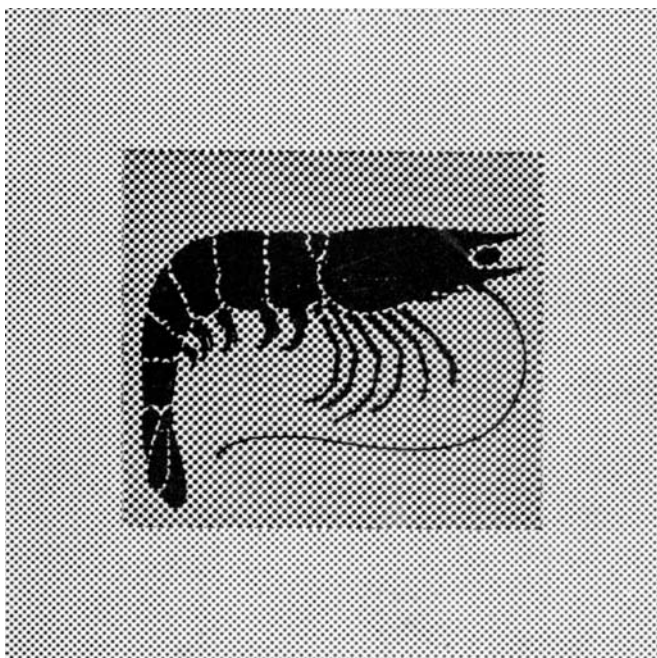


MANUAL OF OPERATIONS: SUGPO POND CULTURE

by

Jurgenne H. Primavera and Florentino D. Apud



EXTENSION MANUAL

NO. 2



AQUACULTURE DEPARTMENT
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
Tigbauan, Iloilo, Philippines

MANUAL OF OPERATIONS: SUGPO POND CULTURE

by

Jurgenne H. Primavera and Florentino D. Apud



AQUACULTURE DEPARTMENT
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
Tigbauan, Iloilo, Philippines

Copyright 1976 by J. H. Primavera and F. D. Apud

1st Printing, August, 1977
2nd Printing, September, 1977

This paper first appeared in **The Philippine Journal
of Fisheries**, 14(2): 160-182.

INTRODUCTION

The idea for a manual on sugpo pond culture started during the series of lectures on various aspects of pond management given by members of the research staff of the Aquaculture Department Leganes Station to caretakers, helpers and other pond personnel from September to November 1975. One of the authors had previous extensive experience managing a private fishpond. Work on the manual began in earnest in early 1976 after roughly a one-year stint in the Leganes pond system working with both experimental and production aspects of *Penaeus monodon* cultivation. Further stimulation was provided by the need for such a manual with the ongoing series of seminars on Sugpo Pond Cultivation and the Fishpond Cooperators Program sponsored by the Training and Extension Division of the Department.

Although the result of many drafts, this work is not meant to be the final word on sugpo pond culture. Rather, it is intended to serve as a guide to fish farmers, extension workers and others in their initial efforts to produce marketable sugpo for local consumption or export. Suggestions on improvements are welcome; such feedback is essential to future revisions of this manual.

A. General Considerations

1. A sugpo pond should follow the various criteria for proper location, design and construction as described in numerous references published by the BFAR and other research organizations and experts in the field.

2. Moreover, the biology of this species demands specific requirements. As a crustacean, *P. monodon* grows only after molting during which it is highly vulnerable to predation and cannibalism. It is therefore essential to maintain a predator-free pond by appropriate prestocking treatments, e.g. pesticide application as well as pond management methods during the rearing period itself.

3. To avoid cannibalism, stress factors such as starvation and low oxygen that cause weakening of individuals must be minimized. To this end, a peripheral or diagonal canal in the pond can serve as refuge during high water temperatures and molting periods. The canal also facilitates water management and harvest.

4. Preliminary data indicate faster growth of sugpo in deeper ponds averaging one meter with lower salinities in the range of 10-20 ppt. A deeper pond means greater water volume available for feeding and other "living" activities. At lower salinities, more of the energy intake is transformed into flesh by growth processes and less is diverted to osmoregulation or the body's saltwater balance.

5. Pond observations and surveys of coastal fry and adult prawn catches show that other species such as *P. merguensis* (*hipong puti*), *P. semisulcatus* (*bulik*) and *Metapenaeus* spp. (*suahe*) abound in Philippine waters. Polyculture of these species together with *P. monodon* would maximize utilization of feeding niches in the pond provided there is little overlap in feeding habits of the different species.

6. Constant reference to Figs. 1-1d while reading the text will be helpful for time-scale purposes.

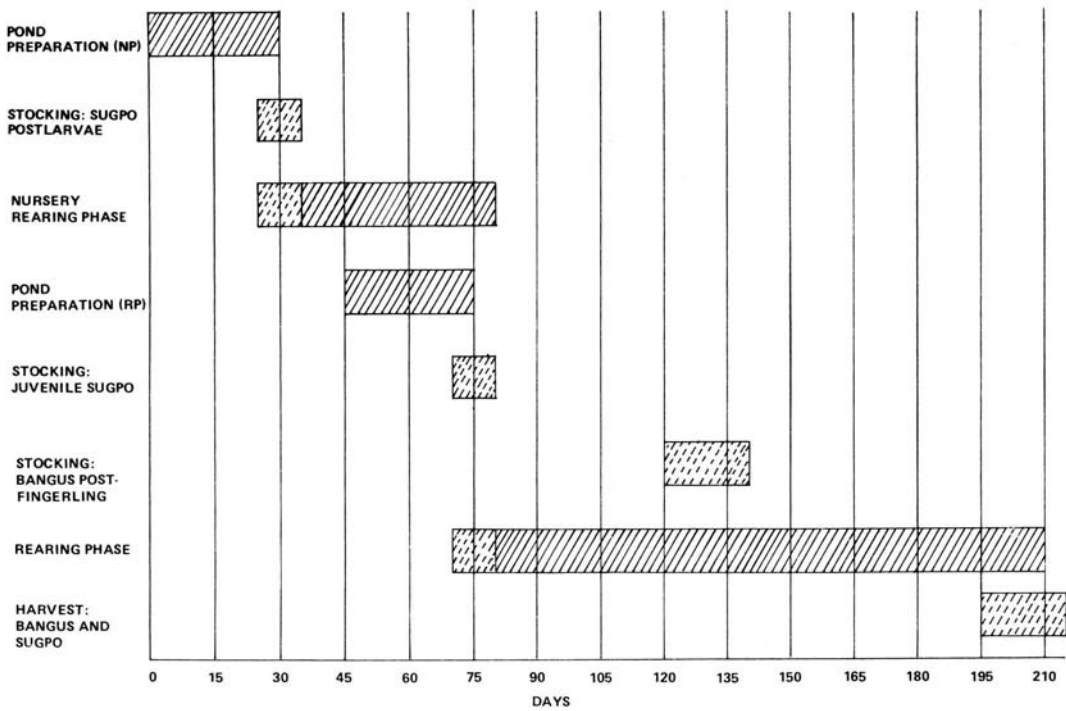


Figure 1. Sugpo-bangus polyculture in ponds (stock manipulation method)

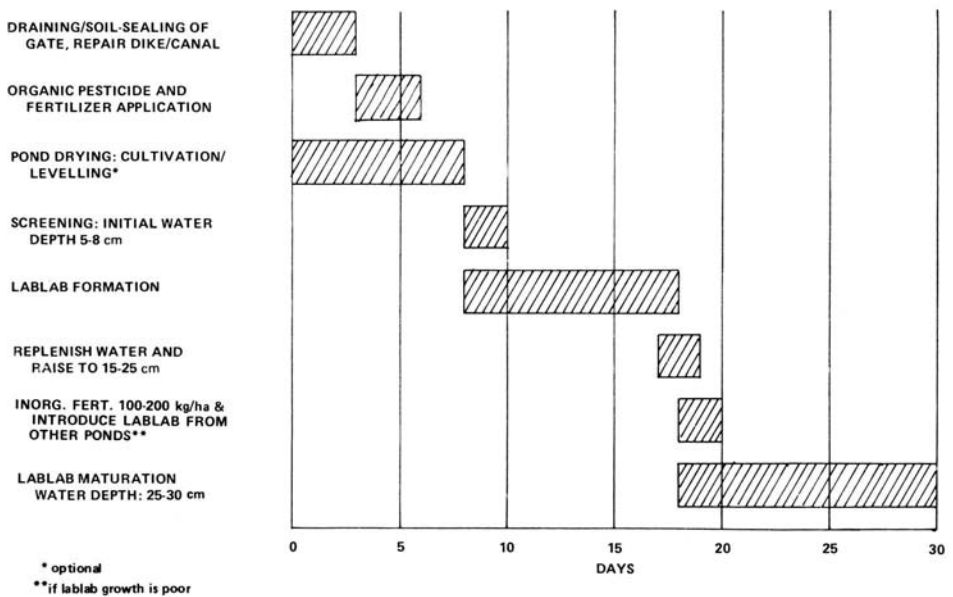


Figure 1a. Details of pond preparation (lablab method)

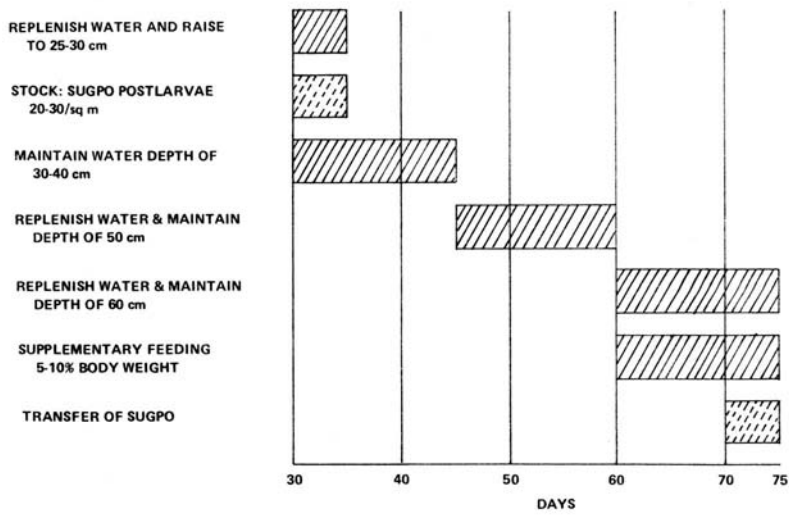


Figure 1b. Details of nursery rearing phase

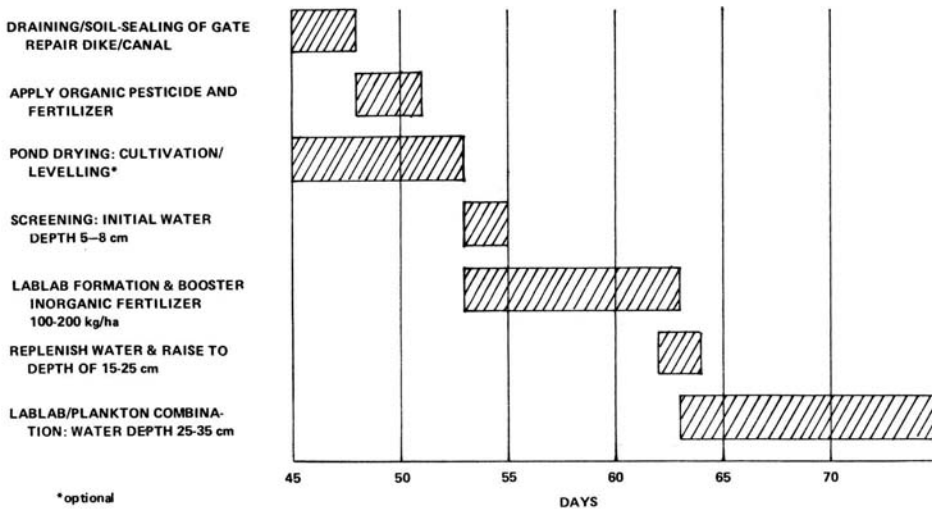


Figure 1c. Details of pond preparation (RP lablab- plankton)

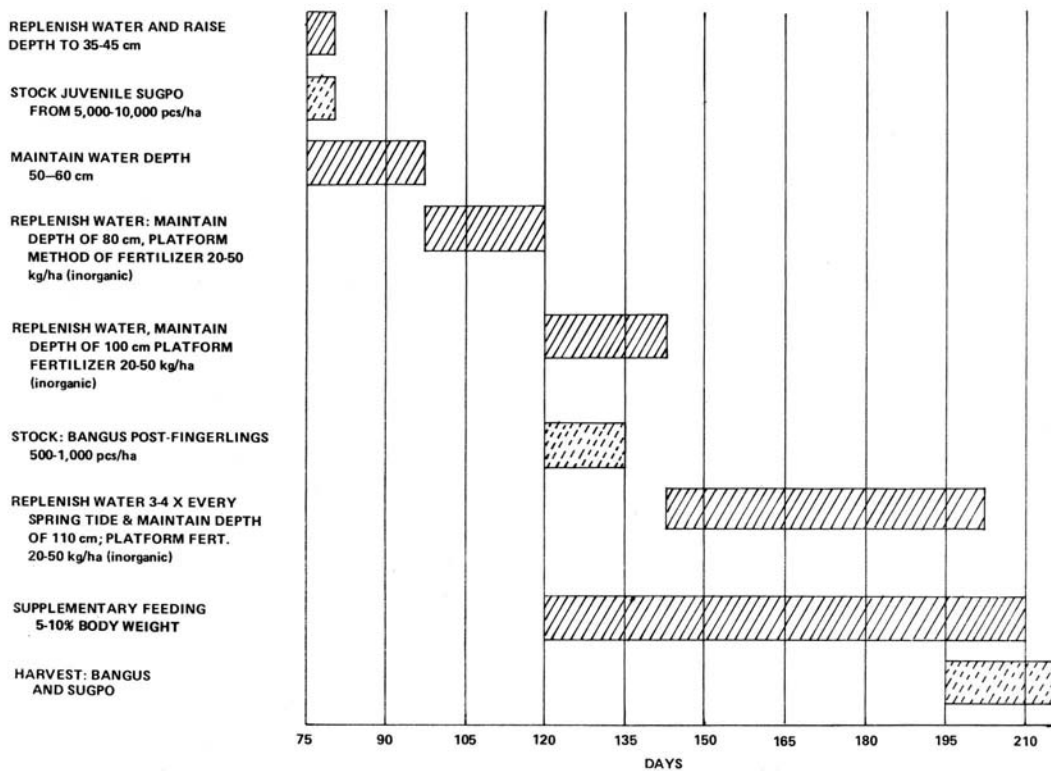


Figure 1d. Details of rearing phase (RP)

B. Pond Preparation

1. Drain the pond completely, soil-seal the gate (Fig. 2) and dry the pond bottom for approximately one week (day 1 to 7-9). While drying, undertake:

- a. dike and canal repair
- b. cultivation and levelling of pond bottom (optional)
- c. screening of pond gate
 - 1) bamboo screen with nylon facing canal
 - 2) bamboo screen with nylon facing pond
 - 3) nylon screen trap (*bulon*; Fig. 3) or bagnet (*lumpot*; Fig. 7) in pond during admission of water
- d. liming for acidic ponds (Appendix I)
- e. organic pesticide application (Appendix I)
- f. organic fertilization (Appendix III)

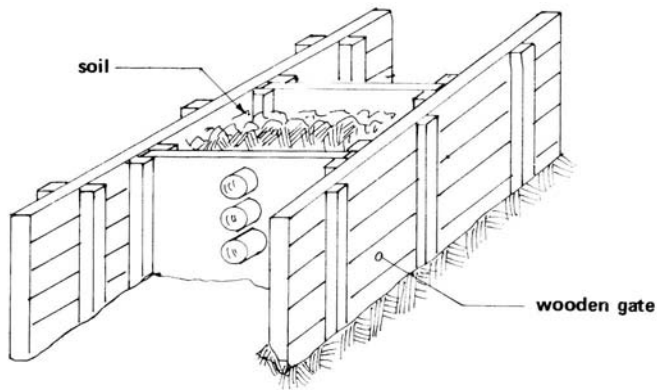


Figure 2. Soil-sealing of pond gate

2. Admit initial water after organic pesticide and fertilizer have settled on pond bottom (day 8 to 10).

- a. first day: 5 cm.
- b. second day: +3 cm.

3. Allow water evaporation and initiate lablab formation (day 9 to 18). Drain water and raise to 10 cm. If lablab is poor,

- a. apply inorganic fertilizer (Appendix III)
- b. scatter lablab gathered from other ponds

4. Allow lablab to grow to maturity (day 18 to 30).

5. Gradually drain all water from pond. Check for presence of pest species, like *Tilapia*, which may have survived the initial draining and pesticide application. Any survivors must be eliminated as they will nest and lay eggs in the pond. Refill the pond and drain again 1-2 more times.

6. Make a final water replenishment and raise water level to 15-25 cm.

C. Stocking

1. Stocking time

- a. Before 9:00 a.m. and after 6:00 p.m. during sunny days, preferably in the morning.
- b. Any time during cloudy days provided pond water temperature is low.
- c. Any time provided there is admission of fresh tidal water into the pond.

2. Age of stock: postlarva P_{10} - P_{20} ; the younger stages may be stocked if healthy.

Table 1. Stocking rates of sugpo following different rearing schemes.

With Transfer		Without Transfer
Nursery pond	20-30 sugpo fry/sq m	monoculture: 1-3 sugpo fry/sq m
Rearing pond	monoculture: 0.5-2.0 sugpo juveniles/sq m polyculture: 0.5-1.0 sugpo juveniles/sq m 0.05-0.1 bangus fingerlings/sq m	polyculture: 1-2 sugpo fry/sq m 0.04-0.06 bangus fingerlings/sq m (2-3 months rearing period)

3. Fry stocking density (Table 1)

a. Stock manipulation with transfer

- 1) Nursery pond: 20-30/sq m (or 200,000-300,000/ha)
- 2) Rearing pond: (see **Transfer**, section D)

b. One single pond with no transfers: 1-3/sq m (or 10,000-30,000/ha)

4. Arrival of fry

- a. Remove ice from the styrofoam containers.
- b. Select one container for actual (head) count before stocking; the remaining containers are for pond stocking.

5. Actual (head counting)

- a. Half fill four to five wide basins (diameter of at least 60 cm) with fresh pond water.
- b. Remove the plastic bag from the styrofoam container, open and gradually add pond water to the bag.
- c. Distribute the fry equally to the different basins.
- d. Start the counting with at least two counters and one recorder for every basin.
- e. Total no. of fry = no. counted for one styrofoam container x total no. of containers (assuming uniform density of fry in all styrofoam containers).
- f. Fry already counted should be continuously collected and released immediately in the pond.

6. Pond stocking of remaining containers

- a. Remove the plastic bags from the styrofoam containers.
- b. Float the plastic bags in different parts of the pond for at least 30 minutes.
- c. Open the bags and take the water temperature with a thermometer. Take the pond water temperature. (If no thermometer is available, dipping one's hand in the water to determine the temperature will do.)
- d. If the temperature difference is 2-3°C or less, release the fry immediately. Lower the edge of the plastic bag into the water and allow the fry to swim out slowly, moving the bag to scatter the fry.
- e. If the temperature difference is 4-5°C or more, let the temperature equilibrate by gradually adding pond water to the plastic bag. Then release the fry as described above.
- f. Direct stocking of fry in the pond is recommended over the use of temporary net enclosures as the *hapa* for acclimatization. The latter subjects the fry to unnecessary stress resulting from competition for space, food and other resources; individuals so weakened as well as those molting are prey to cannibalism.

D. Transfer (from nursery pond to rearing pond)

1. Time of transfer (same as **Stocking**, section C)
2. Size of stock: 2-5 g (30-45 days in nursery pond)
3. Stocking density (Table 1)
 - a. monoculture: 0.5-2.0 sugpo juveniles/sq m
(or 5,000-20,000 sugpo juveniles/ha)
 - b. polyculture: 0.5-1.0 sugpo juveniles/sq m:
0.05-0.1 bangus fingerlings/sq m
(or 5,000-10,000 sugpo juveniles/ha
to 500-1,000 bangus fingerlings/ha)

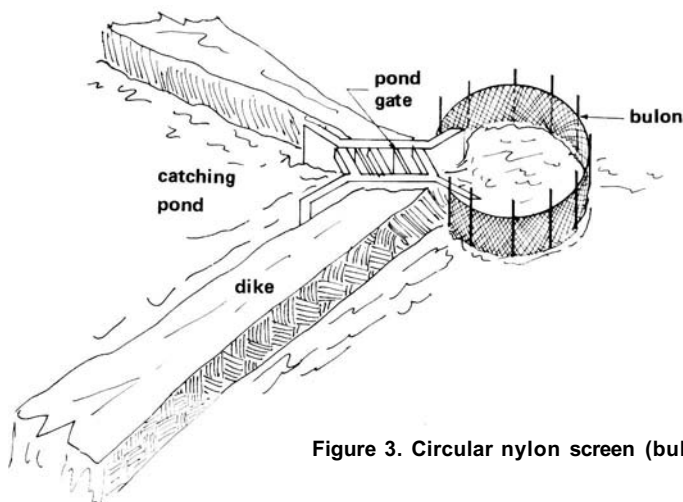


Figure 3. Circular nylon screen (bulon)

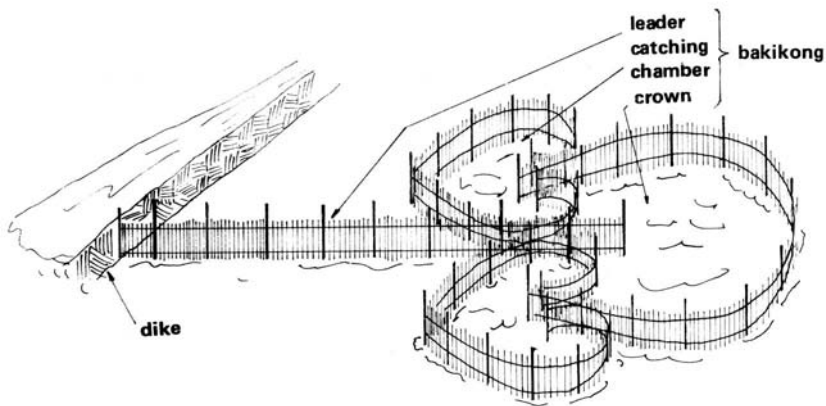


Figure 4. Bamboo shrimp trap (*bakikong*)

4. Methods

a. Shrimp trap or *bakikong* (Fig. 4)

- 1) Install the *bakikong* along the dike 2-5 m from the pond gate.
- 2) Gradually reduce water level to half depth 2-3 hours before the incoming high tide in the evening.
- 3) Admit fresh tidal water.
- 4) Install a gas lamp above the catching chamber to attract the prawns at night time.
- 5) The following day, catch the juvenile prawns inside the trap by means of a scoop net.
- 6) Carry by pail or float by shrimp cage (Fig. 5) or suspension net (Fig. 6) to the rearing pond over short distances.

b. Bagnet or *lumpot* (Fig. 7)

- 1) Slightly decrease water level 2-3 hours before the incoming high tide late in the afternoon or evening.
- 2) Admit fresh tidal water and allow maximum entrance.
- 3) Operate the bagnet immediately in the evening as soon as tide recedes. The ideal time for bagnet operation is between 6:00-7:00 p.m. during the new moon period of spring tide.
- 4) Deliver the stock by pail, shrimp cage or suspension net to the rearing pond.

c. Catching pond method

- 1) Remove all gate screens and flashboards from the pond gate.
- 2) Reduce water level to half depth in the late afternoon or evening.

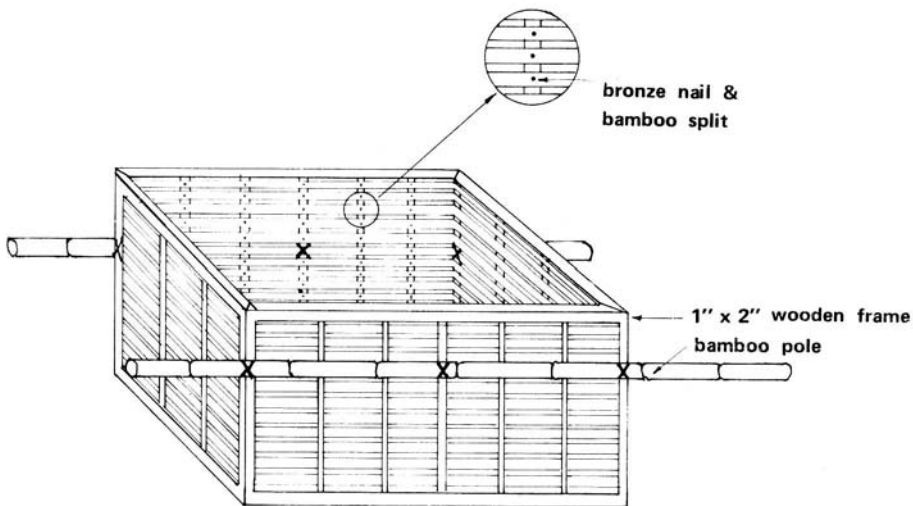


Figure 5. Bamboo cage for transport of juvenile or adult sugpo.

- 3) Admit fresh water in the afternoon or evening.
- 4) Partially drain water in the evening to allow stock to enter the catching pond.
- 5) Return gate screen to the pond gate. Replenish water if needed early the following day.
- 6) Catch the juveniles inside the catching pond by scoop net or seine net early the following morning before the shallow water gets too hot.
- 7) Deliver by pail, shrimp cage, or suspension net to the rearing pond.

d. Manual method (for complete harvest)

- 1) Reduce stock by methods described above.
- 2) Reduce water to the level of the peripheral canal by draining slowly.
- 3) Catch remaining stock in canal by means of seine net (Fig. 8), scissors net (Fig. 9), and dredge net (Fig. 10).
- 4) Reduce water in the peripheral canal to half depth.
- 5) Handpick remaining shrimp.

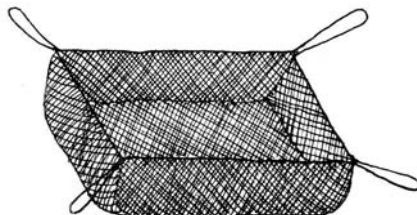


Figure 6. Suspension net (bitinan)

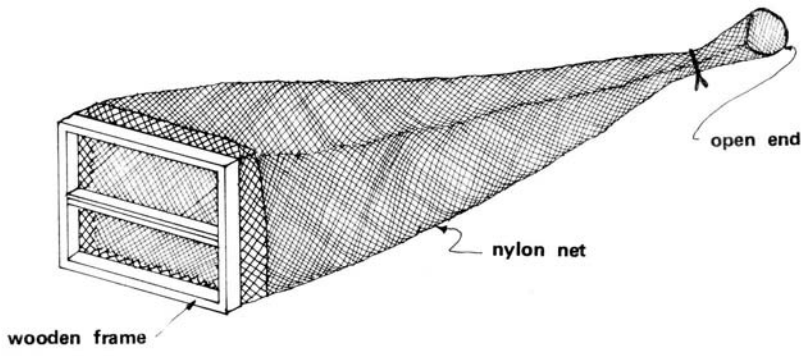


Figure 7. Bagnet (lumpot) attached to wooden frame

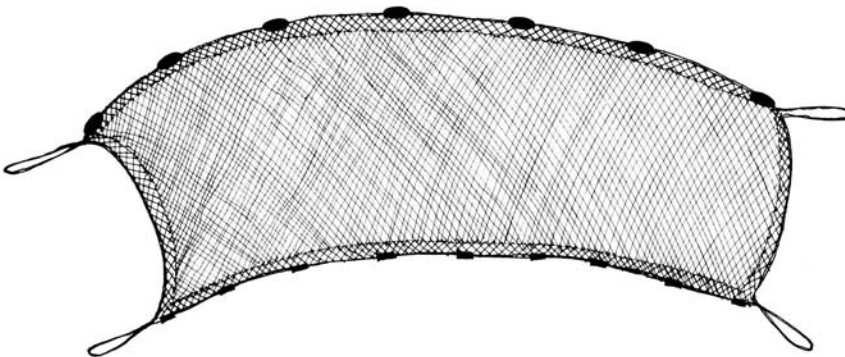


Figure 8. Seine net

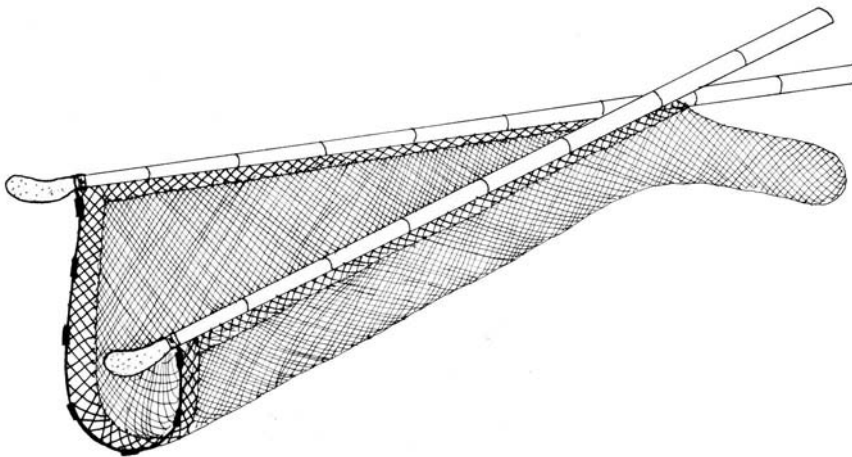


Figure 9. Scissors net

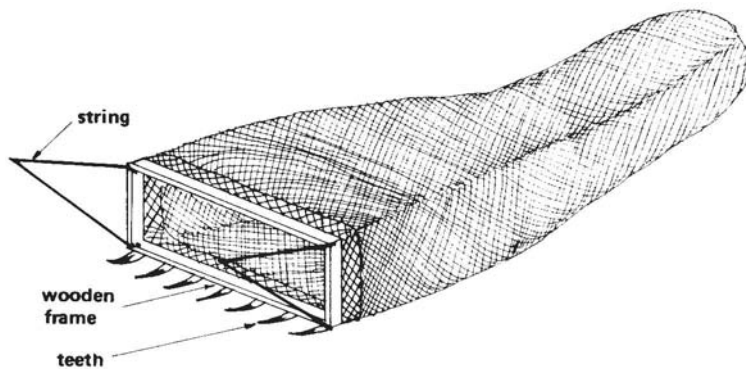


Figure 10. Dredge net

E. Rearing

1. Water management

a. Depth of water

- 1) Nursery pond: 20-25 cm at stocking time, gradually raised by 10 cm every spring tide to a maximum of 60 cm; lablab feeding.
- 2) Rearing pond: 30-35 cm at stocking time, gradually raised by 10 cm every spring tide to a maximum of 110 cm; lablab or plankton and supplementary feeding.

b. Water replenishment

- 1) Replenish water every spring tide.
 - a) Decrease water level a few hours before incoming tide can enter the pond. Then admit fresh tidal water.
 - b) Repeat the above procedure of draining-refilling two more times.
 - c) Without draining, admit fresh tidal water into the pond.
 - d) Allow fresh tidal water a second time to the desired level without draining.
 - e) Water replenishment should average five days (3 draining-refilling + 2 filling) every spring tide.
- 2) Replenish water under stress conditions (low dissolved oxygen, high water temperature, kill fish); during neap tide, use a water pump. Prawns seen swimming at the surface during daylight hours are in stress.
- 3) During hot days or in the early morning when dissolved oxygen is low, circulate the water by the use of a water pump or other means.

- 4) After moderate to heavy rains, allow water to overflow by draining the top layer of the pond. Immediately replace with fresh tidal water or by means of a water pump.
- 5) A separate water inlet (supply) gate opposite the water outlet (drain) gate is recommended to facilitate change of polluted water in the pond.
- 6) During neap tide, soil-seal the gate (Fig. 2) once desired pond water depth and conditions are attained to prevent seepage of water.
- 7) Undertake daily maintenance of dikes to fill up crab holes and prevent water seepage.

2. Natural feeding

a. Lablab

- 1) Install dried twigs at an average of one/20 sq m or 500/ha for shelter of the growing prawns as well as to prevent the accumulation of lablab at the sides of the pond. Place the twigs horizontally in rows perpendicular to the prevailing wind direction. Old coconut leaves and bamboo branches are effective substitutes.
- 2) Reduction of water (prior to replenishment) should be gradual to conserve lablab and late in the evening or early morning when water temperature is low.
- 3) If lablab growth is significantly decreased during rearing, start supplementary feeding.

b. Plankton method

- 1) This method is used in the rearing pond with a water depth of 60-110 cm.
- 2) Apply inorganic fertilizer after water replenishment during spring tide (Appendix III). Do not drain water until the 12th-14th day. Replenish water and repeat application.

c. *Lumut*

- 1) If undesirable filamentous algae or *lumut* become excessive, harvest manually to prevent prawns from getting entangled and trapped in the mats of algae.
- 2) Soften the algae by sun-drying for a few days for use as feed in the same pond or in bangus ponds.

3. Supplementary feeding (5 g to harvestable size; as sugpo grow bigger, they become more carnivorous in diet)

- a. Kind: fresh trash fish from ponds (*bidbid*, *luanluan*, *tilapia*, etc.), mussel

meat or *tahong*, shrimp heads, animal skins, and other meat sources that are readily available and not used as human food.

- b. Amount: 5-10% of estimated body weight of population in pond (Appendix IV).
- c. Preparation: Chop into cubes ranging from 0.5 to 1.0 cm in diameter using smaller sizes for the earlier sugpo stages.
- d. Frequency and manner of feeding: Daily or once every two days in the late afternoon or early evening. Distribute throughout the pond; to reach the center of the pond, construct a catwalk if necessary.

F. Harvest (see **Transfer**, section D)

1. Size of stock: 15-30 pcs/kg or 30-60 g each (4-6 months in the rearing pond with 10-25 ppt salinity range; growth is slower at higher salinities)

2. Harvest the stock on three successive days or nights by means of the shrimp trap, bagnet, or catching pond method. There should be immediate refiling of the pond if the bagnet and catching pond methods are used.

3. On the fourth day, complete harvest by reducing water to the level of the peripheral canal and handpicking remaining prawns.

G. Processing and Transport (The following steps should be done in the shortest possible time with great care and minimum handling to lessen spoilage and preserve quality.)

1. Immediately after harvest, sort according to size. If for export, follow standard sizes and remove heads to reduce bacterial count, discoloration, and storage space requirement. Beheading at the harvest site is preferable because it reduces the amount of ice needed. Heads can be fed to prawns in other ponds.

2. Place in ice with close contact provided by thin alternate layers of ice and prawn. Maximum depth of ice and prawns in a container should not be more than 2-3 feet (60-90 cm) to prevent bruising of bottom layers.

3. Transport containers to open markets or supermarkets for local consumption or to a processing plant for further treatment if for export purposes.

REFERENCES

- ANNUAL REPORT. 1975. Aquaculture Department, SEAFDEC, Tigbauan, Iloilo, Philippines.
- BALISTA, C.D. and I.S. FERNANDEZ. 1973. Handling and processing shrimps for export. Bureau of Fisheries and Aquatic Resources (mimeo).
- BARDACH, J.E., J.A. RYTHER, and W.O. MCLARNEY. 1972. Aquaculture: The farming and husbandry of freshwater and marine organisms. Wiley-Interscience, London.
- CACES-BORJA, P. and S.N. RASALAN. 1958. A review of the culture of sugpo *Penaeus monodon* Fabricius, in the Philippines. Rome FAO 2: 111-123.
- DELMENDO, M.N. and H.R. RABANAL. 1955. Rate of growth of the sugpo (jumbo tiger shrimp), *P. monodon* Fabricius, with notes on its culture in brackishwater ponds. Proc. 2nd Indo-Pacif. Council. 6:424-431.
- DJAJADIREDDJA, R. 1957. A preliminary report on the introduction of the Philippine-type nursery in Indonesia. Tech. Pap. Indo-Pacif. Fish. Council. IPFC/C57/Tech./17, 23 pp. (mimeo).
- HICKLING, C.F. 1962. Fish culture. Faber and Faber, London.
- INLAND FISHERIES PROJECT. 1974. Combination bangus-shrimp culture. IFP Tech. Report No. 4, pp. 9-11.
- INLAND FISHERIES PROJECT. 1975. Monoculture and polyculture of bangus and shrimps *Penaeus* spp. in brackishwater ponds. IFP Tech. Report No. 6, pp. 19-30.
- LARA, D.B.G. 1976. A contribution to the identification of some pathogenic agents causing diseases in shrimps, *Penaeus monodon* Fabricius (sugpo) in the Philippines (manuscript).
- LOPES, J.V. n.d. Present status and problems of prawn culture in the Philippines. BFAR (mimeo).
- MOTOH, H., O. PARAAN, E. BORLONGAN, E. CALIGDONG and G. NALZARO. 1976. Ecological survey of penaeid shrimps of Batan Bay and its adjacent waters II. Aquaculture Department, SEAFDEC, Tigbauan, Iloilo, 64 pp. (mimeo).
- MSU-SCTO-NSDB Marine Fisheries Research Staff, n.d. Sugpo farming. Naawan, Misamis Oriental (mimeo).
- PADLAN, P.G., B.S. RANOEMIHARDJO and E. HAMAMI. 1975. Improved methods of milkfish culture I. Increasing production in shallow, undrainable ponds. Bull. Shrimp Culture Res. Centre 1:33-39.
- PCARR. n.d. The Philippines recommends for inland fisheries: Sugpo (*Penaeus monodon*) culture (mimeo).
- PRIMAVERA, J.H. 1976. Survival rates of different *Penaeus monodon* Fabricius post-larval stages. Aquaculture Department, SEAFDEC (manuscript).
- PRIMAVERA, J.H., F. APUD and C. USIGAN. 1976. Effect of different stocking densities on survival and growth rates of sugpo *Penaeus monodon* Fabricius in a milkfish rearing pond. Phil. J. Science v. 105, n. 2 and 4 (in press).
- SILLS, J.B. 1974. A review of the literature on the use of lime ($\text{Ca}[\text{OH}]_2$, CaO , CaCO_3) in fisheries. U.S. Dept. of the Interior Fish and Wildlife Service, 12 pp. (mimeo).

- SANTIAGO, A. JR., J. LLOBRERA. A. SANCHEZ and A. LLOBRERA. 1975. Preliminary studies on the monoculture of *Penaeus monodon* Fabricius II. Materials for Training in Prawn Culture, Aquaculture Department, SEAFDEC, Iloilo, Philippines (mimeo).
- VILLADOLID, V. AND D.K. VILLALUZ. 1951. The cultivation of sugpo (*Penaeus monodon* Fabricius) in the Philippines. Phil. Jour. Fish. 1:55-65.
- VILLALUZ, D.K. 1953. Fish farming in the Philippines. Bookman, Manila
- VILLALUZ, D.K., A. VILLALUZ. B. LADRERA, M. SHEIK and A. GONZAGA. 1972. Reproduction, larval development and cultivation of sugpo (*Penaeus monodon* Fabricius). Phil. J. Science 98:205-234.

Appendix I

Control of Pests and Predators

1. Mechanical

- a Thorough draining and drying of ponds 2-3 times generally eradicates most unwanted fish species (*Tilapia spp.*, *Elops hawaiiensis*, *Megalops cyprinoides*, *Lates calcarifer*, *Therapon spp.*, gobies, etc.).
- b. Hiring of women and children to manually harvest snails (family Cerithidae) at so much per kerosene can provides income to local people.
- c. Snails that concentrate along the water line or in puddles may also be collected by shovels or rakes.
- d. Regular maintenance of gates and dikes reduces harmful effects of barnacles and crabs, respectively.
- e. Installation of gate screens (bamboo and nylon), bagnet, etc. prevents the entry of most unwanted species during the admission of pond water.

2. Chemical (Emphasis is on prestocking application and on biodegradable organic pesticides which also serve to fertilize the pond.)

- a Throughout a drained but moist pond bottom, uniformly spread any of the following:
 - 1) commercial nicotine at 12—15 kg/ha or tobacco waste (dust, stalks, etc.) at 200-400 kg/ha to eradicate fish and snails
 - 2) commercial saponin at 15—20 kg/ha or tea seed cake (residue of *Camellia* spp. after oil extraction) at 150—200 kg/ha to eradicate fish, snails and crabs
 - 3) quicklime (CaO) at 100—600 kg/ha to eradicate unwanted fish. Milk of lime is a thick solution prepared by dissolving quicklime in water; it is applied

in pools and other watered portions containing fish. For pond conditioning, particularly in acidic ponds, the dosage may be raised to 1,000—2,000 kg/ha.

- b. After 1-2 days, apply organic fertilizer (Appendix III).
 - c. Allow the organic materials to settle in the soil for 4-5 days.
 - d. Admit initial water 5-8 cm deep.
 - e. Remaining unwanted animals may be completely eliminated by applying:
 - 1) saponin at 0.5 ppm (0.4 kg/ha at 8 cm water depth)
 - 2) Bayluscide (niclosamine) at 3-5 ppm (3.2 liters at 8 cm water depth)
 - f. Three days after poisoning, raise water to 15-25 cm.
 - g. Change water completely two times and stock the pond after 1-2 weeks.
3. Commercially prepared *derris* powder (5-8% rotenone) may be applied before stocking in a partially watered pond at 1 ppm (0.8 kg/ha) to 4 ppm (3.2 kg/ha) at 8 cm water depth. If the commercial product is not available, prepare *derris* powder from *tubli* and other local plants.
- a. Sun-dry the roots for one week. The rest of the plant may be replanted like camote cuttings.
 - b. Cut dried roots into pieces and soak in water overnight.
 - c. Remove wet roots and pound thoroughly.
 - d. Soak in water again and agitate to get rotenone into solution.
 - e. Apply solution to the pond. The solution from 4 kg *derris* roots is sufficient to treat one ha at 8 cm water depth.

Appendix II

Diseases

1. The most important microorganisms that cause disease in pond-reared sugpo are chitinivorous bacteria that feed on the exoskeleton and ectocommensal protozoa that attach to surfaces, including gills. If the latter are abundant on gill filaments, they decrease oxygen uptake and gradually weaken the prawns.
2. Diseased prawns are characterized by the following:
 - a. blackening of areas of the exoskeleton

- b. falling off of parts of the walking legs and breaks in the uropods and other exoskeletal parts
 - c. dull luster of the exoskeleton
 - d. sluggish behavior
3. Prevention and/or reduction of disease may be accomplished by:
- a. frequent change of pond water
 - b. not overfeeding; excess food accumulates and decomposes on the pond bottom, providing a favorable habitat for microorganisms.

Appendix III

Fertilization

1. Organic fertilization

- a. One to two days after application of tobacco dust (or other organic pesticides) in a drained pond, spread dried chicken dung throughout the pond bottom at 1,000-3,000 kg/ha
- b. Other organic manures such as carabao and horse dung and composted hay may be used.
- c. Allow the pesticide and fertilizer to settle in the soil for 4-5 days.
- d. Admit initial water 5-8 cm deep.
- e. Follow procedure in Appendix I (section 2, a).

2. Inorganic fertilization

- a. For lablab growth, pond preparation: Broadcast 100 kg (4 bags)/ha of 18-46-0 or 200 kg (8 bags)/ha of 16-20-0 inorganic fertilizer.
- b. For plankton growth, water at least 60 cm depth:
 - 1) Construct a square platform using bamboo or wood with 0.75 sq m of platform surface for each hectare of water. The platform surface must be 15-20 cm below the water surface.
 - 2) Apply 22 kg (approximately 1/2 bag)/ha of 18-46-0 or 50 kg (1 bag)/ha of 16-20-0 fertilizer on the platform immediately following admission of water to 60 cm depth in pond.
 - 3) Repeat application given above after every water change or as needed.

Appendix IV

Estimate of Rate of Supplementary Feeding

1. Fill a 25-L pail with pond water half to three-quarters level. Weigh to the nearest ten grams or to the nearest gram.
2. Get a sample of at least 30 prawns from a *bakikong* and place in the pail. Weigh pail, water and prawns. Minimize handling of stock and other causes of stress. Immediately return stock to pond.
3. Calculations:

a. average body weight (ABW) (g) =
$$\frac{\text{wt. pail + water + shrimp}^{-\text{wt. pail + water}}}{30}$$

b. estimated wt of shrimp in pond (g or kg) = ABW x initial stock no. x estimated % survival

survival = 50% from fry to juveniles

70-90% from juveniles to harvest size

c. amount of supplementary feed (g or kg) = estimated weight of shrimp x 5 — 10%

(Divide into 2 portions if feeding is twice daily.)

4. Sample may be taken at monthly intervals and feeding rates may be adjusted accordingly.
5. If stock appears to be underfed (thin) or overfed (accumulation of excess food in pond bottom), feeding rate may also be adjusted.

ACKNOWLEDGMENT

The authors wish to express their gratitude to Department Chief Dean D. K. Villaluz, pioneer in sugpo research, Dr. Q. F. Miravite, Executive Director, Atty. J. M. Garay, Director for Development and Administrative Services, and Mr. Wilfredo G. Yap, Prawn Program Leader, for their encouragement and support, and to Dr. H. R. Rabanal and Mr. Harry Cook of the South China Sea Fisheries Development and Coordinating Programme for their extensive and extremely helpful comments and suggestions on the preliminary draft. Thanks are also due Mr. R. S. Esguerra, Officer-in-Charge, Leganes Station, Atty. J. A. Agbayani, Jr., Head, Training and Extension Division, Mr. Cesar V. Recio and Dr. Alexander Buenafe for logistical support; Engr. David Lactuan and Mr. Hernando Juntaria for the preparation of text figures; and Maritess Gelvezon, Cora Alba and Alma O.Loresto for typing the manuscript and drafts.

The Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) is an international research organization devoted to the development of aquaculture in the region. Established in the Province of Iloilo, Philippines, it is one of three departments organized under the SEAFDEC Agreement among six nations consisting of Japan, Malaysia, Philippines, Singapore, Thailand and Vietnam. The two others are the Training Department in Bangkok, Thailand and the Marine Fisheries Research Department in Singapore.



AQUACULTURE DEPARTMENT
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
Tigbauan, Iloilo, Philippines