



# PD/A CRSP SIXTEENTH ANNUAL TECHNICAL REPORT

## ECONOMIC AND SOCIAL RETURNS TO TECHNOLOGY AND INVESTMENT AND RISK ANALYSIS OF POND MANAGEMENT STRATEGIES

*Eighth Work Plan, Marketing and Economic Analysis Research 1 and 2 (MEAR1 and 2)  
Progress Report*

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### ABSTRACT

Analyses of economic and social returns to technology and investment and for risk analysis require farm production data. Twenty-one shrimp farm owners and managers were interviewed in Honduras in March, 1998, representing approximately 1/3 of the total number of shrimp farms in the country. The total hectareage represented in the study sample was 54% of the total hectareage in shrimp production in the country. Survey data were entered into an EXCEL spreadsheet for summarization and cross-tabulation. Most of the farms participating in the survey had yields of shrimp that were either in the range of 1,000 - 1,500 lb of head-off shrimp/ha/yr (33%) or 1,501 - 2,000 lb/ha/yr (38%). Farms that stocked PL's at higher rates achieved higher yields. Farms that stocked more than 20 PL/m<sup>2</sup> achieved yields greater than 1,500 lb/ha/yr while those stocking 15 PL/m<sup>2</sup> had lower yields. Farms with yields over 2,000 lb/ha/yr also fed more than 15 lb/ha/d during the dry season. Over half of the respondents fertilized ponds, but most of these were small and medium-sized farms. Most large farms did not fertilize at all. Large farms also tended to be more reliant on hatchery-raised PL's, than were small and medium-sized farms. Shrimp farms appeared to exhibit economics of scale in that large farms tended to have lower costs per hectare than smaller farms.

### INTRODUCTION

The complete analyses for both these studies depend upon survey data collected in Honduras. Survey instruments were designed, translated into Spanish, pre-tested, modified, and administered in Honduras. Originally, ANDAH (Asociacion Nacional de Acuicultores de Honduras) suggested that the questionnaire could be distributed and collected by them. They were particularly interested in a workshop that I would present at the same time. The questionnaires were distributed, but the original response was very poor. It became clear that it would take several weeks to conduct direct personal interviews to complete the survey. Given the prior commitment to the presentation of training workshops, there was not adequate time during that visit to also conduct an adequate number of direct interviews. While ANDAH and CRSP personnel attempted to continue to collect the questionnaires, there was little success. In March, a graduate student was sent to Honduras to conduct direct personal interviews. He returned with the needed information and began to compile it. This report summarizes the survey information collected. The originally proposed analyses are

underway now that the data are in hand and will be discussed in detail in the final report to be submitted by December 31, 1998.

### METHODS AND MATERIALS

Twenty-one shrimp farms were interviewed during March, 1998 (Table 2). This sample represents approximately 1/3 of the total number of shrimp farms in the country (Table 1). Of the total sampled, 38% ranged from 10-150 ha in size, 43% ranged in size from 150-400 ha, and 19% were more than 400 ha in size. The total hectareage represented in the study sample was 54% of the total hectareage in shrimp production in the country.

Survey data were entered into an EXCEL spreadsheet for summarization and cross-tabulation. Relevant tables and graphs were prepared.

### RESULTS

#### Yield

Table 3 indicates the yield distribution of sampled farms by farm size. Approximately 67% of medium-sized (150-400 ha) farms had yields between 1,500 and 2,000 lb/ha/year. Half of the small (10-150 ha) farms had yields of between 1,000 and 1,500 lb/ha/year. No medium-sized farm reported yields less than 1,000 lb/ha/year.

#### Stocking Density

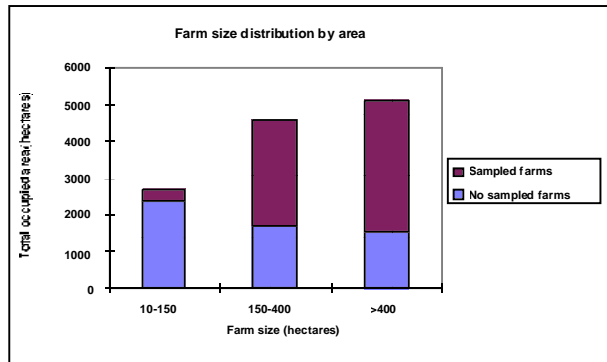
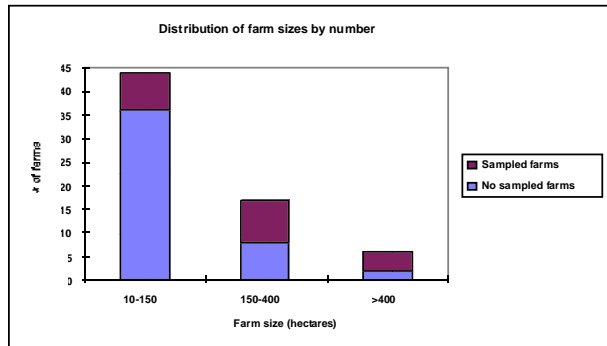
Large farms did not stock more than 20 PL/m<sup>2</sup>, Table 4. Seventy-five percent of the large farms stocked less than

Table 1. Size distribution of farms in Honduras

Size	Number of farms	% of total	Area (ha.)	% of total
10-150 ha.	44	66%	2710.13	22%
150-400 ha.	17	25%	4605.75	37%
More than 400 ha.	6	9%	5089.28	41%
<b>Total</b>	<b>67</b>		<b>12405.16</b>	

Table 2. Size distribution of sampled farms

Size	Number of farms	% of total	Area (ha.)	% of total
10-150 ha.	8	38%	318.22	5%
150-400 ha.	9	43%	2856.5	42%
More than 400 ha.	4	19%	3580	53%
<b>Total</b>	<b>21</b>		<b>6754.72</b>	



15 PL/m<sup>2</sup> and the remaining 25% of the large farms stocked between 15 and 20 PL/m<sup>2</sup>. Medium-sized farms were more variable in terms of stocking densities with 33% of farms reporting stocking densities of less than 15 PL/m<sup>2</sup>, 44% stocking 15-20 PL/m<sup>2</sup>, and 22% stocking more than 20 PL/m<sup>2</sup>. Most farms (63%) in the smallest size category stocked 15-20 PL/m<sup>2</sup>, with an additional 25% stocking at less than 15 PL/m<sup>2</sup> and 13% stocking more than 20 PL/m<sup>2</sup>.

**Feeding Rates - Dry Season**

Most (63%) of the small farms responding to the survey fed at rates of less than 15 lb/ha/day, Table 5. An additional 25% did not feed, while 13% fed more than 15 lb/ha/day. Of the medium-sized farms, 33% did not feed, 56% fed less than 15 lb/ha/day, and 11% fed more than 15 lb/ha/day. All of the largest farms in the study fed their ponds. Seventy-five percent fed less than 15 lb/ha/day and 25% fed more than 15 lb/ha/day.

**Feeding Rates - Wet Season**

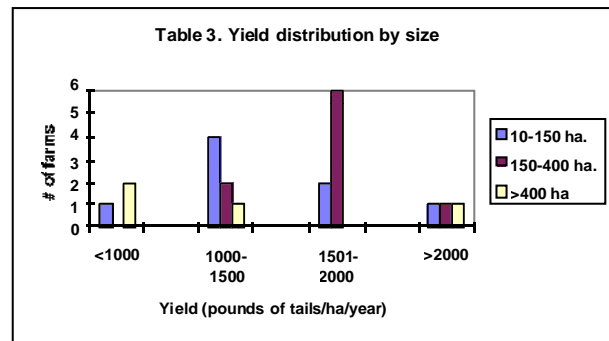
Feeding was a more common practice in the wet season and shrimp were fed at higher rates in the wet season than in the

Table 3. Yield distribution of sampled farms and correlation with size

Yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 1000	3	14%	1	13%
			0	0%
			2	50%
1000-1500	7	33%	4	50%
			2	22%
			1	25%
1501-2000	8	38%	2	25%
			6	67%
			0	0%
More than 2000	3	14%	1	13%
			1	11%
			1	25%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1</sup> The first number of each range corresponds to the number of farms with sizes between 10-150 hectares, the second number to the number of farms between 150 and 400 hectares and the third number to the number of farms larger than 400 hectares.

<sup>2</sup> These percentages indicate the proportion of farms within a given farm size that are grouped in the same yield range. For instance, 13% of small-sized farms, 0% of medium-sized farms and 50% of large-sized farms have yields lower than 1000 pounds/ha/year.



- 67% of medium-sized farms have yields between 1500 and 2000 pounds/ha/year. 50% of small farms have yields between 1000 and 1500 pounds/ha/year.
- No medium farm report yields lesser than 1000 pounds/ha/year.

dry season, Table 6. Of the small farms, 25% fed less than 15 lb/ha/day, 63% fed 15-25 lb/ha/day, and 13% fed more than 25 lb/ha/day. Of the medium-sized farms, 33% fed less than 15 lb/ha/day, 33% fed 15-25 lb/ha/day, and 33% fed more than 25 lb/ha/day. Of the large farms in the study, 75% fed 15-25 lb/ha/day and 25% fed more than 25 lb/ha/day.

**Shrimp Prices and Farm Size**

Shrimp prices vary with shrimp size. There is no relationship between the size of the shrimp farm and the size of shrimp. Nearly half (48%) of the respondents sold shrimp for more than 50 Lempiras/lb, Table 7. Another 33% of respondents sold shrimp for 41-50 Lempiras/lb, while 19% sold shrimp for less than 40 Lempiras/lb.

Table 4. Stocking densities for the winter and correlation with size

Stocking density (PL/m <sup>2</sup> )	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 15	8	38%	2	25%
			3	33%
			3	75%
15-20	10	48%	5	63%
			4	44%
			1	25%
More than 20	3	14%	1	13%
			2	22%
			0	0%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

Table 5. Feeding rates in the dry season and correlation with size

Feeding rates (pounds/ha/day)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
0	5	24%	2	25%
			3	33%
			0	0%
Less than 15	13	62%	5	63%
			5	56%
			3	75%
More than 15	3	14%	1	13%
			1	11%
			1	25%
<b>Total</b>	<b>21</b>		<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

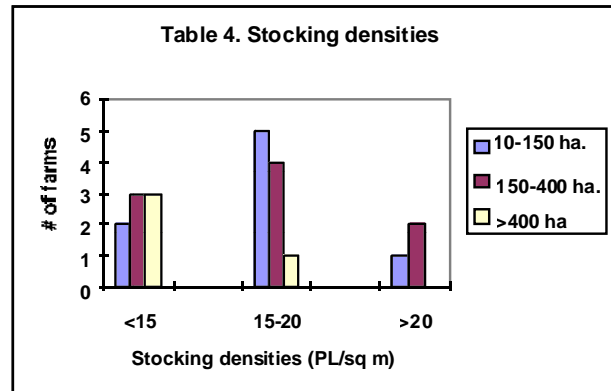
Table 6. Feeding rates in the wet season and correlation with size

Feeding rates (pounds/ha/day)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 15	5	24%	2	25%
			3	33%
			0	0%
15-25	11	52%	5	63%
			3	33%
			3	75%
More than 25	5	24%	1	13%
			3	33%
			1	25%
<b>Total</b>	<b>21</b>		<b>21</b>	

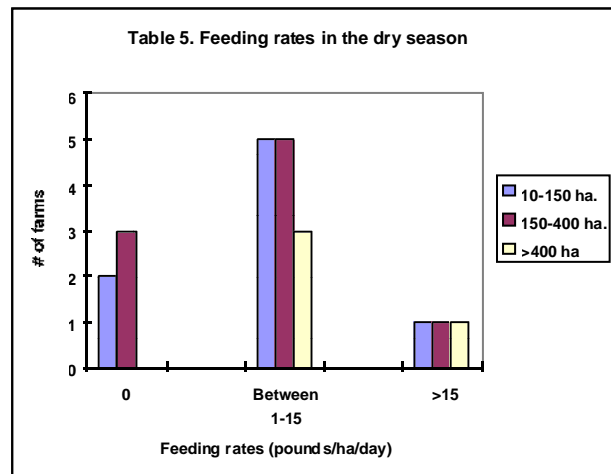
<sup>1,2</sup> See notes from Table 3.

**Feed Price and Farm Size**

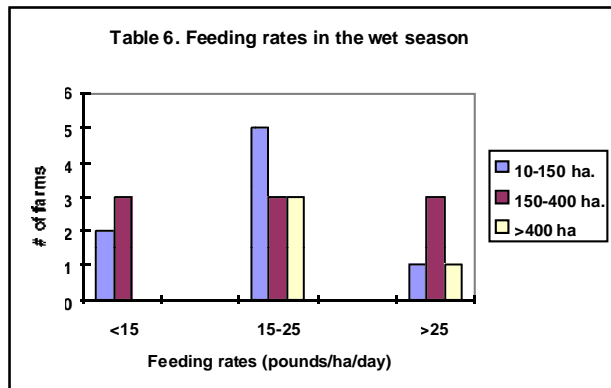
Over half of the respondents (52%) purchased feed for 301-400 Lempiras/quintal of feed, 24% paid 251-300 Lempiras/quintal, 19% paid 201-250 Lempiras/quintal, and 5% paid less than 200 Lempiras/quintal, Table 8. Farms of different sizes did appear



• Large farms do not stock more than 20 PL/m<sup>2</sup>.



• Large farms keep feeding during the dry season.



• Large farms do not feed less than 15 pounds/ha/day.

to pay different feed prices. For example, no large farm paid more than 300 Lempiras/quintal for feed and no small farm paid less than 300 Lempiras/quintal.

**Fertilization**

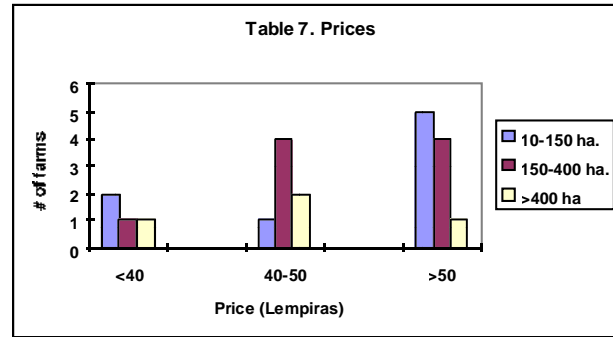
Over half of the respondents (62%) fertilized shrimp ponds, Table 9. Over half (63% and 78%) of small and medium-sized

Table 7. Variation of prices and correlation with size

Price (Lempiras <sup>3</sup> )	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 40	4	19%	2	25%
			1	11%
			1	25%
41-50	7	33%	1	13%
			4	44%
			2	50%
More than 50	10	48%	5	63%
			4	44%
			1	25%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

<sup>3</sup> 1 US Dollar = 13 Lempiras

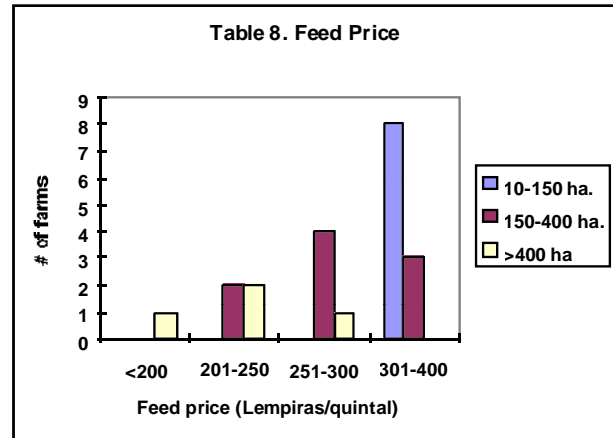


- Prices depend on shrimp size. There is not a correlation between farm size and shrimp price.

Table 8. Feed price and correlation with size

Feed price (Lempiras/quintal)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 200	1	5%	0	0%
			0	0%
			1	25%
201-250	4	19%	0	0%
			2	22%
			2	50%
251-300	5	24%	0	0%
			4	44%
			1	25%
301-400	11	52%	8	100%
			3	33%
			0	0%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

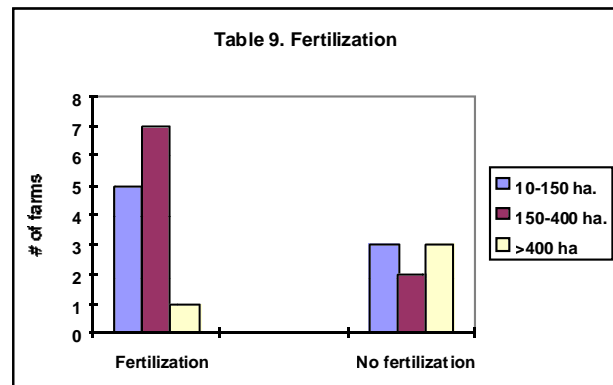


- No large farm pays more than 300 Lempiras/quintal.
- No small farm pays less than 300 Lempiras/quintal.

Table 9. Fertilization

	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Fertilization	13	62%	5	63%
			7	78%
			1	25%
No fertilization	8	38%	3	37%
			2	22%
			3	75%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.



- There was only one large farm reported to fertilize ponds. The decision to fertilize depends mainly on the location of the farm.

Table 10. Use of Lab Post-larvae

	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
0-20% Lab PL	5	24%	4	50%
			1	11%
			0	0
21-50% Lab PL	4	19%	3	37%
			0	0%
			1	25%
51-80% Lab PL	9	43%	1	13%
			6	67%
			2	50%
81-100% Lab PL	3	14%	0	0%
			2	22%
			1	25%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

Table 11. Cost per area unit

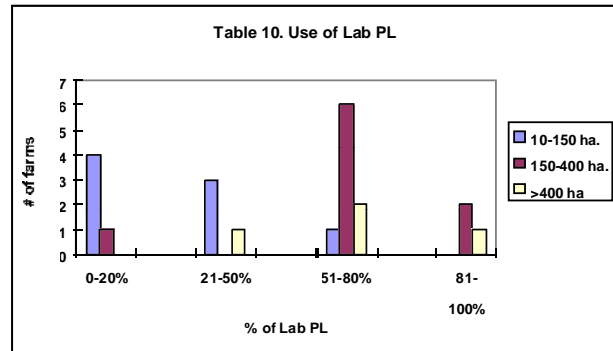
Costs per area unit (Lempiras/ha)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 40,000	5	24%	1	13%
			1	11%
			3	75%
40,000-60,000	7	33%	3	38%
			4	44%
			0	0%
60,000-80,000	5	24%	3	38%
			2	22%
			0	0%
More than 80,000	4	19%	1	13%
			2	22%
			1	25%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

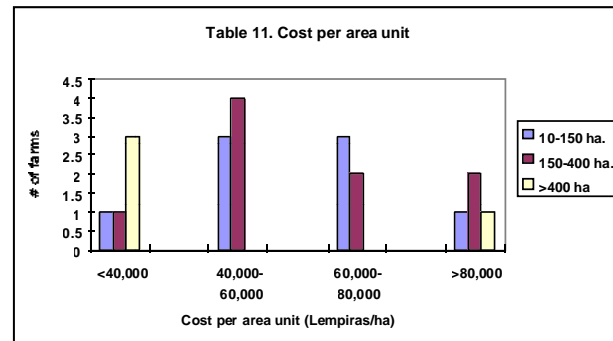
farms fertilized, while 75% of the large farms did not fertilize at all. In fact, there was only one large farm that reported fertilizing ponds. However, the decision to fertilize or not depends mainly on the location of the farm.

**Use of Hatchery - Raised Post-Larvae**

Post-larvae can be obtained either from the wild or purchased from hatcheries. Wild-caught PL's are less expensive and are considered to be hardier and provide better survival than hatchery-raised PL's. More small farms tended to use a higher percentage of wild-caught PL's. Half (50%) of small farms purchased only 0-20% of their PL's from hatcheries, Table 10. On the other hand, half (50%) of large farms purchased from 51-80% of their PL's from hatcheries.



• There is a trend among small farms to rely more on wild PL, which is cheaper. Medium and large farms prefer to work with lab PL.

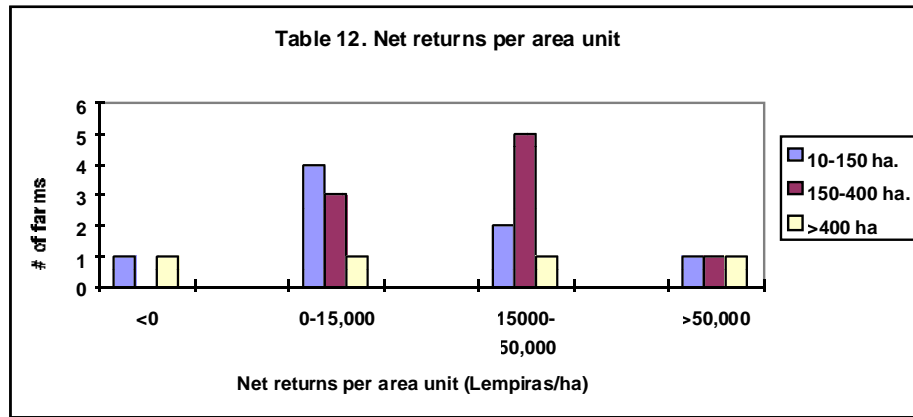


• Large farms tend to have smaller costs per area unit, but this also depends on the strategy chosen by managers.

Table 12. Net returns per area unit

Net returns per area unit (Lempiras/ha)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Negative returns	2	10%	1	13%
			0	0%
			1	25%
Less than 15,000	8	38%	4	50%
			3	33%
			1	25%
15,000-50,000	8	38%	2	25%
			5	56%
			1	25%
More than 50,000	3	14%	1	13%
			1	11%
			1	25%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.



- Two farms (one small and one large) report losses.
- 50% of small farms have net returns lesser than 15,000 Lempiras/ha. 56% of medium farms achieve returns between 15,000 and 50,000 Lempiras/ha.

Table 13. Benefit over cost ratio

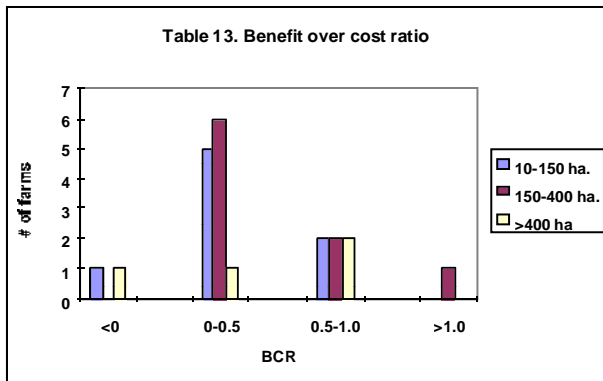
BCR	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 0	2	10%	1	13%
			0	0%
			1	25%
0-0.5	12	57%	5	63%
			6	67%
			1	25%
0.5-1.0	6	29%	2	25%
			2	22%
			2	50%
More than 1.0	1	5%	0	0%
			1	11%
			0	0%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.

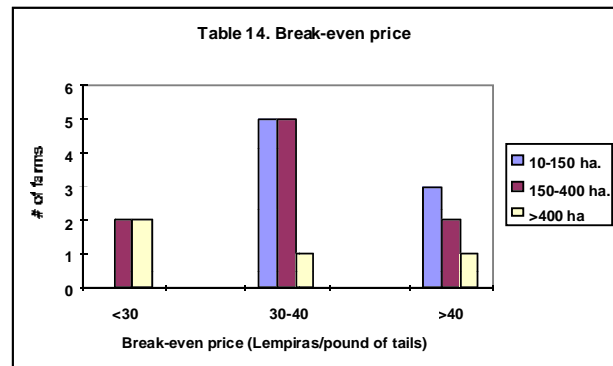
Table 14. Break-even price

Break-even price (Lempiras)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 30	4	19%	0	0%
			2	22%
			2	50%
			0	0%
30-40	11	52%	5	63%
			5	56%
			1	25%
More than 40	6	29%	3	38%
			2	22%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.



- There is one medium farm reported to have a BCR higher than 1.0.



- No small farm has a break-even price lesser than 30 Lempiras.

**Cost Per Hectare**

Most aquaculture farms exhibit strong economies of scale. Shrimp farms appear to also exhibit economies of scale in that large farms participating in the study tended to have lower costs per hectare than smaller farms. Three-fourths of large farms had costs of less than 40,000 Lempiras/ha while only 13% of small farms and 11% of medium-sized farms had costs this low, Table 11. Thirty-eight percent and 44% of small and medium-sized farms, respectively, had costs of 40,000-60,000 Lempiras/ha and 38% and 22% of small and medium-sized farms, respectively had costs of 60,000-80,000 Lempiras/ha.

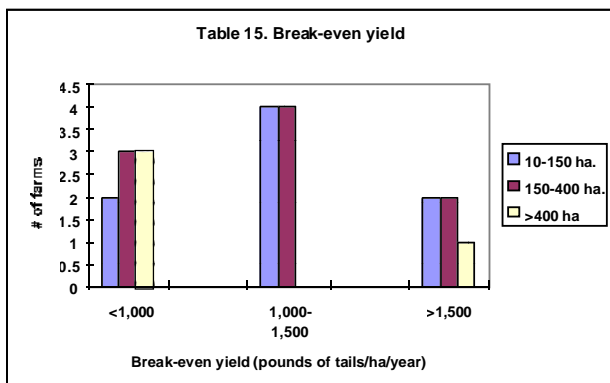
**Net Returns from Shrimp Farming**

Few shrimp farms in the study were losing money. Half (50%) of the small farms generated net returns of less than 15,000 Lempiras/ha, while 33% of the medium-sized farms and 25% of the large farms also generated this range of net returns, Table 12. Over half (56%) of the medium-sized farms had net returns of 15,000-50,000 Lempiras/ha while 25% of small and of large farms generated net returns in this same range. Twenty-five percent of the large farms, 11% of the medium-sized farms, and 13% of the small farms had net returns of more than 50,000 Lempiras/ha.

**Table 15. Break-even yield**

Break-even yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Distribution by size <sup>1</sup>	% <sup>2</sup>
Less than 1000	8	38%	2	25%
			3	33%
			3	75%
1000-1500	8	38%	4	50%
			4	44%
			0	0%
More than 1500	5	24%	2	25%
			2	22%
			1	25%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>1,2</sup> See notes from Table 3.



- Break-even yield is a function of the strategy chosen by managers, not of farm size.

**Shrimp Yields and Stocking Rates**

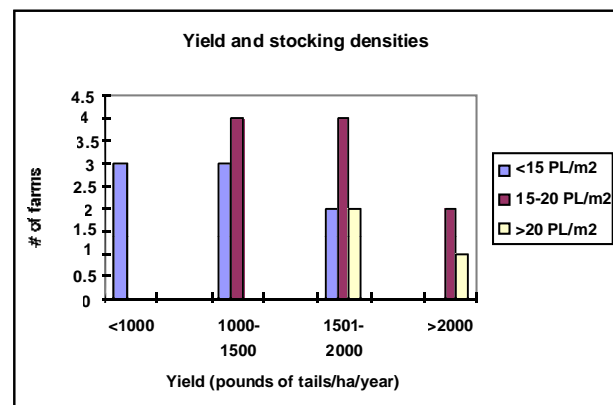
Most of the farms participating in the survey had yields of shrimp that were either in the range of 1,000-1,500 lb of head-off shrimp/ha/yr (33%) or 1,501-2,000 lb/ha/yr (38%), Table 16. Another 14% each had yields of less than 1,000 lb/ha/yr or more than 2,000 lb/ha/yr. Farms that stocked PL's at higher rates achieved higher yields. For example, farms that stocked more than 15 PL/m<sup>2</sup> achieved yields higher than 1,000 lb/ha/yr, while farms that stocked more than 20 PL/m<sup>2</sup> achieved yields

**Table 16. Yield and correlation with other variables**

Yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Distribution by stocking densities <sup>3</sup>	% <sup>4</sup>
Less than 1000	3	14%	<15	3 100%
			15-20	0 0%
			>20	0 0%
1000-1500	7	33%	3	43%
			4	57%
			0	0%
1501-2000	8	38%	2	25%
			4	50%
			2	25%
More than 2000	3	14%	0	0%
			2	67%
			1	33%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>3</sup> Ranges of stocking densities are those used previously in Table 4 (Less than 15, 15-20 and more than 20 PL/m<sup>2</sup>). Farms within a given yield range are distributed by reported stocking densities. For instance, there are 8 farms yielding between 1501 and 2000 pounds/ha/year, 2 of which stock less than 15 PL/m<sup>2</sup>, 4 stock 15-20 PL/m<sup>2</sup> and the other 2 stock more than 20 PL/m<sup>2</sup>.

<sup>4</sup> These percentages correspond to the distribution of farms within a given yield range.



- Farms stocking more than 15 PL/m<sup>2</sup> achieved yields higher than 1000 pounds/ha/year.
- Farms stocking more than 20 PL/m<sup>2</sup> achieved yields higher than 1500 pounds/ha/year.
- All farms that obtained low yields stocked under 15 PL/m<sup>2</sup>.

higher than 1,500 lb/ha/yr, and all farms that obtained low yields stocked less than 15 PL/m<sup>2</sup>.

The farms that yielded more than 2,000 lb/ha/yr fed more than 15 lb/ha/day during the dry season. None of the farms that fed less than this amount produced yields over 2,000 lb/ha/hr. Those farms that fed at less than 15 lb/ha/day produced yields of either 1,000-1,500 lb/ha/day or 1,501-2,000 lb/ha/day. Similar patterns were observed with feeding in the wet season. Farms that fertilized obtained yields higher than 1,000 lb/ha/yr.

ANTICIPATED BENEFITS

Results of the analysis to estimate the economic and social returns to technology and investment will provide justification for the continued funding of PD/A CRSP research through quantification of the program's benefits and impacts. This study will provide the first estimates of the social and economic returns generated by the PD/A CRSP over time.

Results of the risk analysis of pond management strategies will provide important insights into the integration of CRSP technologies into host country farming systems and is intended to provide recommendations for increasing incomes of farmers and rural communities.

Yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Correlation with feeding rates-dry season <sup>5</sup>	% <sup>4</sup>
Less than 1000	3	14%	No feeding	0 0%
			<15	3 100%
			>15	0 0%
1000-1500	7	33%		2 29%
				5 71%
				0 0%
1501-2000	8	38%		3 38%
				5 63%
				0 0%
More than 2000	3	14%		0 0%
				0 0%
				3 100%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

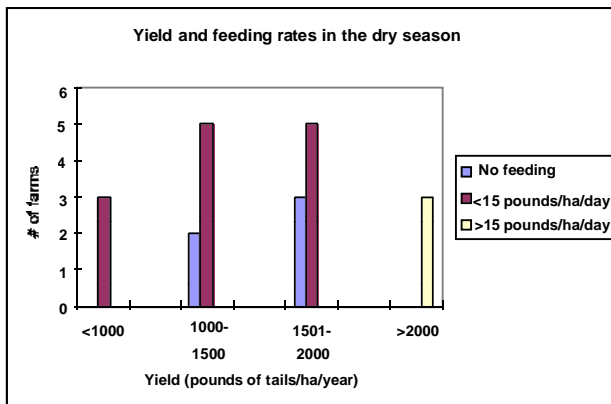
<sup>4</sup> These percentages correspond to the distribution of farms within a given yield range.

<sup>5</sup> These ranges are those used previously in Table 5.

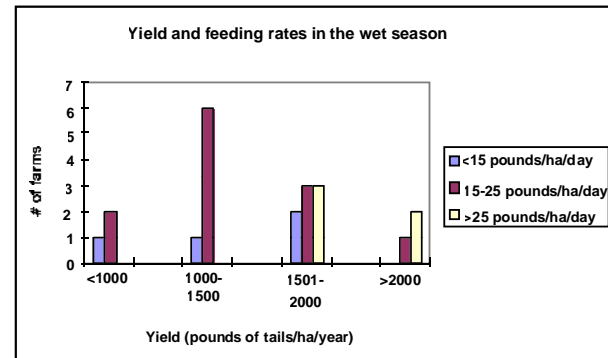
Yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Distribution by feeding rates-wet season <sup>6</sup>	% <sup>4</sup>
Less than 1000	3	14%	<15	1 33%
			15-25	2 67%
			>25	0 0%
1000-1500	7	33%		1 14%
				6 86%
				0 0%
1501-2000	8	38%		2 25%
				3 38%
				3 38%
More than 2000	3	14%		0 0%
				1 33%
				2 67%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>4</sup> These percentages correspond to the distribution of farms within a given yield range.

<sup>6</sup> These ranges are those used previously in Table 6.



• Farms that yielded more than 2000 pounds/ha/year fed more than 15 pounds/ha/day during the dry season.



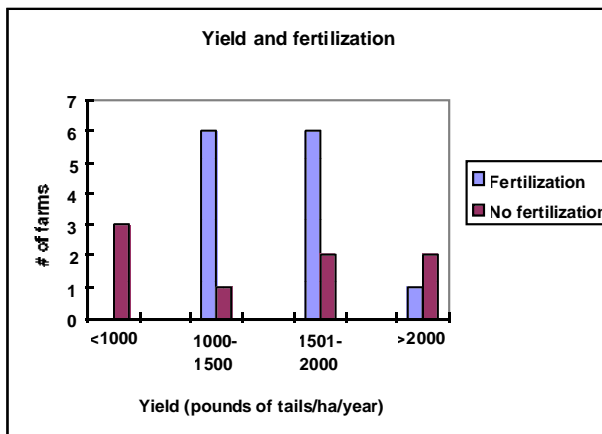
• Farms that fed more than 25 pounds/ha/day yielded more than 1500 pounds/ha/year.



Yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Correlation with fertilization <sup>7</sup>	% <sup>4</sup>
Less than 1000	3	14%	No fertilization	0 0%
			Fertilization	3 100%
1000-1500	7	33%	6	86%
			1	14%
1501-2000	8	38%	6	75%
			2	25%
More than 2000	3	14%	1	33%
			2	67%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>4</sup>These percentages correspond to the distribution of farms within a given yield range.

<sup>7</sup>These categories are those used previously in Table 9.

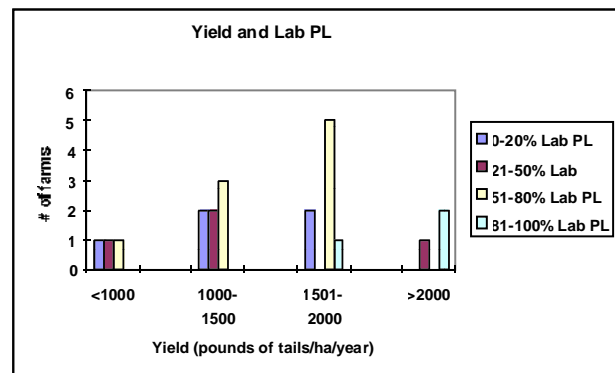


- Farms that fertilized obtained yields higher than 1000 pounds/ha/year.

Yield (pounds of head-off shrimp/ha/year)	Number of farms	%	Correlation with Lab PL <sup>8</sup>	% <sup>4</sup>
Less than 1000	3	14%	0-20%	1 33%
			21-50%	1 33%
			51-80%	1 33%
			81-100%	0 0%
1000-1500	7	33%	2	29%
			2	29%
			3	43%
			0	0%
1501-2000	8	38%	2	25%
			0	0%
			5	63%
			1	13%
More than 2000	3	14%	0	0%
			1	33%
			0	0%
			2	67%
<b>Total</b>	<b>21</b>	<b>100%</b>	<b>21</b>	

<sup>4</sup>These percentages correspond to the distribution of farms within a given yield range.

<sup>8</sup>These ranges are those used previously in Table 10.



- Farms that stocked Lab PL for the most part (81-100%) yielded more than 1500 pounds/ha/year.

