant) at an estimated 100 gm per propagule. Use only one branch. Do not cut the tips of the seaweed branches because new growths will occur in that area.

5. Tie the seedplants at a center balance with the use of strong plastic straw twine. Do not lie them too loose nor too tight. The tie should have at least a 25.4 cm allowance for tying at the monoline filament to hold the propagules.

6. Tie the planting materials at the monoline bottoms so as to hold the seedlings tightly in place while providing enough slack to move smoothly with the water. The distance between seedplants is 40.0-50.0 cm.

7. Farm maintenance. Visit the planted area every three days. Remove infected plants immediately to minimize spread. The disease may be detected by the presence of ice-like white dots.

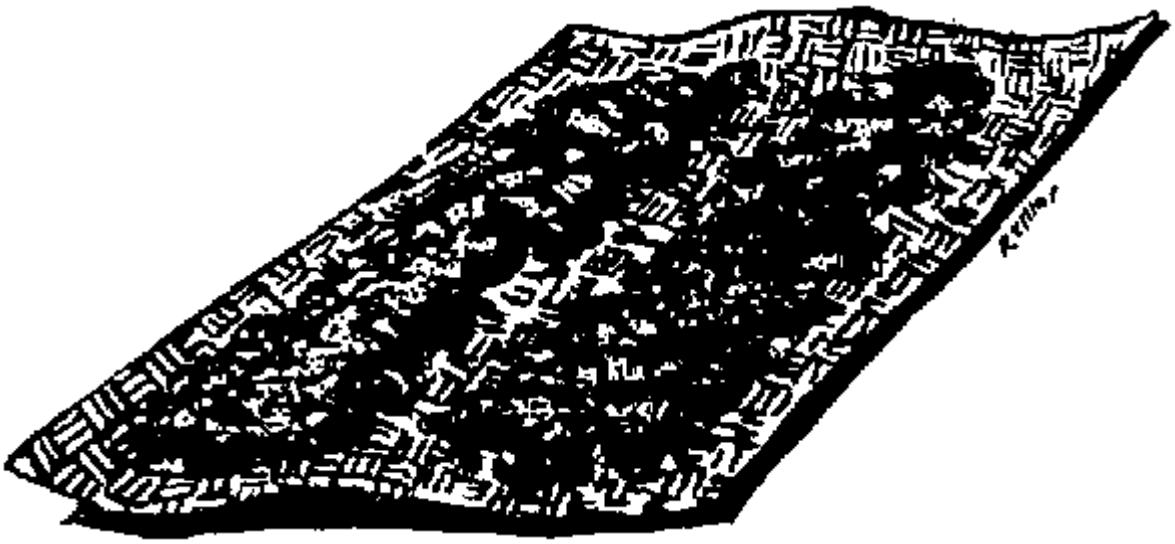
Keep the seaweeds clean. Remove adhering materials and other plants which compete for nutrients and sunlight.

Remove grazers, such as sea urchins and starfishes. In farm sites characterized by strong water currents, place a coarse nylon net at the leeward side of the farm to catch broken plants carried by the water.

8. Harvesting and drying. Eucheuma has an average growth rate of 3.5 to 5 percent of their weight. It is best harvested between 5060 days after planting. A 100-g plant usually weighs 700-1,000 g after two months or more.

Harvesting can be done by either removing the seaweeds individually or by untying both ends of the monoline from the post and loading them in bunches in a wooden boat or in bamboo crates. The mature seaweed plants can be detached from the monoline in the drying pads or platforms later.

Drying is done on any clean pavement by covering with coralon net or canvass, sawali, bamboo slat platforms or coconut fronds. Drying usually takes tour to six days. Eight kilograms of fresh seaweed will yield about one kilogram of dry seaweed.



Drying on sawali (woven bamboo)

Drying on cement

Economics of production - Seaweed farming

	Value(in pesos)	Total Value(in pesos)
Annual Revenue		
At 5% average daily growth rate of		
40,000 seedlings, of 300 g		

each within 2 months = 48,000 kg		
Less:		
Original weight of seedlings (12,000 kg)		
20% mortality (9,600 kg)		
Net production-wet weight = 26,400 kg		
Net production-dried; 8:1 wet to dry ratio = 3,300 kg		
Sale of 3,300 kg/harvest x P7.00/kg x 5 harvest/year		115,500
Annual Production Cost		
1,200 pcs mangrove x P0.80/pc	960	
250 kg of nylon monofilament x P95/kg	2,375	
15 rolls of Finolas twin-plastic straw		
or tie-tie x P45/roll	675	
4,800 kg seedlings x P4/kg	19,200	
25 cm Coralon net for 5 x 5 m seedbin		
x P 15/m	375	
100 m monofilament nylon net x P15/m	1,500	
(3) laborers x P850/month	30,600	
Fuel expenses at P500/month x 12 months	6,000	
Transport cost at P0.40/kg x 16,500 kg	6,600	
Depreciation	3,530	

		71,815
Fixed Investment		

(1) Non-motorized banca	1,500	
(1) motorized pumpboat	22,000	
Farm house	8,000	
Drying platform	3,800	

		35,300
Net Return		
Annual revenue	115,500	
Less: Annual production cost	71,185	

		43,685
Return on Investment		
$\frac{Net\ return}{Fixed\ \text{investment}} = \frac{43,685}{35,300}$		1.24

Source: Trono and Fortes, 1989

Mud crab fattening

Mangrove or mud crab (Scylla serrata) fattening is similar to the principle of fattening or growing chicken (broilers) swine or cattle. The goal is to add weight and size so that they can sold at higher price.

Scylla serrata

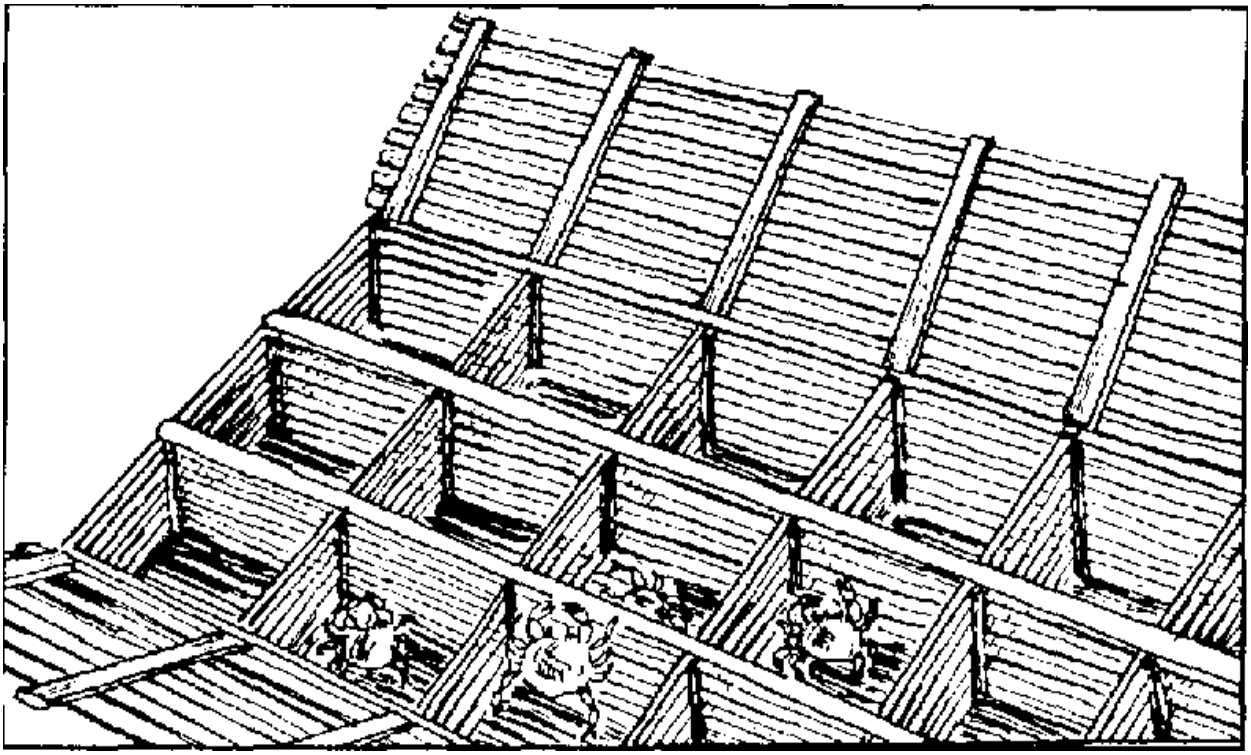
The Philippine mud crab is a much sought-after gourmet seafood especially on important occasions. The gravid or pregnant females with red-orange aligue or egg berries in their bodies are being exported with unlimited demand to Japan China Hong Kong and Taiwan. The Chinese believe that gravid female mud crabs have medicinal properties for the aged and convalescent.

Persistent and extensive catching of the mud crab has led to low catch; it is becoming a rare and expensive food delicacy. Efforts to breed and culture the mud crab in captivity 'have not been successful because of its unique egg-laying and hatching requirements. The female mud crab with eggs on its outer stomach goes to deep waters up to 200 m to lay and hatch its eggs. It is in this area where salinity temperature and available larval food are favorable to the growth of young crabs. The crablets or juveniles return later to brackishwater or mangrove areas to mature. Mud crabs as the name implies dwell in brackishwater habitats such as mangrove swamps where the bottom or substrate is muddy.

Studies gathered through interviews in Himamaylan, Negros Occidental and Pontevedra Capiz in Region Vl have shown that 100 to 175 gram thin crabs can be fattened to 250 to 350 grams in 15 to 20 days. Because of the availability of trash fish and brown mussels in the place the thin crabs are provided food five percent of their body weight. Mud crabs are voracious eaters that can be fattened in a short period.

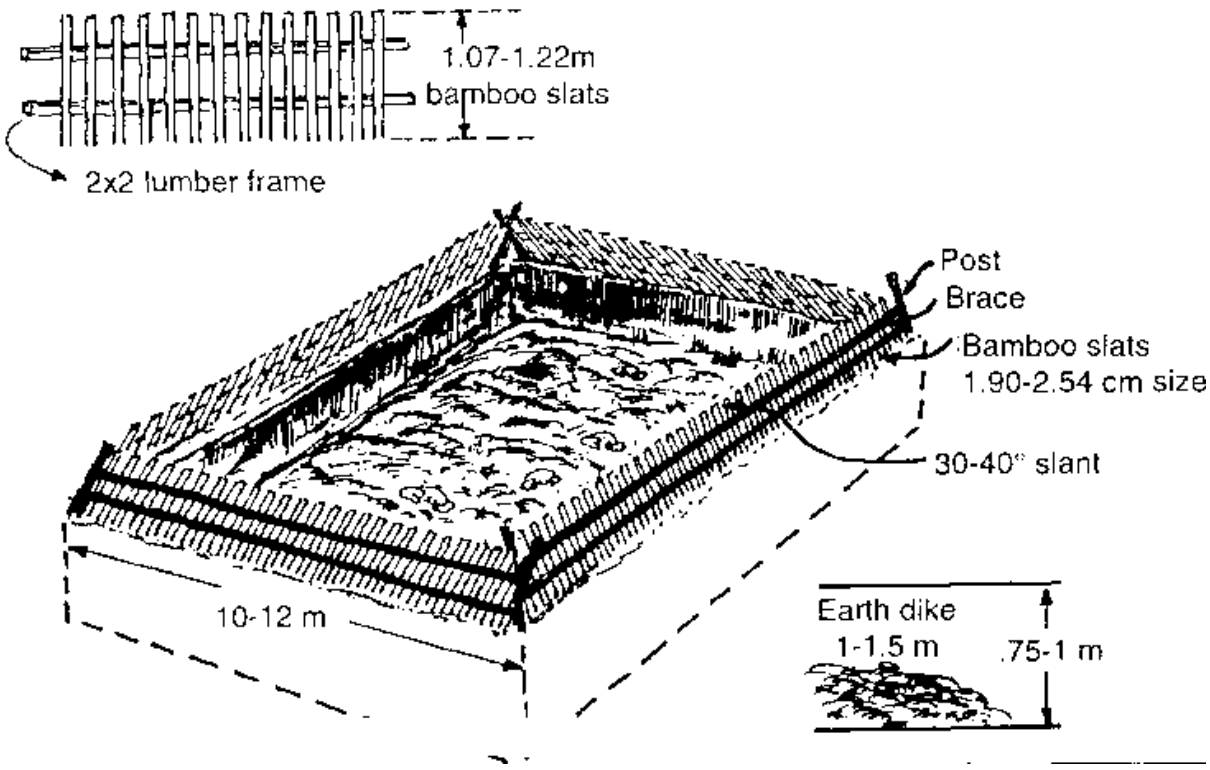
Methods

There are two methods that are commonly used in fattening crabs. One method is the use of bamboo cages 1.83 m long 92 cm wide and 23 cm high. The top cover is provided with holes used in feeding trash fish or mussels. One unit is composed of 18 cubicles or compartments that can hold one thin mature crab each. The cages are anchored to the muddy bottom by a post (813 cm in diameter and 1.221.83 m long) at I to 2 m below the tide level.



The cubicle or compartment-type method.

The other method is the fishpond method. The pond may be constructed in varying sizes ranging from 10 to 20 m wide, 20 to 40 m long and I to 2 m deep dikes. It is placed in brackishwater areas. The fishpond dikes are provided with bamboo slat fences of 2.54 cm wide and 0.91-1.52 m long. The bamboo slat fence is anchored to a 8-13 cm post at a 45-degree angle towards the inside pond. This is done because gravid crabs have the tendency to escape during their spawning period to go to deeper seas. During heavy rains that cause stratification or reduction of oxygen level in the water, the crabs are forced to come out to breath. Also, mud crabs have the instinct to go out at night from their burrows to look for food. At a 45-degree slant of the bamboo slat fence the crabs cannot escape clue to their weight. The bamboo slat is also hard and slippery to cling on. They will only fall back into the fishpond. Fattening ponds can accommodate four to six nieces per square meter.



Mud crab-fattening pond method

The mud crabs are fed with fresh trash fish, roughly five percent of the crabs' body weight, in the early morning and late afternoon. Mud crabs increase their weight at an average of 10 grams per day. Feeding three to five kg of fresh trash fish (brown mussels, fishes, shells, etc.) can give one kg added weight to the mud crabs.

Economics of production—1-ha mud crab farm (2 croppings/year)

	Value(in pesos)	Total Value(in pesos)
Annual Revenue		
Sale of 2,038.08 kg x P80/kg		163,046
Annual Production Cost		
2,000 kg chicken manure x P0.66/kg	1,320	
10,000 pcs crab juveniles x P0.55/pc.	5,500	
3,505 kg trash fish x P5.50/kg	19,280	

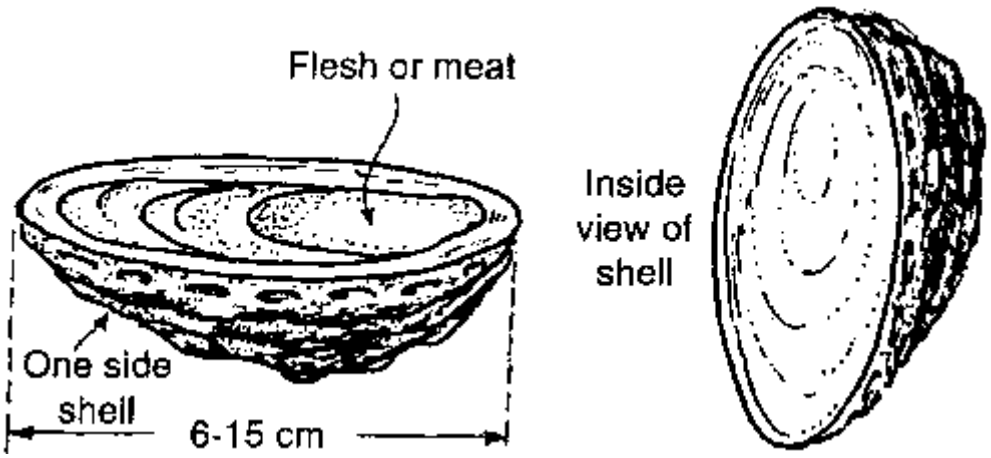
Labor - 2,000 personhours x P5.50/personhour	11,000	
Marketing expenses	3,260	
Repair and maintenance	3,200	
Interest	4,938	
Depreciation	16,618	
(1) Caretaker x P400 x 12 months	4,800	
Tax	31,545	101,461
Fixed investment		88,201
Net return		
Annual revenue	163,046	
Less: Annual production cost	101,46	
		61,585
Return on investment		
Net return 61 585		
---------- = ----------		
Fixed investment 88,201		0 70

Source: SEAFDEC Asian Aquaculture, Vol. XIV, no. 4, December 1992.

Mollusc culture: Abalone

Abalone is a nutritious shellfish, with its meat containing 20 percent protein; it is a highly priced delicacy. Locally, the fresh and dried meats are sold at P70.00 and P300.00/kg, respectively.

The Philippines exports abalone in dried, frozen (steamed, boiled or fresh), canned or bottled forms.



Philippine abalone

Abalones are canned as boiled, preserved in brine solution, smoked in oil, seasoned or roasted. In 1989, the Philippines exported 70,703 kg of abalones worth P446,583 to Japan, Hong Kong and Australian.

The blue-gray mother-of-pearl shell of abalone is widely used in the manufacture of buttons, buckles, inlays, ornamentals and jewelry. It is also used for medicinal purposes. Its viscera yield good quality glue (PCAMRD, August 1991).

Despite the above, however, no serious attempts have been made to undertake research and development of the abalone culture, such as spawning, hatching, larval rearing, juvenile growing, eating habits at various stages and nutrition. Japan, U.S.A. and Australia have undertaken research with their local abalone species, but their cultural technology needs further improvement. It is also expensive and too technical. However, the success in rearing juvenile abalone (more than one year and about 3-7 cm) can supply the needs of grow-out artificial marine ponds and for re-seeding or re-stocking of the natural habitats of abalone. Yet, due to the site specificity of abalone and the different species that exist in different countries, adaptation of the cultural techniques is difficult to evolve.

The existence of favorable environmental factors in the Philippines put the country in a considerable advantage in the development of abalone culture, especially in grow-out technology. Many areas in Southern Philippines have wide and extensive natural grounds and habitats for Philippine abalone. They are the protected bays of coral and rocky bottoms of 5-10 m deep that are free from pollution and abundant in natural food, like diatoms and algae.

Bays and coral reef areas are natural habitats of abalone.

Preliminary findings in the culture of Philippine abalone juveniles at the Mindanao State University in Tawi-Tawi and the Sea Gardens of the Department of Agriculture in Sulu showed promising results in the growth pattern of abalone juveniles. Consistent results were obtained by the two agencies that a captured juvenile abalone of 2.54-5.8 cm long can grow up to 8-15 cm in about 3-5 months in their natural habitat. This breakthrough can now place abalone culture in the Philippines into a very profitable venture by producing export quality abalones with sizes 100-150 percent higher in farmgate price than those collected from the wild which is less than eight cm.

Hundreds of tons of dried abalone whose sizes are less than the export size of 13 cm (mostly 2 54-8 cm) arc being gathered in these areas as observed. This means that production requires 3-5 times in quantity per kg weight and less income due to undersizing. But, if this same quantity is cultured, produce is at least five to eight times the weight with more than double profit.

Due to the local practice, in addition to the tradition of common rights to exploit bottom-dwelling marine resources, by necessity, there must be some form of government involvement in a regulatory capacity. The government should oversee the re-seeding process by prohibiting gravid (spawning) abalone to be caught and restocking process by banning capture of juveniles (2.54-5.08 cm) to replenish the declining stock. To promote the culture of growing abalone, juveniles are only allowed to be captured for growing culture purposes.

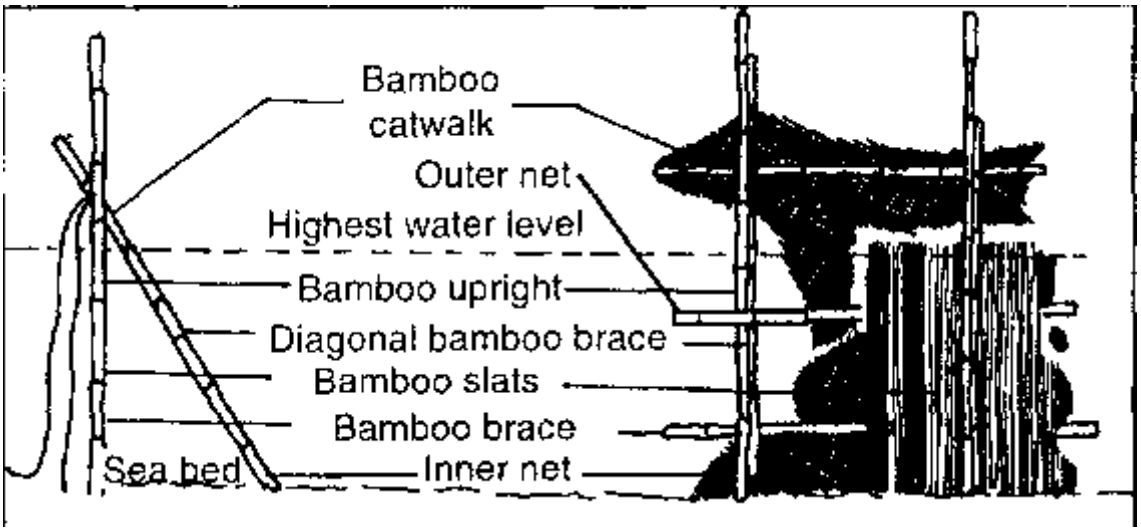
It was observed that the occurrence of Philippine abalone in its natural habitat has a seasonal pattern. It is directly related to wind/current movements. In areas where there is a group of

adjacent islands with extensive coral reef areas, they are usually found at the east side of the islands during south-westerly winds (habagat) and at the western side during north easterly winds (amihan). They are mostly found in areas with calm waters. The peak period of gathering occurs in two to three months during summer (March to June) when amihan and habagat are absent.

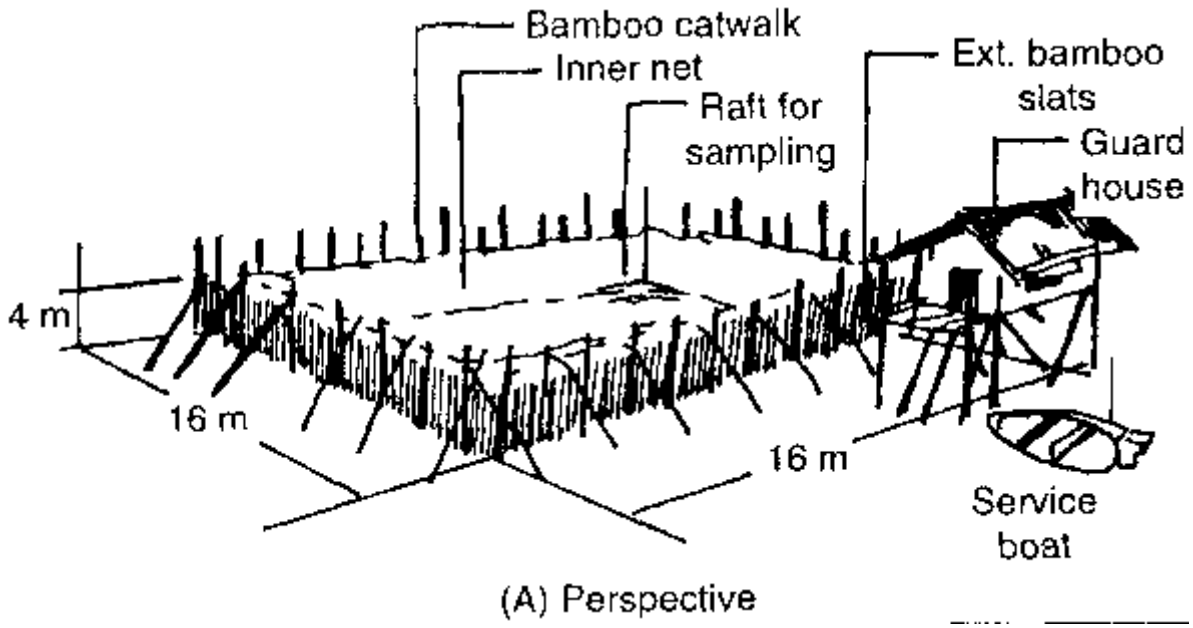
Abalones are active at night (nocturnal) when they come out and stay in shaded or dark areas on the sea bottom during the day. The abundance of seaweeds in the south as natural food for growing juvenile abalones may have contributed to the abundance of abalone.

The simple method of artificial culture in growing young abalones (over one year or 2.54-6.35 cm) is to enclose a natural habitat area of at least 200 sq m with bamboo slats or coralon nets. Pile boulders and other materials, such as dead coral stones (if available), gathered from natural habitat, inside the fenced area. While transferring these materials, ensure that they are continually submerged in sea water Exposing them to sunlight too long may kill the microorganisms growing in these stones. They may even be affected by toxic substances that may hamper the growth and survival of young abalones.

The piled coral rocks serve as attachment, sanctuary and shade for the growing abalones. Twenty to thirty abalone juveniles can be stocked per square meter of abalone pen. They can grow in their natural state without feeding.



Layout of fixed pen showing (A) perspective with guard house and sampling raft,



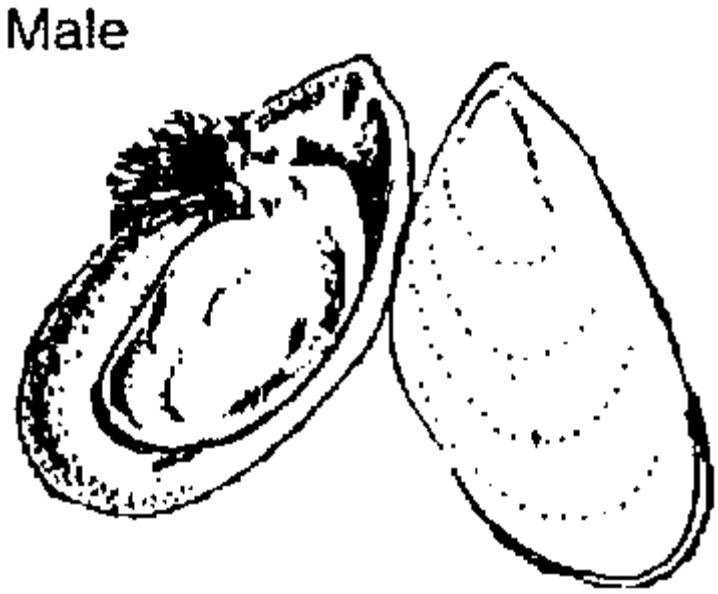
(B) Detail section of fishpen (C) Partial detail elevation

Source: SEAFDEC Manual Series No. 9. 1985

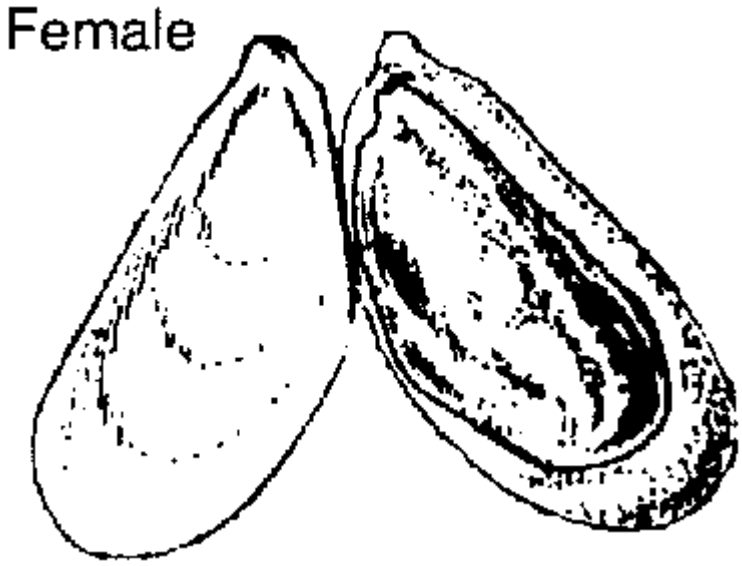
Mollusc culture: Green mussel

The green bay mussel or tahong (Perna viridis) is a popular and delicious food item. It is rich in vitamins, minerals, protein and carbohydrates.

Green mussels were originally regarded as pests before World War II because they competed with food and space in oyster farms. In 1950, it was recognized as a primary bivalve food. The first mussel commercial farm started in Bacoor, Cavite, in 1955.



Male



Female

Site selection

Mussels are known to exist in bays, coves and inlets. They are found in Manila bay, east coast of Panay, Negros Occidental southwest coast and in Maqueda Bay and Jiabong, Samar.

Green mussels may be transplanted in new areas with seeds (juveniles) or breeders for growing and multiplication.

Mussels grow best in brackish to salty waters, with salinity ranging from 20-35 ppt. Good culture sites are indicated by the presence of indigenous existing mussels in the area to have sufficient breeding stock and spatfall. The water must be greenish in color which is an indication of abundant natural food of mussels.

The site must be free from pollution, with enough tidal exchange and moderate currents for the transport of food. It must be protected from strong winds and waves and must be relatively deep from two to four meters. Muddy to sandy bottoms that is semihard and sticky usually produce high yields.

Species, reproduction, food and growth

There are two species used as food in the Philippines, namely: the green mussel and the brown mussel (Modiolus philippinarum). The green mussel commonly referred as tahong is the commercial species.

The male mussels's mantle or meat is milky white to creamy and the female is orange to red orange. Since they have stationary forms of life, either one can change sex for the purpose of reproduction.

Spawners release eggs and sperms into the water where fertilization takes place in a few seconds. Eggs hatch into free swimming larvae within 24 hours and remain at this stage for 15-20 days. After the larvae are ready to settle, they secrete hair-like threads called byssal filaments to attach themselves. This ability to secrete new byssal when cut will allow thinning and transplanting operations. The settlement of larvae is called spatfall and the young mussels are called spats. Spawning normally occurs every two months, but the peak spatfall season in Manila Bay (Bacoor) occurs from April to May and October to November; February to March and September in Eastern Panay; and January to March and July to September in Western Negros Occidental. The spat is about the size of a grain of beach sand.

Mussels eat waterborne phytoplankton and minute organic materials by sucking and filtering water through its four rows of gills that is directed to the mouth. The gills serve both as a respiratory or breathing organ and as a filter-feeding organ.

Spats or larvae are attracted by filamentous objects and later move on to solid substrates or objects. Coconut coir and abaca coir are the best materials that can lure the spats.

Mature mussels can reach the size of 15 cm. in length, but they can be harvested in four to six months' time. Frequent visit, at least every three days, is recommended to check the growth of filamentous algae and the presence of starfish and crabs that prey on the spats. It is best to place bottom nets for crabs or crab traps as an added income to mussel farming. Usually, there are plenty of blue crabs in oyster and mussel culture areas.

Methods of culture

There are five common methods of culture, like: stake (tulos), wigwam, raft or hanging, tray and rope web. The best and most popular ones, however, are the stake and rope-web methods.

Logs, hard bamboo (Bambusa sp.) and light bamboo or bagakay (Schizostachyum lumampao) can be used. However, hard bamboo is more popular because they are readily available and cheaper than logs.

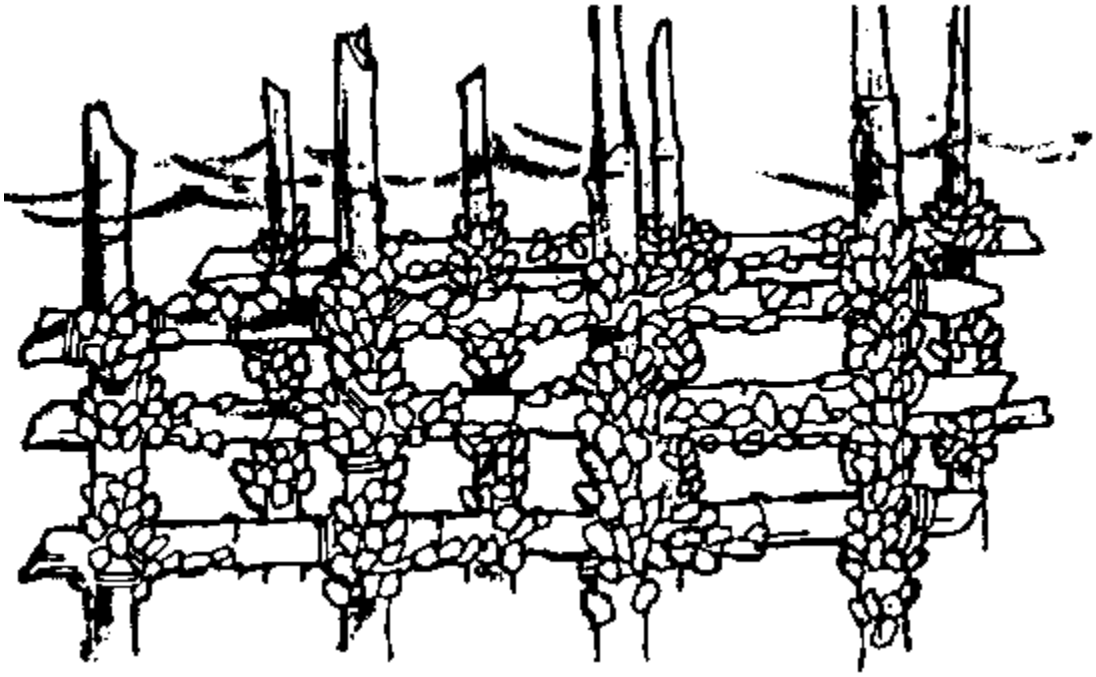
Sharpen the bottom tips of the bamboo and drive it (pile) at the bottom by about one-half meter. Place a hole at the upper section of the bamboo segment to reduce buoyancy. The distance of the bamboos as post is 1-1½ m. Tic or nail the 2-3 m row of horizontal braces (bila). Connect every two rows of poles with short horizontal supports (baral) forming a square with the long bila.

Light bamboos can be used for the supports and braces. The series of squares forms the plot. Leave 1½-2 m in between 2 rows or plots for the wooden boat (banca) to pass through. Tie spat collectors to the poles. Preferably use abaca rope with coconut or abaca coir in the rope lay at 7.62-12.7 cm distance.

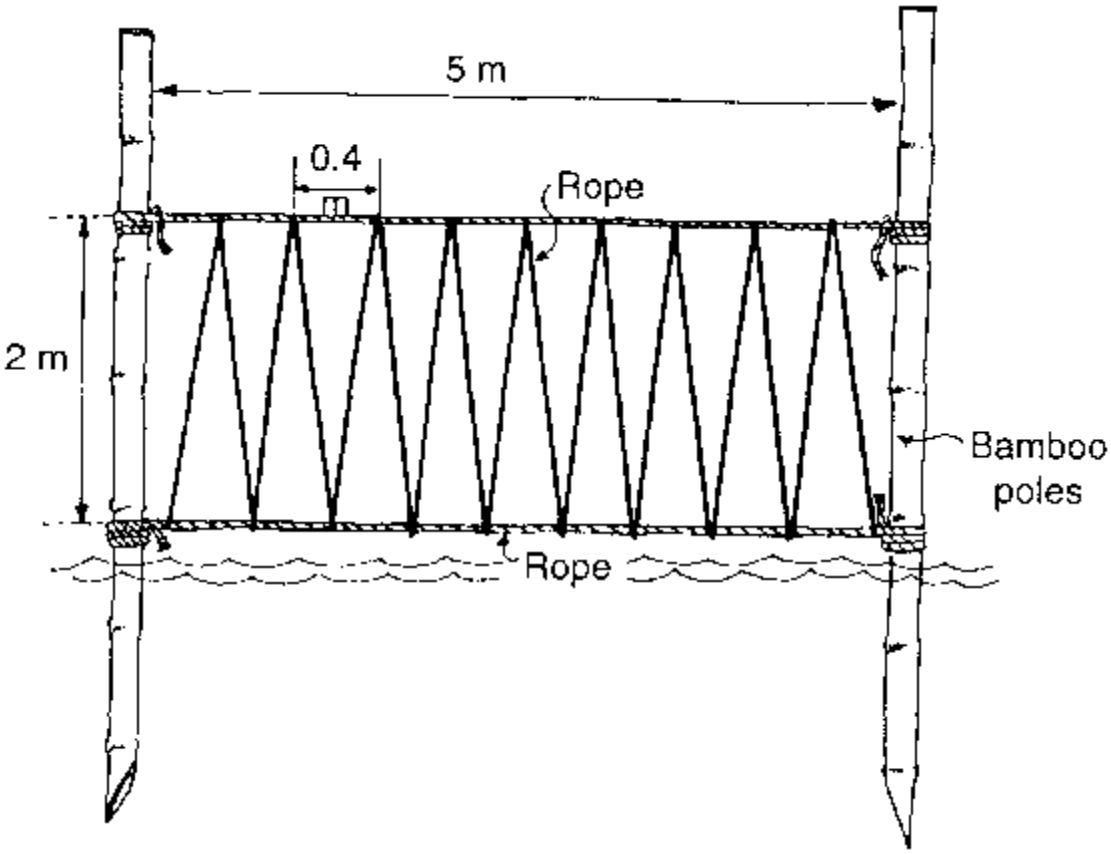
The best time to construct plots is the month before the occurrence of peak spatfall in the area to insure higher production. Mussels settle in the plot materials. The depth of the plots should be 1-2 m below zero tide level at the upper portion and about 0.50 m from the bottom. An average of 1,000-2,000 seeds or pieces of mussels per meter can be attained at these levels.

The rope web method is recommended in areas where there is heavy occurrence of spatfall. A sharpened hard bamboo pole is driven by piling at the bottom by at least ½ m. The upper portion of each segment of the bamboo must have at least 2.54 cm hole to prevent too much pressure from floating. The bamboo poles are 4.0-5.0 m apart. Abaca or polypropylene (nylon) ropes of 12mm-15mm are tied horizontally at the upper portion of at least ½-1 m from zero tide level. Another rope is tied horizontally at the lower portion with at least ½ m from the bottom. The upper and lower rope tied between the 5.0 m distance pole will form a parallel. The distance between the parallel ropes can be 1.5-2 m.

Abaca or nylon ropes of 10.0-12.0 mm diameter are made into webs that are tied vertically in zigzag fashion to the parallel ropes between the bamboo poles. The interval of the zigzag ropes or webs must be at least 30-40 cm. Web-rope lines can be spaced at 1.0-1.50 m rows for space to work on and for wooden boat to pass through.



The stake method



Rope-web method

Bamboo pegs of 20 cm length and 2.0-3.0 cm width are inserted into the zigzag rope lay at spacing of 30-40 cm to serve as spat collectors. Abaca or coconut coir can also be used because mussel spats prefer filamentous or hairy objects as cultches. The two rows of rope webs will form the plots.

Juvenile mussels can be placed in wet gunny sacks in clusters and transported to new areas to be transplanted. Transplanting is done by tying the young or small mussel clusters into the culture medium, like rope web or stakes.

Harvesting

Market preparation and knowledge of peak demands and high prices season are important in the timing of harvesting. Selective harvesting can also be done by harvesting the bigger ones first and leaving the smaller ones to grow further.

Divers are hired to do harvesting in the stake method. This is done by scraping the mussel clusters from the stakes and supports with the use of sharp knife or bolo. Care is taken not to pull the mussel shells because the byssus or beard when detached, can kill the mussels. The byssals are parts of the muscle structure of the green mussel. The mussels are placed in bamboo or rattan baskets and cleaned by continuously dipping them in the sea water. The mussels are separated or detached with the use of scissors.

Marketing of green mussels has never been a problem because of its demand as a source of low-cost protein. Also, it has generated employment in the coastal-producing areas. Green mussels can live three to four days after harvesting by continuously wetting them with sea water. It his a high nutritional and medicinal value.

Mussels are versatile aquatic products. Bivalves culture has a relatively simple technology and the labor is not intensive. The cost of investment is minimal but high profits can be expected.

Economics of production of mussel farm

	Value	Total Value
	(in pesos)	(in pesos)
Annual Revenue		15,154
Annual Production Cost		
Materials	6,406	
Hired labor	2,334	

Miscellanous	448	
Unpaid owner labor	514	
Unpaid family labor	428	
Depreciation	813	10,943
Fixed Investment		
(non-motorized boat, nipa hut,		
tools, wooden oar)		2,904
Net Return		
Annual revenue	15,154	
Less: Annual production cost	10,943	4,211
Return on Investment		
Net return 4,221		
---------- = ----------		
Fixed investment 2,904		1.45

Source: Samonte, Giselle PB., Oyster and Mussel in Western Visayas, Greenfields, April 1993.

Mollusc culture: Oyster

Oyster culture in the Philippines began at Hinigaran, Negros Occidental, in 1921. Oyster or talaba is a popular bivalve delicacy because of its excellent flavor and taste. It is mostly marketed in the shell as freshly-shucked meat. Some salted oyster or bagoong are made during peak harvest season. It is rich in vitamins, minerals, proteins and carbohydrates. The shells are mostly used as raw materials for the manufacture of lime and poultry grit. The shells also serve as spat collectors for culturing.

Mariculture of oysters have been expanding to other areas in the past years. There are about 5 sq km used for oyster culture ranging from 1,500 m-5,000 sq m in about 1,300 farms. Oyster farms are located in 17 provinces comprising Regions I, IV and VI. Major producers are Negros Occidental, Pangasinan and Cavite (Oyster, Commodities Series, No. 64, TLRC 1988). There are little or no available records of oyster preparation exports and data on consumption. Oysters are mostly consumed near production areas.

Oyster or talaba.

Site selection

Oysters thrive best in brackish to marine waters with salinity ranging from 15-26 ppt at 20-30ºC water temperature. Viable oyster farming grounds have indigenous species of spawners that are present. The water should be free from pollution with green to blue-green color. The area should be free from flooding that may result to 0-10 ppt salinity; this causes heavy mortality and heavy siltation. Water depth should be at least 1.5-4.0 m at the lowest tide.

The bottom is either hard non-shifting or soft and muddy. Areas for culture must be naturally protected against strong wind and wave action along landlocked bays or estuaries. Materials for structures should be readily available and cheap. Preferably, sites should be near markets or centers of population within 100 km. The presence of endemic seeds or spats in the area is preferred, but seeding or transplanting of oysters may be undertaken.

Oyster farms are found in 17 provinces located in Regions 1, IV and Vl.

Culture aspects

There are four popular species of oyster for culture:

- Crasostrea iredalei (Talabang tsinelas or slipper-shaped)
- Sacco.strea malabonensis (Kukung kabayo or oblong)
- palmipes (Pulid-pulid or palm-rooted)
- cucullata (Kulot or wild oyster)

The first two species arc recommended for growing.

Peak natural spatting season or spawning usually occurs in January to February and May to September. Fertilization of spawned oyster eggs takes place in the water. After hatching, a planktonic larva emerges and remains in the waters for two to three weeks before settling down. Spats or seeds about the size of sand grain attach to suitable substrates (like logs, stones, shells, bottoms, etc.). The most suitable and commonly used spat collectors are empty oyster shells.

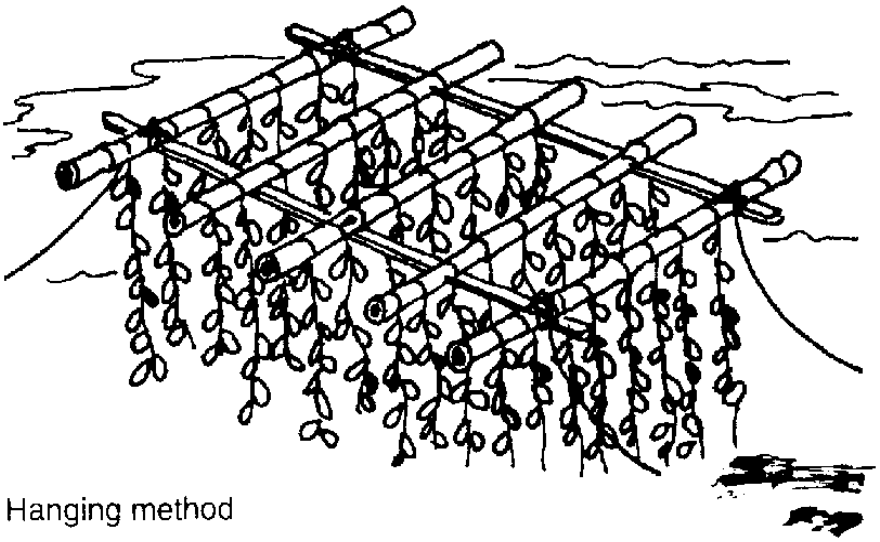
After a growth period of one month, the juvenile oysters (young) measure about 1.27 cm long. Oyster food consists of microorganisms, phytoplankton and organic matter which they strain or filter out from the water with their gills. This explains why oysters thrive well in fertile waters. It normally matures after 6-10 months from seeding.

Culture period should be started before spatting season or spatfall. Juvenile oysters can be transplanted to other areas with no available spats.

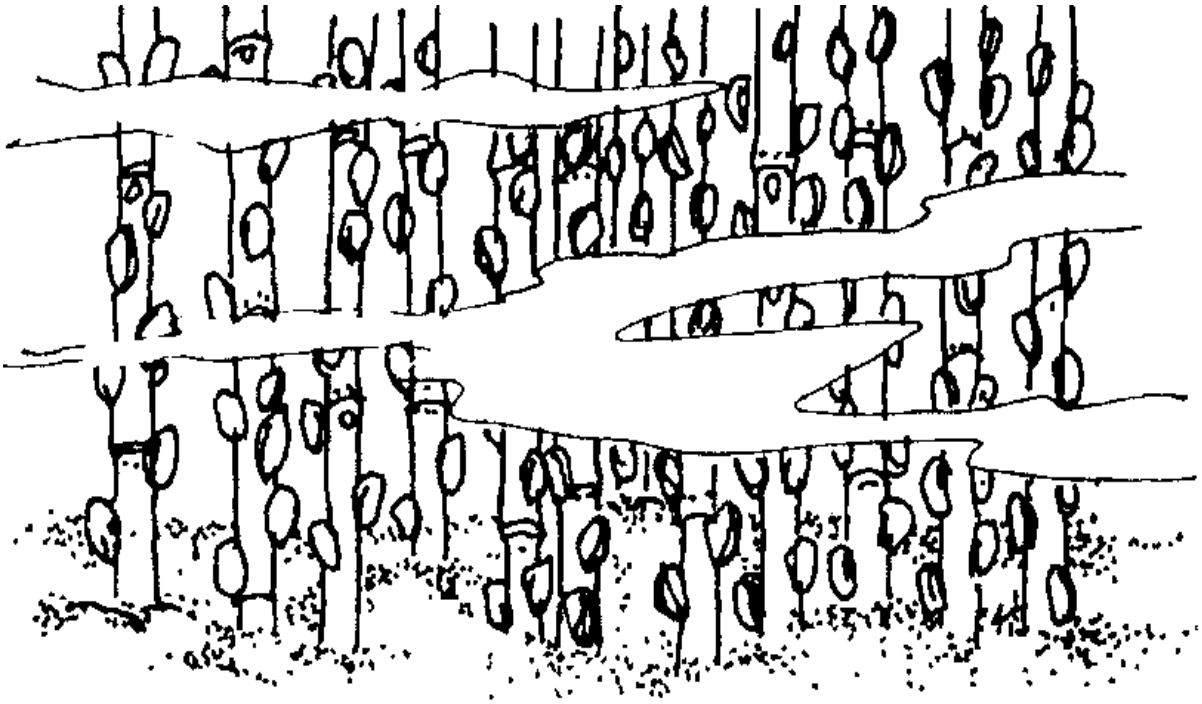
Methods of culture

There are several methods of culture: stake (tulos), hanging (pabitin), long line (sampayan) or stone (paringit). However, the hanging method is recommended.

The hanging method is constructed by piling a 3.04.0 m bamboo post or 7.6212.70 cm diameter wooden post at 4.0 meter distance in between rows and 1.0-1.5 m between rows. The rows should be 8 m long (the normal length of hard bamboo) and the number of rows should be ten per lot. In-between rows are lanes of at least 2-3 m for the caretaker's dugout wooden boat to pass. Bamboo pole platforms are tied to the post at about 0.50 m below zero tide level. Threaded empty oyster shells ranging from 12-16 pieces at a distance of 7.62-10.16 cm in-between shells or clutches serve as the spat collectors. Use No. 3 or 4 polyethelene ropes or plastic twines. The threaded cultches arc then hung al the bamboo pole platforms. Maintan, 20.0-25.0 cm distance between substrates or cultches.



Hanging method



Stake-and-tray method

Maintenance

1. Check the structure for damage and promptly replace damaged parts, where appropriate.

2. Set the hanging oysters just below the normal low tide level.

3. Remove sponges growing on the surface of the oysters. They impede the flow of water and food as well as compete for oxygen and food.

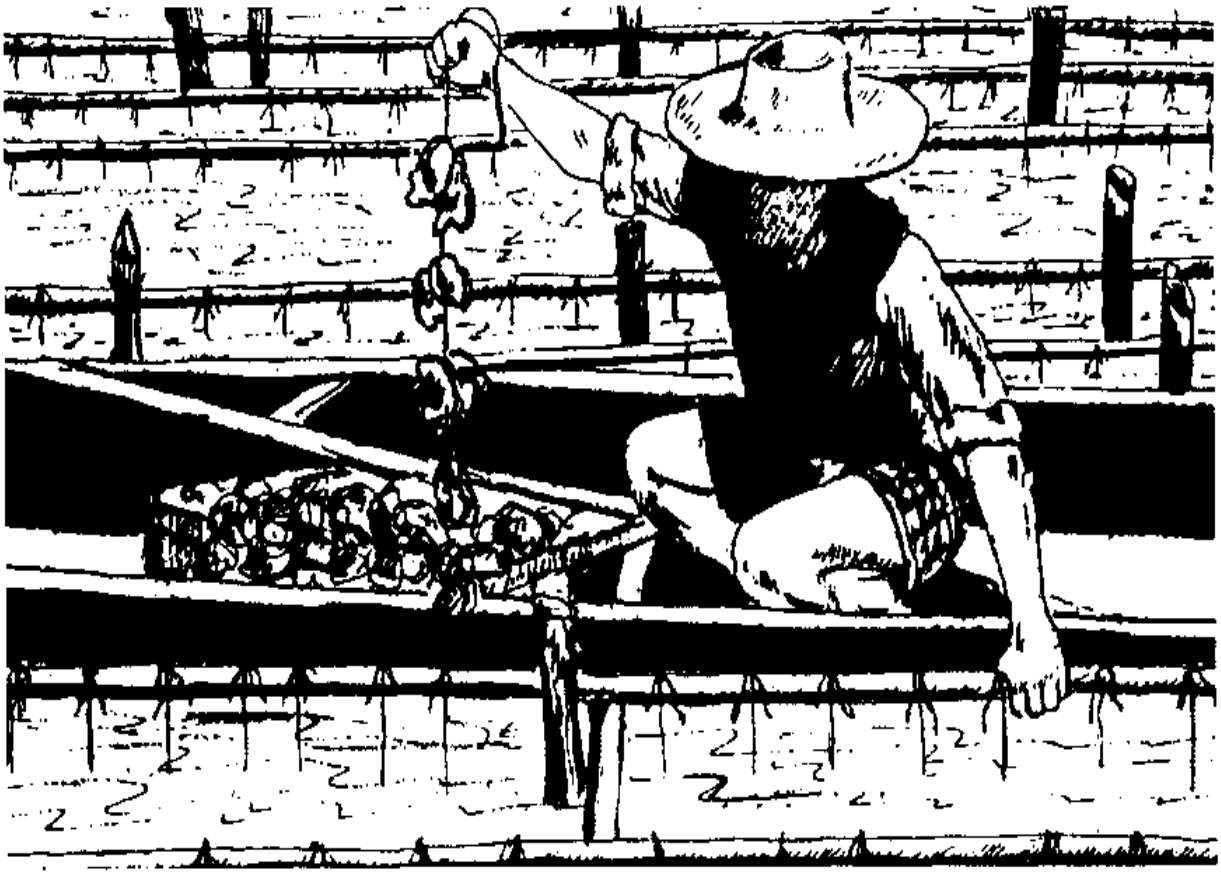
4. It is desirable to construct a caretaker's hut in the farm to deter potential poachers and to facilitate management of the farm.

Harvesting

Not much care is needed in oyster farming, except by guarding it from poachers through frequent visits or by staying at the site two to three months before harvest. Harvesting is done by pulling the hanging cultch lines. Separate the bigger oysters for market and leave the small ones at the bottom bamboo tray to grow further. Submerge and clean harvested oyster shells. Pack them in gunny sacks or bamboo baskets or kaing. The bamboo basket contains about 40 kg freshshell oysters. The marketable size is 6.0-12.50 cm long. Oysters are best harvested before the spatting season of March to May because they are fat and delicious during summer (dry months).

Production can reach 8-12 metric tons per hectare. A family-sized growing area of 2,500 sq m is an ideal, livelihood project for beginners.

In areas where there is an occurrence of red tide that cause poisoning to humans, harvesting should be suspended or stopped until the area is cleared or free from red tide organisms.



Harvesting of oysters

Economics of production - ½ ha oyster farm (139 plots) using plot hanging method with empty oyster shell collectors

Assumptions

1.	139 plots (18 m x 1 m) for one-half ha
2.	1 sack of empty oyster shells (800 pcs)
	makes about 114 collector strings at 7
	cultches or shell per string

3.	350 collector strings per plot x 139 plots = 48,650 strings
4.	6-8 month culture period

	Value	Total Value
	(in pesos)	(in pesos)
Annual Revenue		
Sale of 2,862 kaings x 160/kaing	457,920	457,920
Annual Production Cost		
427 sacks empty oyster shell x 20/sack	8,5402	
50 rolls polypropylene film x 10/roll	2,500	
48,650 preparation collectors x 0.50/collector	24,325	
(4) hanging collectors x 60/day x 7 days	1,680	
Harvesting cost - 2,862 kaings x 10/kaing	28,620	
(1) Caretaker x 1,000/month x 12 months	12,000	
Depreciation	109,725	
Miscellaneous	21,645	209,035
Fixed Investment		
Cost of materials and labor for plot construction		
24 pcs bamboo post (7 cm.)		
3/pc x 139 plots	116,760	
6 pcs bamboo horizontal pole (10-15 cm)		
x 45/pc x 139 plots	37,530	
2 kg monofilament nylon line x		
120/kg x 139 plots	33,360	

Contract labor for construction		
- 200/plot x 139 plots	27,800	
Dug-out banca, 5 m long	5,000	
Tools and diving paraphernalia	1,000	
Shed	2,000	223,450
Net return		
Annual revenue	457,920	
Less: Annual production cost	209,035	248,885
Return on Investment		
Net return	248,885	
---------- = ----------		
Fixed investment 223,450		1.11

Source: The Science and Business of Growing Oysters, PHRDC, 1991.

Natural oyster populations, farming areas and potential sites in the Philippines

1 Buguey, Cagayan (NG,FA)

2 Ilocos Norte (NG, FA)

3 Ilocos Sur (NG, FA)

4 Aringay & Sto. Tomas, La Union (NG, FA)

5 Lingayen Gulf & Tambac Bay (NG, FA)

6 Agno River, Manat, Binmaley, Pangasinan & Davel, Dagupan City (NG, FA)

7 Binuangan & Malolos, Bulacan (NG, FA)

8 Abucay & Mariveles, Bataan (NG, FA, PS)

9 Cavite—Bacoor & Ternate Bays (NG, FA)

10 Balayan Bay, Batangas (NG, FA)

11 Batangas Bay (NC, FA)

12 Tayabas Bay (PS)

13 Makato, Aklan (PS)

14 Sapi-an Bay, Iloilo (NG, FA)

15 Banate Bay, Iloilo (NG, FA)

16 Bacolod (Port of Banago) (NG, FA)

17 Binalbagan and Hinigaran, Negros Occidental (NG, FA)

18 Himamaylan, Negros Occidental (NG, PS)

19 Panguil Bay, Misamis Occ. (PS)

20 Luuk, Bongao Cove, Sacol [s], Zamboanga del Norte (PS)

21 Scall Lagoon, Sta. Cruz, Zamboanga del Norte (PS)

22 Malalag Bay, Davao City (NG, FA)

23 Del Caman Dapa, Surigao del Norte (PS)

24 Calape, Bohol (NG, FA)

25 Cebu (NG, FA, PS)

26 Leyte (PS)

27 Maqueda Bay & Jiabong, Samar (PS, NG)

28 Catbalogan, Samar (PS)

29 Sorsogon (NG, FA)

30 Pagbilao Bay, Quezon (PS)

31 Alabat Island, Quezon (PS)

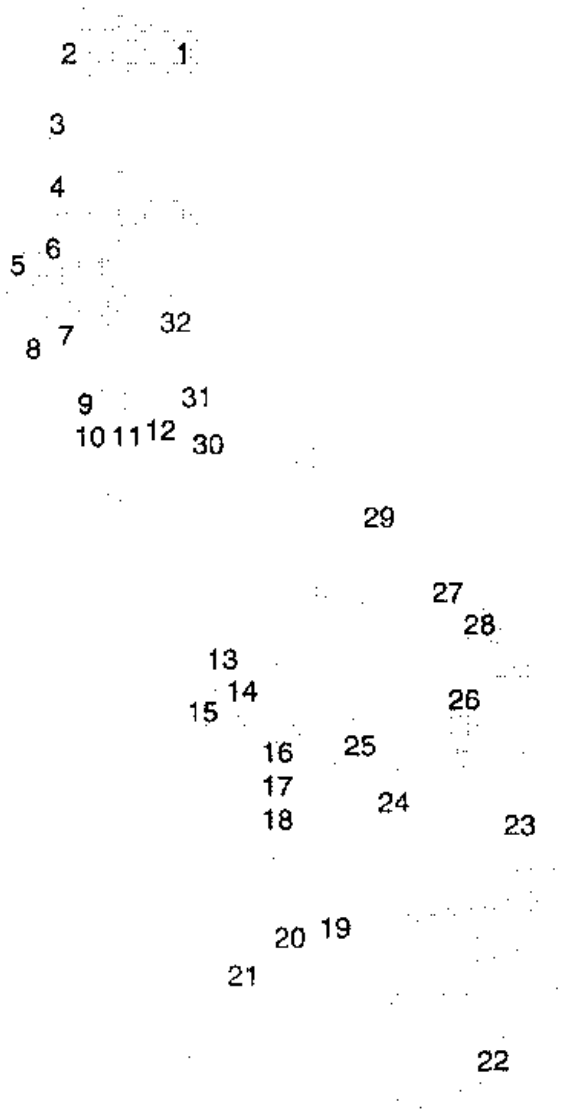
32 Polilio Island, Quezon (PS)

Legend

NG - Natural grounds

FA - Farming areas

PS - Potential sites



Farming areas and potential sites in the Philippines

Source: The Feasibility of Oyster and Mussel Farming by Municipal Fishermen in the Philippines, South China Sea Fisheries Development and Coordinating Programs, January 1982.

Fish culture in cages

Both fish pens and fish cages are confinement structures used for rearing fish. The pen, however, is larger; it ranges from 10,000 sq m to more than a square kilometer in contrast to the cage which ranges in size from one square meter to several hundreds of square meter. Also, cage culture is done in at least one-meter water depth or in deeper waters. Thus, this type can either be stationary or a floating cage which can then be established in the sea, lake, cove or river where biophysical factors are favorable.

Species of fish that are grown in fish cages are usually expensive and sold live for a certain group of consumers. Demand for live fish exports to Taiwan, Hongkong and China is fast-increasing. Seafoods that are popularly exported alive and grown in cages are grouper, humphead wrasse, lobster and seabass. These species, when cooked alive, command more than triple in prices. Wrasse and groupers are first-class fish species that are believed to also have medicinal properties for sick and recuperating people.

Site selection

Fish cages should be installed in suitable areas that are protected from strong waves and currents, free from pollution and accessible to the farmers and market. A minimum depth of one meter is required.

Fish cages

There are two common types of floating fish cages: the bamboo frame cage and the nylon net cages with frames. They are both provided with anchors and floats. Fish cage rearing can be done in freshwater and brackishwater areas.

Bamboo frame fish cages

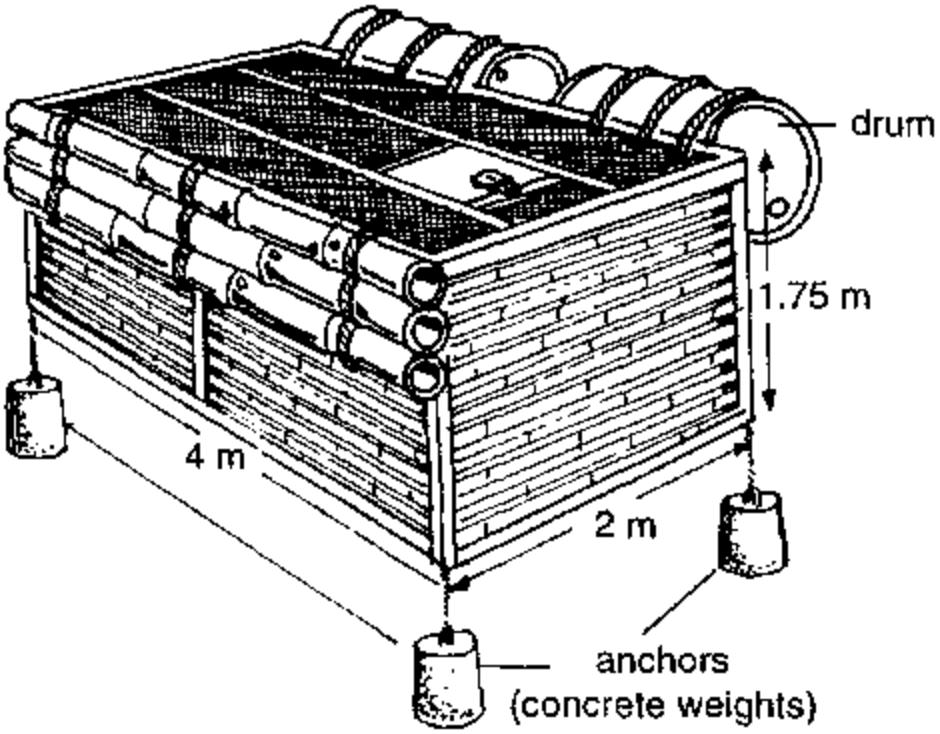
They are made of hard bamboo slats tied or nailed to wooden frames. The usual measurements are: 2 m long, 2 m wide and 2 m deep, 3 x 3 x 2 m and 4 x 2 x 1.75 m. They are provided with whole bamboo floats or empty drums at the top side. Net or bamboo top cover with door and lock is provided.

Advantages

- Cages are easy and cheap to construct.
- Cages can be operated cooperatively.
- Cages are easy to stock and feed
- Fish grow fast in cages.
- Cages are easy to harvest.

Net fish cages

They are made of fine-meshed (0.32-1.27 cm) nylon nets connected to a float frame of whole bamboo with empty drums of plastic or styrofoam to enhance buoyancy. The empty drum is optional for a small-sized net cage. The usual size is 8-10 sq m with 2 m-2.5 m depth. The net cages are provided with concrete weights that also serve as anchors. The cage is also provided with a mooring line to keep it in place, as well as reinforcement bamboo frames to spread the nets.

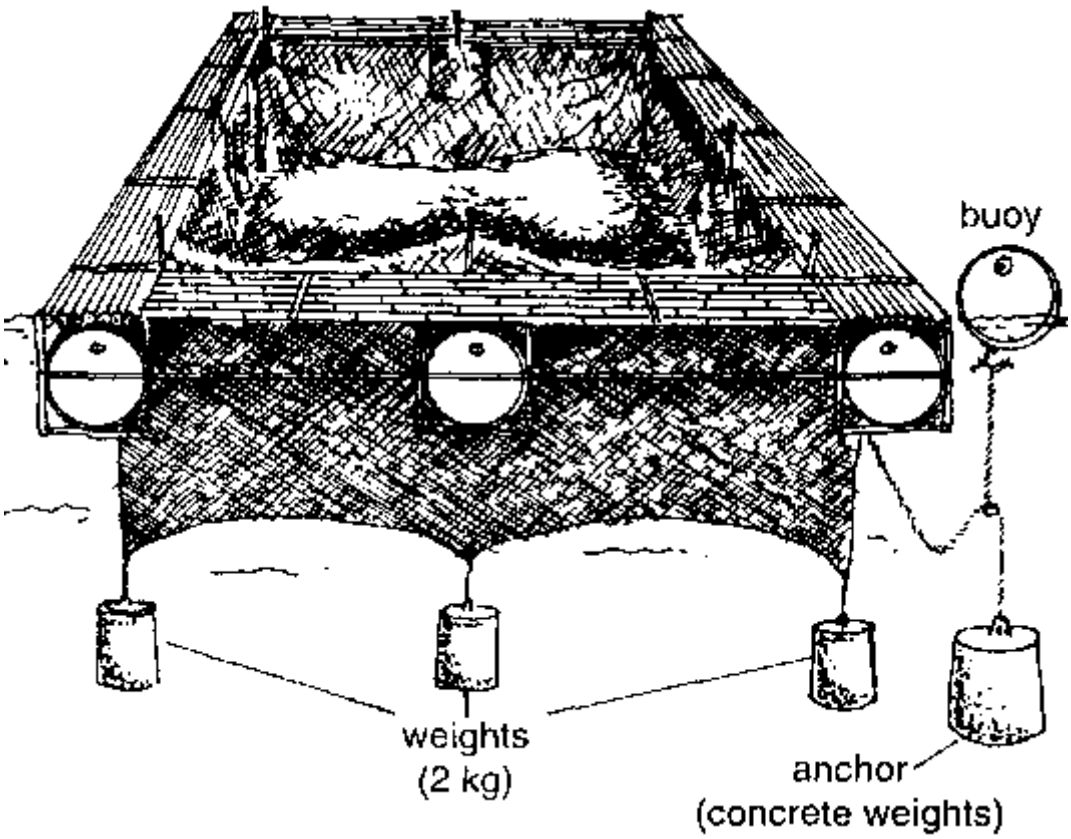


Floating bamboo fish cage

Management

Fish cages can be used for fish fattening or growing. For growing purposes, use fingerlings. Before stocking, weigh and count the fish.

As a nursery for fingerlings, the cage should be made of fine mesh net. The size is appropriate for easy handling. There are two cages —the first is a brooder's cage with a 1.255.0 cm mesh size This is placed inside a bigger cage which functions as the confinement cage or as a conditioning cage for fishes, subject to transport. This is commonly used for rearing fingerlings to marketable-sized fish. The net's mesh size depends on the size of fish or fingerling that would be stocked initially. The cage area usually ranges from 1 sq m to 100 sq m or more and the depth ranges from 1.0-2.0 m or more. Cages are subject to fouling organisms. Clean heavily fouled nets as often as necessary to ensure efficient water change.



Floating fish net cages

Check the net daily for possible damages to prevent escape of the stocks. Check also the structure (e.g., bamboo structures, ropes, sinkers, floats, etc.). Guarding the fish cages should be done at all times to prevent losses from poaching. Construct a caretaker's hut at the culture site to discourage poachers.

Rearing of the stock

Fish sampling is done at least every month to determine the growth rate and the proper quantity of feed to be given. Expose the fish to outside parameters that may affect their feeding performance which eventually affects their growth rate. During the wet season, water temperature usually drops; thus, decelerating growth rate. In summer, the growth rate is faster. Hence, feeding should be regulated. Practice an addition feeding to determine the actual food needs of the fish, especially before the sampling schedule. Do not feed fish subject for sampling.

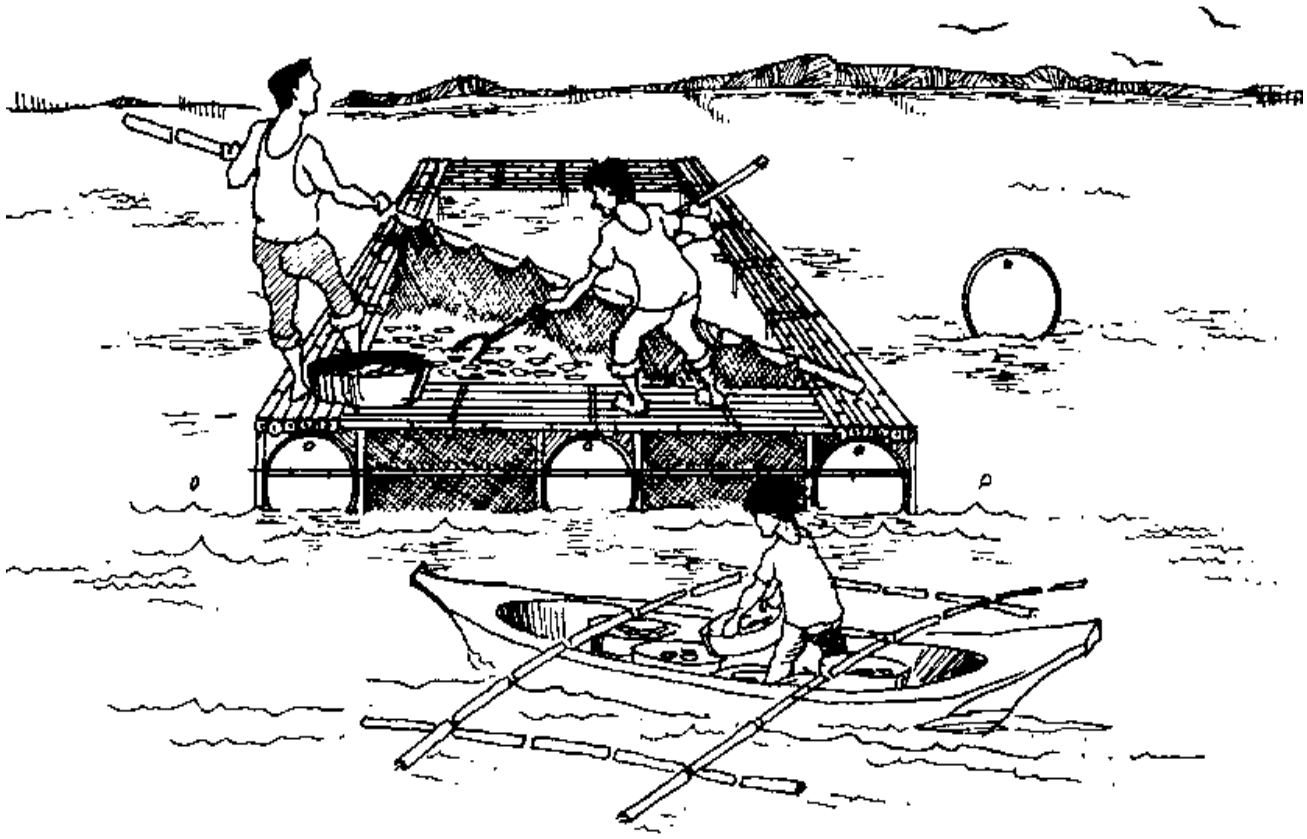
On the average, depending on the fish species and the kind of feeds, the feeding rate is three to five percent of the body weight. Give commercial feeds at three percent and trash fish at five percent. In the absence of commercial type, an alternative feed may be made at home, suited to fish requirement, e.g., a 70-percent rice bran, mixed with 30-percent fish meal or fine trash fish for Tilapia mosambica (hybrid). Feeding should be done early in the morning and late in the afternoon by equally dividing the feed needed. It is important that feeds are available at all times when using fish cages. Feeding trays may be used to mimize wastage of feeds.

Culture period ranges from three to five months. The stocking rate can be 5-20 pieces per square meter.

Harvesting and marketing

Here is one way of harvesting fish: For the net cage, untie the bindings at the corners and sides of the net from the float frame. Insert a bamboo pole at the upper edge of the net cage and push the net along in order to corner the fish at one end. Scoop the fish with hand nets.

The fish, if sold live, fetches a higher price. It is, therefore, advisable to place the fish in double plastic bags containing well-oxygenated water. The bags are then placed in styrofoam or burl bag containers. Dead fishes to be sold should be packed in crushed ice at the rate of 1:4 by weight (1 kg ice to 4 kg fish) for nearer markets and 1:1 ratio for more distant markets at a temperature of 0° C which is good only for 24 hours or less.



Pull out the net for cleaning and repair after harvest.

Fish culture in pens

The implementation of the Agrarian Reform Law covered fishponds which resulted the imposition of a ban on the issuance of new fishpond lease agreements and their renewal. The law prompted many businessmen to grow fishes in pens instead, because this is exempted.

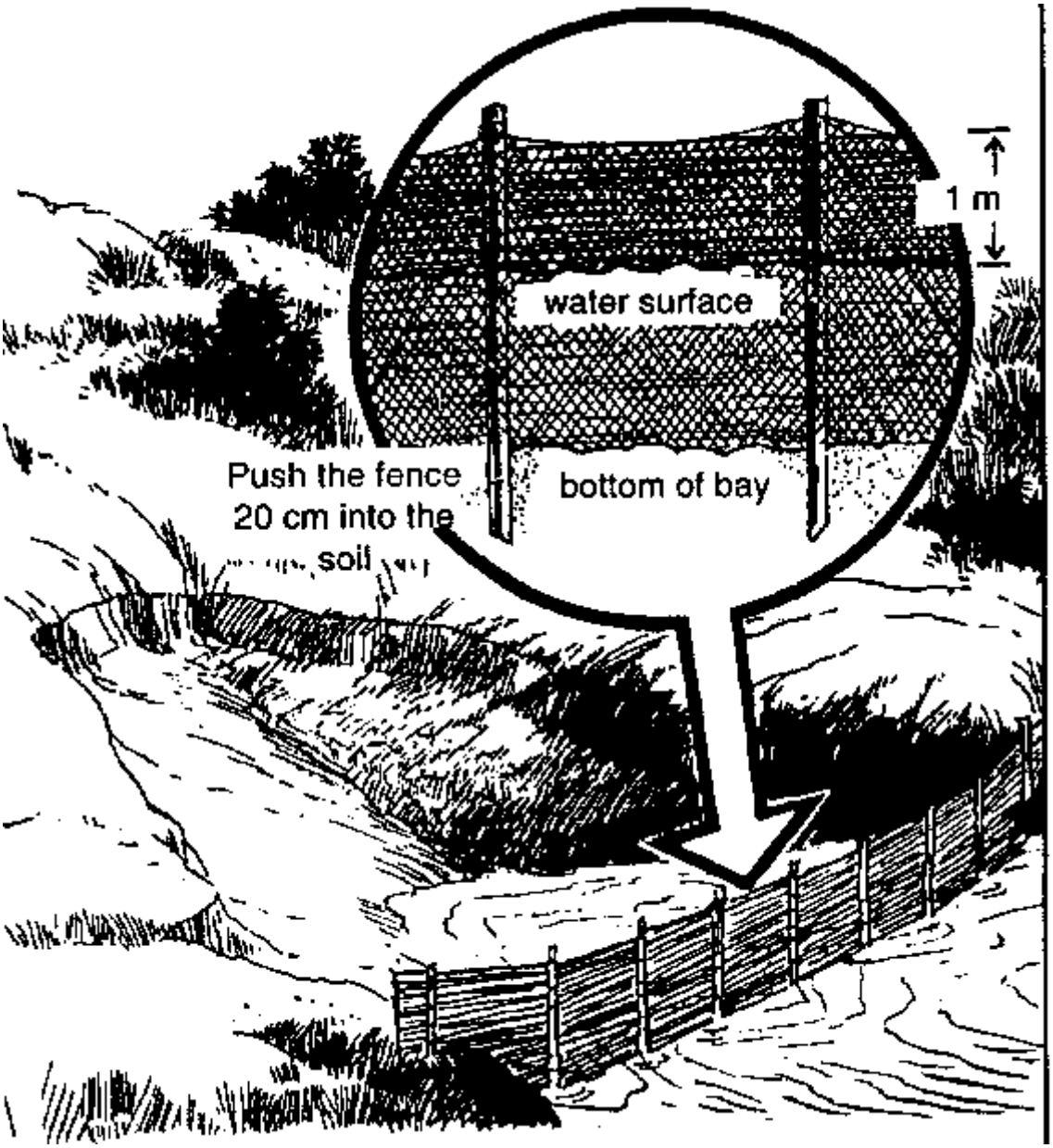
Fish-pen culture also became popular because of the fast-increasing demand for live fish both for export and domestic consumption. The price of exotic live fish is about triple to quadruple compared to the traditional chilled fish, such as groupers, seabass, lobsters, etc. Many Chinese and Japanese businessmen believed that eating live fish gives good fortune and luck. Studies also show that the prices of developing fishponds are quite prohibitive compared to establishing fishpens.

The availability of fingerlings for growing in fishpens also promoted the rapid expansion of fish culture using pens. Southeast Asian Fisheries Development Center (SEAFDEC) and the private sector have made breakthroughs in breeding milkfish, seabass and grouper in captivity. Prawns, tilapia and shrimp (Macrobrachium spp.) were successfully produced earlier in hatcheries.

Also, although the fish pen is similar to fishponds, free-flowing water in the pen provides adequate supply of dissolved oxygen critical to fish culture. The use of aerators in fishponds is becoming expensive and risky because of erratic electricity. Fish pens will likewise put underutilized freshwater and brackishwater aquatic resources into productive use.

Fish pens can be set up in brackish and freshwaters, depending on the type of culture and kind of fish to be grown. Bays and coves, places with laminar and steady flow of water, optimum oxygen content and food are desirable places for establishing a fish pen. For small lakes and rivers, fish-pen management is relatively easier due to its proximity. However, seasonal patterns (e.g., seasonal overturn or oxygen cycle) should first be determined to ensure viability of this activity.

In freshwater bodies, polyculture may be done to maximize its use and efficiency, provided the species to be grown are compatible. An example of polyculture is a combination of carp, tilapia, shrimp and clams in the fish pen. Tilapia is a surface feeder while carp is a bottom eater, like the clam and shrimp. Tilapia mosambica can also exist in brackishwater and can be combined with seabass or grouper.



How to construct the fence

Polyculture can be practiced in both saline and freshwaters. For instance, Tilapia mosambica can co-exist with seabass or grouper. Tilapia fingerlings can, thus, serve as natural food since the grouper and seabass are carnivorous while the tilapia is planktonic. Milkfish can also be combined with mud crab and tiger prawn.

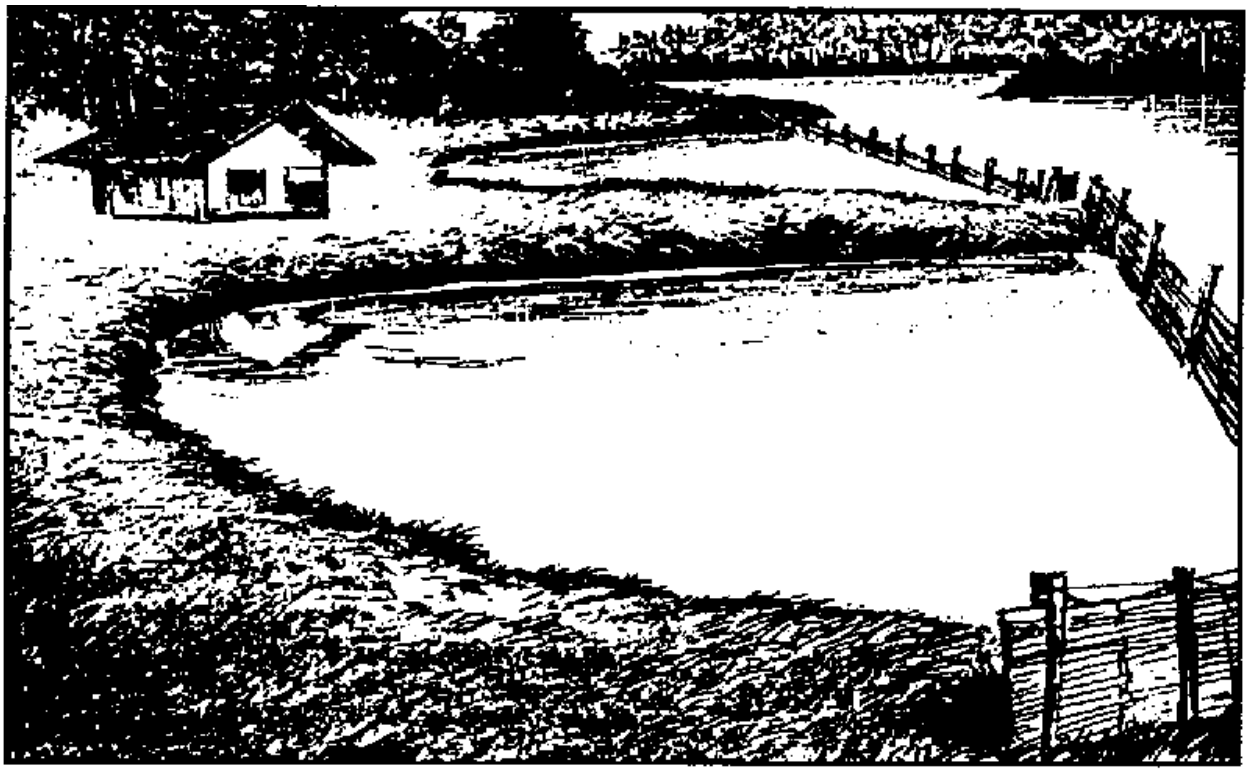
Freshwater fish pens should be shallow, ranging from 50.0 to 80.0 cm to allow rapid multiplication of food materials, such as phytoplankton, algae (lumot) and other plants. On the other hand, brackishwater fish pens should be 1.0 m to 1.5 m below zero tide level to allow effective photosynthesis. Ideal salinity conditions are usually from 10 to 25 ppt.

Methods of fish-pen construction

The type of construction depends on the configuration of water bodies and the desired species. Two common fish pen structures are the barricade and full-fence type. Both types can use either the slat or flattened bamboo fence or the combination of nylon nets and bamboo frames. Hang the net one meter from the water surface to prevent fish from escaping while the bamboo posts should be higher than the highest high tide level by at least 30 cm to ensure confinement of the stocks inside even during the flooding period.

Barricade Type

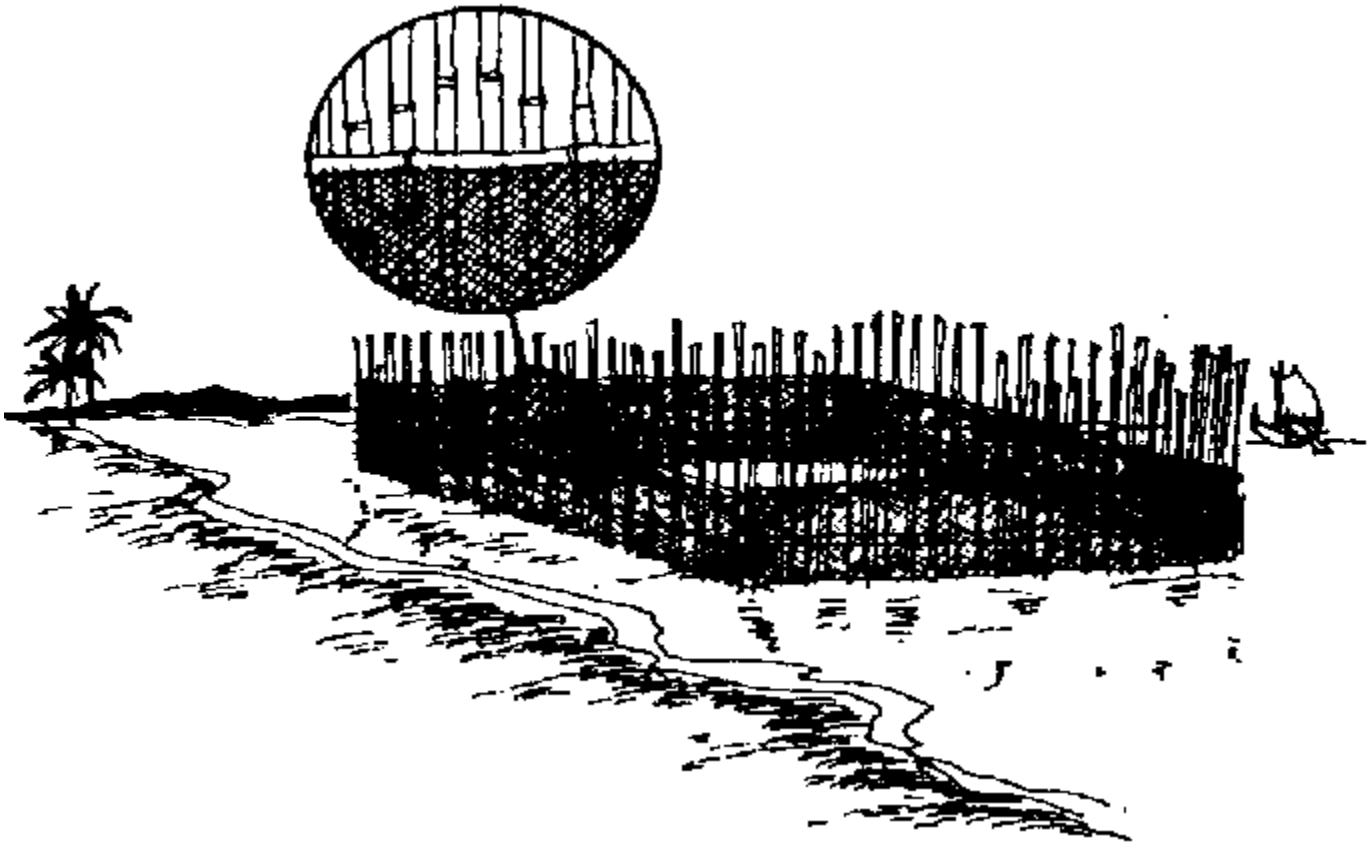
This type of fish pen is applicable in narrow shallow inlets, small coves or submerged protected bays or lakes. Barricade fish pen is more economical because you have to fence only one, two or three sides.



Barricade fish pen

Conventional fish pen

This type is more common in big bodies of water, like bays and lakes where tidal fluctuation occurs and where waters rise and recede frequently. It is fully enclosed with a fence, using either flattened bamboo or bamboo slats and polyethylene or coralon nets framed with bamboo or wood.



Typical conventional fish pen

Management of fish pens

Check the net enclosure daily for damages to prevent the escape of fish. A practical method of monitoring is by setting up a gill net in the four corners of the pen. A fish caught in any of these corners would indicate net damage in the enclosure net. Another is simply by finding out if those fishing (with gill net) near the pen have caught any of the species grown in the pen. This may, however, become a difficult way of monitoring net damages.

Supplemental or full feeding depends on the species of fish grown. Freshwater fish, like milkfish, tilapia or carp, need full feeding for the intensive method (20,000 to 30,000 fingerlings per 10,000 sq m) and supplemental feeding for semi-extensive (10,000 to 15,000 per 10,000 sq m). Selective feeding is done under extensive method of culture (3,000 to 7,000 per 10,000 sq m).

The amount of commercial feed given is normally computed at three percent of the body weight.

Monoculture of brackishwater fish species, like seabass and grouper, needs full feeding of trash fish, mussels or snails. Fresh trash fish is computed at five percent of the body weight of the fish population. Sampling of weight should be done at least every five days. Siganid or rabbitfish also needs supplemental feeding together with prawns.

Polyculture of tilapia with grouper or seabass needs supplemental and selective feeding. Stock the tilapia breeders at least one to 1½ months earlier to allow lead time for the production of fingerlings as feed.

Feeding should be done at least twice a day-one in the early morning and one in the late afternoon, equally dividing the amount of feeds required.

Monoculture stocking in fish pens can be done at two to five fingerlings per square meter.

Harvesting

Selective harvesting can be done using pole and hook, cast net or gill net. Full harvesting is usually done with the use of seine nets during low tide. Tilapia cannot be fully harvested because about 20 - 30 percent burrow in the bottom during harvesting. At any rate, any volume can be harvested everyday, depending on the market (i.e., demand, price). The culture or growing period of different species ranges from three to five months.

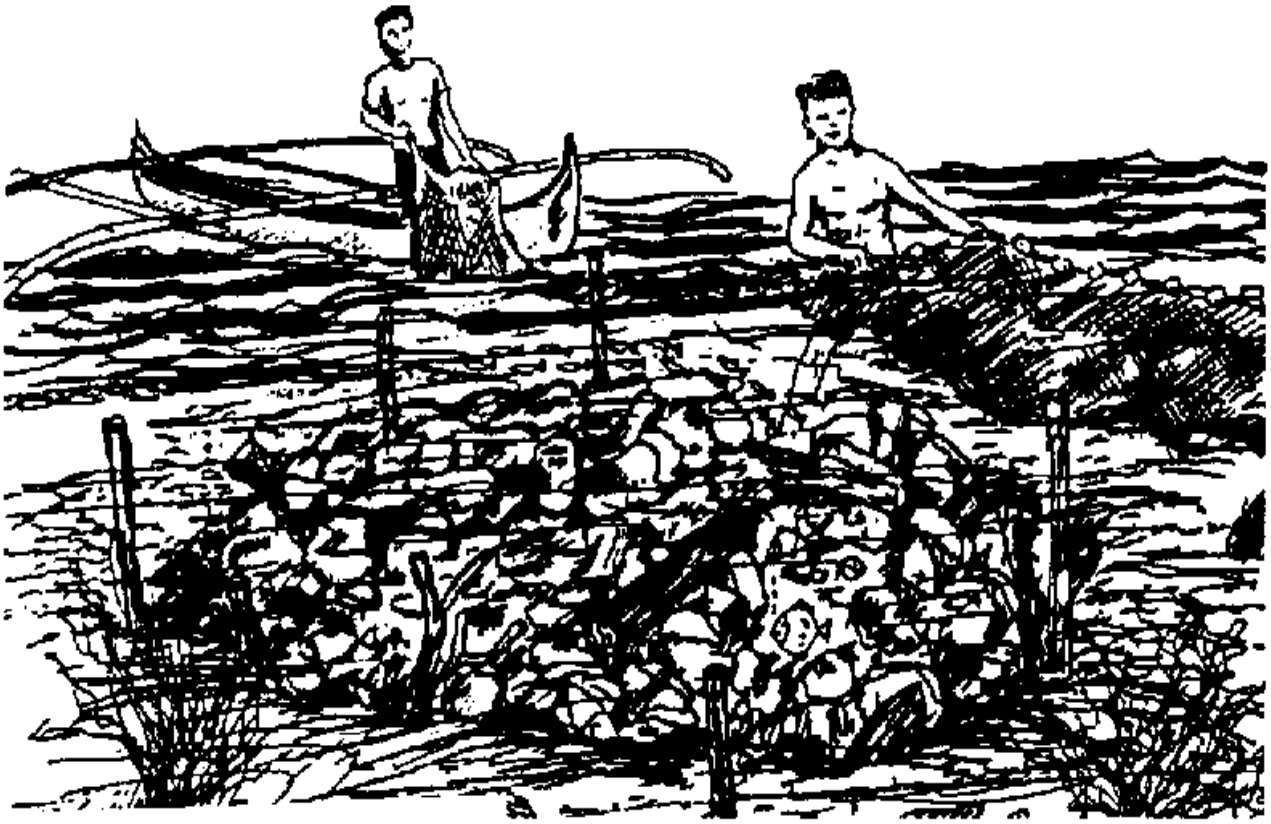
Since live fish fetch higher price, transport harvested fish in double plastic bags with oxygenated water. Use styrofoam or burl bag containers.

Profitability of fishpen culture

There is less initial capital needed in fish pen culture because, unlike with fishponds, purchase of land is not necessary. The economics of production varies, depending on the site, type of pen, kind of fish cultured and method of culture. Profits for brackishwater fish are usually higher than those from freshwater. It is more advantageous and profitable to grow expensive fish species in fish pens that are popularly sold alive. Growing in fishpens can be done two to three times a year.

Capture fisheries

Fish corrals



Fish corral

Establishing fish corrals (baklad) is one popular method of catching fish along tidal flats, in coral reefs and mangrove areas. They are located in bays or near estuaries with moderate currents (not strong waves), affected by tidal fluctuations. This fishing gear is stationary and is constructed in areas known to be rich fishing grounds.

Most fish species that travel with tide currents are trapped by the fish corrals. They can trap different species, like crustaceans (crabs and shrimps), demersal fish (groupers, snappers, etc.), mollusks (squid, cuttlefish, etc.), etc.

A fish corral needs high capital but requires only minimal and periodic light labor. It can also be highly profitable.

Method of construction

The fish corral consists of a guiding barrier or leader made of bamboo slats with nylon nets connected to a 3.0 cm wooden post. The size of the corral varies from 30.0-100.0 m wide. It is shaped like an arrow tip, pointed towards the sea from shoreline. At the back of the leader is the playground, a semiround shape made of the same materials as the leader. Connected to the playground is the terminal pound or bunt where the fish are trapped. The bunt is usually heart-shaped with a small opening. The nylon net of the leader and playground is finemeshed with sizes of 1.27-1.9 cm opening. The terminal pound is similarly built as the playground, but with finer mesh nylon nets of 1.27-1.90 cm. This is to prevent small impounded fish to escape.

Normally, the movements of fish are guided by tidal currents. At high tide, they travel towards the shore to forage and look for food. During low tide, they follow the current drifting towards the sea. If they happen to enter the fish corral contraption, they are finally trapped.

Harvesting

Collecting the captured fish can be done daily or every two to three days. It is usually done early in the morning or sometimes during low tides. Collect the trapped fish by scooping them with hand nets. Small fish net seines are sometimes used to fully empty the pound.

Economics of fish corral

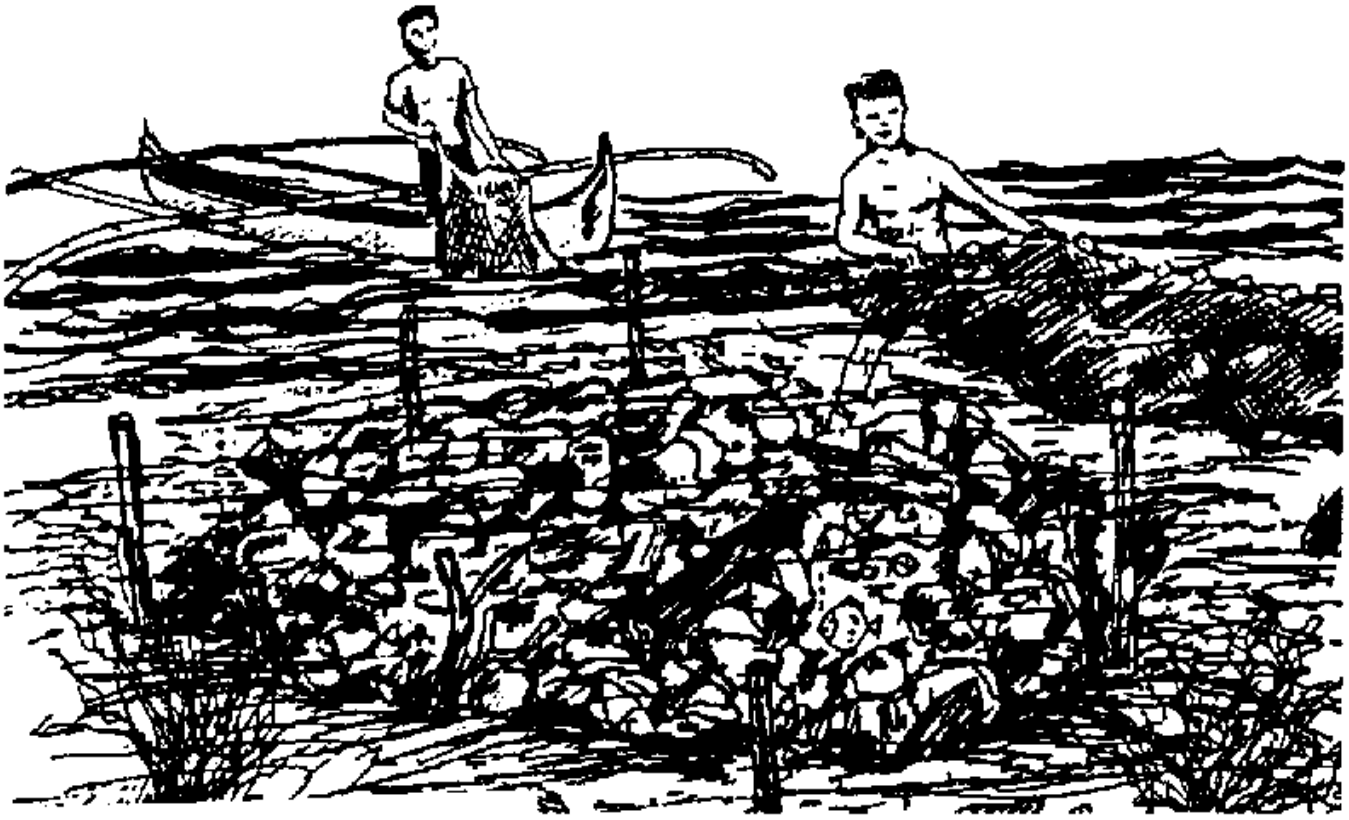
Information on fish catch from fish corrals may be difficult to extract from fishermen. However, records from the Negros Occidental School of Fisheries at Binalbagan in 1987 showed a return on investment (ROI) of about 200 percent. Very informal discussions with fishermen reveal rough estimates of about 300-800 percent ROI per year.

Other considerations

Owners of fish corrals should be organized and vigilant in protecting their municipal waters from illegal commercial fishing, such as blast and poison fishing to ensure sustainability. Efforts should also be made to undertake mangrove protection and development, where appropriate, to ensure the health and productivity of the surrounding area which, in turn, will redound to the productivity within the fish corral.

Fish trap: Amatong

Traps, like the amatong, were commonly used before and during World War II. The adoption of this fishing method was facilitated because of the abundance of fish and because it was safer for fishermen to fish near the coast to avoid being sighted by Japanese ships. The depletion of fish and reduced catch in the last two decades, due to massive destruction of fish habitats and use of destructive fishing gear saw the disappearance of the amatong. However, coupled with care and consideration of other factors, such as number of amatong users and the like, it can be utilized in addition to other traditional fishing gears.



Fish trap : Amatong

Site selection

The amatong should be located in areas that are not exposed to strong winds and water currents. Preferably, it should be in sandy to muddy-sandy bottoms with wide tracts of low-tide areas within the vicinity of mangroves, seagrasses and coral reefs. Brackishwater areas are preferred because of the presence of several species of seafoods, like demersal fishes (grouper, seabass, rabbitfish, snapper, etc.), crustaceans (shrimps, crabs, etc.) and some seashells. Protected bays, coves, mangroves, seagrass beds, tidal flats and atolls are ideal sites; while areas along reservoirs, lakes, rivers, swamps, estuaries, idle fishponds and water impoundments are alternative sites. If possible, the amatong should be located near residences for better security.

Construction of amatong

The best time to establish fish shelter traps along the coast is during the lowest low tide.

The recommended dimension is 6 m-3 m and 0.50-1 m deep. Excavate the seafloor or bottom and place the excavated materials around the trench. Excavation is done to reduce the sudden change of temperature during the tidal fluctuations. Excavation may not be necessary in submerged areas two to three m deep.

Coral rocks are piled first at the bottom for at least three tiers. Filling of rocks can be in heaps or continuous. Pile small bundled tree twigs and branches on top of the coral rocks all around the trench. Bundling will facilitate easier removal during harvest. Pile a few bigger branches on top of the twigs to keep them in place or as weight. Use ropes to tie the top of the piles to prevent loosening of the tree branches pile and washing away during strong currents.

A few days after the amatong is established, moss, algae, plankton, etc., grow at the surface of the piled materials of rocks and tree branches. The accumulation of food materials in this substrate attracts various species of fish which feed on them. During high tides, some fish leave the contraption to forage for other foods. During low tide, most of the fish return to them. Soon, the amatong becomes a permanent shelter. Normally, several units of amatong are established near each other in groups of at least five or more units. They should be closely guarded from poachers who sneak inside using poisons, nets, or dynamites. Staying and sleeping in the amatong area with dogs few days before harvest will deter poaching. Cooperative vigilance should be practiced by amatong fishermen in each village.

Harvesting

Depending on the abundance of fish and the prevalence of amatong in the area, harvesting is usually done one month after the initial establishment and every two to three weeks thereafter. In Bohol, where many fishermen use amatong, they harvest at 11.5 months interval.

Harvesting is done as soon as colonies of fish are observed inside the contraption. Enclose the whole trench with bamboo strips or any fish net similar to fish corrals during low tide. Remove the piled materials inside and carefully place them around the amatong. Piled materials are continuously submerged in water or not overexposed to sunlight so as not to kill the microorganisms and plants attached to the substrates as future food materials in the next amatong.

The excavation is filled with coral rocks or dead corals, stumps and small branches of trees.

Use hand nets or just simply comb it with nets (ring net) to catch the fish inside after the enclosure is cleaned with amatong materials. See to it that small fishes (fry or juveniles) and gravid (pregnant) fishes are set free as a conservation measure. They will continue to grow or multiply in the amatong areas.

If sedimentation occurs in the trench, the depth is maintained by further digging. The contraption may be lined with coral rocks at the top edge of the trench.

In areas with limited mangrove stands, cooperative effort should be exerted by amatong users to establish additional mangrove areas.

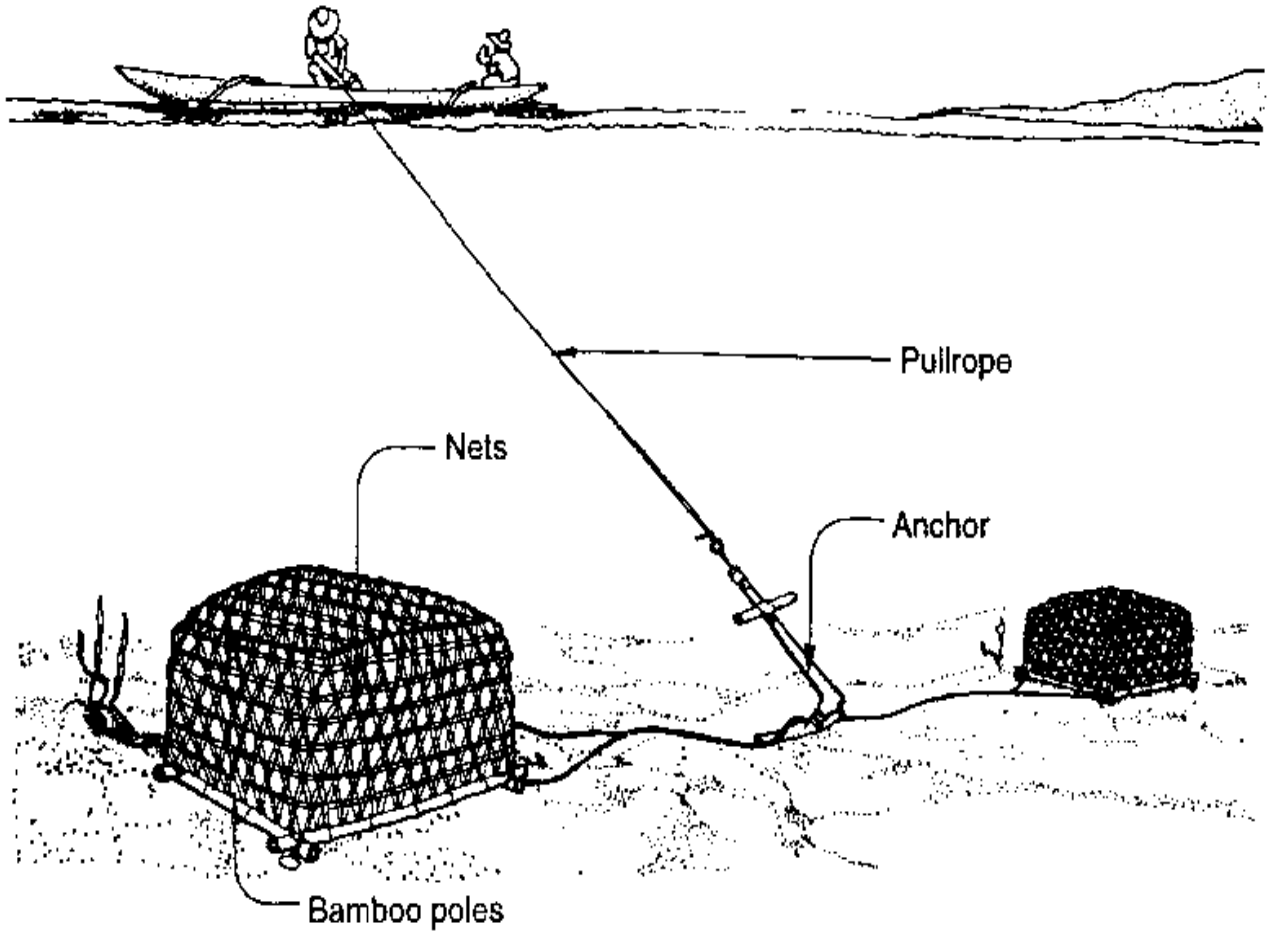
Economics of production

Preliminary trials conducted in Batangas in 1987 showed that establishing amatong will cost about P300.00 per unit. For economies of scale and as an income-generating project, at least five units should be taken cared of by one fisherman or family. Batangas data average 3-5 kg assorted fish caught every three weeks. In Bohol, the reported average catch per unit is 5-7 kg every month.

At an assumed catch of five kg per unit per month, five units may have a total catch of 25 kg per month. At an assumed average price of P30.00 per kilo, a fisherman's expected income is about P750 per month or P9,000 per year. With an initial investment of P1,500 for five units, an amatong fisherman may attain a 500-600 percent of ROI (return-on-investment) per year. This is a favourable investment for employed people, granting that the sharing is 60 percent for fisherman and 40 percent for the financier.

This is an all-year-round fishing method and ecologyoriented livelihood project that is highly profitable.

Fish traps: Modified multipurpose fish trap



Bubo, a fish trap used throughout the Philippines for catching coral reef species.

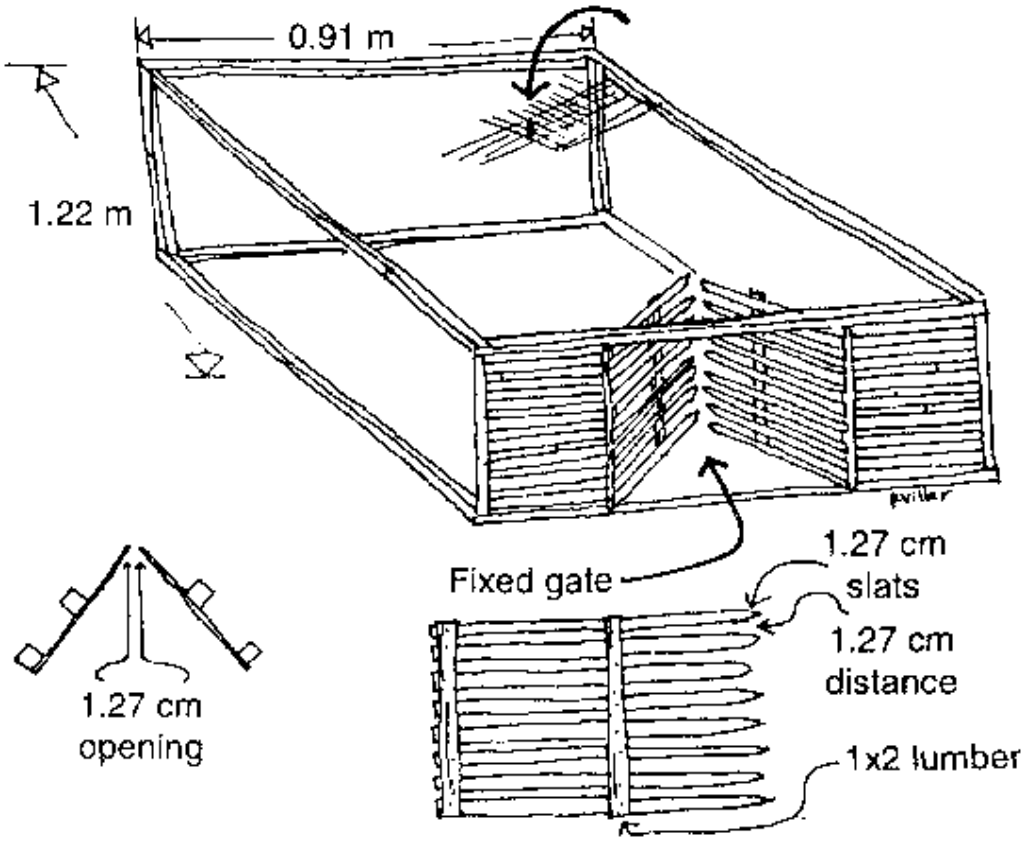
Fish trap (bubo) is the most common and widely used fishing paraphernalia in the Philippines. However, for the past decades, not much has been done to improve or modify this fishing gear to increase its efficiency to catch and lengthen its use at a lower cost than the traditional types. It takes a longer time to finish one unit and one must have the skill of weaving.

The most common material is bamboo or rattan, which usually lasts four to six months of continuous use because it is easily broken and damaged during the catching process. It is made in different sizes of 0.61-3.05 m long and at various forms of opening or mouth, ranging from 0.61-1.5 m wide. Also, the cost is quite expensive, ranging from P150-P600 per piece. To some extent, it has limited use and efficiency. It is for this reason that modification was undertaken. Various improved models were tried in the Batangas-Mindoro area in 1986 and 1987.

The traditional fish trap is weaved at hexagonal-shaped hole with or without corner frames. Usually, it is oval-shaped from top view, semihalf round at front and back view and semioval at side view.

Many fishermen who use plastic net, mononylon net, wire net and other stronger materials for their fish trap say that it catches lesser fish compared to the common fish trap. They believe that these materials contain certain chemicals that, when emitted, make fish shy away from the traps. Also, there is a theory that bamboo, rattan and wood can produce plankton and other microorganisms that attach themselves to the common fish trap, which attracts fish better because they serve as their food. It is from this theory that the modified fish trap has to retain the wood and bamboo as its material components and the coralon net as its cover because they can produce indigenous food materials of fish and do not emit chemical substances that distract fish.

The proposed modified fish trap uses coralon net with sizes from 1.27-2.54 cm opening as its top, side and bottom covers. This is the net usually used as fence in fish corrals or fish pens. The use of coralon net is to keep the fish trap light for easy handling and can last three to five years. The entry or front opening is made of thin bamboo skin, nailed to a lumber strip of 2.543.81 by 5.08-6.35 cm The back or opposite opening for fish caught is also made of the same materials. The frames are usually made of hard lumbers, like guijo or other tree species, that are used for wooden boat building. These lumber species are more durable in water-submerged conditions. Copper nails are used to resist rusting. The bamboo strips should be nailed at horizontal position. They are rectangular in shape and varying in sizes from 0.61-3.05 m long, 0.61-1.5 m wide and 0.35-0.76 m height. The size preference is normally dictated by the frequency of harvesting the trapped fish. The longer the interval of the harvest, the bigger is the size.



Cover with coralon or nylon net

The fish trap can be used with or without fish baits inside. Placing fish baits inside the laid fish traps increases the chance of trapping carnivorous fish species, like groupers.

Weights or stone boulders are attached at the corners to serve as anchors.

The principle behind fish traps is the tendency and instinct of many fish species to look for shelters. The mouth or opening of the fish traps serves like the mouth of coral, sand and mud holes as shelters, sanctuary or hiding place.

Fish pots can be used in different water conditions, such as freshwater, brackishwater and salty water areas. The various places for fish traps are rivers, lakes, reservoirs, estuaries, mangroves, bays, intertidal flats, coral reefs and semideep sea.

The fish naps are laid at the bottom by dropping them in the waters. They are provided with sinkers (stone, metal, concrete, etc.) to keep them in place. A buoy is connected to the fish trap with ropes to serve as a marker and for pulling out during harvest.

Economics of fish trap

Field data from coral reef areas in Albay gulf showed an average catch of 1-2 kg per day; Negros Occidental with an average of 0.50-1 kg; Mindoro-Batangas area at 0.25-1 kg; and SUBASTA (Sulu/Basilan/Tawi Tawi), at an average of 2-4 kg per day.

The modified fish trap recommended will cost about P150-P200 per unit, which can last for at least two years. With an estimated average of 0.50 kg catch per unit per day, a one-year catch can reach about 150 kg of various species of fish. An expected income of P4,000.00 per unit is possible.

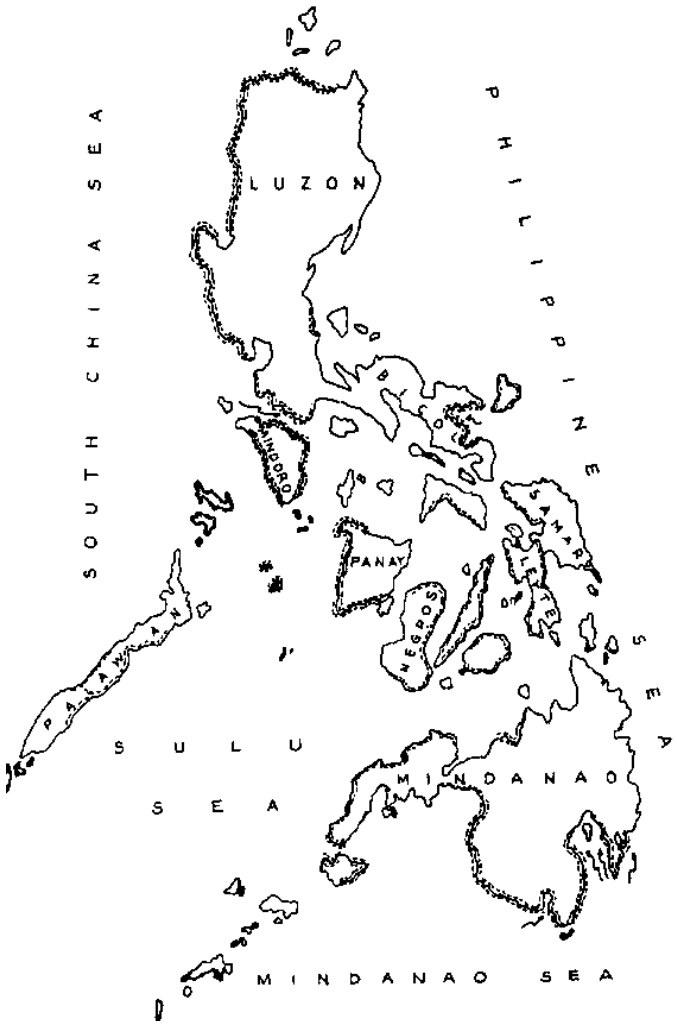
Fish trap operators should be encouraged to engage in mangrove reforestation and protection to attain sustainability of the project. At the same time, they should be vigilant in protecting their municipal waters from illegal fishing, like trawls, blast, cyanide and electric fishing. It was observed in Sulu that the introduction of fish traps in coastal areas has practically eliminated illegal fishing.

Milkfish-fry gathering

Normally, milkfish fry (Chanos chanos) are collected along brackish coastal waters near the mouth of rivers and streams where stands of mangroves are present. The fry appears in different places and various seasonal peaks. Fry season usually starts in March until July, with May and June as the peak months. The bangus fry is very much in demand to stock freshwater and brackishwater milkfish fishponds. However, the supply of bangus fry is highly erratic and unstable because it is highly dependent on wild fry catch. Breeding and raising milkfish fry in captivity is already being tried at Southeast Asian Fisheries Development Center, Iloilo.

Bangus growers usually stock their fishponds at 1020,000 fry or fingerlings per 10,000 sq m. The length of culture varies from 4-8 months or twice a year.

Rearing period coincides with the abundance of natural fish food. Usually, the culture period starts from March to April until July and August and the other is July-August to February-March of the next year. Seeding or growing is also timed with the fry season.



Bangus fry grounds in the Philippines

Adapted from: Philippines Recommends for Milkfish, PCARRD 1983.

Fry grounds and season

Areas like Leyte del Sur, Western Samar, Bohol, Negros Oriental and Occidental, Antique and Iloilo have two peak seasons that occur in March to July and October to November. Regions like Cotabato and Zamboanga del Sur have a year-round fry occurrence.

Peak gathering days occur during high tides after two or three days following a new moon or a full moon.

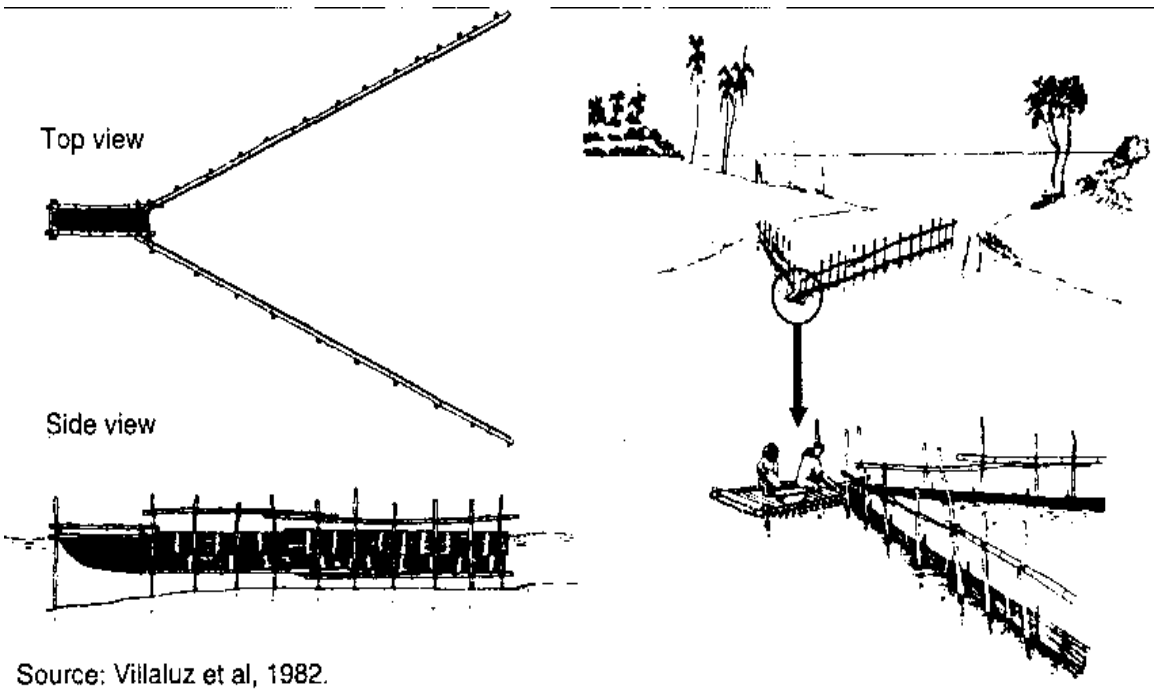
The gonadosomatic index (GSI) or peak-spawning season of milkfish begins in March to June and drops in August to September. During the breeding season, the rising GSI value coincides with rising seawater temperature. Spawning regularly occurs among five to seven-year old milkfish or sabalo in the wild with body weight of three to five kg. Fertility is about 300,000 to 1 million eggs per kilogram weight of sabalo. Sabalo is the female milkfish or breeder. (Greenfields, December 1989).

Collecting or gathering gear

Some commonly used bangus fry catching methods are: (Philippines Recommends for Milkfish, PCARRD, 1983)

Tidal set net (Saplad or Tangab)

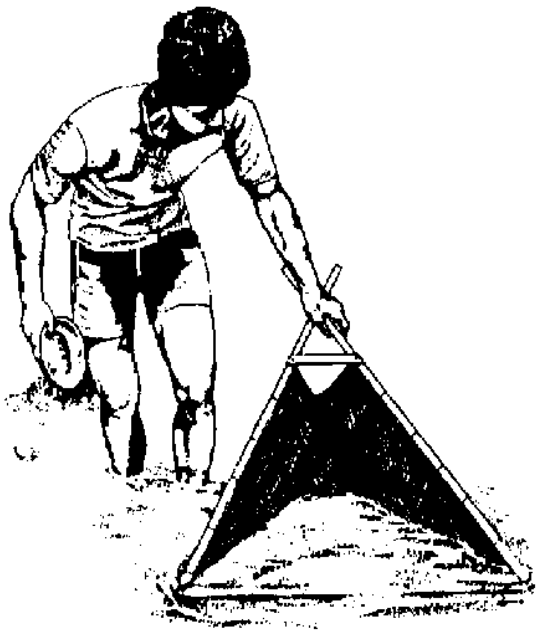
This is a stationary V-shaped barricade with bagnet placed hammock-like behind the narrow end. The walls or wings are made of split bamboo slats 3-15 m long or fine-meshed nylon netting with ends tied to poles (post) set firmly at the bottom ground. Tangab is set in shallow portions along river banks, estuaries and tidal creeks near the opening of the sea. The parts are detachable during impending floods. The fry are guided by the wings into the bagnet where they are scooped out. The Tangab can collect 3,000-20,000 fry in a day's operation.



Tidal set net or tangab

Skimming net (Hudbud)

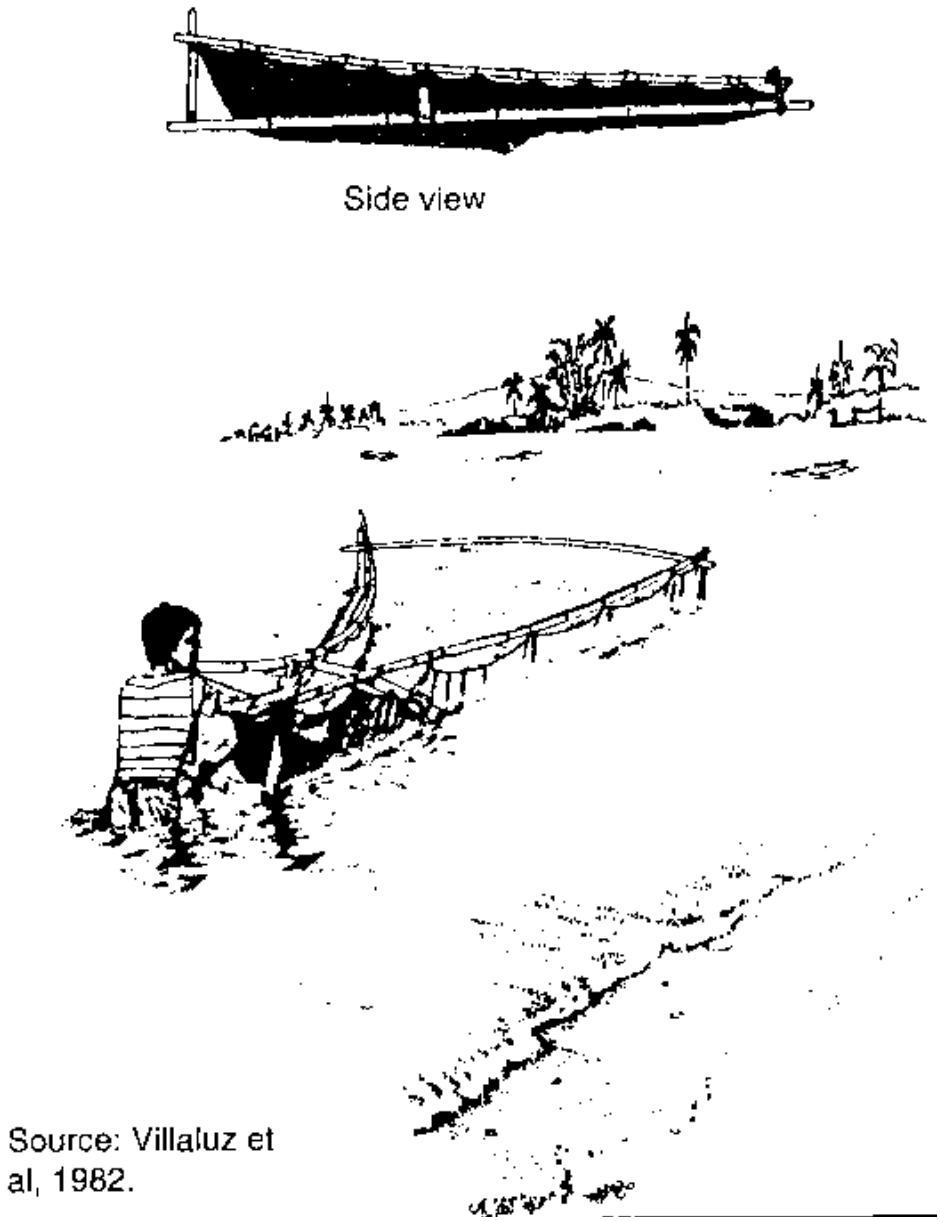
It is made of double sheet nylon netting (mosquito net), mounted on a triangular frame 1-2 m long and 1/2-1 m wide opening. It is pushed or towed in wading depths to deeper waters mounted in a banca. This gear is useful in mangrove areas that inhibit the use of the other types of active gears.



Skimming net or hudbud in operation. (Source: Villaluz et al, 1982)

Fry sweeper (Bakabaka)

This is a fan-like gear framed by whole hard bamboos and a detachable fine meshed nylon netting. The frame measures 2-4 m at the sides and 2-3 m at the opening. A bagnet is strung within the narrow end of the frame. Sinamay is usually sewn over the nylon net at the end portion of bagnet to prevent sticking of bangus fry in the nylon netting. The wings of the bottom net are provided with stone or lead metal sinkers. The sweeper is pushed along waistdeep to chest-deep waters for 28 hours depending on fry availability. Daily catch can reach from 200-2,000 fry.



Fry sweeper or bakabaka.

Double stick net (sarap or sagyap)

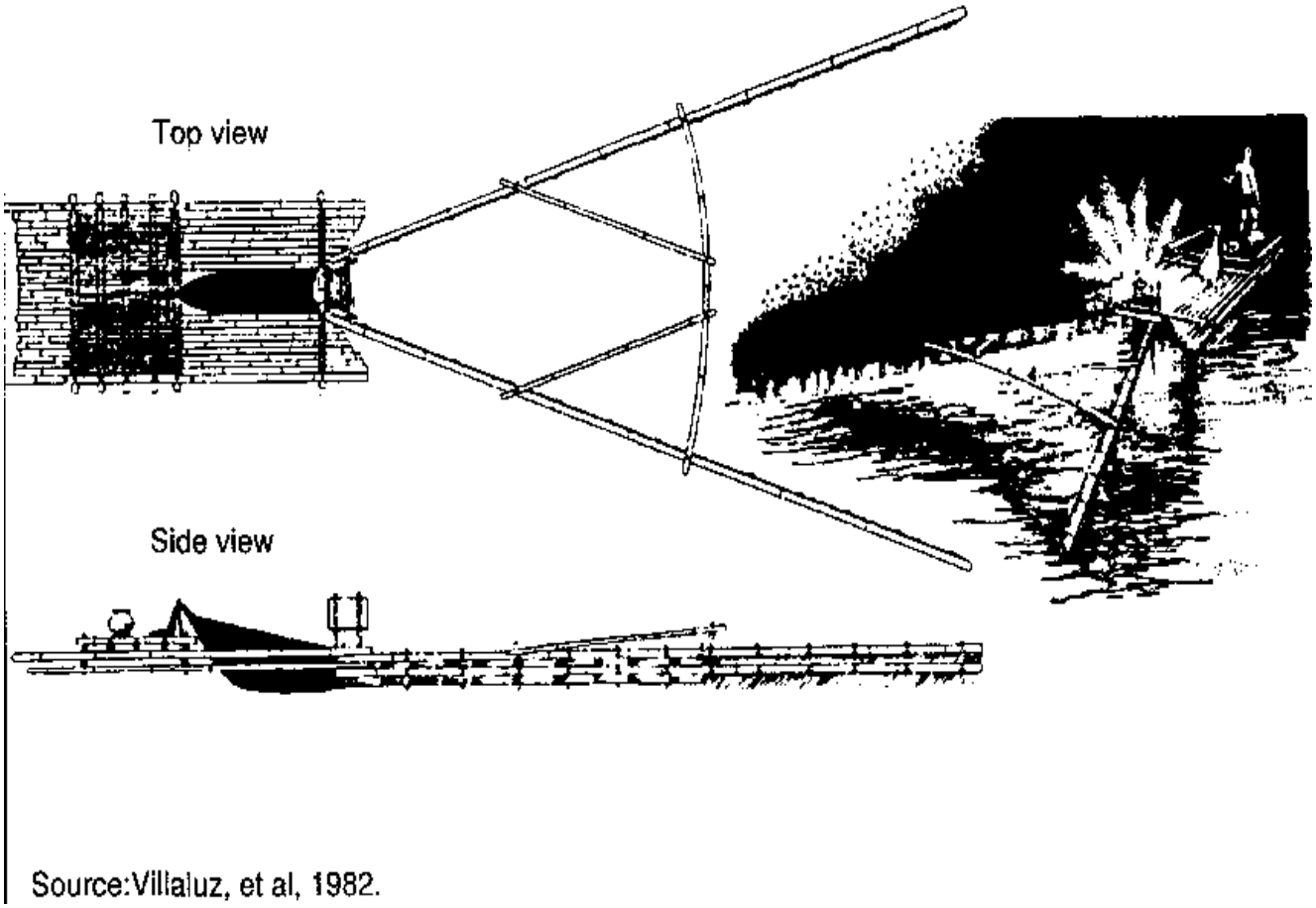
This is a rectangular seine held between two light bamboo poles. The net is made of fine meshed nylon (mosquito net) or sinamay cloth 1-1.50 m wide and 6-8 m long. It is operated in wading depths with two persons at each end dragging the net seine along the seashore. The catch can range from 200-1 500 fry in two to six-hour operation.

Double stick net or "sagyap"

Bulldozer

This is similar to the fry sweeper but is provided with bamboo platform (raft) along the sides of the bagnet and at the back . It is generally operated at night with a strong kerosene lamp (Coleman or Petromax) mounted in front of the bagnet. The bulldozer gear is propelled by bamboo poles by pushing. Sometimes, outboard motor is used. The catch ranges from 1,000-10,000 fry in three to sixhour operation.

Bangus fry are attracted to strong steady lights, hence the bulldozer method is recommended. Other collecting gears can also use strong lamps during night catching to increase efficiency of catching.



Bulldozer milkfish try catcher

Handling and marketing

The collected bangus fry are placed in well-ventilated containers, preferably wooden vats or big earthen jars filled with clean brackishwater. Keep them in cool areas. Overexposure to sunlight should be avoided. The fry are brought to the concessionaires' buying stations (or fry buyers/assemblers in the village if there is no concessionaire) without delay.

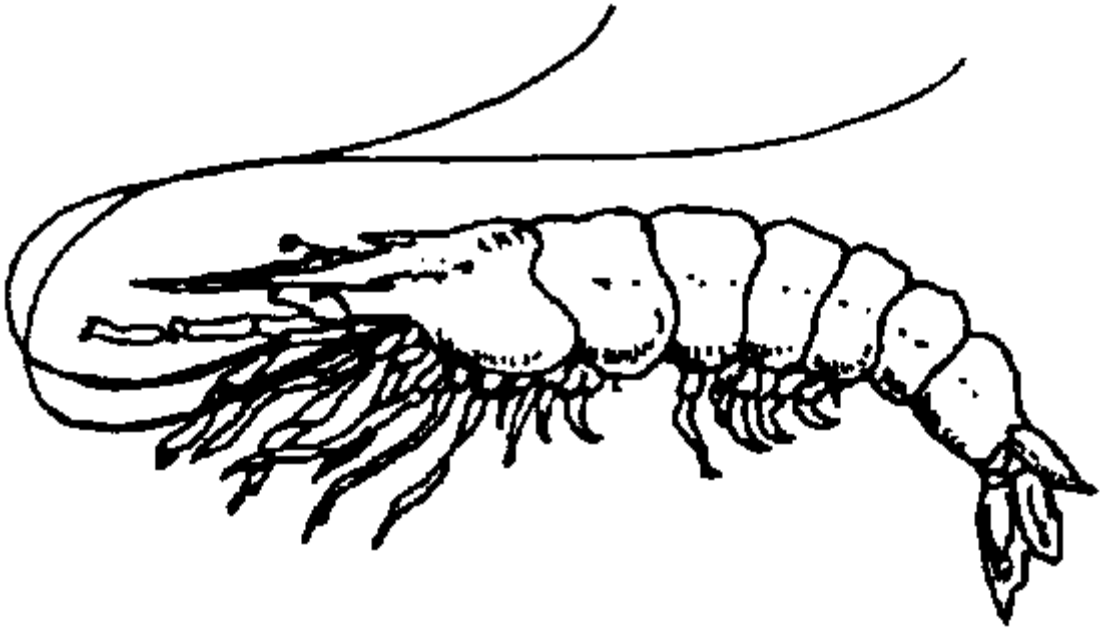
Economics of production-27,100 sq m milkfish pond

		Total value
		(in pesos)
Annual Revenue		
Sale of 5851 kg x P21/kg x 7 runs/year		122,871
Annual production cost (lime,		
fertilizer chicken manure,		
fingerlings, labor)		24,206
Fixed investment		27,100
Net return		
Annual revenue	122,871	
Less: Annual production cost	24,206	98,665
Return on investment		
Net return 98,665		
---------- = ----------		
Fixed investment 27,100		3.64

Source: Alvarez, Ramiro C., The New Modular System of Raising Milkfish, Greenfields, February 1991.

Prawn-fry gathering

Most black tiger prawn or sugpo (Penaeus monodon) growers in the Philippines are concerned with the efficient production of marketable and good quality prawns from post-larvae (juvenile to sub-adult) in brackishwater fishponds.



Penaeus monodon

Majority of the prawn growers believe that efficient production with high survival, good growth and relatively disease-free prawn fry will come from the wild (not hatchery-bred). It is also preferred by most prawn growers and commands a higher price than the nursery-bred fry.

Natural seasonal occurrence of prawn fry is normally observed in areas with mangrove stands along brackishwater (15-27 ppt salinity) areas. Fry catching has generated seasonal income among the coastal people, especially children, unemployed youth and mothers who cannot brave the high seas for fishing.

Spawning and fry stage (post-larvae)

The life cycle of the crustacean prawn starts when the female attains sexual maturity at the age of 10-12 months when mating occurs during the molting of the female. The gravid (pregnant) prawns go to offshore areas of 20-70 m deep to lay their eggs. Two or three consecutive spawning can release half to one million eggs that can take place in one season.

The eggs hatch 12-15 hours after spawning. After 10-12 days and two more larval stages, they metamorphose into post-larvae which are similar to the adults. The post-larval stage occurs in brackishwater areas.

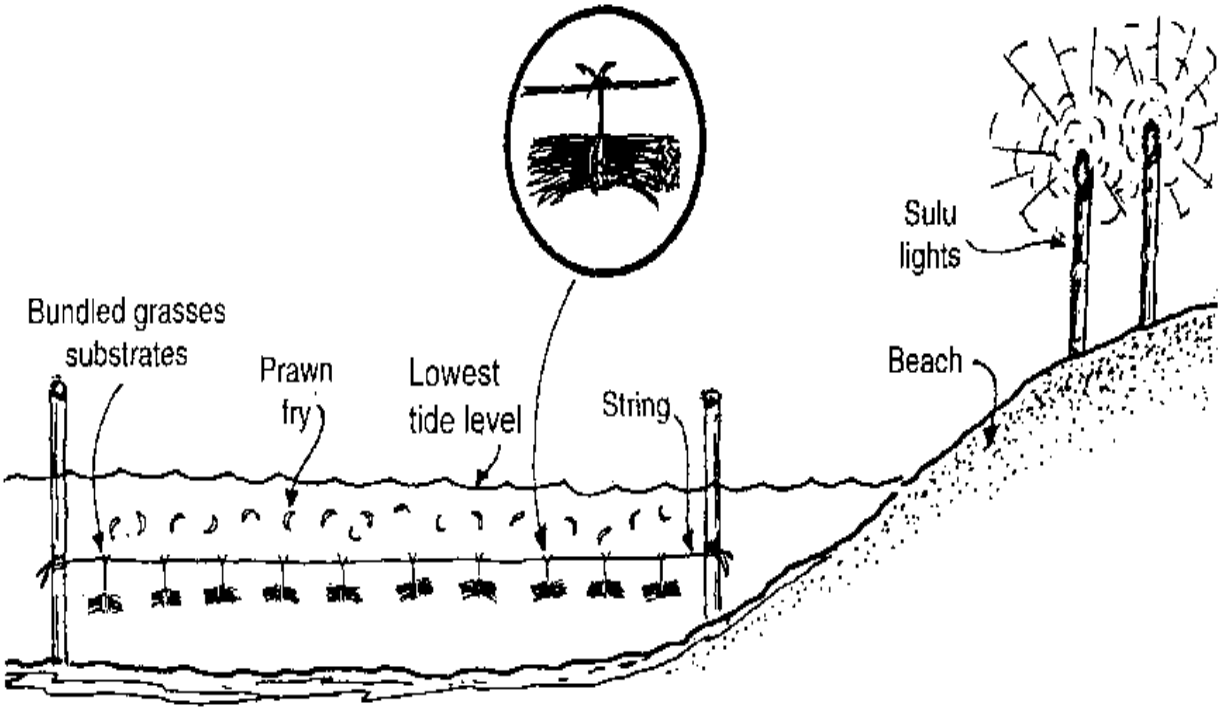
The adults remain in the sea (offshore) up to the old age of three to five years. However, some prawn species undergo spawning and stay in brackishwater without going to the open sea. Normally, the fry catching peak season is from September to February and May to June.

Methods of prawn-fry gathering

Most prawn-fry gathering municipalities still use the traditional method of fry catching—the hand net, push net (sagyap), fry sweeper and the fish corral type (tangab). Improved fry-catching technology not only increases catch that would otherwise be eaten by other fish species or lost, but also bigger income for fry gatherers.

An improved method of prawn-fry gathering is by placing several (5-20) bamboo torches (sulo) along seashores or near river mouths at night. Prawn fry is attracted by low-intensity moving lights. Fry catching can now be done during the night by using the fry sweeper.

Another improved method of catching prawn fry is with the installation of a series of bundled (tied) coastal grasses (dried or fresh) tied on long lines or rows of strings (plastic twine or No. 4 nylon rope). Place several sulo along the beaches or near river mouth and install several lines with bundled grasses tied to the lines at 40-50 cm distance of at least 20-30 m long. The rows or lines should be facing the sea. At night, the prawn fry are attracted by the sulo and, at the same time, cling to the substrates. Clinging to the materials (or bundled grasses of 5.08-7.62 cm diameter and 30.48 cm long) is an instinct of prawn fry for them to seek food source and as their shelter and sanctuary. Gathering of the fry is best done by using rectangular hand nets. Place the hand nets below the grass bundles, lift the grass line and shake the substrates so that the clinging fry will drop at the hand net. Fry gathering under this method can be done at dawn or daytime.



Prawn fry catching using the sulo and grass.

Prawn fry that are caught are placed in well-ventilated containers like pails, drums or wooden vats and kept in cool areas. Earthern jars or pots are used in bringing them to buying or concessionaire centers. Counting can be done by scooping the fry in the water.

Studies conducted in Western Batangas and Lubang Island (Occidental Mindoro) showed that higher catch by two to eight times is attained by using the improved method, using sulo and substrates versus the traditional ones.

Economics of production (prawn)

Assumptions	
Stocking density	less than 50,000/10,000 sq m
Water management	tidal or pump
Aeration	no aeration
Fry source	wild
Feed use	natural supplementary
Dike construction	Earthen
Crops/year	1-2
Harvest method	total harvest
Survival rate	60% or less
Production/cycle (kg.)	500 or less
Economics of production	
Capital investment (per ha)	
a. Pond development cost	P 30,000-50,000
b. Working capital	P 10,000-48,000

Total production cost per cycle	P 64,254.64
a. Direct cost	P 50,987.50
b. Indirect costs	P 13,167.14
Cost/kg output	1a 47.60
Net return per year	P 195,490.71
Return-on investment	1.09

An extensive system (stocks subsist on natural food grown with or without fertilization and pond water is changed through tidal exchange) of prawn culture requires a stocking density of less than 50,000/10,000 sq m and an investment requirement of P40,000-P98,000/10,000 sq m. With a survival rate of 60 percent, maximum annual production is approximately 1,000 kg. Annual production cost is P126,509.28 while net return is P195,490.71. Return on investment is 1.09 (Greenfields, Vol. 7, No. 1, January 1987).

Land-based activities

Processing

Salted-fish drying

Fisheries cover the whole operation of catching fish, processing or preservation and marketing of the product.

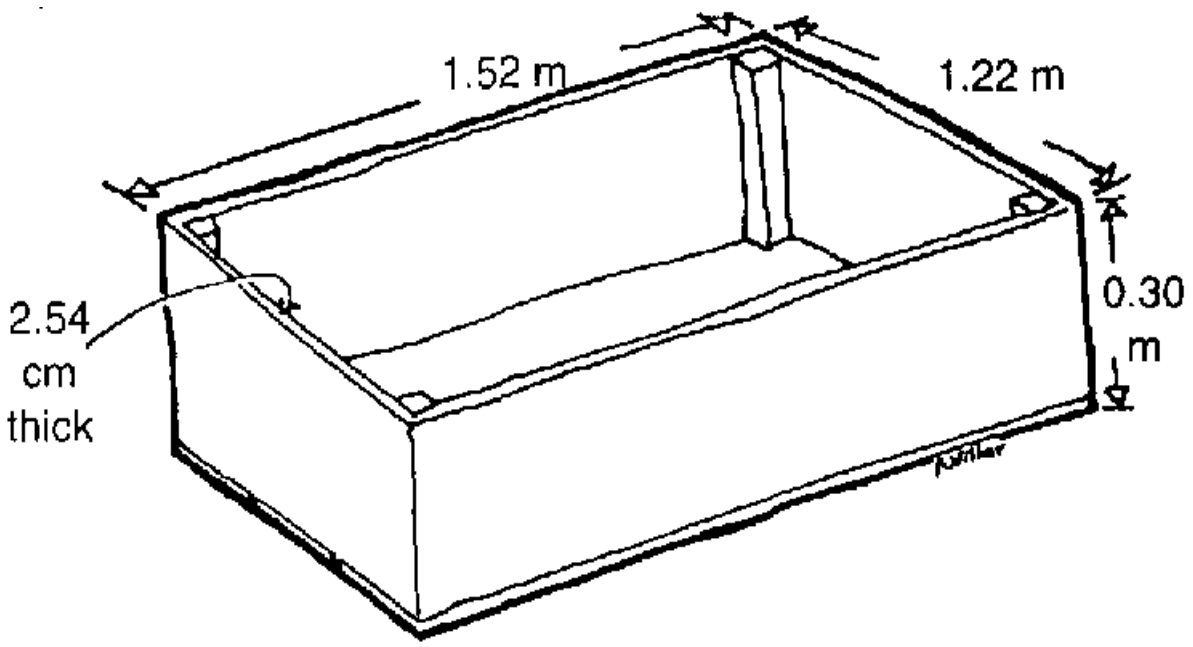
Due to the acute shortage of ice and lack of storage facilities in their villages, most fishermen have resorted to fish processing as an alternative for saving their catch from rapid spoilage. Fish can only last 12-15 hours in fresh condition after catching.

Preservation of fish is often an opportunity to use underutilized family labor and generation of employment in coastal areas. Salted dried fish processing is mostly done by women, children and unemployed youth who cannot go fishing.

Fish is easily spoiled due to microorganism activity (bacteria, etc.), chemical deterioration (breakdown of fats or enzymatic activity) and infestation (blowfly insect or vermins). There is no simple solution to spoilage, but there are preservation methods which can be applied to inhibit perishability. Deterioration starts when the fish die; and to slow down perishability, salting and drying fish is one process. In many cases, preservation improves product/market preference, increase quality and storage life and commands better prices.

Principles of salting and drying

Salt solution removes water from the fish flesh to a point where microbial and enzymatic activities are inhibited. Salty concentration of 6-10 percent in the fish tissue will prevent bacterial activity (UNIFEM, Food Technology Source Book, No. 4 1988). Microorganisms. known as hallophilic bacteria, are, however, saltloving; but, drying will stop these bacteria. Salt will penetrate into the fish flesh until the concentration is equal to the outside where no movement of water or salt occurs. The brine solution can be used further by boiling to remove surface foam and adding more salt as required. Boiling of the unused brine solution by evaporation will result to crystal salt recovery; but processors do not practice this.



Soaking vats or tubs made of wood

Drying is the transfer of moisture from the product to the air. The two stages of drying is the removal of (a) surface moisture and (b) the internal moisture from the fish. Drying is effected by (a) air movement and (b) heating by the sun. Sun-drying salted fish is the common practice in the Philippines.

Methods of salted fish drying

The use of crystal white coarse salt is preferred. Preparation of the brine solution is generally practiced in the Philippines, using three mixture ratios to suit various fish species and consumers' preference. They are:

1. 50 kg (1 sack) salt is dissolved in 100 liters water (strong solution)—Ratio 1:2

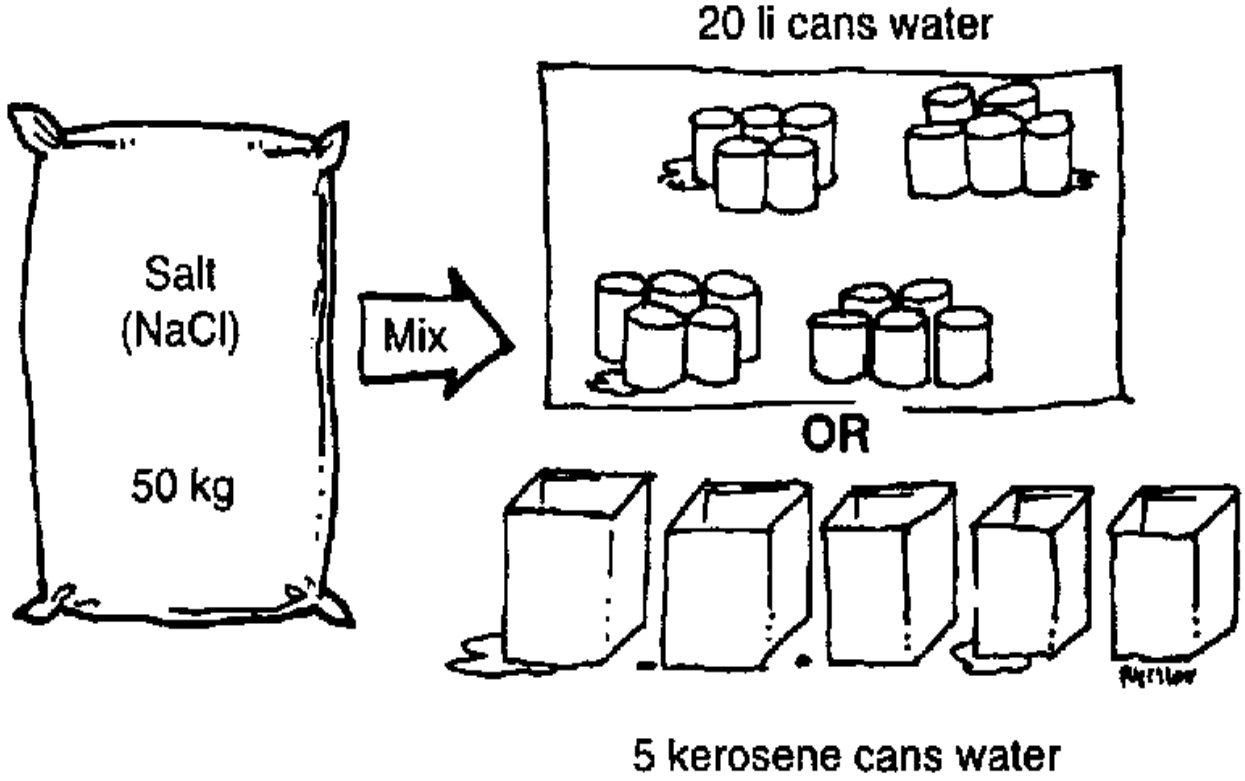
2. 50 kg salt is dissolved in 150 liters water to form a medium brine solution—Ratio 1:3.

3. 50 kg salt is dissolved in 200 liters water to form a light brine solution—Ratio 1:4.

Mix the solution thoroughly by continuously stirring with a wooden paddle until all the salt is dissolved. Use wooden tubs or vats as brine containers. This can be a discarded wooden boat or dugout or fabricated lumber.

Clean the fish thoroughly from slime and dirt by washing them in clean water. Drain the fish in about 20 minutes and soak them in the brine solution for two to five hours. Soaking time depends on the species of fish. Small fish, like sardines and mackerels, normally requires two to three hours. Large fish are soaked for three to five hours. Usually, large species need splitting and

removal of gills and guts. The size, oil content and flesh texture determine immersion time. Quality of salted dried fish depends on the state of freshness prior to processing.

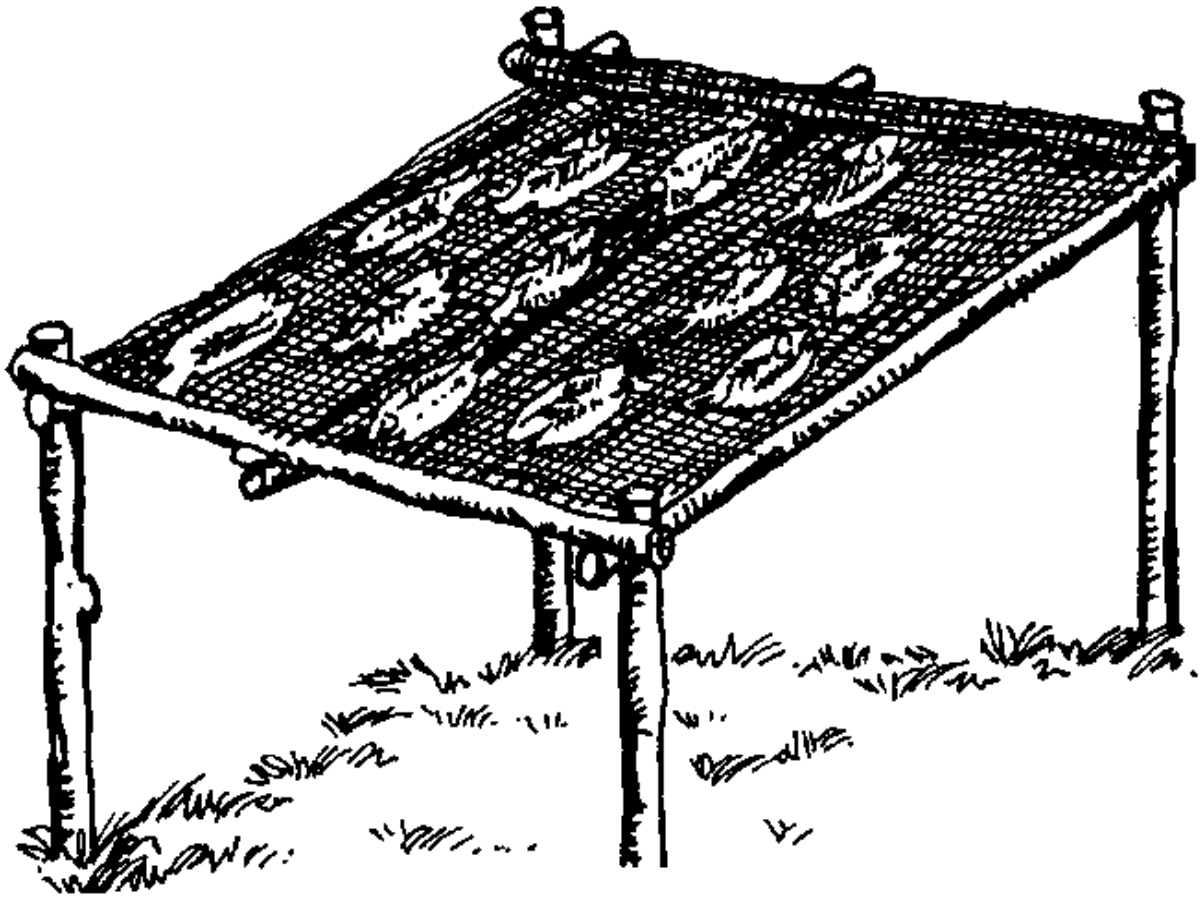


Mixing ratio of brine solution: 1 sack salt/50 kg mixed with 5 kerosene cans (20 liters) water.

After soaking, dry them in mats (bamboo or burl), nets, trays, bamboo slats or covered ground. Drying can last from three to six days depending on light intensity, wind movement, fish species and thickness of flesh. An indication of well-dried fish is the reduction of weight from, 65-75 percent or moisture content of dried fish from 14-18 percent.

Many commercial fish-drying areas are located in isolated small islands or far from population centers which are free from house fly (bangaw or langaw). The blowfly usually lay their eggs during drying and, later, the eggs hatch into maggots or worms that damage the processed fish. Thorough drying will minimize rotting. Do not use insecticides as commonly practiced in many places, because of their harmful effects to health.

The dried fish are usually packed in wooden crates with wax paper lining or corrugated boxes with newspaper lining for shipments. For local marketing, wooden, bamboo or rattan baskets are used.



Tray method of drying salted fish.

Economics of production—salted-dried fish (Roundscad)

	Value	Total value
	(in pesos)	(in pesos)
Annual Return		
1,300 kg dried fish/month at		
P27.50/kg x 10 months		357,500
Annual Production Cost		
30,000 kg fish x P10/kg	300,000	

7,200 kg salt x P1.30/kg	9,360	
13,000 pcs plastic bag x P0.08/pc	1,040	
Water at 4/day x 200 days	800	
(2) laborers at 25/day x 200 days	10,000	
Interest	3,726	
Depreciation	171325,097	
Fixed Investment		
(1) unit brining tank	200	
(1) unit plastic sealer	290	
Knives and other utensils	20	
(20) pc drying trays at P3/pc	60	570
Net return		
Annual return	357,500	
Less: Annual production cost	325,097	32,403
Return on Investment		
Net return 32,403		
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Fixed investment 570		56.85

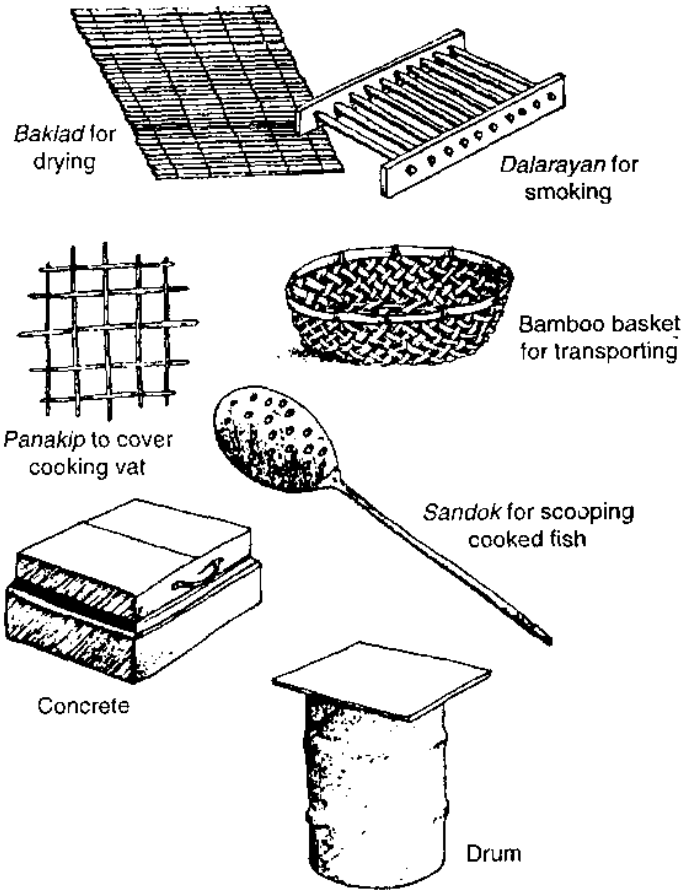
Source: Technology of Improved Drying Method of Roundscad, PCAARD, Vol. Vl, no 3/84,1994

Salted-smoked-fish processing

While salted-fish drying is commonly practiced in remote, rich fishing grounds, salted-smoked fish (tinapa) is mostly done in urban centers. Salted-fish drying is done mainly to prevent deterioration, but smoking fish is done to improve taste and flavor. The quality of smoked fish is highly dependent on the degree of freshness of the fish. More and more people are shifting to smokedfish preference and it is fast becoming a delicacy food. Smoked fish may even be more profitable than fresh fish because of demand and preference.

Principle of smoking

The preservative effect of the smoking process is due to the drying and the deposition in the flesh of natural wood smoke chemicals. Smoke from burning wood contains compounds that inhibit bacteria, while heat from fire causes drying. The longer it is smoked, the longer the fish will keep. Avoid resinous types, like pine that imparts unpleasant flavor and taste. Also, do not use poisonous types of fuelwood like Euphorbia. Smoking techniques do not preserve the fish but are merely cosmetic to produce smoky flavor (UNIFEM Food Technology Source Book, No. 4, 1988).



Materials for smoking fish

Processing method

The materials needed are: Baklad (bamboo strips) for drying, dalarayan (tray) for smoking, bamboo baskets, vats or tubs, brine solution, oil drum smoker, smoking trays and fuelwood or smoking materials.

The popular fish species suited for salted smoked fish are: sardines, mackerels and milkfish.

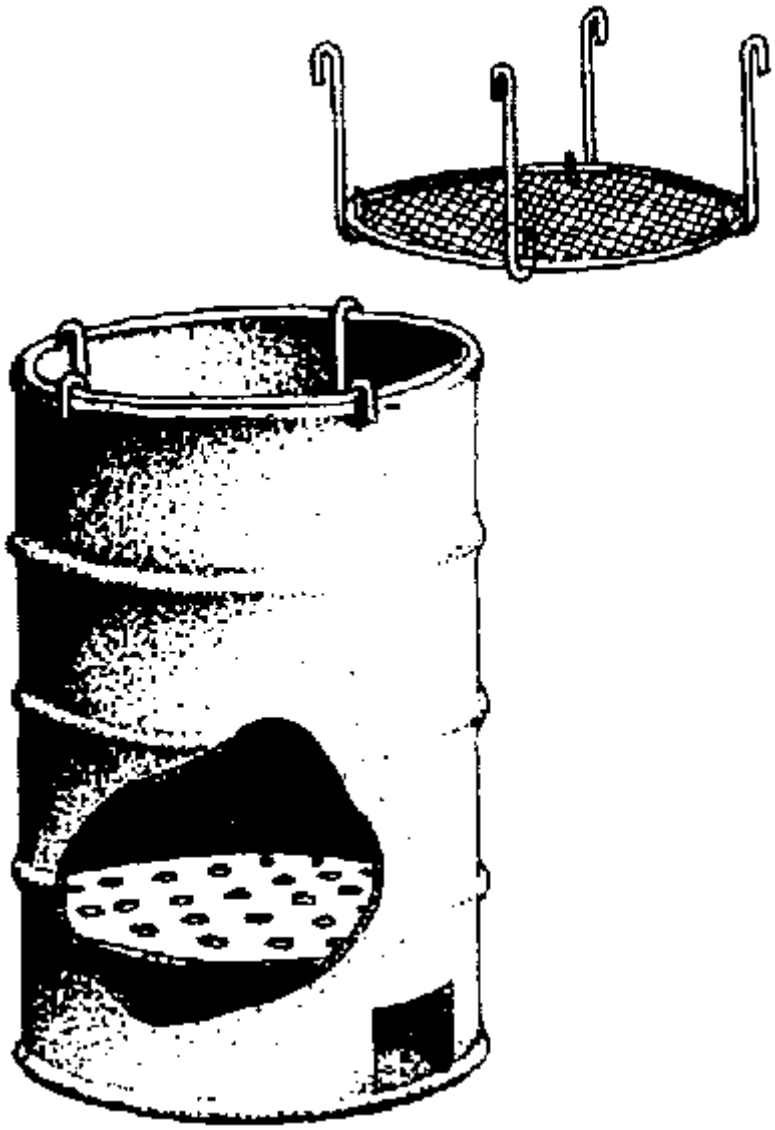
Fish are cleaned by thoroughly washing them with clean water (sea or fresh). Large fish are gutted. Fish are soaked in light brine solution of 2 kg salt to 20 liters of water. Soaking time depends on the size of the fish, ranging from two to four hours. Salted fish are placed in baskets of wood or bamboo strips. They are suspended in aluminum kettles or boilers until the fish is slightly cooked (two to four minutes boiling). The fish are dried in baskets or trays and left to cool overnight.

Arrange the salted cooked fish in smoking fish trays horizontally and place them inside the smoking furnace (oil drum). The furnace is heated below by smouldering with charcoal, sawdust, wooden chips or semi-dried leaves. Smoking time varies depending on the size and taste desired. Common practice is until the fish is thoroughly dried. The position of the trays is alternated frequently to provide an even curing and smoking.

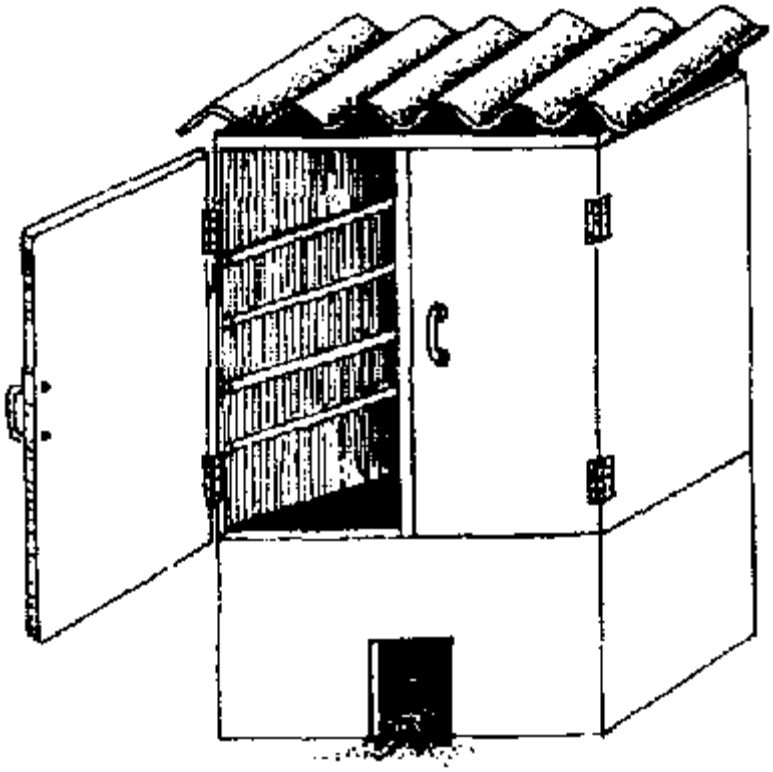
Cool the smoked fish and pack them in woven rattan or bamboo baskets. Storage time can last from four to eight days at ambient temperatures.

Cylindrical ovens, made by joining two opened oil drums, are used by artisanal processors. A stoke hole is cut at the base of the oven in which a fire is made. A perforated metal sheet can be inserted inside the drum just above the fire to act as a smoke spreader. Trays are suspended towards the top of the drum to hold the fish.

The simple version of an Altona oven consists of a brick or cement fire box located below a smoking chamber made of metal. The fish are placed on trays which slide into the smoking chamber. Many other versions of this kiln have been constructed, using less expensive materials, such as mud or fired bricks instead of metal.



Oil-drum smoker



Altona-type oven

Economics of production—smoked fish (milkfish)

	Value	Total value
	(in pesos)	(in pesos)
Annual Revenue		
Sale of 2,500 kg/month		
x 18.50/kg x 10 months	444,000	
Annual Production Cost		
30,000 kg of fresh bangus x P12/kg	360,000	
200 sacks of salt at P50/sack	10,000	
Water at P4/day x 200 days	800	
Firewood at P20/day x 200 days	4,000	

400 sacks sawdust x P30/sack	12,000	
250 kw/mo of electricity x		
P1.16/kw x 10 months	2,900	
2 laborers x P30/day x 200 days	12,000	
Interest	5,180	
Depreciation	1,087	407,967
Fixed Investment		
(1) unit brining tank	4,000	
(2) units cooking kettles	1,000	
(20) pcs bamboo trays	3,000	
(20) pcs bamboo baskets	300	
(2) units concrete stove	600	
(3) units drum smoke house	600	
Knives and utensils	500	10,000
Net return		
Annual revenue	444,000	
Less: Annual production cost	407,967	36,033
Return on Investment		
Net return 36,033		
---------- = ----------		
Fixed investment 10,000		3.60

Source: Canning of Smoked Bangus, PCAARD, Vol. Vll.

Other livelihood endeavours

Duck raising

Remote coastal areas often lack the supply of poultry meat and eggs essential to good nutrition and health. If it is available, the price is more expensive compared to urban centers.

One alternative is duck (itik or bibi) raising. Duck raising does not need much labor and care. This allows mothers, children or other members of the family to engage in a profitable food-based enterprise. Ducks are efficient producers of animal protein for the family and provide extra income.

Ducks require simple shelter, are resistant to common poultry diseases and can thrive on feeds locally available. It is an economical, useful and multipurpose water fowl appropriate to coastal areas.

They grow best along watered areas. The presence of mangroves, seagrasses and coral reefs in most coastal areas are rich natural sources of food. Ducks are voracious eaters and efficient scavengers.

In many coastal areas where malarial disease is prevalent (because of the presence of mosquito larvae that thrive in brackishwater), duck raising can minimize-if not control-its incidence by feeding on mosquito larvae (worm-like). However, a few crops in coastal areas can also be destroyed by ducks.

Duck (itik or bibi)

Breeds

The traditional multipurpose breed is white or black; the most commonly raised in most rural areas, it can lay 100-120 eggs per year. The improved Pateros breed can lay 120-200 eggs per year. The egg-type Khaki Campbell breed can lay 200-250 eggs per year. Newly-introduced hybrid-egg types, like CV-2000, can lay 250 eggs and up. The recommended breeds for coastal areas are Muscovy and Pateros (mixed colors).

Different production methods

There are four commonly used production systems in the Philippines.

Scavenging system

This is most widely used in coastal and inland areas. A flock of 3() and below are allowed to range free over the village and return to the homeyard in the evening.

Herding system

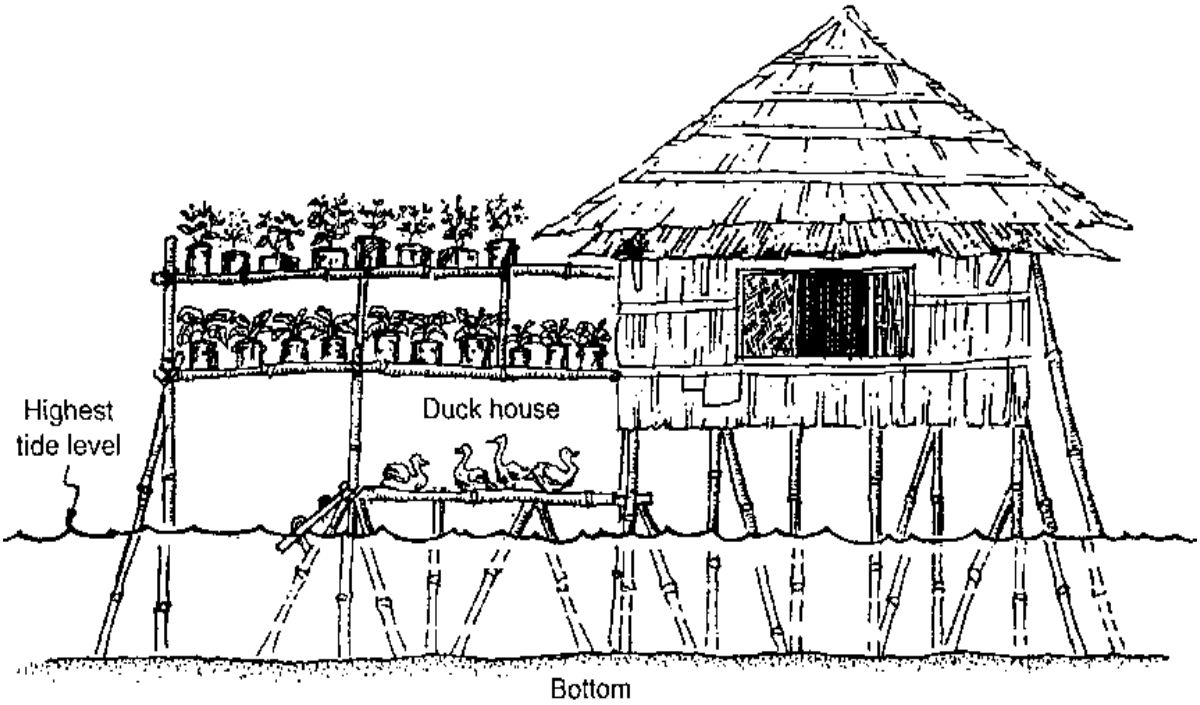
Growing or laying ducks is allowed into wet lands, irrigation areas or harvested paddy fields scavenging for food during the day. They are herded into enclosures during the evening and night. If the natural feed supply is exhausted, they are transferred to other feeding sites.

Landing system

This is common in South Kalimantan (Borneo), Indonesia, where vast tracts of swamplands are available. The ducks arc provided with floating houses with fences on rafts. They feed on aquatic animals and plants given to them or by scavenging.

Confinement or intensive system

This is practiced by commercial growers with large flocks of more than 100 birds. They are kept in pen systems with shelters and are fed with available, commercial feeds.



Proposed design of duck shelter in coastal areas.

Management and care

A household may start with 15 birds of 13 female (ducks) and 2 males (drakes), as its source of food and income.

Most houses within tidal fluctuations have their own open porch for drying fish, etc. One can build the ducks' shelter under the porch or under the house. A one-half meter clearance from the highest tide level area should be allowed below the flooring of the ducks' house. A three-feet clearance from the family house floor to the ducks' house floor is enough. This can be done by using bamboo slats that are closely nailed to the flooring. Bamboo fences may also be provided. Place rice straw or other grass materials on the floor as litter. Provide nests for laying or brooding. One can use bamboo, discarded tires or other containers as feeders. Also, provide ladders. Ducks in coastal areas usually perform well because of the presence of aquatic and marine animals, like fish, snails, larvae, etc., and water plants, such as algae and grasses which they can feed on. Supplemental feeding may be done with kitchen leftovers, trash fish, rice bran, corn, cassava and other grains that can be bought for extra feeding, if necessary.

Allow at least two to three ducks to brood their eggs as replacement stocks. The rest of the eggs may be used for family consumption and/ or sale. Peak laying of ducks is 18 months after six to seven months. Dispose or sell all the flock after the 1 8-month period, if there is a replacement available.

If the village has a history of recurring common fowl, diseases like Avian Pest, Fowl Pox and Fowl Cholera, request the services of the Municipal Livestock Technician for vaccination of the birds.

Economics of production—duck raising

Raising ducks may be a profitable project, especially in a rice-growing area with sufficient supply of water. Based on the experience of Mr. Antero Villareal of Barangay Plaridel, Llanera, Nueva Ecija, who started with only 200 ducklings in his 500-sq-m backyard and P7,000 as seed capital, a net profit of P17,850 from sales of fresh duck eggs was realized after five months. In 1987, he again bought 2,500 female ducklings at P8.50 each from Pampanga. He earned a net profit of P 150,000 from the eggs laid by 900 ducks in 1989 and used the money to buy the 20,000 sq m ricefield he is cultivating.

Today, he owns a balut factory and his 800 ducks provide most of his freshegg requirements: 600 for sale daily; 2,000 for salted eggs; 12,000 for balut production every three days; and 3,000 for hatching every week. His market extends up to the Munoz-San Jose City area (Greenfields, June 1993).

Pot gardening for coastal areas

Majority of the houses in the fishing communities in Southern Philippines or Mindanao are constructed in areas within tidal influence. Hence, there are no lands to grow vegetables.

Far-flung coastal fishing villages are practically isolated from the sources of vegetables important to nutrition and health. Vegetables in town centers are also quite expensive. A fisherman in Mindanao can catch enough fish for his family's consumption; vegetables, however, are quite in short supply to achieve a balanced or improved nutrition.

Yet, a combination of vegetable and fish preparations is not only more nutritious but also more palatable.

Vegetable gardening may provide part-time employment to family members. Mothers or youth can raise vegetables in pots. In general, common vegetable varieties, like eggplants, tomatoes, pechay, etc., do not require complex technology.

Fisherfolk families are now oriented and encouraged to diversify available household labor to engage in meat, egg and vegetable production not only to provide variety of food for better nutrition and health but also for added income.

Pot gardening

A 50-container vegetable garden can be attended to easily as a part-time activity of fisherfolk. Plastic bags, tin cans, clay pots or indigenous materials, like bamboo, discarded wooden boat and coconut husk, may serve as growing pots.

Mindanao has the longest rainfall belonging to Types II and IV climatic zones of at least eight months' wet season. This is about the growing period of most seasonal vegetable varieties, like beans, squash, tomatoes, eggplants, spinach, etc. Extra water containers from rainwater can be provided for the 50 vegetable pots.

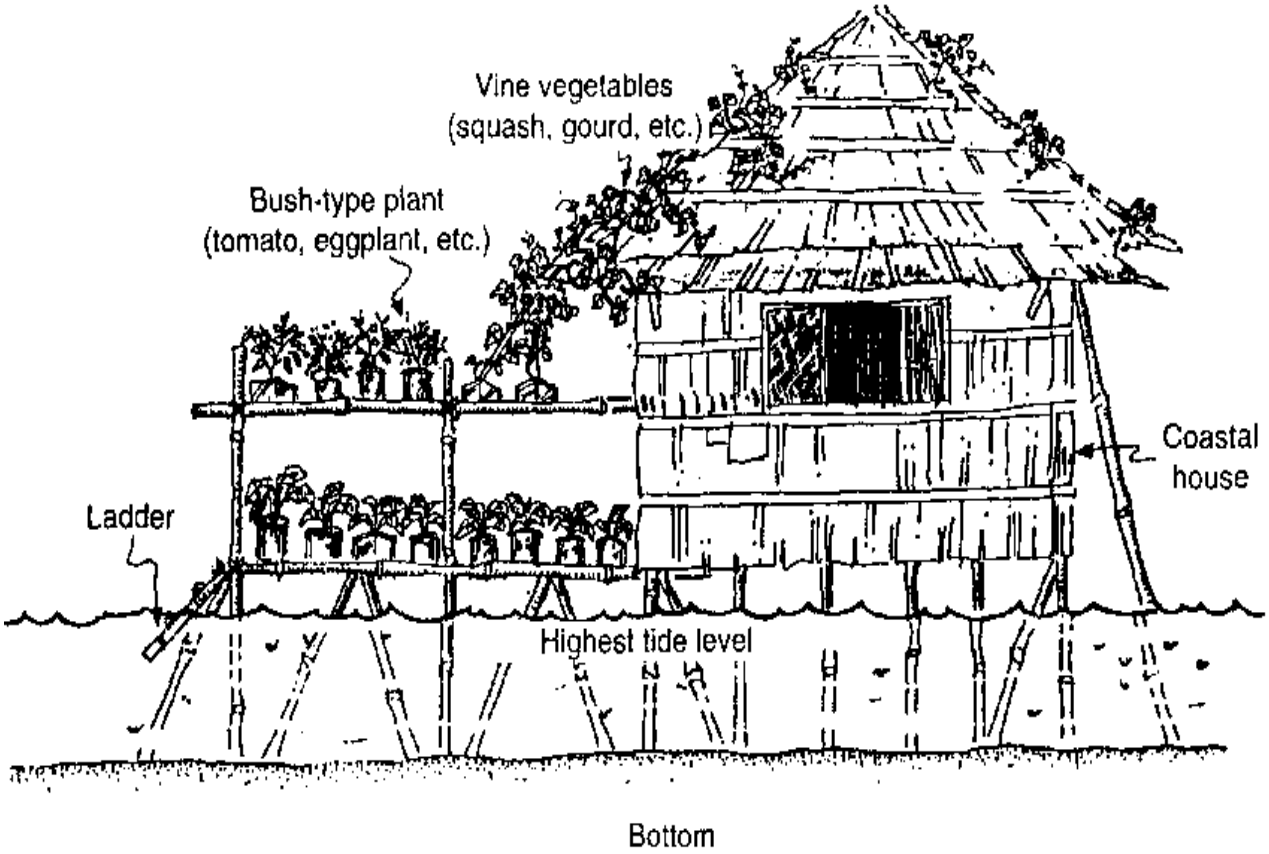
A community-type vegetable nursery is one of the priority projects of Agricultural Technicians (ATs) in the villages. The ATs can also provide the necessary training and information for various vegetable varieties. With 50 vegetable pots or containers, a fisherman can raise at least five kinds of vegetables of 10 plants each.

Methods of pot gardening

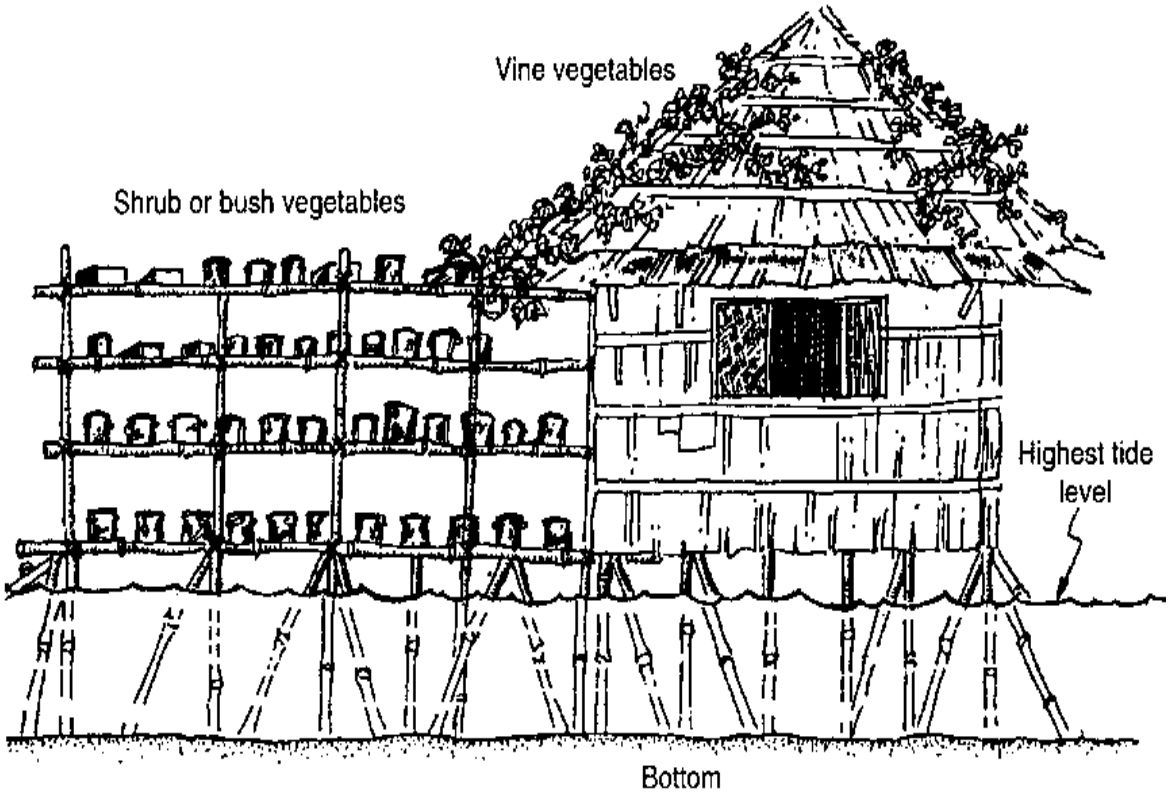
Mix one-fourth part compost or animal manure with one-third part of garden soil (preferably coming from rich, light to medium soil). Fill up the containers with the soil mixture.

Vegetables that are large-seeded, like beans, squash, etc., can be planted directly to the pots. Sow small-seeded varieties' like tomatoes, pechay, etc., first in seedbeds for two to three weeks before transplanting them. Vine plants, like squash or ampalaya (bitter gourd), can climb the rooftops of the house or porch.

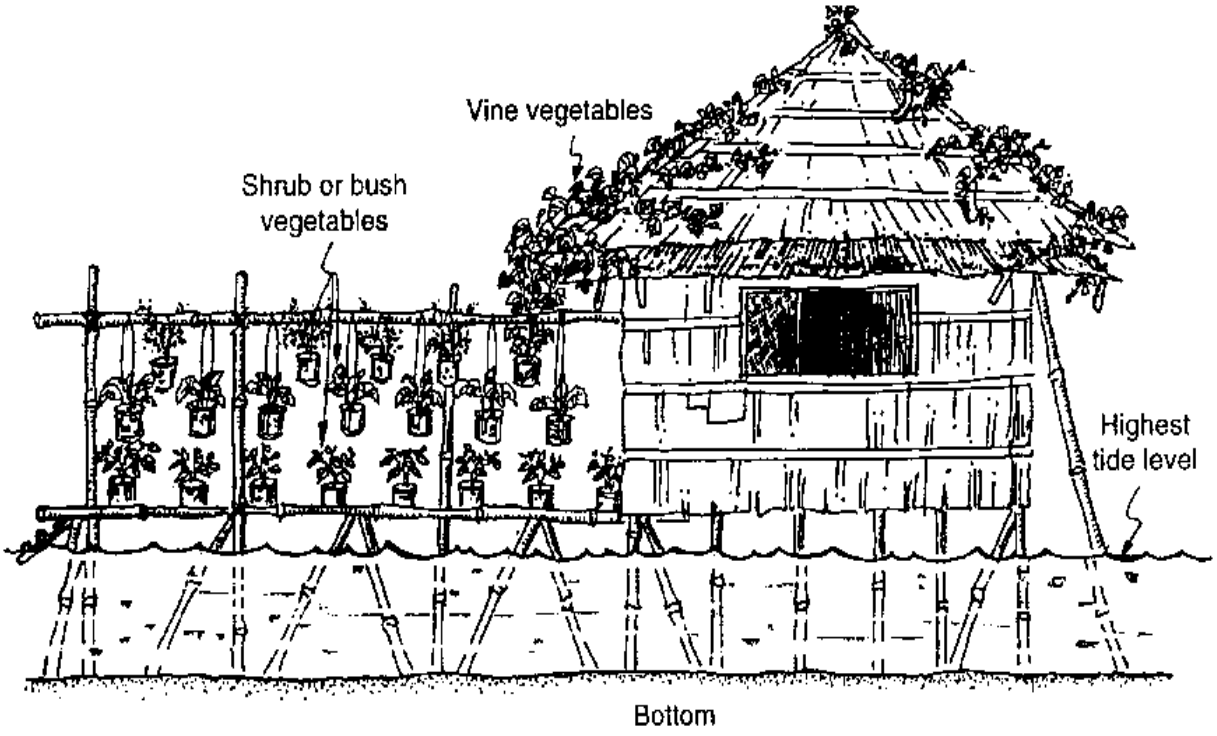
Almost all houses above water have porches for many uses, such as for drying salted fish, for fishing paraphernalia, etc. A bamboo or wooden rail may be provided at the edges of the porch to place the pots. Another way is to place three to four rack-type bamboo or wooden tiers to place the pots. Three to four horizontal poles can also be used where you can hang the containers.



Rail-type pot gardening for coastal areas.



Rack type of vegetable pots.



Hanging type of vegetable pots.

Care of plants

Pot gardening under coastal conditions is believed to be less prone to vegetable pest and diseases, although this is not yet properly documented. Do not spray pesticides in the vegetable gardens because of their bad effects. Instead, use plant repellents, like marigold flower, etc. These can also serve as decors, beautifying a fisherman's house. In addition, ducks eat insects which minimize pest infestation.

Most vegetable varieties do not require too much water. When there is no rain for five to seven days, some varieties need watering.

Additional compost can be done during replanting. Some vegetable varieties like, tomatoes, eggplant, etc., can be pruned and fertilized to produce new growth. Pruning vegetables also hastens harvesting.

Harvesting

One-time harvesting can be done on short, leafy vegetables like pechay or mustard after 50-60 days. Most fruit vegetables are harvested continuously. Part of the harvest can be sold to neighbors or nearby markets.

Production

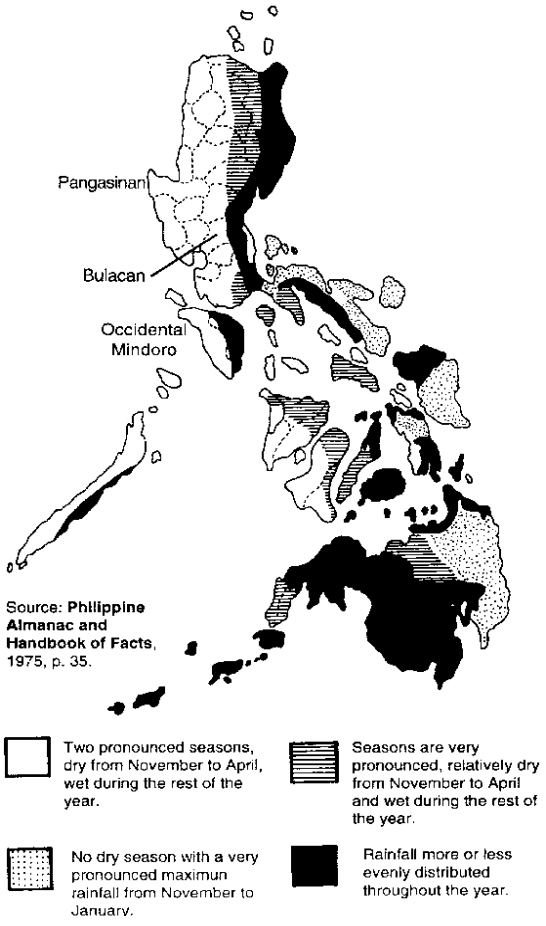
Practically, the expenses in coastal pot gardening are very minimal. Seeds can be requested free from neighboring inland villages or public nurseries. Containers can be collected from nearby villages. Expenses can be incurred in putting up rails, racks or hangers for the pots. A 50-pot garden will need at least P250.00. Depending on the combination of vegetables to be grown, one popular vegetable in great demand is eggplant. The eggplant can give at least 40 fruits per fruiting season of four to six months. With 50 plants producing 40 fruits, one can have 2,000 fruits. This will easily give an income of P1,000 (lowest estimate) in one-half year.

Vegetables are high-profit crops in coastal areas.

Salt production using Plastic sheets

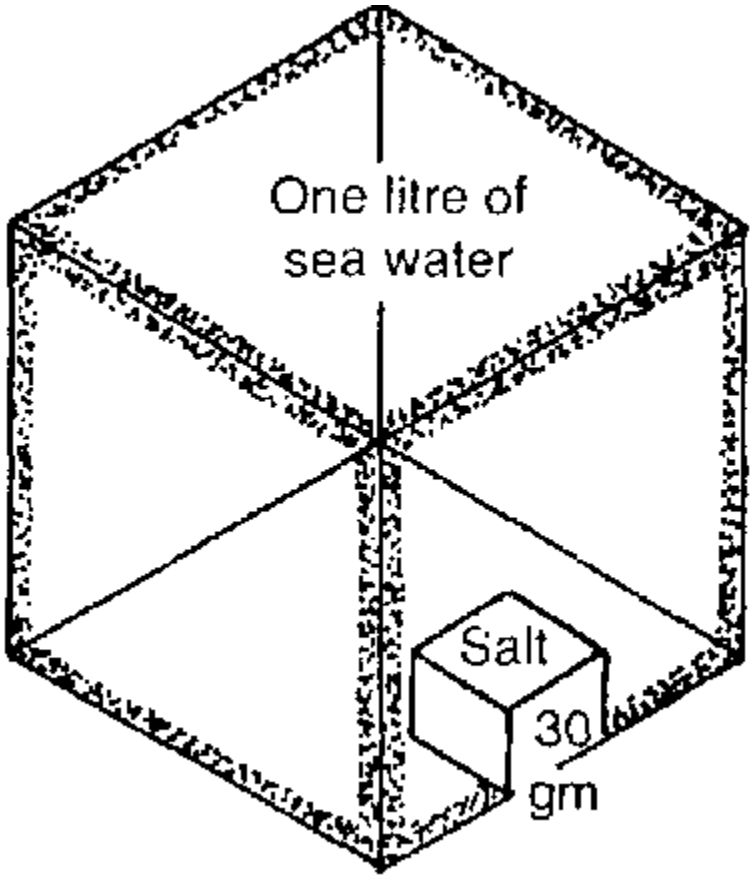
Table salt (sodium chloride) is an important product in the coastal areas for household and industrial uses and especially for fish processing like salted-fish drying, fish sauce (patis) and fish paste (bagoong). Salt production can be done by family members who do not brave the high seas for fishing. Housewives, youth and children can undertake the work. The production technique being advocated here puts idle and barren open coastal lands into productive use and minimize mangrove destruction from the pond-tile method of producing salt.

Traditionally, the coastal provinces in the Philippines with the Type I climate of distinct dry and wet seasons, like Paranaque, Bulacan, Pangasinan and Occidental Mindoro, are the biggest producers of salt. However, due to the conversion of salt ponds into subdivisions and prawn culture in the 1980's in the first three provinces, Occidental Mindoro is now the number one producer of salt. Salt production, using plastic sheet, is now recommended for various coastal areas, regardless of the type of prevailing climate. It is also about 80 percent less expensive than the traditional pond-tile method. The plastic ponds can be provided with roll-over plastic cover in case of rainfall.



Climatic types of the Philippines

Salt-making unit using plastic sheet



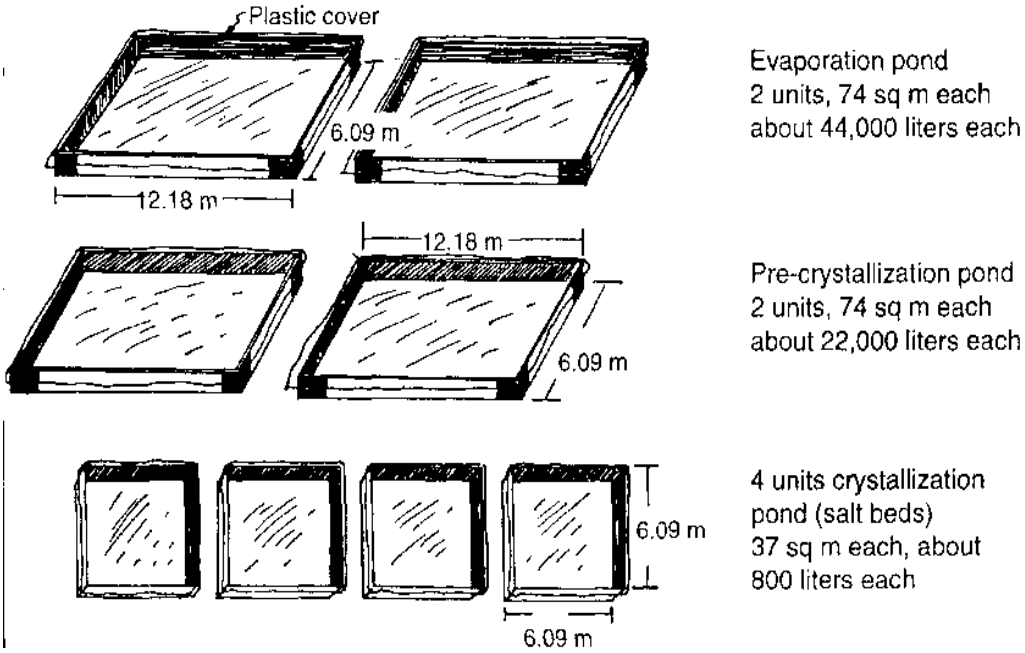
Sea water contains 30-40 g of salt per 1000 cc or 1 liter (30-40 kg of salt per 1000 liters). One kilo is about 1 liter.

The plastic ponds have a perimeter frame of 5.0 cm thick lumber (preferably coco lumber where wood lumber is expensive) with varying widths.

The plastic sheet should be black, with thickness of at least .025 mm. Seawater evaporate 2.62 cm more quickly on black color than on white or light color which reflects sunlight.

It is recommended that one-unit plastic pond shall consist of two units rectangular evaporation ponds measuring 12.0 x 6.0 x 0.6 m; two units pre-crystallization rectangular saltbeds measuring 12.19 m x 6. l 0 m x 38.10 cm; and, four units crystallization square saltbeds, measuring 6.0 m x 6.0 m x 7.50 cm.

Provide strong posts where the lumber frames are nailed. Hold the plastic sheets in place with thumbtacks.

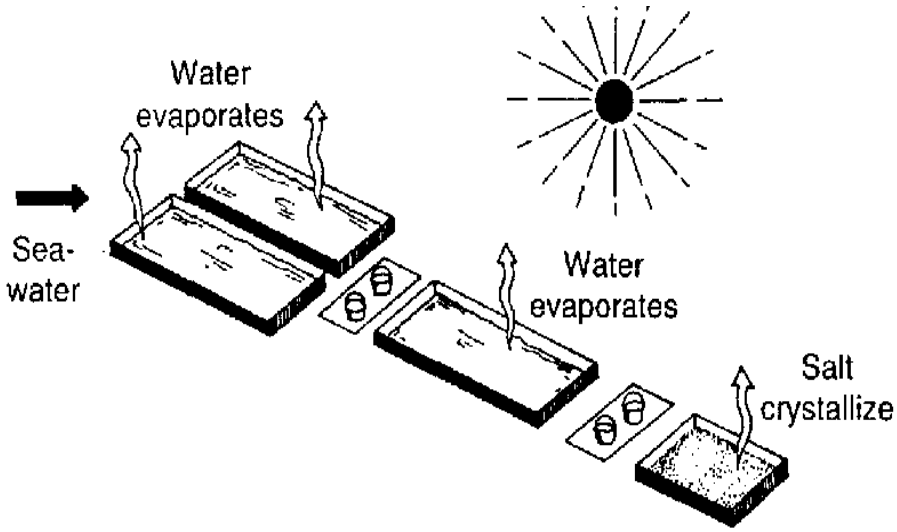


Proposed small-scale plastic-solar salt production

The land should be well-leveled and cleared of all plants and sharp objects (stones, nails, coral, stumps) that can damage or make hole to the plastic sheet. The land should also be wellcompressed before the frames are placed.

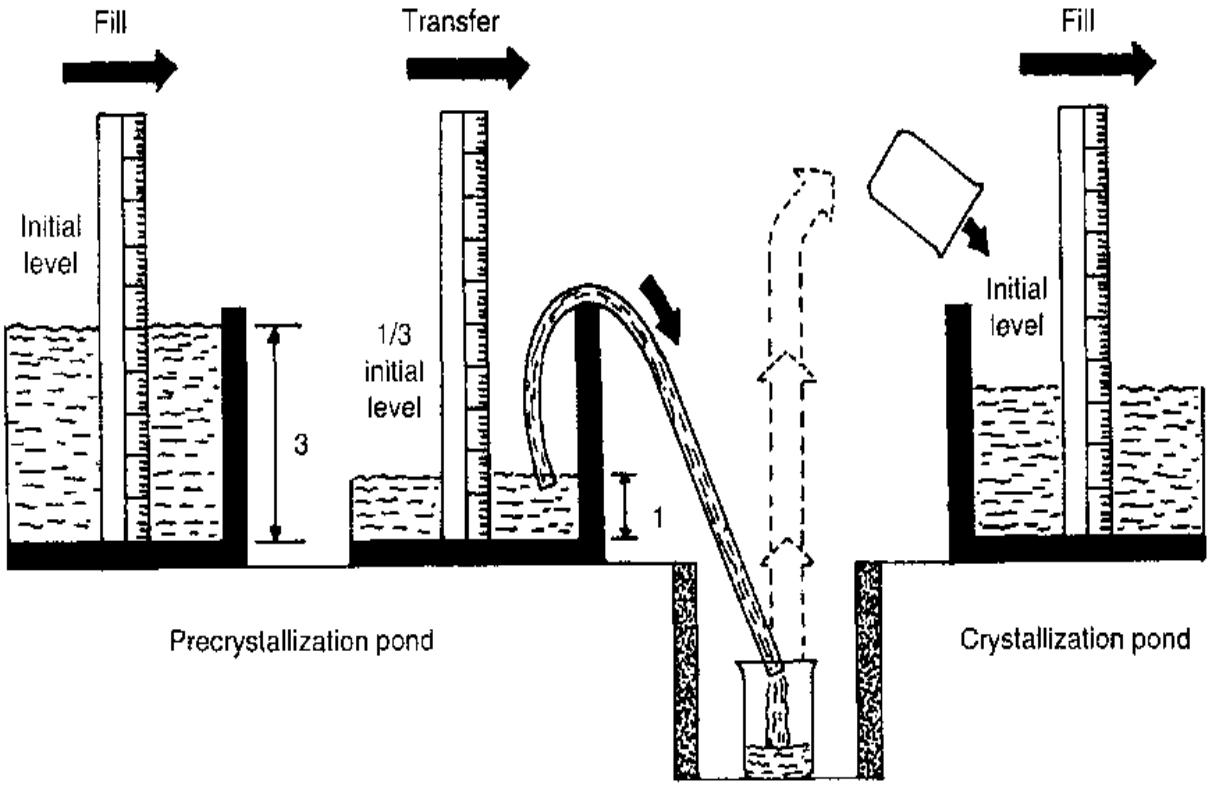
1. Usually, three sets of ponds are needed— evaporation, concentration and crystallization)

2. The position of the different ponds should be gradually sloping towards the lower elevation or drain.



Process of sea water evaporation pond

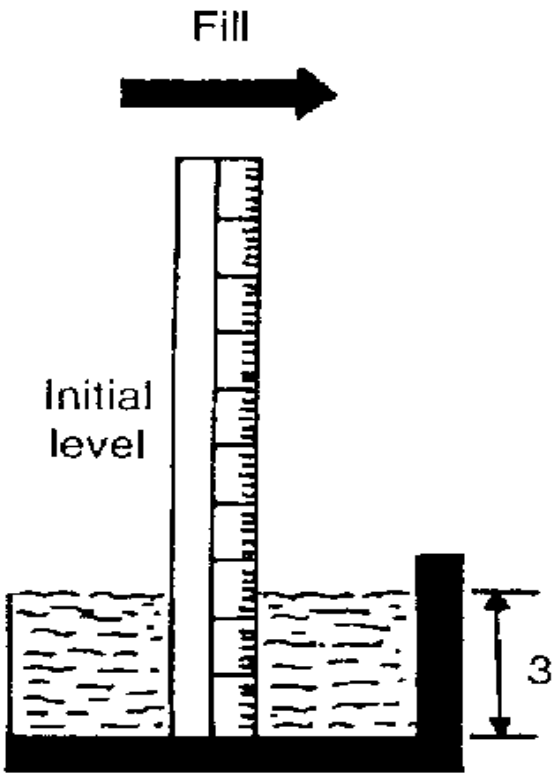
3. Transfer the sea water more easily to the evaporation pond with the use of manual-type centrifugal pump or pedal pump (used for irrigation) anchored to a wooden platform. This is recommended for a small-scale production of two to four production units. The pumped water shall pass through a wooden or bamboo canal to the evaporation pond. This is done to elevate the flow of sea water to the salt production site by using wooden post where the canals are attached.



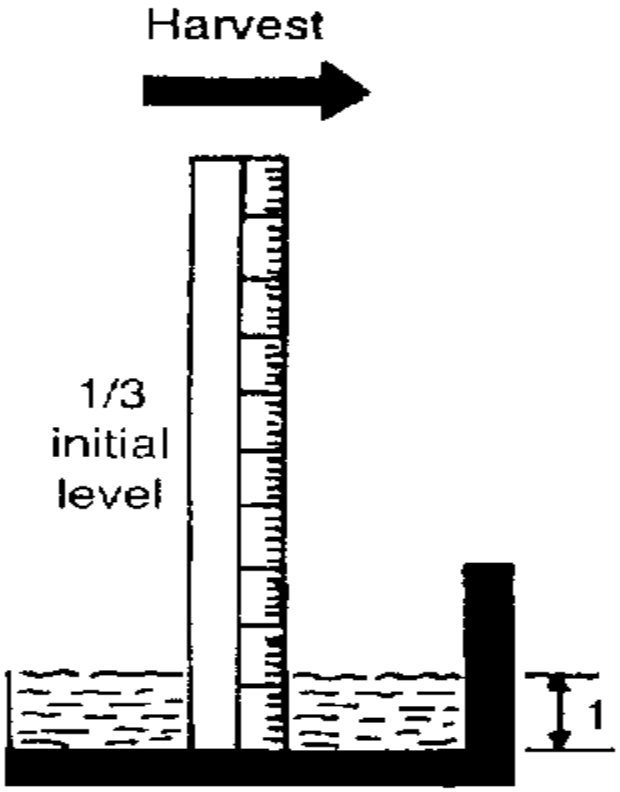
Precrystallization process

4. Leave the water in the ponds to evaporate.

5. After reducing the initial volume to one half, siphon off or transfer the brine to the concentration pond. The evaporation time to one half the initial-volume level depends on light intensity, air movement and size of pond. Siphoning can be done with the use of plastic hose with 1.27-1.59 cm hole in varying numbers.



Crystallization process



Crystallization pond

Salt heap space

6. Leave the brine solution in the concentration pond to further evaporate until its initial volume is reduced to one third.

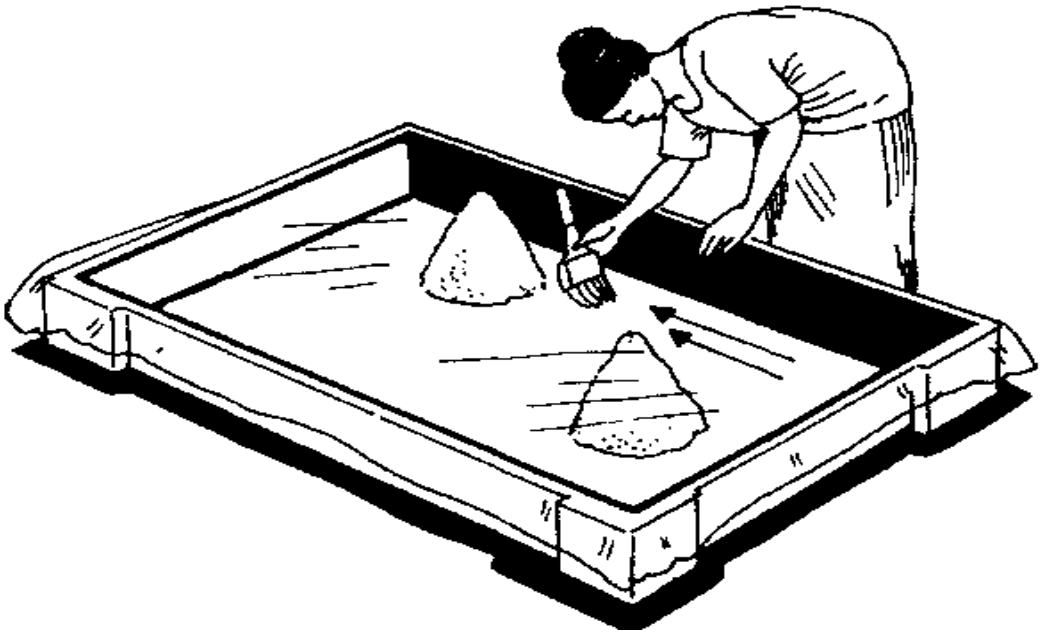
7. Then, siphon it off or transfer to the crystallization pond or saltbeds. Use plastic hose of 1.27-1.59 cm diameter for siphoning. A pail or bucket can also be used but it is labor-and time-consuming. Attach two water faucets of 1.59 cm size between evaporation and concentration if the elevation of the source is higher.

8. Leave the brine in the crystallization pond to evaporate further until it is reduced to one third of its original level. At this time, salt crystals begin to form when the brine is almost evaporated.

- Better-quality salt is obtained when the seawater is filtered through a cotton cloth before transferring to the different evaporation ponds. This is to remove impurities.

- While a salinometer can be used to measure the concentration of salt in the brine, the best indicator for practical purposes is the reduction in the level of the brine solution.

9. Collect the salt crystals and expose them further to sunlight to dry in small heaps.



Harvesting process

Economies of production

The three sets of ponds (evaporation, concentration and crystallization) in the production unit measure 144 sq m each or a total of 432 sq m per unit. The 1991 cost estimate using black plastic sheets, coconut lumber and manual pumps, was about P15.00 per square meter or a high estimate of P7,000 per unit.

At an assumed production of 150 days per year at 20 kg, the expected gross income is P18,000 per unit in about five to six months' thee. Considering that the initial capital cost is deducted from the first year, a three-year period (the least expected lifespan of the unit) can yield at least a gross income of P54,000 per unit, with an initial capital of P7,000.00. This is about 200-250 percent ROI per year. The normal practice of contract sharing is 60 percent for financier and 4() percent for salt producer.

Small-scale salt production can be promoted through public investments by wage-earners who have at least P7,000.00 savings per year to be invested in the so-called "adopt a fisherman family" public-investment scheme. Salt production is a practically risk-free venture that can give high profits.

Glossary

A

Abaca coir Abaca fiber.

Algae Algae range from singular organisms to large, complex colonies of kelp and from the blue green algae to yellow, green, brown and red organisms. A good number of species are edible.

Avian pest An acute, highly contagious viral disease in poultry.

Bay A part of the sea extending landwards.

Blowfly A kind of fly which deposits its eggs on meat or wound of living animals.

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 ecosystems 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 as heavily calcified encrustations which bind the reef framework together.

Cultch Material used to collect oyster spat.

E

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

F

Floater A device used to facilitate floating.

Fowl cholera An acute septicemic disease of birds caused by bacteria.

Fowl pox A viral disease in poultry, characterized by wartlike lesions in less feathered areas of the body.

Fry The young or brood of fishes or other organisms.

G

Gravid Heavy with young/ pregnant.

Gunny sack A strong, coarse sacking made from plant fibers.

H

Halophilic Flourishing in salt water.

l

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

Intertidal flat Part of the seashore, usually under water at high tide and exposed during low tide.

L

Lake A considerable inland body of standing water.

Larva The preadult stage of many organisms, which does not resemble the adult. The larva usually exploits a different food source from that of the adult.

M

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

Mantle A soft fold, enclosing the soft body parts.

Monoculture Cultivation of only one species.

Mother of pearl A shiny calcareous substance composing the innermost layer of a molluscan shell.

N

Nocturnal Occurs at night.

P

Parts per thousand (ppt) Unit used in referring to the amount of dissolved inorganic minerals (salts) in seawater.

Phytoplankton Tiny plants that drift in the sea.

Polyculture Culture of more than one species.

R

Red tide Seawater affected by the red tide phenomenon exhibits discoloration due to a large population of some phytoplankton species; often fatal to many forms of marine life.

Reservoir A place where anything is kept in store.

Return on investment The ratio of income to capital invested in a business.

River A natural stream of running water.

S

Salinometer An instrument used to measure salinity.

Seagrass A marine flowering plant, a few species of which are similar to terrestrial grasses in appearance. Sixteen species are found in the Philippines. Seagrasses are valuable ecosystems 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.

Spat A newly settled or attached young oyster.

Spatting season Spawning season.

Spawner A nature aquatic female which lay many small eggs.

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