EXTENSION, CREDIT AND ECONOMICS

POND CULTURE OF MUD CRAB (Scylla serrata): AN ECONOMIC ANALYSIS

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ABSTRACT

The study compares the profitability of mud crab pond culture with existing crab fattening practices in Iloilo.

Monoculture of Scylla serrata *at stocking densities of 5.000, 10.000. 15,000 and 20,000 pcs/ ha are compared for economic feasibility. Highest return on investment, return to equity, and shortest payback period* were *obtained from a stocking density of 5000/ha. Production cost ranged from 35.78 P/kg. at 5000/ha stocking density to 55.05 P/kg at 20,000 stocking density. Partial budgeting showed that no incremental benefit accrued from increasing the stocking density to 10,000/ha. Discounted economic indicators. such as net present value, benefit-cost ratio and internal rate of return, were also highest at 5,000/ha stocking density.*

INTRODUCTION

As an important commercial seafood, mud crab commands a high price in the domestic and export markets of the Philippines. Current prices of mud crab in Iloilo range from 80-140 P*/kg. Female crab command higher prices (150-200 P/kg) than male crab (60-80 P/kg).

In 1987, municipal, marine and inland fishery production of mud crab in the Philippines was 6 13 t and 224 t respectively (Centre for Research and Communication, 1989). Mud crab are caught in the extensive mangrove swamps and estuarine waters using gillnets, baited traps, fish traps and hooks (Cowan 1984; Motoh 1983). The culture of mud crab in ponds is becoming popular.

The objective of this study was to determine the economic feasibiliity of the pond culture of mud crab at various stocking densities.

METHODOLOGY

Technical data used in the economic analysis of the monoculture of mud crab *(Scylla serrata)* were derived from the experiment of Baliao *et al* (1981) conducted at the Southeast Asian Fisheries Development Center's Leganes Research Station. An updated comparative economic analysis was performed on the monoculture of mud crab *(Scylla serrata)* at stocking densities of 5000; 10,000, 15,000 and 20,000 juveniles/ha with two crops/year. Calculations are presented on a per hectare basis, using Philippine cost prices as of August 1991.

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* US $ 1= P: 27 appx **(mid-1991)**

The economic feasibility analyses were based on the formulae of Shang (198 1). Economic indicators, such as return on investmnet (ROI), return on equity (ROE), and payback period, were determined. ROI was computed by dividing net income after tax by the total investment, ROE by dividing net income after tax by owner's equity and the payback period by dividing the total investment by the sum of the net income after tax and annual depreciation. Five-year cash flows were discounted at 10 per cent to determine the net present value (NPV), benefit-cost ratio (BCR) and internal rate of return (IRR). NPV was computed by subtracting discounted costs from discounted revenues, BCR by dividing discounted revenues by discounted costs and IRR by using a Lotus computer programme.

For comparison, identical capital outlay and depreciation were used for each stocking density. The acquisition cost of land was not included as the study assumed that existing milkfish/shrimp ponds would be used. Working capital was equivalent to the variable costs plus repairs and maintenance costs, and caretaker's salary during the first crop. A 50:50 debt/equity ratio was used.

RESULTS AND DISCUSSION

Investment, costs and returns

Mean weight, percentage survival, relative growth increment, gross production and feed conversion values for the different stocking densities are shown in Table 1. Capital outlay and annual depreciation for a 10ha monoculture crab farm was P64,020 and P16,618 respectively (Table 2 facing page). Investment requirement for a l-ha crab monoculture ranged from P88,201 for 5000/ha stocking density to P1 l 1,484/ha for 20,000/ha stocking density (Table 3 facing page). investment consisted of capital outlay and working capital for one crop.

Table 1: Stock and harvest data for mud crab (S.serrata) monocultured at four stocking densities in 100 m^2 ponds.

Treatment	*Stocking density (1100m^2)*	*Harvest1100 m^2*			*Relative growth increment (g/day/crab)*	*Feed conversion value*	*Cross production (kg/ha/crop)*
		Number recovered	*Average wt.(g)*	*Percentage survival*			
1	50	44	*231.60*	*88.00*	*2.28*	*1.72*	*1.019.04*
II	100	*52*	*196.63*	*52.00*	*1.89*	*2.16*	*1,022.48*
III	150	*57*	*171.11*	*38.00*	*1.61*	*3.85*	*975.33*
IV	*200*	*62*	*178.11*	*31.00*	*1.69*	*4.04*	*1.104.28*

Source : **Baliao et al [198 1]**

Table 2: Capital investment and annual depreciation for a 1-ha crab monoculture farm

Capital outlay	*Quantity*	*Unit cost (P)*	*Total cost (P)*	*Economic life (years)*	*Annual depreciation (P)*
Pond development			50,000	5	10,000
Perimeter fencing					
Bamboo poles (pcs)	150	22	3,300	2	1,650
Banata fabrication (pcs)	110	20	2,178	2	1,089
Nylon monofilament	17	105	1,777	2	888
Nails (kg)	4	17	66	2	33
Plastic sheet (rolls)	5	176	880	2	440
Construction of mounds (units)	100	44	4,400	2	2,200
Caretaker's hut*			1,100	5	220
Tools and equipment*					
Digging blade	2	165	66	5	13
Bolo	2	66	26	5	5
Spade	1	204	41	5	8
Scoopnet	2	55	22	2	11
Traps. bamboo	8	22	35 **	2	18
Basins, 20 li	2	105	42	3	14
Pails. 10 li	3	39	23	3	8
Pails. 60 li	2	160	64	3	21
Total			64.020		16,618

*Aflocated to 5 ha: 5-ha allocation calculated for 1-ha

Table 3: Investment requirement and debt-equity ratio for 1-ha crab monoculture at various stocking densities

Investment	*Stocking Density*			
	5000	10000	15000	20000
Capital outlay	64.020	64.020	64,020	64,020
Working capital * for one crop	24:181	29.443	40.624	47,464
Total investment	88.201	93.463	104,644	111,484
Debt (50%)	44,100	46,731	52,322	55,742
Equity (50%)	44,100	46,731	52,322	55,742

* Working capital includes variable **costs, repairs and maintenance costs, and caretaker's salary**

Comparative costs and returns of the different stocking densities are shown in Table 4. Annual net income after tax was highest at P58,583/ha at a stocking density of 5000/ha and decreased as stocking density increased. A socio-economic study conducted by Lapie and Librero (1979) in the Philippines showed that a crab monoculture farm produced 339 kg/ha with net farm income of 1888 P/ha.

Table 4: Costs and returns for a 1-ha crab monoculture at various stocking densities

Item	Unit Cost	5,000		10,000		15,000		20,000	
		Quantity	Total	Quantity	Total	Quantity	Total	Quantity	Value
1. **REVENUE (kg)**	80.00	1,019	81.523	1,022	81.798	975	78,026	1,104	88.343
2. **VARIABLE COSTS**									
Chicken manure (kg)	0.66	1,000	660	1.000	660	1,000	660	1,000	660
Crab juveniles(pc)	0.55	5.000	2.750	10,000	5,500	5.000	8.250	20.000	.000
Trash fish (kg)	5.50	1,753	9,640	2.209	12.147	3,755	20.653	4.461	24.537
Labour (manhours)	5.50	.000	5,500	1.000	5,500	1.000	5.500	1.000	5.500
Marketing expenses (2%)			1.630		1,636		1.56		1.767
Subtotal			20,180		25,443		36,624		43,464
3 **FIXED COSTS**									
Repairs and maintenance			1,600		.600		1,600		.600
Interest			3,969		4,206		4,709		5,017
Depreciation			8,309		8,309		8,309		8,309
Caretaker's salary- P400/month/ha			2,400		2,400		2.400		2,400
Subtotal			16,278		16,515		17,018		17,326
4. **TOTAL COSTS (2+3)**			36,458		41.958		53.642		60,790
NET INCOME									
5. Net income before tax (per crop) (1-4)			45.065		39.840		24,384		27,553
6. Net income before tax (2 crops/yr)			90,130		79,680		48,768		55,106
7. Tax (35%)			31,545		27,888		17,069		19,287
8. Net **income after tax** (2 crops/yr) (6-7)			58,585		51,792		31,689		35,819
Return on investment (RUI)			66%		55%		30%		32%
Return on equity (RUI)			133%		111%		61%		64%
Payback period (year)			1.17		1.37		2.17		2.13

Net income from three crab fattening farms in Balasan, Iloilo, averaged 39,074 P ha/year (Table 5). The production cost ranged from 31 P/kg to 86P/kg. Average Return on Investment was 64 per cent.

ROl, Return on Equity (ROE) and payback period also showed the same trend. ROl was 66 per cent **for 5000/ha. Agbayani *et* al (1990) obtained ROl at 124 per cent for the same stocking density with three crops per year. Seville (1987) obtained ROl of 44 per cent for a 500 m² crab farm stocked with 3** crab/rn2.

Table 5: Costs and returns of crab fattening in ponds in Balasan, Iloilo

Item	1	2	3	Average
Farm area (m^2)	1.000	7,500	2.500	3.667
Fattening period (days)	15	30	15	20
RETURNS				
Avg. weight (g/crab)	188	500	833	507
No. of crab harvested	40	100	48	63
Production (kg)	8	50	40	33
Selling price (P/kg)	95	100	110	102
1. **Total returns**	714	5000	4398	3,371
COSTS				
Stocking (165 g avg. size)				
Density (pcs)	40	130	50	73
Cost of crabs (P/pc)	6	8	6	7
2. **Total cost of seed (P/crop)**	240	1,040	300	527
Feeding (kg/day)	5	6	12	8
Cost of feed (P/kg)	2	2	4	3
Cost of feed/day (P)	10	12	42	21
3. **Total cost of feed (P/crop)**	150	360	630	380
Labour mandays	8	IS	8	10
Opportunity cost of labour	40	40	40	40
4. **Total labour cost**	300	600	300	400
5. Total cost (P/crop) (2+3+4)	690	2,000	1,230	1,307
6. Net income per crop (P) (1-5)	24	3,000	3,168	2,064
7. Number of crops/year	24	12	5	14
8. Net **income/year (P) (6** x 7)	576	36,000	15,840	17,476
PER HECTARE:				
Stocking density (pcs/ha)	400	173	200	258
Net Income(P/ha/year)	5,856	48,000	63,365	39,074
Cost per kg	86	40	31	52
Return on Investment*	4%	95%	93%	64%

* Investment includes cost of fencing materials.

Feed and labour were the major cost items for crab monoculture at 5000/ha stocking density. At 10.000-20,000/ha stocking densities, cost offeed and juveniles comprised a larger portion of production costs. This is consistent with the increasing FCR as stocking density increases. Average **production cost ranged from** 35.78 P/kg at 5000/ha to 55.05 P/kg at 20,000/ha (Table 6).

Table 6: Comparative cost indicators of production for a 1-ha crab monoculture (1 crop)

Item	Stocking density 5000	10000	15000	20000
Average feed cost (P/kg)	9.46	11.88	21.18	22.22
Average juvenile cost (P/kg)	2.70	5.38	8.46	9.96
Average labour cost (P/kg)	5.40	5.38	5.64	4.98
Average marketing cost (P/kg)	1.60	1.60	1.60	1.60
Average cost of debt (P/kg)	3.89	4.11	4.83	4.54
Average variable cost (P/kg)	19.80	24.88	37.55	39.36
Average total cost (P/kg)	35.78	41.04	55.00	55.05

Feasibility analysis

Partial budgets of crab at 5000/ha and 10,000/ha stocking densities showed that cost of crab juveniles, trash fish and marketing expenses increased by P5,263 (Table 7). This resulted in a decrease of P4,988 in net benefit, indicating that no incremental benefit accrued from increasing the stocking density to 10.000/ha.

Table 8 shows the discounted economic indicators for a 1-ha crab monoculture farm at the **four stocking densitites. The NPV gives the** net worth of the project for **its entire project** life and was highest at P149.331 for 5000/ha stocking density. The BCR indicates the cost efficiency of the project. Stocking at 5000/ha was more cost effficient compared to stocking **mud crab at 10,000/ha, as indicated by the**

Table 7: Partial budget for a 1-ha crab monoculture at 5000 **and 10,000 stocking densities**

	5,000	10,000
Revenue	81,523	81,798
Variable costs		
Crab juveniles	2,750	5,500
Trash fish	9,640	12,147
Marketing expense	1,630	1,636
Total	**14,020**	19,283
Marginal revenue	275	
Marginal cost	5,263	
Net benefit (decline)	(4,988)	

Table 8: Discounted economic indicators for 1-ha mudcrab monoculture at various stocking densities (10% discount rate)

Item	5000	10000	15000	20000
Discounted revenue	676,739	679,021	647,709	733.348
Discounted cost	527,408	573,147	657.665	746.060
Discounted net cash flow	149.331	105,873	(9,956)	(12,712)
Net present value	149,331	105,873	(9,956)	(12,712)
Benefit cost ratio	1.28	1.18	0.98	0.98
Internal rate of return	365.23%	162.02%	1.36%	—0.91%

higher BCR derived from stocking at 5000/ha. The IRR represents the return over the life of the project to the resources engaged in the project. Highest IRR *(365* per cent) was obtained from 5000/ha stocking density. The discounting method showed that stocking at 15,000/ha and 20,000/ha was not economically viable.

CONCLUSION

The monoculture of mud crab in brackish water ponds is economically feasible at stocking densities of 5000/ha and 10,000/ha. Pond owners may diversify their business by allocating portions of their ponds to mud crab culture. Further research on improved pond management and polyculture systems should be pursued.

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ANNEXURES (see over)

ANNEXURE I

Loan amortization schedule for 1-ha crab monoculture

Stocking density	*Initial loan*	*Year*	*Annual payment*	*Interest (18%)*	*Principal*	*Balance*
5000	44,100.28	1	14,102.29	7938.05	6,164.24	37,936
		2	14,102.29	6,828.49	7,273.81	30,662
		3	14,102.29	5,519.20	8,583.09	22,079
		4	14,102.29	3,974.25	10,128.05	11,951
		5	14,102.29	2,151.20	11,951.10	0
10000	46,731.48		4,943.69	8,411.67	6,532.03	40,199
		2	14,943.69	7,235.90	7,707.79	32.492
		3	14,943.69	5,848.50	9,095.19	23,396
		4	14,943.69	4,211.37	10,732.33	12,664
		5	14,943.69	2,279.55	12,664.15	0
15000	52,321.53	1	16,731.27	9,417.88	7,313.39	45,008
		2	16,731.27	8,101.47	8,629.80	36,378
		3	16,731.27	6,548.10	10,183.16	26,195
		4	16,731.27	4,715.13	12,016.13	14,179
		5	16,731.27	2,552.23	14,179.04	0
20000	55,741.99	1	17,825.05	10,033.56	7,791.50	47,950
		2	17,825.05	8,631.09	9,193.96	38,757
		3	17,825.05	6,979.18	10,848.88	27,908
		4	17,825.05	5,023.38	12,801.68	15,106
		5	17,825.05	2,719.08	15,105.98	0

Interest Rate **0.18;**
Payable Period *5* **years;**
Grace Period **None;**
Conversion Rate **0.3198**

ANNEXURE II

Five-year cash flow for a 1-ha crab monoculture at various stocking densities (2 crops/year)

	5000 crab/ha					10,000 crab/ha				
Item	YI	Y2	Y3	Y4	Y5	YI	Y2	Y3	Y4	Y5
Revenue	163,046	171.199	179,759	188,747	198,184	163,596	171,776	180,365	189,383	198,852
Capital cost	64.020	0	13,923	148	0	64.020	0	13,923	148	0
Operating cost										
Chicken manure	1,320	1,386	1,455	1,528	1,604	1,320	1,386	1,455	1,528	1,604
Crab juveniles	5.500	5.775	6,064	6.367	6,685	11.000	11,550	12,128	12,734	13,371
Trash fish	19,280	20.244	21,256	22,319	23.435	24,294	25.509	26,784	28,123	29,530
Labor	15.800	16,590	7.420	18.290	19,205	15,800	16,590	17,420	18,290	19,205
Marketing expenses	3.261	3.424	3.595	3.775	3.964	3,272	3,436	3,607	3,788	3,977
Repair & maintenance	3.201	3,361	3.529	3,706	3,891	3,201	3,361	3,529	3.706	3,891
Interest	7.938	6,828	5,519	3,974	2,151	8,412	7,236	5,848	4,211	2,280
Tax	57.06	59.920	62.916	66,061	69,364	57,259	60,122	63,128	66,284	69,598
Subtotal	113,366	117,528	121,754	126,021	130,300	124,557	129,189	133,899	138,664	143,455
Total cost	117,386	117,528	135,677	126,169	130,300	188,577	129,189	147,822	138,812	143,455
Net cash flow	(14,340)	53.670	44,081	62,578	67.884	(24,981)	42.587	32,542	50,571	55,397

	15,000 crab/ha					20,000 crab/ha				
Item	Yl	Y2	Y3	Y4	Y5	Y1	Y2	Y3	Y4	Y5
Revenue	156.052	163,855	172,048	180.650	189,683	176,685	185,519	194.795	204.535	214,762
Capital cost	64.020	0	13.923	148	0	64.020	0	13,923	148	0
Operating cost										
Chicken manure	1,320	1.386	1.455	1,528	1,604	1,320	1,386	1,455	1,528	1,604
Crab juveniles	16,500	17,325	18,191	19,101	20,056	22,000	23,100	24.255	25,468	26,741
Trash fish	41.305	43,370	45.539	47.8 16	50.207	49,074	51,528	54,104	56,810	59,650
Labor	15,800	16.590	7,420	18,290	19,205	15,800	16,590	17,420	18,290	19,205
Marketing expenses	3,121	3.277	3,441	3,613	3,794	3,534	3,710	3,896	4,091	4,295
Repair & maintenance	3,201	3,361	3,529	3,706	3,891	3,201	3,361	3,529	3,706	3,891
Interest	9,418	8,101	6.548	4,715	2,552	8,034	8,631	6,976	5 023	2,719
Tax	54,618	57,349	60,217	63,228	66,389	61,840	64,932	68,178	71,587	75,167
Subtotal	145.283	150760	156,340	161,996	167,698	166,802	173,238	179,814	186,503	193,272
Total cost	209,303	150.760	170,263	162,144	167,698	230,822	173,238	193,737	186,651	193,272
Net cash flow	(53.250)	13.095	1.784	18,506	21,985	(54,137)	12,281	1,058	17,884	21,489

ANNEXURE III

Discounted cash flows for crab monoculture

(at 5,000/ha)

Year	*Revenue*	*Cost*	*Net factor*	*Discount factor 10.00%*	*Discounted revenue*	*Dis counted cost*	*Dis counted net cash flow*
1	163,046	177,386	(14,340)	0.9091	148.224	161,260	(13,036)
2	171,199	117,528	53,670	0.8264	141,487	97,131	44.356
3	179,759	135,677	44,081	0.7513	135,055	101,936	33,119
4	188,747	126,169	62.578	0.6830	128,916	86,175	42,741
5	198,184	130,300	67,884	0.6209	123.057	80.906	42,151
Total	900.935	687.060	213,873		676,739	527,408	149.331

(at 10,000/ha)

Year	*Revenue*	*Cost*	*Net factor*	*Discount factor 10.00%*	*Discounted revenue*	*Discounted cost*	*Discounted net cash flow*
1	163,596	188,577	(24,981)	0.9091	148,724	171,433	(22,710)
2	171,766	129,189	42,587	0.8264	141,964	106,768	35,196
3	180,365	147,822	32,542	0.7513	135,511	111.061	24,450
4	189,383	138,812	50,571	0.6830	129,351	94,811	34,540
5	198,852	143,455	55,397	0.6209	123,472	89,074	34,397
Total	903,962	747,855	156,107		679,022	573,147	105,873

(at 15 000/ha)

Year	*Revenue*	*Cost*	*Net factor*	*Discount factor 10.00%*	*Discounted revenue*	*Discounted cost*	*Discounted net (ash flow*
1	156,052	209,303	(53,250)	0.9091	141,866	190,275	(48,410)
2	163,855	150,760	13,095	0.8264	135,417	124,595	10,822
3	172.048	170,263	1,784	0.7513	129,262	127,921	1,341
4	180,650	162,144	18,506	0.6830	123,386	110,747	2,640
5	189,683	167,698	21,985	0.6209	117,778	104,127	13,651
Total	862,288	860,168	2,210		647,709	657,665	(9,956)

(at 20 000/ha)

Year	*Revenue*	*Cost*	*Net factor*	*Discount factor 10,00%*	*Discounted revenue*	*Discounted cost*	*Discounted net cash flow*
1	176,685	230,822	(54,137)	0.9091	160,623	209,838	(49,215)
2	185,519	173,238	12,281	0.8264	153,322	143,172	10,150
3	194,795	193,737	1,058	0,7513	146,353	145.558	795
4	204,535	186,651	17,884	0.6830	139,700	127,485	12,215
5	214,762	193,272	21,489	0.6209	133,350	120,007	13,343
Total	976,296	977,720	(1,425)		733,348	746,060	(12,712)

MUD CRAB FATTENING TECHNOLOGY TRANSFER TO THE SMALL-SCALE FISHERFOLK OF RANONG PROVINCE, THAILAND

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ABSTRACT

As part of the Bay of Bengal Programme's extension activities with small-scale fisheries, attempts have been made in Ranong, Thailand, to transfer the technology of mud crab fattening and culture to small-scale local fishermen. The trials failed because of the following problems that had not been properly assessed before they were introduced.

- *Unfavourable environmental conditions.*
- *Seed stock shortages.*
- *Inadequate training.*
- *Untimely financing.*
- *High investment cost and high risk.*

INTRODUCTION

In connection with the project 'Extension Services for Small-Scale Fisheries in Ranong'. jointly introduced by the Department of Fisheries, Thailand, and the Bay of Bengal Programme, trials were carried out to transfer to the small-scale fisherfolk in Ranong Province, south Thailand. the technology of fattening and culture of mud crab (*Scylla serrata*)

This project, started in 1987, will continue until the end of 1992. The Project's activities can be broadly classified as:

Adapting, demonstrating and extending fisheries technologies, such as aquaculture (oyster culture, shrimp and fish cage culture, green mussel and crab fattening).

introduction of improved fishing gear (crab and squid traps).

Processing.

Facilitating credit (establishment of revolving funds).

Promoting income generation for women in fisherfolk communities.

Improving fisherfolk access to social services provided in co-operation with other agencies.

Overfishing has been responsible for the problems of the fisherfolk in the province. In response, considerable effort has gone into trials with different types of aquaculture activities as a possible alternative or to supplement the reduced revenues from the capture fishery. In the light of the successes with crab fattening reported from Chantaburi and Surat Thani Provinces. it was decided to test its feasiblity in the Ranong area.

Small crab were already being caught in the area, but market prices were relatively low. It was envisaged that value could be added by culture and, thus, improve earnings.

AN OUTLINE OF THE EXTENSION PROCESS

In early 1988, 13 fisherfolk from eight villages throughout the Province were selected by the Provincial Fisheries Officer and the village leaders. The criteria for selection were that the participants would already be engaged in catching crab, have access to land and were living in villages with extensive crab catching enterprises.

The participants were initially trained in the technology during a study tour to Surat Thani on the west coast of Thailand. This was followed with a one-day workshop at the project office in Ranong. Project staff thereafter provided on-site training during their monthly visits.

The methods for culture and fattening and the type of earthen ponds promoted were quite similar to those in the Surat Thani area. (See Anuwat Rattanachote and Rachada Dangwatanakul 1991.)

It was originally planned to procure bank credit for the fisherfolk, as very few of them could afford the relatively high investment costs. However, the banks refused to extend credit as the participants could not provide any kind of collateral acceptable to them.

In order to implement the scheme, the project therefore decided to give limited support to each of the fisherfolk as an incentive to start the activity. For various reasons, it was not until quite late in the project cycle (February 1989) that each of the 13 fisherfolk received Baht 5000* and signed an agreement to repay the amount, into a village revolving fund, within a year. The participating fisherfolk were organized into a group which planned to hold monthly meetings at each other's culture sites in rotation, in order to share their learning and experience.

By July 1989, only five of the members had actually taken up the activity. Two were fattening females for eggs, two were culturing small crab, and one did both. All the participants used earthen ponds of sizes varying between 210 and 304 m^2. One culturist owned three ponds, while the other four had one each. The remaining eight group members had not yet started due to an insufficiency of funds and the very late distribution of even that.

In August, at the peak of the rainy season, the active members were urged to stop their work, as the Provincial Fisheries Officer's previous experience had shown that frequent salinity drops caused high mortality among the crab. The risk of flooding of ponds and subsequent escape of the crab from them was also very high.

In November, at the beginning of the dry season, the Project urged the members to take up the activity again. Repayments to the revolving funds had been very poor, in spite of continued efforts by the Project staff to recover the loans. It was felt that this failure might have serious negative effects in the villages, as other fisherfolk in the same villages had received similar loans from revolving funds for other Project activities.

During the 1991 season, the same five fisherfolk continued their activities, but once again they faced several problems. such as shortage of crab for fattening, and low market prices. Some of the participants who had refused to take up the activity stated that the long rainy season, during which activities had to be stopped, rendered it questionable whether the total earnings justified the effort and investment.

The total repayment of the loans till June 1991 was only 54 per cent and this was repaid by ten of the members. This has been poor compared to repayments of other revolving funds and loans given by the Project.

It was, therefore, decided after three years of trials of crab fattening that it was time to stop. It had become obvious that this technology faced more problems and was more risky than had been envisaged at the beginning. The high investment cost and risk could only be borne by the better-

* US $ 1 = 25 Baht appx. (1989)

off fisherfolk in the community. But though the Project failed, some important experience was gained from the problems that arose and the constraints that were encountered.

The main problem areas pointed out below might serve to illustrate the interrelated factors that need to be considered prior to promotion of crab fattening among small-scale fisherfolk in a given area:

- From the start of the Project, the feasibility of the culture itself was more or less taken for granted, as crab fattening was already being done with great success in other coastal areas in Thailand and abroad. Specifically, the positive experience from nearby Surat Thani served as a model, and all studies made during the trials were conducted there. The very limited number of culture operations in the Ranong area hardly offered a sound basis for generalization. However, the situation in Ranong differs in many crucial aspects from that in Surat Thani.

- The rainy season in Ranong province is very long — about eight months — during which there is very heavy rainfall. Further, the land is hilly, causing flooding of rivers and the low areas along the coastline. This resulted in severe problems for the crab culturists. The ponds were repeatedly flooded, allowing crab to escape. Low water salinity and silting caused high mortality of stocked crab. The only solution to this problem was discontinuation of activities during the height of the rainy season, making the culture period shorter than that elsewhere. This, in turn, reduced return on investment, as yearly depreciation costs were pretty much the same everywhere.

- Tidal differences in Ranong are higher (3 - 4 m) than in Surat Thani (l-2 m). The earthen ponds had therefore to be constructed with higher dykes, which, in turn, posed severe difficulties in ensuring proper exchange of water. During neap tide, this was possible only with pumping. The combination of heavy rainfall and insufficient water exchange accounted for sudden and drastic drops in salinity. Apart from culture problems, these conditions also resulted in considerably higher investment on the construction of ponds as well as the necessary equipment.

- Special environmental conditions also constrained other culture trials the Project has been engaged in, such as oyster, shrimp and fish cage culture. In all these cases there was a much higher degree of risk than at other locations with more stable climatic condition and more easily controllable environments.

RESOURCES

Seed supply

Many of the participants experienced difficulties in getting a sufficient supply of crab, including seed for culture as well as larger males and females for fattening. Some participants gave this as their reason for giving up the activity. Throughout the Project, the potential of the crab resources in the area to sustain further expansion was routinely discussed. Though these discussions was mainly in connection with the possibility of introducing a more efficient crab trap, the problem also had implications for the fattening scheme. A study of the resource base, including speculation as to whether the Ranong crab are another variety of *Scylla serrata*., is being made, but no final conclusion has been reached. It does, however, seem that the resource is being overexploited.

Feed supply

It proved difficult to get sufficient trash fish, especially during neap tides. As a consequence, the growth rates in the cases of some of the crab was very low and some of the participants could get only low returns on their investment. The sustainability of the trash fish resource is also a cause

for concern. Trash fish consists not only of low-value fish, but also of juveniles of many valuable species.

CULTURE vs. FATTENING

It had been assumed that culture as well as fattening would be possible in the area. The holding of female crab until development of gonads proved to be the most economically feasible technique. Still, special attention had been paid to promoting the rearing of small crab to marketable size, considering the low prices paid by dealers for small size wild crab and the potential danger to the resource as a consequence of more intensive catching of female crab.

However, the growth rates of cultured crab did not seem to live up to expectations. A test of the growth rate of Ranong crab cultured at the Surat Thani Brackishwater Fisheries Centre was carried out (Pripanapong and Youngvanitset 1991). The result showed that the rearing time for very small crab under 150 g was too long. Crab beyond this size had fair growth rates and reached marketable size in about two months' time, although the profits were not good. Given the adverse environmental conditions in Ranong, it is even less likely that crab fattening could be profitable there.

ECONOMY AND MARKETING

During the Project, a cost/benefit analysis was carried out in Surat Thani showing that the enterprise was indeed economically viable (Hanvivatanakit 1990). This study was made at a rather late stage and was not combined with a comparison of the specific conditions in Ranong, such as the higher investment costs, the shorter season when culture or fattening is possible, the risks involved, and the differences in marketing patterns.

Due to differences in grading, the prices of marketable crab are different in Ranong, giving an overall lower net income from the enterprise. Further, adding to the problems the Ranong culturists face, getting sufficient supplies of small crab, is the thriving crab culture and fattening business in Surat Thani, which has created a special market for small crab in other areas of Thailand. Many fish traders from Ranong District are a part of a larger market chain that dominates the trade in small and culturable crab. Consequently, in Ranong, it is difficult to buy small crab, and, more importantly, the fisherfolk selling crab are obliged to deliver their total catch, not just the part of it that is marketable to consumers.

EXTENSION METHODOLOGY

Selection of participants

One of the main reasons why the Project, in spite of the financial assistance given, managed to motivate only a few of the actual participants in the scheme to take up culture and fattening trials is that some of them were not seriously interested in the technology. Due to the relatively high investment costs, the risks involved and the necessity of possessing land, it was clear that an approach had to be made only to the better-off fisherfolk in the local communities. However, many of these fisherfolk were engaged in several other more profitable activities, and, as soon as the problems became obvious, they lost interest.

Training and follow up

The poor results might have been prevented with more comprehensive training and closer follow-up work than what was actually done. The necessary knowledge and skills to take precautions against cannibalism, avoid improper feeding and loss of crab due to continuation of activities during the peak rainy season were, apparently, not imparted to the participants.

Credit

Due to the high investment costs, some source of credit or funding is necessary to enable most fisherfolk to start such an activity. As procurement of bank credit proved impossible, the Project decided to, provide some assistance towards the total cost involved, which, for some participants, amounted to around Bht. 30,000. (The cost and returns study from Surat Thani indicated an average of Bht. 42,000 as the necessary investment cost, including land costs. The average loans taken were Bht., 8,500. Rattanachote and Dangwatanakul (1991) gave Bht. 14,400 for pond construction alone). This definitely constituted one of the major reasons why the fisherfolk in Ranong could not pursue this activity.

Due to reasons beyond the control of the Project, financial support was given at a very late stage, in the optimal season for culture. This caused further loss of interest among the fisherfolk.

CONCLUSION

The main lesson for the Project has been that even though a technology is well-proven in one area, transfer of it to another must be carefully done. It is vital to carry out thorough preparations during the demonstration phase.

Given that the technology had been relevant to the fisherfolk, and had not stressed the resource, it would probably have been possible to solve the above problems with the extension methodology, given time.

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