SUSTAINABLE PRODUCTION SYSTEMS OF AQUATIC ANIMALS IN BRACKISH MANGROVE AREAS: 2001-2005

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INTRODUCTION

Under the Memorandum of Understanding (MOU) between SEAFDEC (Southeast Asian Fisheries Development Center) and JIRCAS (Japan International Research Center for Agriculture Sciences) an agreement was forged to collaborate on a research study on the growth, prevention and control of diseases of aquaculture fishes. Several studies are now being conducted at SEAFDEC AQD in Iloilo, Philippines. Under the same project, JIRCAS also implemented a research study on sustainable aquaculture in Thailand, "Sustainable Production System of Aquatic Animals in Brackish Mangrove Areas."

Implemented from September 2003 to February 2004, the study aimed to determine the role of benthic organisms as food of marine resources, the shrimp farming areas and the number of shrimp farms. Using six shrimp ponds with an area of 40 m x 20 m where the potentials of closed and circulating systems to purify shrimp farm wastewater were compared.

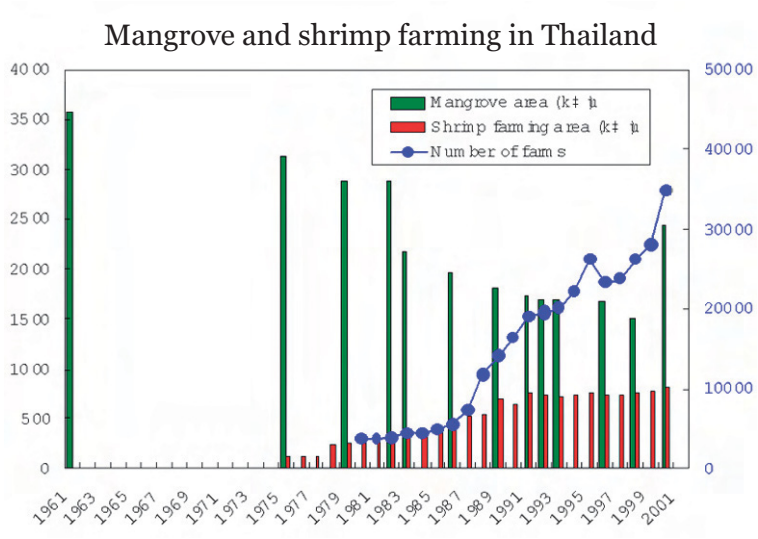
The shrimp culture in Thailand started in the mid 1970s and subsequently increased in mid 1980s with the intensification of production systems. The high inputs of intensification inversely resulted to the decrease of mangrove areas. In Samut Songharm Province which is situated in the Gulf of Thailand, mangrove areas decreased to almost 0 for the last 15-20 years (Fig. 1). Due to the concerted efforts of the residents in the community and in support of the Royal Princes of Thailand, mangrove tree planting was started in the coastal areas in 1999. Fig 1 shows the areas covered by mangroves in the Province of Samut Songharm that mark the decrease and increase of mangrove areas.

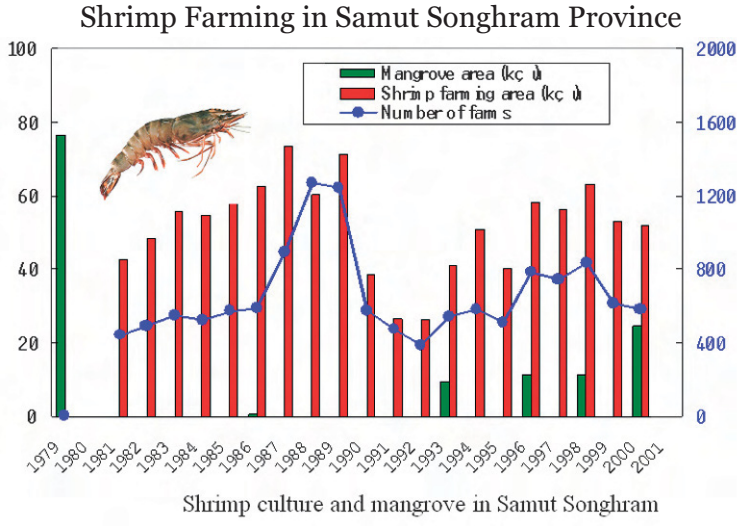
RESULTS AND DISCUSSION

Closed versus circulating system

Mangroves play a very important role in the ecosystem. The activities in the mangrove ecosystems include: production, circulation and purification. The experiment conducted in Samut Songharm area near Kasetsart University in Bangkok, Thailand made use of 6 ponds. Each pond has 40 m x 20 m area. Ponds 4 and 5 were planted to mangrove trees (*Rhizophora* spp). Pond 1 which used closed system served as the control. Under the circulated systems, two treatments were compared (Fig. 2). One treatment used 1:2 mangrove-shrimp ratio where one pond was planted to mangroves and the other two were stocked with shrimps. The water in ponds 2 & 3 comes from the pond where mangroves were planted and the same time serves as the receiving pond of the wastewater coming from the grow-out ponds 2 & 3. The other circulating system used 1:1 mangrove-shrimp ratio had one pond planted to mangroves and the other one stocked with shrimps applying the same circulating principle. Each shrimp pond was stocked with 12,500 pcs of shrimps at 20/m^2. After four and a half months of culture, the result showed that Pond 6 using circulating system with a ratio of 1:1 mangrove-shrimp pond yielded the biggest average size shrimp with FCR of 1.51. In Pond 2 to 6, the production, survival rate as well as average size indicates that purification of wastewater is effectively done in the circulating system between ponds 5 and 6. In Ponds 2 and 3, the ability to purify wastewater is not as efficient as in pond 6.

Figure 1. Shrimp culture and Mangrove in Thailand





Shrimp culture and mangrove in Samut Songhram

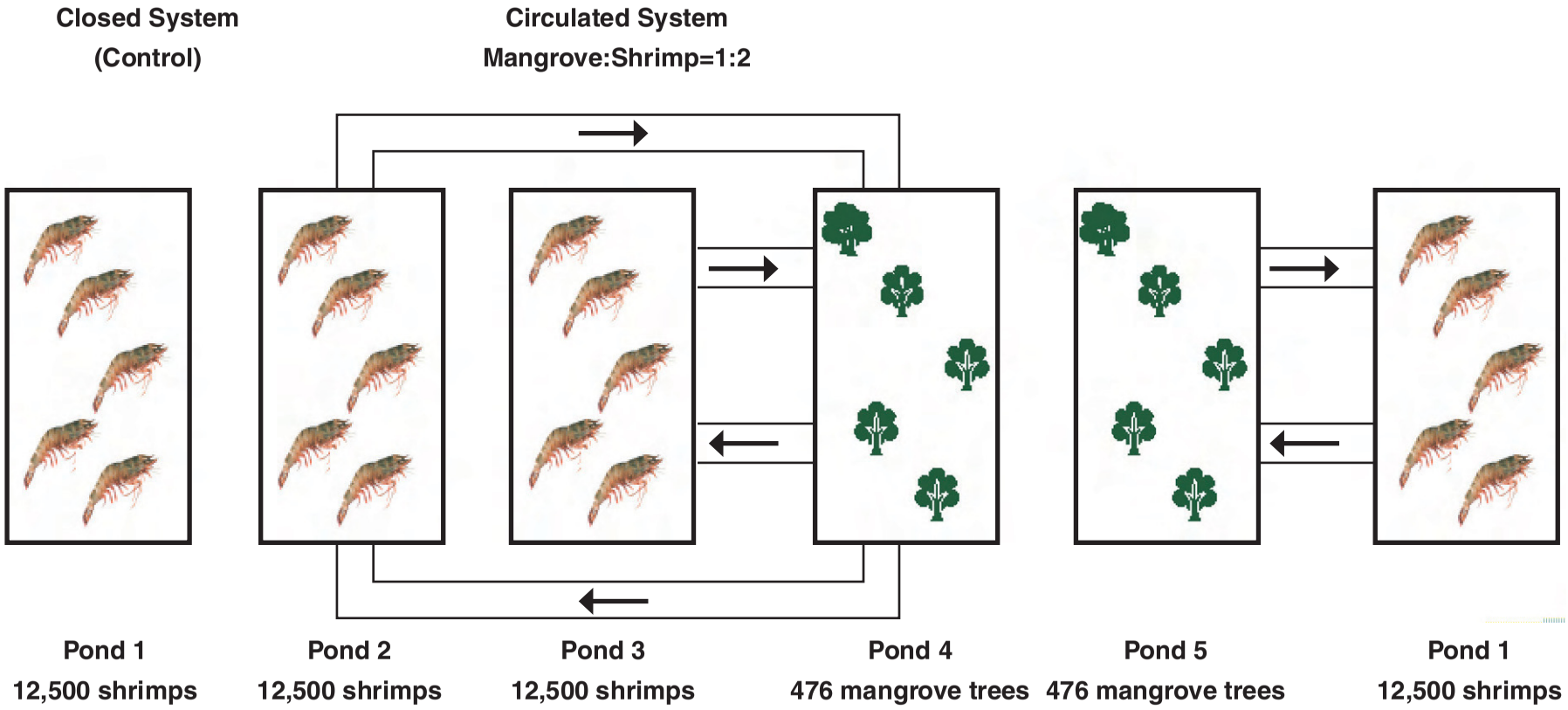


Figure 2. Culture experiment for *Penaeus monodon*

Circulated System
Mangrove:Shrimp=1:1

Nutrient condition in culture ponds

This study also determined many kinds of nutrients condition, TDP and TDN in the shrimp ponds, however, results indicated that there is difficulty to distinguish their differences. Among the macro-benthos, the dominant species are the *Balanus* sp. Fig. 3 shows the macro-benthos found in the ponds. The trend of changes in wet weight were noted and shown in Fig. 4.

Figure 3. Results of experiment

Site : Samut Songhram coastal aquatic Research Station, Kasetsart University

Date: September 19, 2003 – February 12, 2004

	Pond 1 Closed	Pond 2 2 ponds	Pond 3 2 ponds	Pond 6 1 pond
No. of stocked (A)	12500	12500	12500	12500
Culture density (N/m^2)	20	20	20	20
No. of harvested (B)	8276	7735	7654	8433
Survival rate (B/A) (%)	66.2	61.9	61.2	67.5
Total Production (Kg)(C)	240.4	194.6	193.7	264.8
Production (Kg/ m^2)	0.30	0.24	0.24	0.33
Average size (C/B)(g)	29.0	25.2	25.3	31.4
Feed (Kg) (D)	352.8	345.4	320.6	400.1
FCR (D/C)	1.47	1.77	1.66	1.51

Figure 4. Macro-benthos

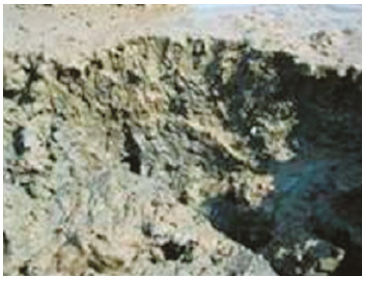
	Pond 1 Closed	Pond 2 Circulated	Pond 3 Circulated	Pond 4 Mangrove	Pond 5 Mangrove	Pond 6 Circulated
Nematoda(線虫)	○		○	○	○	○
Annelida(環形動物)						
Polydora sp.	○	○	○	○	○	○
Perinereis sp.		○		○	○	
Mediomastus sp.			○			
Capitellidae		○		○	○	
Polychaeta	○	○	○	○	○	○
Mollusca(軟体)						
Cerithium coralium					○	○
Thiara riquetii	○		○	○	○	○
Thiara scabra	○	○			○	
Thiara sp.	○	○	○	○		○
Melanoides tuberculata		○			○	
Cerithidea cingulata	○	○	○	○	○	○
Rissoidae			○	○	○	○
Iravadiidae				○	○	○
Assiminea brevicula				○		
Assimineidae	○			○	○	○
Stenothyra acuta	○					
Stenothyra sp.				○	○	○
Stenothyridae				○	○	
Eulimidae						○
Opithobranchia						○
Gastropoda					○	
Arthropoda(節足動物)						
Ostracoda	○		○	○	○	○
Copepoda					○	
Harpacticoida				○		
Balanus sp.	○	○	○			○
Isopoda					○	
Chironomidae			○	○	○	
Insecta				○	○	
Gammaridea				○	○	
Number of taxa	11	9	11	19	22	15

Balanus sp.

Cerithidea cingulata

Perineeis sp.

Polydra sp.



Perinereis

Polydra

Collection and culture polychaetes

Polychaetes collected from mud flat were cultured in tanks and found to be: a) possible to culture in short periods; (b) possible to reproduce; (c) increase the number; and (d) reproduce for the next generation (Fig. 5)

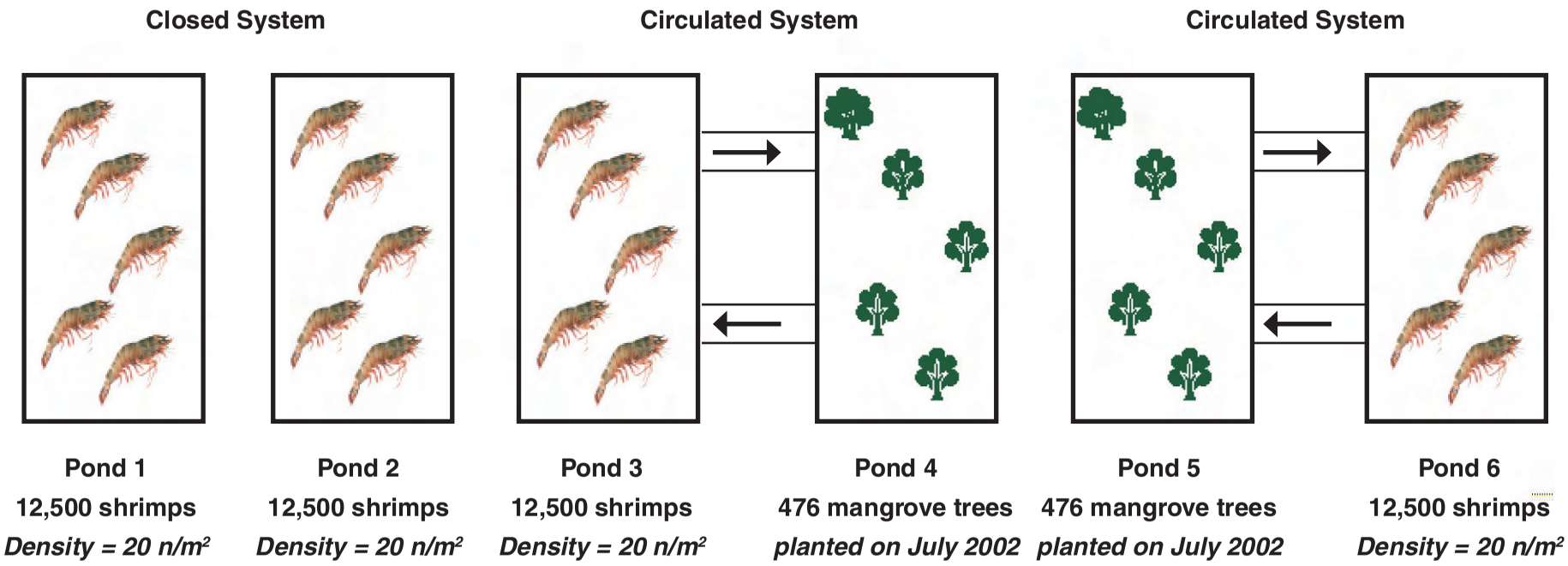
Another set of experiment was conducted to compare again the closed and circulating systems using another treatment. Closed system will be used for ponds 1 & 2 while circulating system for ponds 3 and 6 using the same mangrove-shrimp ratio (1:1) plus *Polychaetes perenereis* spp. Each shrimp pond was stocked 12,000 shrimps at a stocking density of 20/m^2. Water was exchanged every week in ponds 3 and 4, 5 & 6. The shrimps will be culture for four months.

Recommendations:

From the results of the series of experiments, the following technologies can be used to improve water and sediment quality:

1. water purification by mangrove (closed)
2. water purification of mangrove (circulated)
3. land preparation for shrimp culture
4. bio-mediation
5. sediment improvement using pump
6. paddle wheel

Figure 5. Culture experiment of *Penaeus monodon* (the second of May 24, 2004)



Experiment will be started on 24 May 2004, and continued about 4 months.
PL24 Penaeus monodon will be stocked in shrimp aquaculture ponds.
Rhizophora sp. were planted in mangrove ponds on July 2002.
Polychaetes perenereis spp were cultured in Ponds 3-6
Water was exchanged every week between Pond 3 and Pond 4, Pond 5 and Pond 6.

TECHNOLOGIES FOR IMPROVEMENT OF WATER AND SEDIMENT QUALITY

Water purification by mangrove (Closed)



Water purification by mangrove (Circulated)


Bio-mediation



Land preparation for shrimp culture


Paddle wheel



Sediment improvement using pomp