

A WISE USE TECHNOLOGY OF MANGROVE-FRIENDLY AQUACULTURE IN INDONESIA: SILVOFISHERY

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I. Introduction

The area of mangrove in Indonesia decreased in the period 1982-1993 (Table 1). Coastal aquaculture, however, was not the main activity causing mangrove destruction in Indonesia. The area of mangrove decreased by about 1 million ha and about 0.8 million ha in the period 1982-1987 and 1987-1993, respectively. The area of brackishwater ponds, however, has only increased by about 40 thousand ha and about 70 thousand ha in the period 1982-1987 and 1987-1993, respectively.

Table 1. Areas of Mangrove and Brackishwater Ponds in Indonesia (in 1000 ha)

	1982	1987	1993
1. Mangrove ^a	4,251.0	3,235.7	2,490.2
2. Brackishwater ponds ^b	220.4	263.2	331.8

A. *Silvofishery*

A form of integrated mangrove tree culture with brackishwater aquaculture, in order to conserve the mangrove resource while allowing people earn incomes.

B. *Cultured Species*

Milkfish, red tilapia, sea bass, tiger prawn, mud crab; Fishes and shrimps are cultivated in canal/pond; Mud crab is cultivated in a pen on mangrove central platform area.

^a Source: *National Strategy for Mangrove Management in Indonesia*. Office of the Minister of Environment, Department of Forestry, Indonesian Institute of Sciences, Department of Home Affairs, and the Mangrove Foundation. July 1997.

^b Source: *Fisheries Statistics of Indonesia*. Directorate General of Fisheries 1988 and 1997.

II. Site Selection Criteria

A. Environment Conditions

Salinity : 15-30 ppt.
DO : >4 ppm
Water pH : 6.5 - 9

Soil texture :

For fish culture : mud, sandy-mud, sandy-clay
For shrimp culture : muddy loam

Protection : should be protected from strong wind and wave.

Pollution : should be far from industrial areas.

Security : involve the local community, to develop a community-based conservation and management system of mangrove resource.

Vegetation density : 0.2-2.5 trees/m
For fish culture : 0.2 trees/m
For shrimp culture : 2.5 trees/m
For crab culture : 2.5 trees/m

B. Feeding Rate

1. Sea bass culture : 5-10% of average body weight/day; Twice in a day
2. Shrimp culture : 3-10% of average body weight/day; Twice to four times in a day.
3. Crab culture : 3-10% of average body weight/day; Twice in a day.

C. Monitoring

1. Physico-Chemical
DO, pH, salinity should be monitored daily
2. Security monitoring was done by the owner.
3. Stock sampling was carried out weekly.

D. Harvest and Post Harvest

1. Method of harvesting : total harvesting

2. Harvest size : depend on market demand;
Average size
Milkfish : 300-500 g/fish
Sea bass : 500-700 g/fish
Shrimp : 20-30 g/shrimp
Crab : 250-350 g/crab
3. Gears : Trap-net, cash-net, gill-net.
4. Packing and transport:
 - a. Live fishes : Transported in the aerated container.
 - b. Dead fishes : Packed in the insulated box with ice.
 - c. Shrimps : Packed in the insulated box with ice.
 - d. Live crabs : Tied up all legs.

E. *Economics*

1. Investment, Production Cost, Return and Profit of Aquaculture on Mangrove Area:
2. Silvofishery (in Rp. 1000)

	Milkfish ¹	Sea bass ¹	Red tilapia ¹	Shrimp ¹	Crabs ²
Investment	540	873	523	873	46
Production cost/crop	1356	2036	1882	2077	320
Return/crop	1852	4320	2800	4950	331
Profit/crop	496	2284	918	2873	96
Annual profit	1488	4568	2754	5746	864

Salinity : 15-30 ppt

DO : > 4 ppm

Water pH : 6.5 - 9

Soil texture

For fish culture : mud, sandy-mud, sandy-clay

For shrimp culture : muddy loam, clay

For crab culture : muddy loam

Protection : should be protected from strong wind and wave.

Pollution : should be far from industrial areas.

Security : involve the local community, to develop a community-based conservation and management system of mangrove resources.

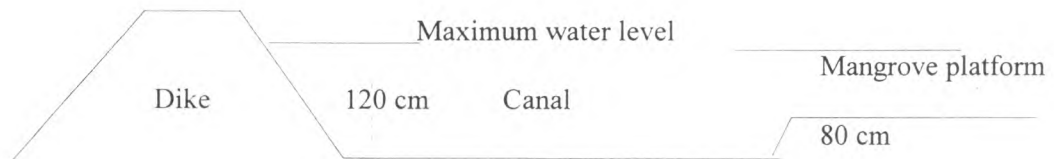
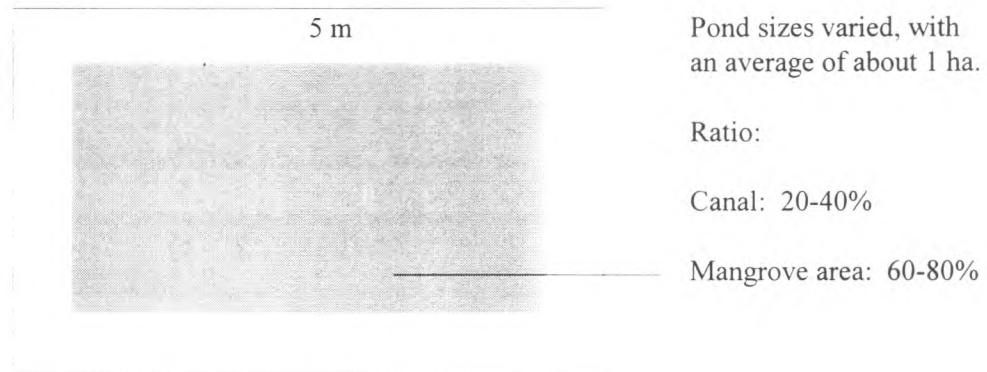
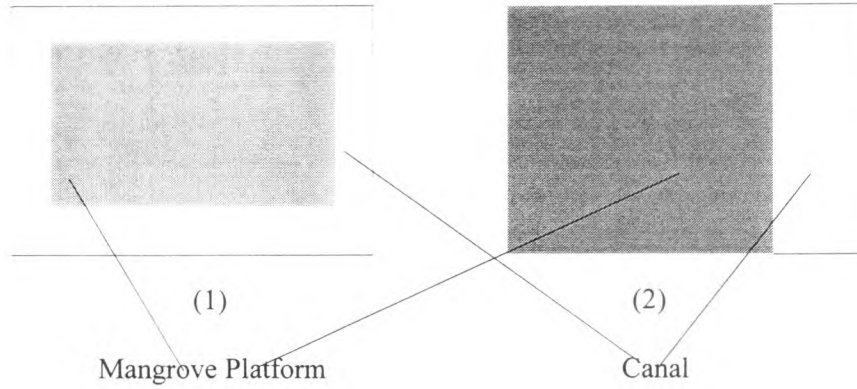
¹ Cultivation was carried out in a 1-ha pond

² Cultivation was carried out in a one (2.5x1.2x1.5m) bamboo cage

III. Design and Construction

A. Basic Models:

(1) Mangrove within the pond, and (2) Mangrove outside the pond.



IV. Preparation

A. Pond bottom drying

Pond bottom is dried after the crop is harvested

B. *Pests and predators eradication*

Pests and predators are eradicated, by using teaseed and lime, prior to cultivation. A trap with fine mesh size or bamboo screen is operated in the gate during cultivation.

C. *Tilling of the canal bottom*

Tilling of canal bottom is usually carried out before cultivation.

D. *Fertilization*

Fertilizer is applied to increase pond productivity. This includes inorganic fertilizer, i.e. 100 kg Urea/ha and 50 kg TSP/ha, and organic fertilizer, about 500-1000 kg/ha.

V. *Water Management*

A. *Water exchange:*

1. For shrimp culture : 20%/day started at day 15 after fry stocking
2. For fish culture : 10%/3 days
3. For crab culture : 10-30%/2 weeks

VI. *Stocking*

A. *Monoculture*

B. *Stocking density:*

1. Milkfish culture : 7,500 fry/ha; size of fry = 40g/fry
2. Sea bass culture : 6,000 fry/ha; size of fry = 10 cm
3. Red tilapia culture : 8,000 fry/ha; size of fry = 10 cm
4. Shrimp culture : 15,000 fry/ha; size of fry = PL-16
5. Mud crab culture : 200 crabs/pen (2.5 x 1.2 x 1.5 m bamboo cage); size of fry = 50-70g/fry

C. *Fry production*

Fry of fish and shrimp are produced in hatchery

D. *Fry collection*

Fry of mud crab are collected from some coastal areas

VII. Feeding

A. *Type of feed*

1. Milkfish : bottom algae
2. Sea bass : trash fish
3. Shrimp : pellet
4. Crab : trash fish, meat of mollusk

B. *Source of feed and preparation*

1. Bottom algae : Naturally available
Fertilization can increase the abundance of algae
2. Trash fish : By-catch of local fishing
Mince the fish
3. Pellet : Supplier
Commercially prepared
4. Mollusk : Collected from wild stocks
Mince the mollusk