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THE SHRIMP FARMING INDUSTRY IN THE PHILIPPINES

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The shrimp farming industry in the Philippines is the culture of shrimp (*Penaeus monodon*) in brackishwater and seawater grow-out farms to marketable size. The industry is highly dependent upon the other sectors/components of the shrimp culture industry, including:

1. the shrimp hatcheries for their supply of fry (PLs);
2. the feed millers for their supply of commercial pelletized feeds, primarily for semi-intensive and intensive shrimp farms;
3. the shrimp processors/exporters for the purchase of their harvests;
4. the financial institutions for their capital and operational costs; and
5. the research institutions and the government for solutions to technical and other problems.

Such dependence makes shrimp farming vulnerable. Other than that, it is also a high risk business. In addition, monsoon rains, typhoons, and floods can significantly affect shrimp farming. Pollution from watershed activities and from self-generated organic load has resulted in slower shrimp growth, higher susceptibility of shrimp to diseases, and mass mortalities. Widely fluctuating export market prices and demands are also major concerns of the industry.

Status

The status of the shrimp farming industry was examined to identify prevailing issues and problems. Field surveys were made in Luzon, Visayas, and Mindanao from August 4 to September 3, 1992. Questionnaires on farming systems were completed through interviews with the farm manager/owner or farm technician. A total of 40 interviews were completed during the survey (Table 1). Two interviews were from traditional farming, six from extensive farming, 29 from semi-intensive, and three from intensive. The distribution of samples in relation to farming systems does not indicate actual distribution of these farming systems in the country. The survey became skewed toward semi-intensive farms because the Bureau of Investments and shrimp growers associations/cooperatives identified and prioritized the farms to be interviewed. Time constraints prevented a more randomized sampling.

Table 1. Distribution of samples in the field survey, by province

Province	No. of samples
Pangasinan	4
Bulacan	1
Pampanga	1
Bataan	1
Batangas	2
Cebu	4
Bohol	2
Negros Occidental	10
Iloilo	3
Capiz	2
South Cotabato	4
Davao del Sur	2
Misamis Occidental	3
Agusan del Norte	1
TOTAL	40

Areas devoted to shrimp farming. The total area of shrimp farms in the country in 1992 was 49,478 ha, of which 47,774 was devoted to the black tiger shrimp; 1,006 to endeavor shrimp (*Metapenaeus ensis* or "hipong suahe"); and 638 to white shrimp (*P. indicus, P. setiferus* or "hipon puti") (Table 2). The total hectarage under shrimp production constitutes 23% of the country's brackish-water fishponds.

Luzon has 20,940 ha (44%) of total shrimp farm area; Visayas has 14,314 ha (30%); and Mindanao, 12,519 ha (26%). Regions VI and III have the greatest areas of shrimp farms in the country, reflecting the suitable resources for development; while far fewer farm areas are found in Regions I, II, VIII, and NCR. The Ilocos regions are expected to have few areas for shrimp farming in view of the rugged terrain and lack of brackishwater areas. The National Capital Region being highly urbanized is not expected to have significant shrimp farms.

Shrimp farming systems. Shrimp farming utilizes a variety of farming systems influenced by variables such as climate (monsoons), capital availability, site location, tidal variations, source of water supply, marketing of harvested products, and availability and cost of farm inputs. As a result, regional differences in farming systems have developed. Existing farming systems are classified on the basis of the field survey (Table 3).

Variations of the different farming systems have been made by shrimp farmers to solve their problems. In extensive shrimp farms, a portion of the stock are transferred from a grow-out pond to another, with the rationale of providing a larger space for the shrimp to grow. This "modular" type of pond transfer also provides the shrimp a much cleaner environment with more abundant natural food. In some instances, a break is made in the dike between two extensive

Table 2. Preliminary estimates of area (in hectares) of black tiger shrimp, endeavor shrimp, and white shrimp, by region and province, 1991

	Black tiger shrimp	Endeavor shrimp	White shrimp
NCR	**317**	-	-
REGION I	**345**	-	-
llocos Sur	32	-	-
La Union	1	-	
Pangasinan	312	-	-
REGION 2	**30**	-	-
Cagayan	30	-	-
REGION 3	**12,363**	-	-
Bataan	1,507	-	-
Bulacan	1,813	-	-
Pampanga	9,019	-	-
Zambales	24	-	-
REGION 4	**2,514**	**244**	**197**
Aurora	26	-	-
Batangas	116	2	2
Cavite	121	-	-
Marinduque	129	-	-
Mindoro Occ.	272	-	-
Mindoro Or.	556	-	-
Palawan	68	2	2
Quezon	1,222	218	190
Romblon	4	22	3
REGION 5	**5,372**	**403**	**134**
Albay	37	-	-
Camarines Norte	582	22	10
Camarines Sur	822	128	-
Catanduanes	57	22	-
Sorsogon	1,011	-	107
Masbate	2,863	231	17
REGION 6	**12,288**	**75**	**98**
Iloilo/Guimaras	818	-	0
Aklan	1,267	-	-
Capiz	6,885	75	91
Antique	25	-	6
Negros Occ.	3,293	-	1
REGION 7	**1,051**	-	-
Bohol	506	-	-
Negros Or.	213	-	-
Cebu	332	-	-

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	Black tiger shrimp	Endeavor shrimp	White shrimp
REGION 8	**977**	-	**5**
Leyte	149	-	-
Southern Leyte	3	-	-
Eastern Samar	4	-	-
Northern Samar	190	-	-
Western Samar	631	-	5
REGION 9	**6,710**	**324**	**92**
Basilan	89	-	-
Zamboanga del Norte	297	-	26
Zamboanga del Sur	6,324	324	66
REGION 10	**1,450**	-	**7**
Agusan del Norte	516	-	-
Misamis Occ.	425	-	-
Misamis Or.	122	-	5
Surigao del Norte	387	-	2
REGION 11	**1,345**	**20**	
Davao Oriental	21	3	-
Davao del Sur	199	-	-
South Cotabato	352	-	-
Surigao del Sur	773	17	-
REGION 12	**3,014**	-	**88**
Lanao del Norte	1,565	-	15
Lanao del Sur	116	-	-
Sultan Kudarat	133	-	73
Maguindanao	1,200	-	-
TOTAL	47,776	1,006	638

Source: Bureau of Agricultural Statistics, Department of Agriculture.

grow-out ponds to allow the shrimp to transfer on their own. The shrimp farmer is able to obtain a more accurate count and biomass of the shrimp (thus supplemental feeding rate is improved), and is able to assess the growth and condition of the shrimp during transfer.

Crops of shrimp are rotated with milkfish in some semi-intensive farms, allowing the milkfish to clean the pond of organic matter. However, since stock densities of milkfish are high (25,000/ha) and the fish are often fed pellets, the purpose of pond cleaning is defeated.

One pond within the farm is often rotated out of production for fallowing and exposure to the air for a crop period.

Limestone is used in semi-intensive and intensive farms, in places where

Table 3. Summary of comparative features of various shrimp farming systems in the Philippines

	Traditional	Extensive	Semi-intensive	Intensive
Stocking density (pc/m^2)	<1	1-5	>5-20	>20
Average farm area (ha)	73	40	14	7
Pond area (ha)				
Smallest	4.50	0.53	0.58	0.34
Largest	9.25	1.90	1.48	0.67
Pond water depth (cm)	30-80	80-100	100-120	120-150
Life support system				
Aerators	None	As needed	Present	Present
Pumps	Present in some	Present	Present	Present
Salinity maintained	Rainfall dependent	Rainfall dependent; 18-25 ppt	18-25 ppt	10-25 ppt
Water supply	Tidal	Tidal with occasional pumping	Tidal with pumping	Pumping only
Type of feed used	Natural food; trash fish; small crustaceans; animal by-products	Trash fish, snails; small crustaceans; mussel meat combined with commercial pellet	Commercial pellet; infrequently fed snails, mussel meat, crustaceans, trash fish, *Artemia* biomass	Commercial pellet; infrequently fed snails, mussel meat, crustaceans, trash fish, *Artemia* biomass
Frequency of feeding/day	1	2-4	3-5	3-5
Method of culture	Transfer from NP-RP	Modular; straight culture	Straight culture	Straight culture
Average survival (%)	30-50	60-80	75-90	80-90
Culture period (days)	100-150	120-220	120-180	140-155
ABW at harvest (g)	40-70	25-61	20-47	26-40
Production (kg/ha/yr)	<220	220-1,840	>1,840-6,800	Above 6,800
No. of crops/year	2-3	1-2	1-3	1-3
Age of fry at stocking	PLs 10-18	PLs 10-20	PLs 12-45	PLs 15-20

ABW, average body weight; NP, nursery pond; RP, rearing pond; PL, postlarvae. Source: Survey results and key industry sources.

it exists and is accessible, for shrimp pond construction and in covering the pond bottom during pond preparation after the black soil has been scraped off. This increases pond soil pH and alkalinity, reduces the liming of ponds, and is seen by the shrimp farmers to have helped in lessening incidence of diseases.

A longer pond preparation (two to three months) is now practiced in semi-intensive and intensive farms. The intention is to fully oxidize and decompose the organic matter resulting from uneaten feeds and shrimp fecal matter. The general trend in pond preparation, regardless of culture system, is to have a longer pond preparation during the dry months than the rainy months (Table 4). More intensive culture systems generally utilize a longer pond preparation time, especially now that the shrimp growers have realized the effect of organic pollution in their farms. The application of hydrated and agricultural lime before and after pond bottom tilling at the rate of 2,000-3,000 kg/ha is a common practice in pond preparation as a prophylactic treatment and to correct soil pH.

Stocks are sampled at intervals to determine growth rate and to estimate feed rate. One traditional shrimp farm conducts stock sampling at 45 day intervals, and the other only prior to harvest. Some extensive farms sample every week throughout the culture period, while others weekly or monthly after the first 30 days of culture. In semi-intensive and intensive systems, most of the shrimp farms sample stock weekly after the first 30 days of culture, while others sample at 10, 15, or 30 days after the first 30 days of culture.

Feed management. Traditional shrimp farms typically use natural food (Table 3). Extensive farms use trash fish, snail ("kuhol"), small crustaceans, and brown mussel meat (combined with commercial shrimp pellet). (The "kuhol" is the golden snail, *Ampullaria* sp., a pest in many rice fields in the country.) On the other hand, semi-intensive and intensive farms use starter, grower, and finisher commercial shrimp pellets. In later part of the culture (or when the shrimp's ABW is about 20-25 g), some semi-intensive and intensive farms supplement pelleted feeds with "wet feed" such as trash fish, brown mussel meat, kuhol, and *Artemia* biomass.

The feeding frequency for traditional farming is only once a day from the start of feeding (after the first 30 days of culture) until harvest (Table 3). In extensive farming, feeding frequency is twice per day during the first 30 days of culture, then increased to 4 times per day from 45 days of culture to harvest. For semi-intensive and intensive systems, feeding frequency is 3 times per day for the first 30 days, then 4-5 times per day for the rest of the culture period. The feeding frequency for semi-intensive and intensive farms comes from recommendations by the feed manufacturers, and is adhered to by most growers.

Feed conversion ratios (FCR) attained by the different culture systems vary considerably (Table 5). Extensive shrimp farms have a wide range of FCR, from 1.2 to 3.0 with an average of 1.88; intensive farms from 1.5 to 2.5 with an average of 1.93; and semi-intensive farms from 1.4 to 3.5 with an average of 2.05. The efficiency of extensive farms is due to the fact that the shrimp utilize natural food grown in the pond as its primary source of nutrition, with commercial feed as a supplement to the natural diet. According to the shrimp growers, their FCRs are affected by pond management, quality of feed, feed management

Table 4. Duration (days) of pond preparation by region

Culture system	Region 1		Region 3		Region 4	Region 6	Region 7		Region 10		Region 11
	Summer	Wet	Summer	Wet			Summer	Wet	Summer	Wet	
Traditional			30	7-14							
Extensive			60	14		30-120			45-60	30-45	
Semi-intensive	21-30	45-60			30-45	30-90	30-60	30-45	30-60	30-45	30-60
Intensive					30-60		60-90	45-60			

Table 5. Feed conversion ratios obtained by shrimp farmers

Culture system	Region 1		Region 4		Region 6		Region 7		Region 10		Region 11		Overall
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	average
Extensive					1.2—3.0	2.1			1.5-1.8	1.65			1.88
Semi-intensive			1.7-1.9	1.8	1.4-2.5	2	1.5-2.5	2	1.5-3.5	2 5	15-2.5	2	2.05
Intensive	1.8-2.2	2	1.5-2	1.75			1.6-2.5	2.05					1.93

(feed consumption monitoring and feeding frequency), water quality, and age of pond.

Incidence of shrimp diseases. Most farmers note incidence of infectious diseases or its clinical symptoms (Table 6). The most common diseases/clinical symptoms are tail rot, black and brown gills, MBV, and the presence of filamentous algae. As one solution, semi-intensive and intensive farmers apply hydrated lime to induce molting of shrimp. The incidence of shrimp diseases in traditional and extensive farms is far less than the more intensive environments. Recently in Negros Occidental and Capiz, Infectious Hypodermal and Hematopoietic Necrosis Virus (IHHNV) has been identified as an agent causing poor growth and mass mortality.

Growth rate of shrimp. Some shrimp growers furnished growth data. Results show that shrimp grew faster before 1989 (Fig. 1), when the ponds were newly constructed. During this time, the shrimp could be grown to an ABW of 31-35 g in 110-120 days of culture (DOC) even at high stock densities of 15-25/m^2. Larger sizes (41-50 g) could be attained within the same DOC but at lower stock densities of 5-10/m^2. As the shrimp ponds accumulated organic matter in the bottom, slower shrimp growth was experienced. It now takes 150-220 DOC to attain the 31-35 g size (Fig. 1).

Table 6. Infectious diseases and clinical symptoms observed by shrimp farmers in 1992

Disease	Traditional	Extensive	Semi-intensive	Intensive	Total
MBV (Monodon baculovirus)		1	10	1	12
IHHNV (Infectious hyperdermal hemato-poietic necrosis virus)			5	1	6
Filamentous bacterial disease			8		8
Chronic soft-shell syndrome	1	1	9		11
Red Disease			6		6
Soft blue shell syndrome			6		6
Black/brown gills	2	1	19	3	25
Bamboo back			11		11
Protozoans		2	6	1	9
Tail rot	2	1	24	3	30
Barnacles			7	2	9
Black spots	1		8	1	10
Black meat			4		4
Elephant ear			6		6
Algal			9	3	12
Gill rot		1	4		5

Dry and wet seasons affect shrimp growth rates (Fig. 2). In most of the Philippines, the wet month period (May to October) is the best time to grow shrimp because of more ideal salinity in the water sources. Salinity gets to be quite high during the dry months, slowing growth and reducing survival. The exception to this pattern is Region I (Pangasinan); better shrimp growth rates are attained during the dry month period (November to March). In this area, the rains bring the water salinity to almost freshwater and makes the water turbid. During the dry months, salinity is optimal (18-25 ppt).

Issues and problems

Environmental. The crowding of shrimp farms in specific areas has overloaded the carrying capacities of drainage systems (river channels or tidal creeks) rendering them incapable of absorbing the organic loads from shrimp ponds and other users of the river. This condition was observed in Regions I, III, VI, X, and XI.

Site selection has been poor; conversions of coconut, sugar and rice lands that have elevations higher than the sea level and quite distant from the water source make the use of tidal variations impossible. Often, these lands are committed to intensive farming of shrimp and the option to shift to lower valued commodities is no longer feasible because of the high cost of energy to pump water.

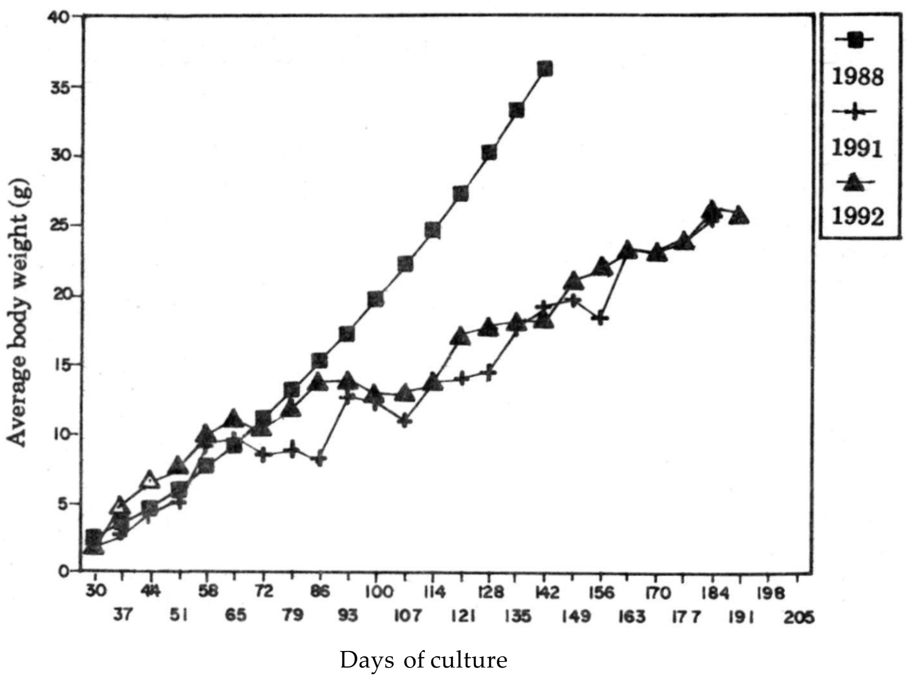

Fig. 1. Comparison of shrimp growth curves in semi-intensive farms for 1988, 1991, and 1992.

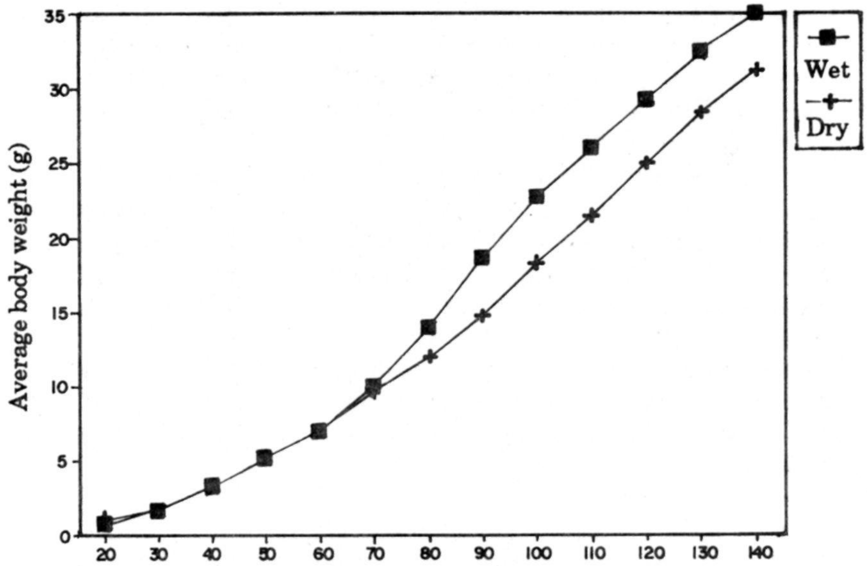

Fig. 2. Comparison of growth curves for semi-intensive shrimp farms in wet and dry seasons, 1992.

Pumping of ground water in semi-intensive and intensive shrimp farms has led to seawater intrusion of groundwater aquifers, and loss of well waters in surrounding communities. This has caused social conflicts (Cebu, Negros Occidental). Conflicts have also developed between multiple uses/users of river channels, including shrimp farms, subsistence fishing (use of fish traps), disposal of effluents and wastes from communities and industries, and agricultural runoff. The ability of rivers to flush themselves of pollution through tidal exchange or discharge has been hampered by siltation at the river mouth (Region VI-Negros,Iloilo,and Capiz; Region X - Panguil Bay and Butuan City). In Regions III, IV, and VI, complaints have been made about the effluents of sugar centrals/mills (molasses and chemicals). Distilleries have also been identified as a point source of pollution.

In view of the environmental (water quality) problems in shrimp farms, many farms now practice longer and more elaborate pond preparation in order to minimize the organic content inside the ponds. However, water quality still remains poor. It is hypothesized that ammonia and nitrite, produced by the deamination of proteins in uneaten feeds and shrimp wastes, become sub-lethal. Significant ammonia concentrations have been found one kilometer offshore from shrimp farm estuaries in Negros Occidental.

The Mt. Pinatubo eruption adversely affected shrimp farm areas in Bataan, Pampanga, and Zambales due to lahar deposition in river channels and shrimp farms. Tidal and water discharge from river channels have been restricted, causing turbid water for shrimp farms. Additional brackishwater farms have been lost due to lahar deposits. In Pangasinan, lahar is carried by rivers supplying shrimp farms, and this is exacerbated by heavy monsoon rains.

There is speculation that El Niño was responsible for a long drought period this past year. The resultant high salinities and temperatures caused poor growth and low survival, and a higher incidence of disease, an observation consistently found in all areas.

Diseases. Shrimp diseases have become more prevalent recently; part of this can be attributed to the drought in 1992, and part to the increasing intensification of farming systems. Poor pond water and soil quality is attributed to the accumulation of uneaten feeds and shrimp feces. The poor environment predisposes the shrimp to infectious processes, resulting in slower growth and poorer survival.

High cost of production. Cost of shrimp production in the country is considered higher than those of other shrimp-producing Asian countries (particularly Thailand and Indonesia). The variable production cost (per kg of shrimp) in the different systems:

	Extensive	*Semi-intensive*	*Intensive*
Variable cost	P88.48	P137.60	P114.69

Major contributors to the variable cost are:

	Extensive	*Semi-intensive*	*Intensive*
Feeds	26%	55%	66%
Fry	24%	13%	9%
Energy	0%	11%	10%
Salaries/wages	14%	9%	7%
Pond preparation	3%	5%	2%
Repair/maintenance	13%	3%	3%
Others	19%	2%	3%

Feeds are by far the greatest variable cost in the semi-intensive and intensive production systems. The high cost for fry in extensive system is due to the low survival rate under this type of management.

Fry quality. Many farmers indicate that there is variability in fry quality. Fry quality criteria have been established to screen fry prior to purchase from hatcheries or fry brokers. The most common complaint is the lack of correlation between the fry quality criteria and the performance of the fry in the pond.

Feed quality. Feed quality has also been blamed by shrimp farmers for the industry-wide poor feed conversion ratio, slow growth and low survival. Feed conversion ratios attained in semi-intensive and intensive farms range from 1.4 to 3.5. Poor feed conversion results in uneaten feed decomposing in the pond bottom, creating a stress on the shrimp by deteriorating the water quality with higher organic content, biological oxygen demand, ammonia, and nitrite.

Comprehensive Agrarian Reform Program. Issues raised by farmers against CARP include (1) the unacceptance of farms by banks as collateral for loans and (2) insufficient compensation vis-a-vis their high capital investment in the construction of the farm.

Incentives of the Board of Investments. BOI-registered shrimp farms note the following difficulties:

1. the extensive documentation required for BOI registration;
2. the time required to get BOI registration, due in part to the highly centralized processing of applications;
3. the long time needed to obtain export certification from shrimp processors/exporters; and
4. the difficulty of obtaining complete "rebates" of tax credits from feed millers.

High cost of money. The high interest rates (24-30%) has made shrimp farming less lucrative, especially when export prices decrease. Some shrimp farmers which had difficulty liquidating loans under guaranty of corporations and advanced credits are now leasing their farms.

The government mandate to all banks to lend 25% of their loan fund for agricultural projects, including shrimp farming, has not been effective. Shrimp farmers have noted that much of the agricultural loan fund are not loaned to agricultural projects but instead invested in treasury bills of the Central Bank.

Shift of shrimp farms to lower stock density and to milkfish farming. Because of the unreliable and inconsistent shrimp market prices and the environmental problems developing in the industry, some shrimp farms have decided to lower their stock densities or to shift to milkfish farming (e.g., Pangasinan). Lower stocking density is a general trend observed in all the areas surveyed. It is, therefore, anticipated that shrimp production will decrease in 1992 simply from a reduction in hectarage devoted to culture. The shift to lower stock density and to milkfish farming is an indication that shrimp growers realize the need to search for alternative solutions to the problems of the farming industry.

Solutions adopted by shrimp farms. The current problems of the shrimp culture industry necessitated alterations in farming systems and management on the part of the private sector. Some of these are:

1. Use of nursery ponds to grow fry to juveniles prior to stocking in grow-out ponds. The fry are tested for growth and survival rates for a 30-day period; poor fry stock are discarded, saving time and money that would have been spent in grow-out culture.
2. Integration of the components of the shrimp culture industry under one management, such as integrating hatchery operations, grow-out operations, processing and exporting as practiced by some large corporations.
3. Research is being done by the industry, such as corporations and-shrimp cooperatives, to solve some of the problems. Research on feed quality is being done by feed millers. The Negros Agri-Aqua Development, Inc. does applied research to solve problems of water quality and to monitor shrimp pond dynamics.

4. Establishment of diagnostic laboratories for fry, soil, and water quality.
5. The establishment of associations/cooperatives within the province or the region in order to solve common problems together. These organizations conduct seminars and workshops to update their scientific knowledge on shrimp farming, open direct marketing conduits to importing countries, monitor shrimp export price fluctuations, and disseminate technical and other information to members through newsletters.

Recommendations

The following recommendations adhere to the general philosophical guidelines on sustainable development of the shrimp culture industry. To achieve this, the industry needs to protect itself and its environment from organic pollution, and allow equitable resource allocation and utilization. Since there is always social accountability and social equity that accompanies an industry, as provided by the Constitution and laws of the land, opportunities also need to be provided for small fishermen/farmers to participate and benefit from the industry.

Crop rotation of shrimp and milkfish. In order to lessen the demands on the watershed, crop rotation of milkfish and shrimp is recommended, with milkfish culture during the dry month period or during the poor shrimp crop season in the area. This crop rotation technique has been applied successfully for three years at the Brackishwater Aquaculture Center, U.P. in the Visayas, Leganes, Iloilo where the Type I climate (two pronounced seasons) exists.

Milkfish (100 g) are stocked at 1500-2000/ha in November-March when salinity is high; fingerlings are grown to the 100-g size in another pond. Milkfish have proven to be effective in reducing the organic load in the pond from the previous shrimp crop that is grown from May to October. The larger milkfish are more efficient in grazing or filtering *lab-lab* or plankton and feeding on organic debris. When harvested, the milkfish are 300 to 500g in size, with a total harvest of about 500-750 kg/ha. Milkfish survival rate is often 95% or more. No feeding is given to milkfish and no fertilizers are introduced. *Lab-lab* or plankton growth is sufficient because of high amounts of organic nutrients in the pond.

Shrimp are stocked after a two-month pond preparation - tilling, washing, drying, and liming the pond bottom. No scraping of black mud is necessary. After water conditioning, PL 13-15 are stocked at 8-15/m^2 and reared to harvestable size using the technology for semi-intensive culture in feeding, tidal and pumping water management (except pumping of freshwater), and aeration. Survival ranges 75-90%. Shrimp are harvested at 31-35 g, producing 2.5-3.5 t /ha in a single crop.

Use of pond reservoirs for water supply and treatment ponds for discharge water. The use of pond reservoirs to settle organic matter from the water source before use in grow-out ponds will assist in cleaning the water supply. In Thailand, these reservoirs are about 30% of the farm area; they have deeper peripheral canals and shallower central portion to allow light penetration and growth of phytoplankton. The pumping of water during high tide obtains better water quality. The pond reservoir can also be used for growing shrimps to broodstock sizes (100 g for male and 70 g for female) at extensive stocking rates (3-5/m^2). Since growing broodstock takes about ten months or more, the stock are transferred to *hapas* while the reservoir is cleaned and prepared between crops. The area of the pond reservoir depends upon the volume needed for pond water management and the frequency of high tides in the area.

A primary treatment pond should accommodate discharge water from ponds, allowing the settling of organic matter prior to disposal in the surrounding environment. The culture of filter organisms like mussel in the settling pond assists in the reduction of organic matter. Algae such as *Gracilaria* and *Caulerpa* should also be cultured on an experimental basis to further clean the water. If these organisms can be cultured in the settling pond, additional financial benefits can be derived.

Use of nursery ponds in shrimp farming. Some shrimp farms use nursery ponds to rear PL 18-20 to juveniles for at least 30 days. Nurseries offer the following advantages:

a. In a month, the farmer can determine the growth and survival of a batch of PL. If the PL performance is poor, the farmer can abort the run and save time and money.

b. During the transfer from nursery to grow-out, the farmer can accurately estimate the biomass of shrimp, leading to more accurate projections of feeding rates in the grow-out phase.

c. Juveniles to be stocked for grow-out can be selected. Smaller juveniles (slower growing) can be culled and more uniformly sized shrimp can be expected during harvest.

Development of shrimp farm estates for small fishermen/farmers. The shrimp farm estate should be under one management with the fisherman/farmer beneficiaries agreeing to management decisions on culture technology, operations, marketing of harvest, and bulk buying of pond inputs (fertilizers, feeds, lime, etc.). The fisherman/farmer beneficiaries own the parcels of land and receive profits generated from the farm estate. However, a professional manager should be hired by the cooperative to handle the estate management. Further vertical integration of a shrimp hatchery and/or feed mill into the estate should be considered.

Expansion of shrimp farm areas. Expansion of shrimp farms is recommended within existing fishponds and marginal lands that are not wetlands. Prior to a final decision to convert these lands into shrimp farms, studies should be made on the carrying capacity of the water source and drainage area (river, bay, sea) to absorb organic and other pollution from the watershed and the planned farm. The size and intensity level of shrimp farm operations should be determined by the study. Regulation of expansion by government agencies protects both the future farms and the communities in these areas from potential environmental problems, and allow the multiple use of the resources. This can eventually lead to the zoning of areas suitable for shrimp farms.

Shrimp pond dynamics: pond soil and water quality research. Research on pond soil and water quality is necessary to determine the effects of intensity levels of farming systems on the quality of the pond soil and water, and to determine the pond preparation necessary to clean the pond bottom of undesirable materials prior to culture of shrimp. Ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen, hydrogen sulfide, organic matter, total phosphorus, acidity, iron, aluminum, and bacteria are parameters which can be monitored in pond soil and water. A vertical profile of these parameters in the pond bottom may be desirable, to a depth of 0.3 to 0.5 m. Preliminary data from the Brackishwater Aquaculture Center, U.P. in the Visayas indicate that organic matter, ammonia-nitrogen, and nitrite-nitrogen are high in the pond soil and water during the latter part of the culture period (4th and 5th month), and are directly correlated to stocking density.

Pond soil and water profiles should be compared for ponds converted from milkfish pond, sugarland, coconut land, riceland, among others. Comparisons should also be made before and after pond preparation, during and after the culture period, and at different stock densities. The results could provide insights for proper pond preparation and stocking densities to be used by shrimp farmers.

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Discussion

The technical issues discussed by the workshop participants include:

- Standard quality criteria for shrimp fry; marketing
- Pollution in intensive ponds; accumulation and disposal of black soil in the pond bottom; the use of settling or biological ponds
- Growth of farmed shrimp
- Alternatives to intensive shrimp culture: crop rotation, polyculture, and "rest" cycles
- Standard pond management techniques
- Feeding shrimps
- Professionalization of hatchery technicians through accreditation
- Sourcing of spawners; role of the middlemen
- Shrimp as a value-added product
- Incentives that can be granted by the government investors
- Deformities in hatchery-bred milkfish fry