EFFLUENTS FROM INTENSIVE CULTURE PONDS OF TIGER PRAWN (*PENAEUS MONODON* FABRICIUS)

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ABSTRACT

Quality of the effluents during growing period of tiger prawn from five intensive culture ponds in the eastern coast of the Gulf of Thailand were monitored. The effluents discharged into recieving water containing 11.6-251.0 mg/l of total suspended solid. Biochemical oxygen demand of the effluents were between 2.5 and 60.5 mg/l. Phosphorus content varied from 0 to 0.1018 mg/l as P for soluble orthophosphate and from 0.0069 to 0.7236 mg/l for total phosphate. Ammonia nitrogen concentration in the effluents were between .0021 and .8676 mg/l. Nitrate nitrogen was found in low concentration between 0 and 0.0263 mg/l as N. However, the accumulation of nitrite in the effluents were recorded in certain sampling period with the highest concentration of 0.4094 mg/l as N. The effluents had pH between 7.1 and 8.9, dissolved oxygen between 2.8 and 13.8 mg/l, salinity between 9 and 36 ppt, and turbidity between 2 and 68 NTU

INTRODUCTION

Intensive culture of *Penaeus monodon* is widely practiced in coastal area of Thailand. Beginning in 1981 in experimental state, intensive shrimp farming was rapidly expanded, beginning from 1985, when culturing technique was developed to produce 6.25

ton of shrimp per hectare per four and a half months (Musig, 1988). Sharp rise in cultured shrimp production occurred in 1988 when total production of cultured shrimp increased to 75,000 tons comparing to the production of 25,000 tons in 1987. Cultured shrimp production in Thailand increased to 100,000 tons in 1990 (Coastal Aquaculture Division, 1991). Most of the farmer increase stocking rate to 50-60 shrimp/m^2 or more comparing to 15-20 shrimp/m^2 at the beginning. This result in higher production as much as 12.5 tons/ha or higher. However, effluents from shrimp ponds created pollution problems in coastal water. In 1989, some shrimp farming areas in the Inner Gulf of Thailand started to have a problem of mass mortality of cultured shrimp. This problem was also spreaded to other farming areas in the eastern and the southern coast. At the average feed conversion ratio of 2.0-2.5, a large amount of organic matter were left in aquatic environment.

In this study quality of effluents from intensive shrimps ponds were investigated as well as BOD, suspended solid, and nutrient load in the effluents.

MATERIALS AND METHODS

Effluents from intensive culture ponds of *Penaeus monodon*, of a shrimp farm in Trad province on the eastern coast of the Gulf of Thailand, were collected and analyzed for biochemical oxygen demand, nonsettleable solid, total suspended solid, soluble ortho-phosphate, total phosphate, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, turbidity, pH, salinity, and dissolved oxygen.

In the first month effluent samples were taken at 15 and 25 days after stocking. After second sampling, the samples were taken every week until harvest.

Culture system of the farm consist of a 1.5 ha reservior, a supply canal, and four grow out ponds with surface area of 0.51, 0.57, 0.61 and 0.61 ha. The depth of the reservior was 2.70 m. Average depth of grow out ponds was 1.70 m.

Water were pumped into the reservior, during high tide period and overflow through the gate into water supply canal. Other water pumps were used to pump water from water

supply canal into grow out ponds. Effluents were released through slice gates which were designed to create the outflow of bottom layer of water into drainage canal.

The grow out ponds were stock with tiger prawn at stocking density of 53-62 shrimp/m^2. The reservior was also stocked with shrimp at the density of 10 shrimp/m^2.

Aerators were provided both in reservior and grow out ponds.

Water exchange were done at 15 days and 25 days after stocking followed by two consecutive one week interval. Then water exchange schedule was set at approximately every three days for one month and every two days for one month followed by daily water exchange till harvest.

Culturing period were 4 1/2 months. Shrimp production from grow out ponds were between 10.3-14.7 ton/ha. Shrimp production in reservior was 2.5 tons or 2.55 ton/ha. Total shrimp production in grow out ponds and reservior was 30.2 tons.

Effluent qualities were analyzed according to the methods recommended by APHA et. al. (1989) and Grasshoff (1978).

RESULTS AND DISCUSSION

Monthly average and range of effluent quality from shrimp ponds are presented in Table 1. Biochemical oxygen demand of the effluents varied from 2.5 to 60.5 mg/l. Monthly average of BOD of the effluent increased from 5.2 mg/l during the first month to 8.0 mg/l in the fourth month and rose to 38.2 mg/l in the last two weeks. The highest BOD values were recorded from the effluents during harvesting period.

Total suspended solid in the effluents varied from 11.6 to 251.0 mg/l while nonsettleable solid varied from 10.4 to 176.0 mg/l. Monthly average of total suspended solid decreased from 48.5 mg/l in the first month to 44.1 mg/l in second month then increased to 71.4 mg/l in the fourth month and increased to 132.6 mg/l in the last two weeks. Monthly average of total nonsettleable solid followed the same trend of total suspended solid which average values decreased from 29.0 mg/l in the first month to 22.2 mg/l in second month then

increased to 37.7 mg/l in the fourth month and rose up to 98.4 mg/l in the last two weeks (Table 1).

Ammonia nitrogen in the effluents varies from .0021 to .8676 mg/l. Nitrite nitrogen varies from 0 to 0.4094 mg/l. Both ammonia and nitrite showed the clear trend of increasing in average values from first month to the last two weeks as well as total inorganic nitrogen which increased from .0084 mg/l in first month to .3999 mg/l in the last two weeks. However, average concentration of nitrate nitrogen were fluctuated with the highest average concentration of .0050 mg/l in the last two weeks. Concentration of nitrate nitrogen varied from 0 to .0263 mg/l.

Phosphorus content in the effluents varied from 0 to .1018 mg/l as P for soluble orthophosphate and from .0069 to .7236 mg/l as P for total phosphate. Highest average concentration of phosphorus also occurred in the last two weeks (Table 1).

pH of the effluents varied between 7.1 and 8.9. Dissolved oxygen varied between 2.8 and 13.8 mg/l. Salinity varied between 9 and 36 ppt. Turbidity varied between 2 and 68 NTU.

Total volume of effluents from all of the four grow out ponds was 152,532 m^3 with total BOD of 2,779 kg, total inorganic nitrogen of 37.13 kg, total phosphorus of 24.09 kg, total suspended solid of 13,443.3 kg, and nonsettleable solid of 8,646.8 kg (Table 2). This equivalent to 93 kg of BOD, 1.34 kg of inorganic nitrogen, 0.87 kg of phosphorus, 449.6 kg of total suspended solid, and 289.2 kg nonsettleable solid per ton of shrimp. Total load of nutrients, BOD, and solids in the effluents increased from first month till harvesting period.

The amount of effluent released in the last two weeks included all of the water drained out from ponds during harvest. Seventy four percent of BOD, 53 percent of total suspended solid, 54 percent of total phosphate, and 58 percent of inorganic nitrogen were released in this period. High percentage of BOD, total suspended solid, total phosphate, and total inorganic nitrogen were also released in the fourth month.

If these figures are used to calculate the amount of pollutant released to Thai coastal water using total annual production of 200,000 ton of shrimp per year, total load of BOD per year will be 186,000 tons.Total amount of total suspended solid released into natural water will be 89920 tons per year and total amount of inorgnic nitrogen and total phosphorus released from shrimp farms per year will be 248 and 174 tons. These amount of pollutants should be reduced by proper management of shrimp pond effluent in order to maintain good quality of coastal waters. If possible, effluent standard for intensive shrimp farm should be imposed.

REFERENCES

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Table 1. Quality of effluent from shrimp ponds (average values and range)

Parameter	Culturing period				
	1st month	2nd month	3rd month	4th month	last 2 weeks
BOD (mg/l)	5.2	6.0	7.1	8.0	38.2
	(2.5-8.3)	(4.3-9.0)	(3.0-10.7)	(6.3-10.2)	(19.0-60.5)
Ammonia nitrogen	0.0060	0.0462	0.1711	0.1867	0.3335
(mg/l)	(0.0104-0.2763)	(0.0104-0.1826)	(0.0021-0.8676)	(0.0062-0.5755)	(0.0214-0.8104)
Nitrite nitrogen	0.0013	0.0013	0.0080	0.0146	0.0614
(mg/l)	(0.0-0.0026)	(0.0002-0.0039)	(0.0-0.0974)	(0.0-0.085)	(0.0006-0.4094)
Nitrate nitrogen	0.0011	0.0020	0.0027	0.0016	0.0050
(mg/l)	(0.0-0.0034)	(0.0-0.0065)	(0.0-0.0139)	(0.0-0.0052)	(0.0-0.0263)
Soluble orthophosphate	0.0075	0.0102	0.0066	0.0115	0.0471
(mg/l as P)	(0.0069-0.0138)	(0.0-0.0153)	(0.0-0.0139)	(0.0014-0.0244)	(0.0014-0.1018)
Total phosphate	0.2245	0.0736	0.1138	0.1227	0.2397
(mg/l as P)	(0.0209-0.7236)	(0.0069-0.1753)	(0.0138-0.2806)	(0.0166-0.1910)	(0.0995-0.3585)

Table 1. (continued)

Total suspended solid	48.5	44.1	67.8	71.4	132.6
(mg/l)	(29.2-81.0)	(11.6-91.0)	(33.0-138.0)	(27.2-100.0)	(94.0-251.0)
Nonsettleable solid	29.0	22.2	37.1	37.7	98.4
(mg/l)	(20.0-52.0)	(10.4-36.4)	(20.4-82.0)	(20.0-100.0)	(19.2-176.0)
Dissolved oxygen	7.7	7. 0	6.1	5.7	6.2
(mg/l)	(4.4-13.8)	(4.7-9.7)	(3.0-9.5)	(2.8-8.6)	(3.6-11.3)
pH	8.1	8.3	7.9	7.9	7.9
	(7.5-8.4)	(7.1-8.9)	(7.1-8.8)	(7.5-8.4)	(7.3-8.1)
Salinity (ppt)	10	10	11	30	34
	(10.0-10.0)	(9.0-13.0)	(7.0-17.0)	(24.0-35.0)	(32.0-36.0)
Turbidity (NTU)	13.75	16.9	32.3	20.4	28.2

Table 2. Nutrients and BOD load in the effluents

Parameters	Culturing period					Total	Total load per ton of shrimp
	1st month	2nd month	3rd month	4th month	last 2 weeks		
Volume of effluent (m^3)	3,230	22,034	21,655	51,655	54,018	152,532	-
BOD load (kg)	16.8	132.2	153.8	412.8	2,063.5	2,779.1	93.0
Total phosphorus (kg)	0.73	1.62	2.46	6.33	12.95	24.09	0.87
Total inorganic nitrogen (kg)	0.03	1.09	3.94	10.47	21.60	37.13	1.34
Total suspended solid (kg)	156.7	971.7	1,468.2	3,683.9	7,162.8	13,443.3	449.6
Nonsettleable solid (kg)	93.7	489.2	803.4	1,945.1	5.315.4	8,646.8	289.2