STOCKING RATIOS OF HYBRID CATFISH (*Clarias macrocephalus x C. Gariepinus*) AND NILE TILAPIA (*Oreochromis niloticus*) IN INTENSIVE POLYCULTURE SYSTEM

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INTRODUCTION

- Hybrid catfish has become one of the most popularly cultured freshwater fish in Southeast Asia.
- Main problem of intensive hybrid catfish culture is environmental pollution. About 78.8% of N and 85.5% of P from feed input are released into the surrounding water lost from catfish cage culture.
- Many previous studies have proven that Tilapia can utilize nutrition of waste for their growth in integrated systems successfully by reusing nutrition from the waste in culturing systems.

So, it is very important to study the stocking ratio of Nile tilapia to hybrid catfish in intensive polyculture.

Objectives

- To compare the growth performance of hybrid catfish and Nile tilapia in polyculture at different stocking ratio
- To compare water quality in polyculture at different stocking ratio
- To determine the nutrient utilization efficiency and nutrient budget in polyculture at different stocking ratios
- To compare the economic returns in polycultrure at different stocking ratios
- To determine and recommend the appropriate stocking ratio of Nile tilapia to hybrid catfish in intensive polyculture systems


Experimental period: 3/3/2003 to 2/6/2003
Experimental site: 15 outdoor concrete tanks at AIT hatchery
Tank area: 5- m^2 ; Water level: 0.9m;
Covered by net; Aeration system.
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Experiment Design

Treatments	T1	T2	T3	T4	T5	T6	T7
Stocking ratios (Tilapia:H. catfish)	0:100	5:100	10:100	15:100	20:100	25:100	30:100
Replications	3	2	2	2	2	2	2

Size of fingerlings: Hybrid catfish: 25.4 g Nile tilapia: 20.4 g

- Kind of feed: CP feed (crude protein 30%)
- Feeding: 2 times at 0830h and 1530h and 6 days per week
- Feeding rate: 5% of BWD (<100 g), and 3% BWD (>100g).
- Feeding rates was based only catfish biomass estimated by biweekly fish sampling

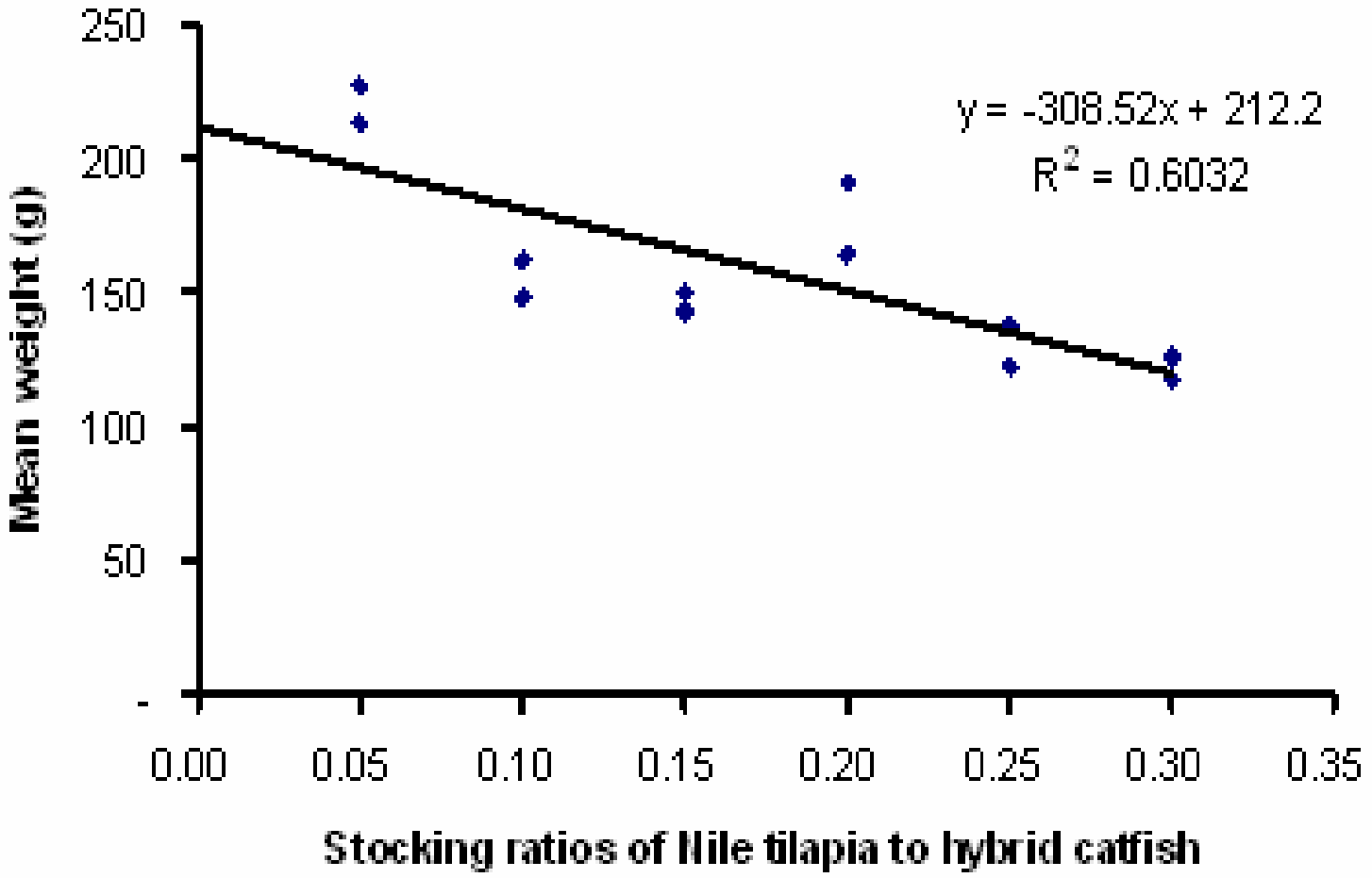
RESULTS AND DISCUSSION

Growth performance of hybrid catfish cultured in the monoculture and polyculture system for 91 days

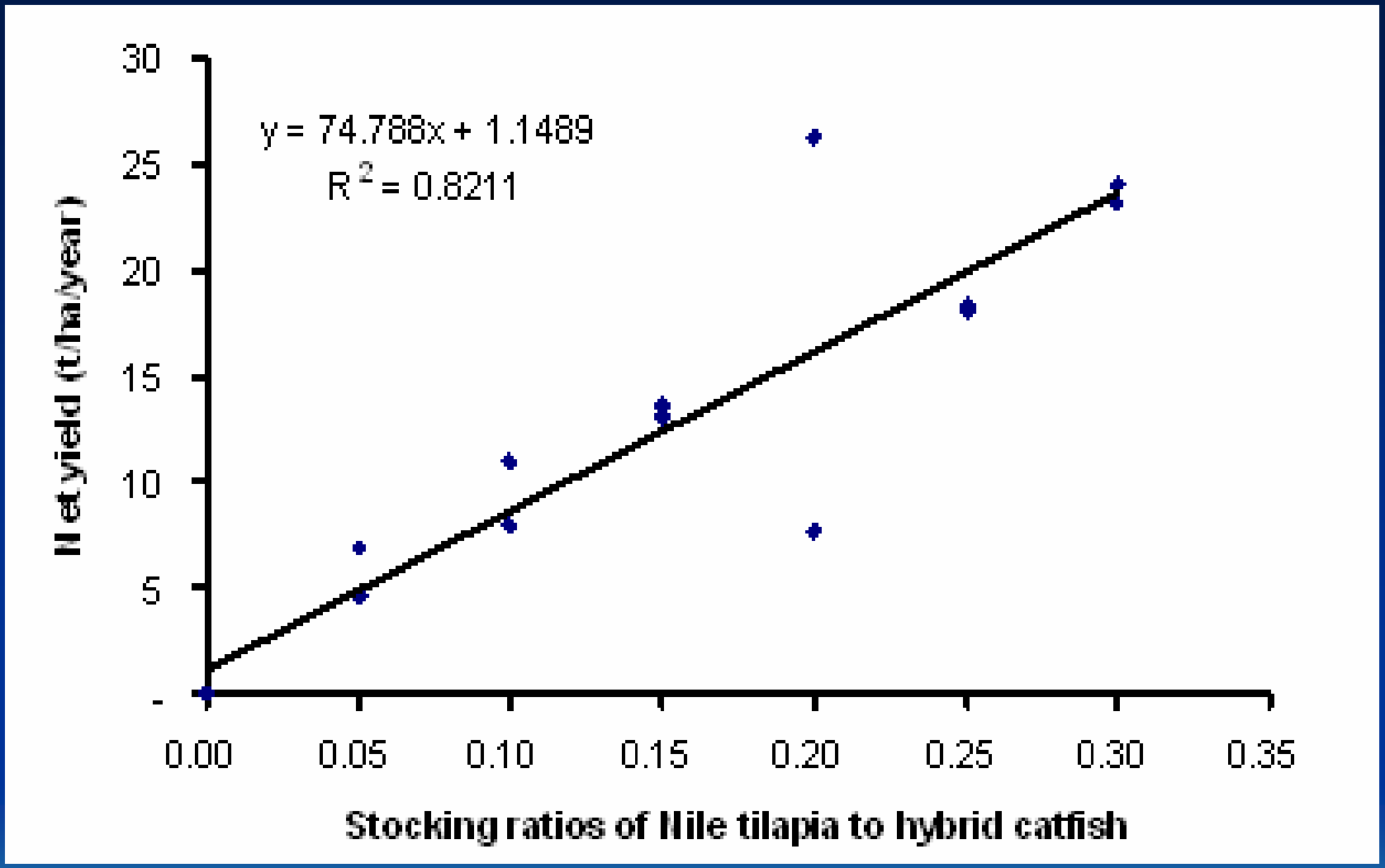
Parameter	Treatments (Nile tilapia: Hybrid catfish ratio)						
	T1 (0:100)	T2 (5:100)	T3 (10:100)	T4 (15:100)	T5 (20:100)	T6 (25:100)	T7 (30:100)
Stocking							
Density (fish/m^2)	20	20	20	20	20	20	20
Total No. of fish	100	100	100	100	100	100	100
Mean weight (g/fish)	25±1.2	25±0.7	25±0.7	26±0.6	26±0.3	26±0.1	25±1.8
Total weight (kg/tank)	2.5±0.1	2.5±0.1	2.5±0.1	2.6±0.1	2.6±0.0	2.6±0.0	2.5±0.2
Harvest							
Mean weight (g/fish)	196±5.4	198±3.2	182±4.4	190±2.7	181±0.3	199±12.0	180±0.6
Total weight (kg/tank)	18.4±1.1	19.1±0.2	18.2±0.4	19.0±0.3	17.4±0.3	19.0±0.5	17.2±0.8
FCR	1.15±0.06	1.11±0.02	1.13±0.02	1.18±0.06	1.19±0.09	1.17±0.00	1.22±0.02
Survival Rate (%)	93.67±3.48	96.50±0.50	100.00±0.00	100.00±0.00	96.00±2.00	95.50±3.50	95.50±4.95
Weigh gain							
Mean weight gain (g/fish)	170.99±5.88	172.23±2.44	156.17±3.61	164.10±3.31	155.47±0.55	173.14±11.97	155.08±3.10
Daily weight gain (g/fish/d)	1.88±0.06	1.89±0.03	1.72±0.04	1.80±0.04	1.71±0.01	1.90±0.13	1.70±0.03
Total weight gain (kg)	15.9±1.2	16.5±0.1	15.6±0.4	16.4±0.3	14.8±0.3	16.4±0.5	14.7±0.6
Net yield (kg/m^2/crop)	3.2±0.2	3.3±0.1	3.1±0.1	3.3±0.1	3.0±0.0	3.3±0.0	2.9±0.3
Net yield (t/ha/year)	127.4±9.5	132.6±1.1	125.3±2.9	131.6±2.7	118.9±2.5	131.4±3.6	117.9±4.7
Gross yield (kg/m^2/crop)	3.7±0.2	3.8±0.0	3.6±0.1	3.8±0.1	3.5±0.1	3.8±0.1	3.4±0.2
Gross yield (t/ha/year)	147.6±8.7	153.0±1.7	145.6±3.5	152.1±2.2	139.5±2.7	152.0±3.6	138.0±6.7

Growth performance of Nile tilapia cultured in the polyculture system for 91 days

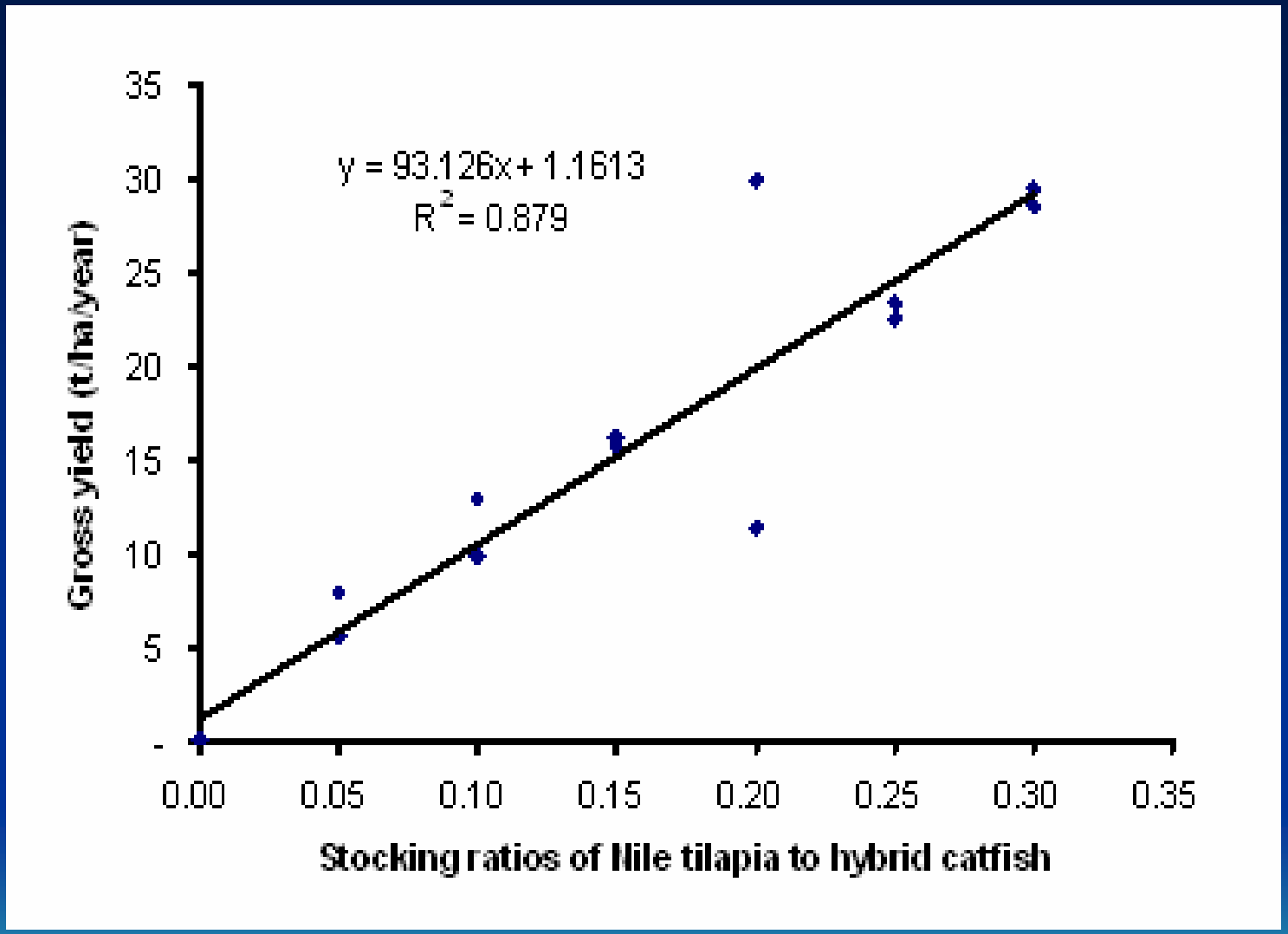
Parameter	Treatments (Nile tilapia: Hybrid catfish ratio)						
	T1 (0:100)	T2 (5:100)	T3 (10:100)	T4 (15:100)	T5 (20:100)	T6 (25:100)	T7 (30:100)
Stocking							
Density (fish/m^2)	-	1	2	3	4	5	6
Total No. of fish	-	5	10	15	20	25	30
Mean weight (g/fish)	-	23±0.25	22±0.03	20±0.17	21±0.49	22±1.16	21±0.04
Total weight (kg)	-	0.11±0.00^{a}	0.22±0.00^{b}	0.30±0.00^{c}	0.41±0.01^{d}	0.55±0.03^{e}	0.63±0.00^{f}
Harvest	-						
Mean weight (g/fish)	-	220±6.90^{a}	155±6.71^{bc}	147±3.50^{cd}	177±13.40^{b}	129±7.35^{cd}	121±5.95^{d}
Total weight (kg)	-	0.77±0.13^{a}	1.31±0.18^{ab}	1.83±0.03^{abc}	2.37±1.06^{abc}	2.64±0.04^{bc}	3.34±0.08^{c}
Survival Rate (%)	-	70.00±10.00	85.00±15.00	83.33±3.33	65.00±25.00	82.00±6.00	91.67±1.67
Weigh gain	-						
Mean weight gain (g/fish)	-	198±6.64^{a}	133±6.68^{bc}	126±3.68^{cd}	156±13.89^{b}	107±8.51^{cd}	100±5.89^{d}
Daily weight gain (g/fish/d)	-	2.35±0.08^{a}	1.58±0.08^{bc}	1.50±0.04^{cd}	1.86±0.17^{b}	1.28±0.10^{cd}	1.20±0.07^{d}
Total weight gain (kg)	-	0.66±0.13	1.09±0.18	1.53±0.03	1.96±1.07	2.09±0.01	2.71±0.08
Net yield (kg/m^2/crop)	-	0.13±0.03	0.22±0.04	0.31±0.01	0.39±0.21	0.42±0.00	0.54±0.02
Net yield (t/ha/year)	-	5.7±1.16	9.4±1.52	13.3±0.23	17.0±9.30	18.2±0.13	23.5±0.66
Gross yield (kg/m^2/crop)	-	0.2±0.03^{a}	0.3±0.03^{ab}	0.4±0.01^{abc}	0.5±0.21^{abc}	0.5±0.01^{bc}	0.7±0.02^{c}
Gross yield (t/ha/year)	-	6.7±1.17^{a}	11.3±1.52^{ab}	15.9±0.26^{abc}	20.6±9.21^{abc}	22.9±0.38^{bc}	29.0±0.68^{c}



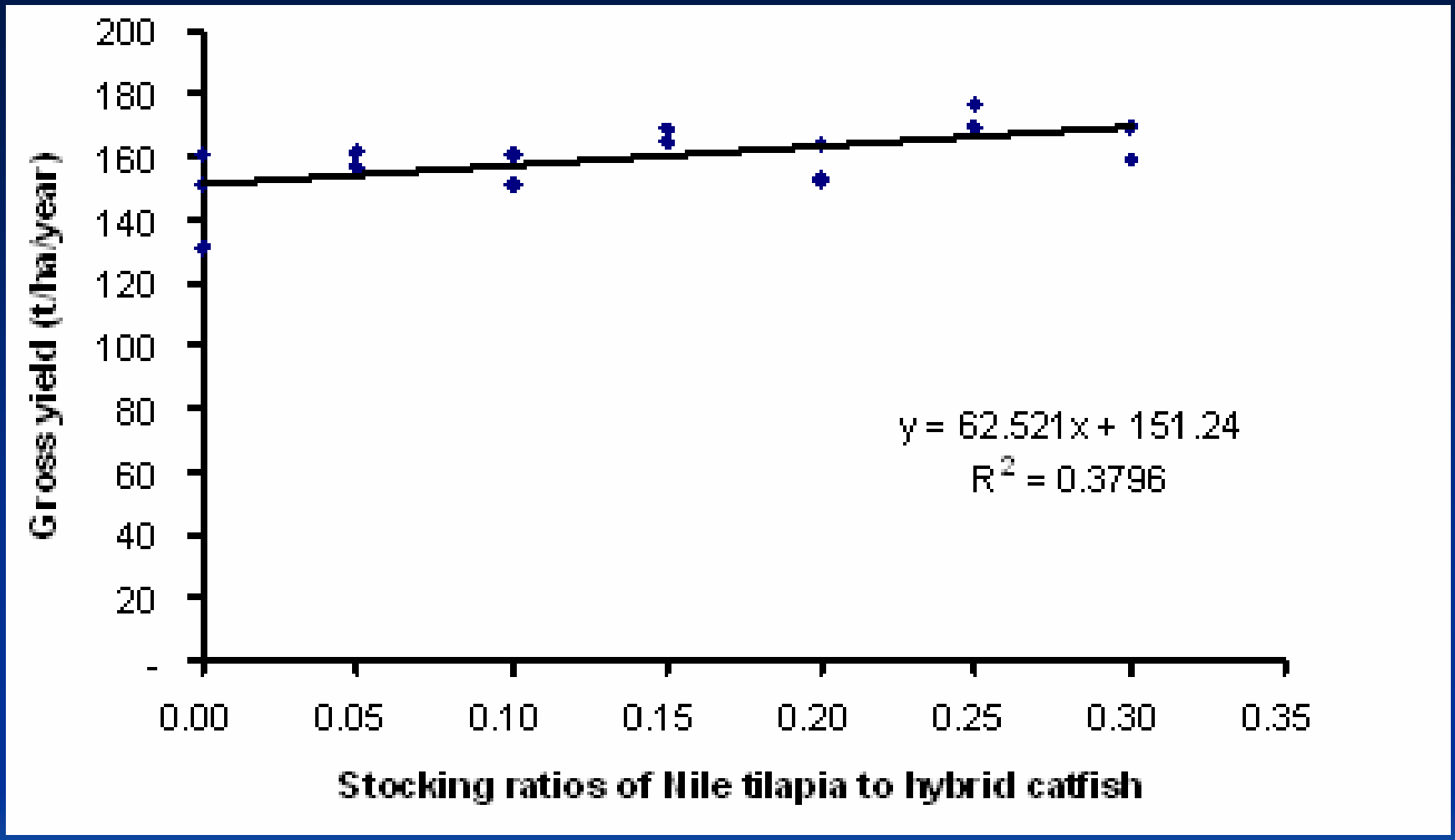
Relationship between mean weights of Nile tilapia and stocking ratios



Relationship between net yields of Nile tilapia and stocking ratios



Relationship between gross yields of Nile tilapia and stocking ratios



Relationship between combined gross yields and stocking ratios

Distribution (%) of TN and TP in the polyculture system of hybrid catfish and Nile tilapia

Parameters	Treatments (Nile tilapia: Hybrid catfish ratio)						
	T1 (0:100)	**T2** (5:100)	**T3** (10:100)	**T4** (15:100)	**T5** (20:100)	**T6** (25:100)	**T7** (30:100)
Nitrogen							
Feed input	100	100	100	100	100	100	100
Gain in catfish	63.15±1.65^{a}	62.79±5.63^{ab}	60.37±2.92^{ab}	54.82±0.96^{ab}	53.23±3.64^{b}	54.27±1.32^{ab}	58.50±3.44^{ab}
Gain in tilapia	-	2.46±0.91	3.46±0.78	5.27±0.17	6.54±2.44	6.72±0.73	7.82±0.05
Effluent water	24.29±3.92	31.67±3.42	29.21±1.11	26.68±11.54	30.72±4.85	28.14±5.77	23.23±1.78
Loss in sediment	2.12±1.18	1.35±0.36	0.56±0.01	0.97±0.25	0.83±0.14	0.83±0.21	0.66±0.22
Unaccounted	10.44±5.14	1.73±1.66	6.41±1.01	12.27±12.08	8.67±5.90	10.04±8.02	9.79±1.39
Total	100	100	100	100	100	100	100
TN gained	63.15±1.65	65.25±4.72	63.83±2.14	60.09±0.79	59.77±1.20	60.99±2.05	66.32±3.39
TN wasted	36.85±1.65	34.75±4.72	36.17±2.14	39.91±0.79	40.23±1.20	39.01±2.05	33.68±3.39
Phosphorous							
Feed input	100	100	100	100	100	100	100
Gain in catfish	39.24±2.12	43.30±1.76	42.66±5.36	40.94±1.89	40.21±5.56	42.70±2.48	39.81±1.63
Gain in tilapia	-	1.76±0.54	2.56±0.62	4.19±0.61	5.76±4.66	5.43±0.65	7.35±0.12
Effluent water	25.95±4.16	20.23±4.84	21.22±2.79	20.91±0.82	24.32±2.28	19.37±3.77	24.15±1.49
Loss in sediment	3.55±1.21	3.18±0.03	1.76±0.13	3.21±0.36	2.37±0.28	2.25±0.49	2.20±0.58
Unaccounted	31.27±4.63	31.54±4.00	31.80±1.31	30.75±0.59	27.35±2.64	30.25±6.48	26.49±1.98
Total	100	100	100	100	100	100	100
TP gained	39.24±1.22^{a}	45.06±0.86^{ab}	45.22±4.23^{ab}	45.13±1.77^{ab}	45.96±0.64^{ab}	48.13±2.22^{b}	47.16±1.07^{b}
TP wasted	60.76±2.12^{a}	54.94±1.22^{ab}	54.78±5.98^{ab}	54.87±2.50^{ab}	54.04±0.91^{ab}	51.87±3.13^{b}	52.84±1.52^{b}

Values of water quality parameters measured at the end of the monoculture and polyculture systems of hybrid catfish and Nile tilapia

Parameters	Treatments (Nile tilapia: Hybrid catfish ratio)						
	T1 (0:100)	T2 (5:100)	T3 (10:100)	T4 (15:100)	T5 (20:100)	T6 (25:100)	T7 (30:100)
DO at dawn (mg/L) S.E.(±)	1.2±0.18	1.1±0.02	1.4±0.03	1.3±0.46	1.4±0.09	0.9±0.13	1.0±0.05
Temperature (C)	30.9±0.1	30.8±0.1	30.9±0.0	30.8±0.0	30.9±0.1	30.9±0.0	30.9±0.0
PH	6.54±0.38	7.55±0.11	6.48±0.41	6.76±0.39	6.09±0.34	6.97±0.47	6.44±0.49
Total alkalinity (mg/L as $CaCO_3$)	84±34	18±2	33±13	63±51	48±37	76±54	54±4
TKN (mg/L)	40.31±1.78	49.24±4.04	45.60±0.37	44.96 ±15.02	45.07±4.52	49.01±9.20	36.42±5.38
TAN (mg/L)	0.24±0.09	2.16±1.86	0.26±0.10	1.38±1.14	2.09±1.88	0.71±0.49	0.25±0.02
UIA-N (mg/L)	0.001±0.000	0.000±0.000	0.000±0.000	0.001±0.001	0.001±0.000	0.001±0.001	0.001±0.000
Nitrite-N (mg/L)	0.30±0.12	0.08±0.06	0.08±0.01	0.15±0.11	0.10±0.01	0.27±0.05	0.12±0.06
Nitrate-N (mg/L)	9.22±4.04	19.48±2.32	14.02±2.01	13.56±8.44	16.20±2.44	13.34±4.88	12.00±0.12
TP (mg/L)	14.00±0.18	13.87±0.18	13.01±0.10	15.50±0.65	11.67±0.29	13.76±0.78b	12.17±0.75
SRP (mg/L)	8.77±1.13	10.70±0.06	9.41±0.04	10.49±1.65	9.48±0.62	9.22±1.50	8.76±0.12
Chlorophyll a (mg/m^3)	588±221	289±103	481±58	343±100	572±58	712±187	557±87
TSS (mg/L)	513±111	364±30	439±17	442±16	276±8	486±60	399±33
TVS (mg/L)	997±44	1,067±79	1,011±27	1,022±48	966±12	1,069±69	1,008±22

Partial budget analysis (Baht) for hybrid catfish and Nile tilapia polyculture in the 91-day experiment (based on 5-m^2 cement tanks)

Parameters	Treatments (Nile tilapia: Hybrid catfish ratio)						
	T1 (0:100)	T2 (5:100)	T3 (10:100)	T4 (15:100)	T5 (20:100)	T6 (25:100)	T7 (30:100)
GROSS REVENUE							
Hybrid catfish	496.6±29.4	514.9±5.6	490.2±11.8	512.0±7.4	469.7±9.0	511.7±12.2	464.4±16.0
Adult tilapia	-	15.5±2.7	26.1±3.5	36.6±0.6	47.4±21.2	52.8±0.9	66.7±1.1
Total	496.6±29.4	530.4±8.3	516.3±15.2	548.6±6.8	517.1±12.2	564.5±11.4	531.1±17.1
VARIABLE COST							
Tilapia fingerlings	65	65	65	65	65	65	65
Hybrid catfish fingerlings	-	5	10	15	20	25	30
Total cost of feed	377.9±17.3	384.2±2.7	370.3±1.0	403.5±11.7	369.0±19.7	401.9±10.5	375.2±14.1
Electricity	43.7	43.7	43.7	43.7	43.7	43.7	43.7
Cost of working capital	9.7±0.3	9.9±0.1	9.8±0.0	10.5±0.2	9.9±0.4	10.7±0.2	10.2±0.3
Total cost	496.3±17.6	507.8±2.8	498.8±1.1	537.7±11.9	507.6±20.0	546.2±10.7	524.1±14.4
NET RETURN	0.3± 20.1	22.6± 11.1	17.5± 14.2	10.8± 18.7	9.5 ±7.9	18.3± 0.7	7.0 ±2.7
ADDED COST	-	11.5	2.5	41.4	11.3	49.9	27.8
ADDED RETURN	-	22.3	17.2	10.5	9.1	17.9	6.6
ADDED RETURN/ADDED COST	-	1.9	7.0	0.3	0.8	0.4	0.2

CONCLUSIONS

- Growth of Nile tilapia decreased linearly with increased stocking ratios of Nile tilapia to hybrid catfish; however, growth of hybrid catfish was not significantly different among all stocking ratios
- With increasing stocking ratios of Nile tilapia to hybrid catfish from 0:100 to 30:100, net and gross yields of Nile tilapia and Nile tilapia plus hybrid catfish increased linearly, while net and gross yield of hybrid catfish were not significantly different
- There were no significant differences in nitrogen utilization efficiently among the catfish monoculture and polyculture; however, phosphorus utilization was efficiently lowest in hybrid catfish monoculture compared to the polyculture of hybrid catfish and Nile tilapia

❖The addition of Nile tilapia into hybrid catfish tanks did not improve water quality. Water quality fluctuated largely among experimental tanks deteriorated towards the end of the culture period in all treatments

❖Compared to hybrid catfish monoculture, the ratio of added return to added cost was highest in the polyculture at 10:100 ratio of Nile tilapia to hybrid catfish, intermediate at 5:100 ratio, and lowest at higher ratios (15-30:100).

❖ This study has demonstrated that the intensive polyculture of hybrid catfish which Nile tilapia is feasible and that the appropriate ratios of Nile tilapia to hybrid catfish are 5-10:100

RECOMMENDATIONS FOR FUTURE STUDY

- This experiment should be conducted at the fixed same amount of feed input at all stocking ratios to better understand the roles of Nile tilapia in the intensive polyculture with hybrid catfis
- Timing of stocking Nile tilapia should be considered in the intensive polyculture with hybrid catfish
- Size of Nile tilapia at stocking may be smaller to avoid competition of pelted feed with hybrid catfish but to use natural foods derived from waste of hybrid catfish culture
- The similar experiments should be conducted in earthen ponds to develop the appropriate strategy of intensive polyculture of hybrid catfish and Nile tilapia, which can be used by farmers

THANK YOU VERY MUCH