Doing Development by Growing Fish: A Cross-National Analysis of Tilapia Harvest and Marketing Practices

Interim Work Plan, Socioeconomic Study

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(Printed as Submitted)

Introduction

The Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP) has been organized to generate basic science that may be used to advance aquacultural development. The research network has focused on tilapia (*Oreochromis niloticus*), sometimes called "the aquatic chicken." Tilapia is an export commodity generating foreign exchange as well as a subsistence crop for other parts of the farm sector. Farm ponds provide food security, nutrition, and occasional cash income for the rural poor (Castillo et al., 1992; Lightfoot et al., 1991). This paper examines the primary methods of fish harvesting and marketing tilapia in four CRSP countries. Practices and perception related to marketing tilapia are summarized across the research sites.

Aquaculture as a Development Intervention

Fish farming is undertaken as a development intervention for manifold reasons. On one level, fish farming can increase the supply of fish for urban and rural consumers thereby enhancing the quality and quantity of the food supply. At the village level, fish farmers and their families can benefit from improved food security, diet variety, protein availability, and cash income from fish sales.

The tilapia enterprise plays a diverse set of roles in farm and family systems. The identity of fish culture is contingent on the needs of the family and the resources—land, labor, and capital—that can be applied to the activity (Pollnac, 1992). In some cases, industrial scale tilapia farms play a significant role in industry development by providing fingerlings, processing facilities, and a corporate voice in national aquacultural policy. This analysis focuses on medium- and small-scale family farms where fish farming can make the most immediate contribution to family well-being (Cernea, 1991a; 1991b).

Sustainability

Sustainability is the ultimate measure of success for a development intervention (Molnar et al., 1991). If people continue to grow fish while being emulated by their neighbors and residents of other communities, aquaculture will have furthered the cause of development and food security (Molnar and Duncan, 1989). Sustainability has environmental, social, and institutional dimensions (Ben-Yami, 1986; Coughenour, 1992; McCorkle, 1989).

Aquaculture is socially sustainable when neither its benefits nor its costs are concentrated in one segment of the population while having at least some direct impact on those most in need. Ideally, fish farming should engender equitable participation in its benefits across a wide spectrum of socioeconomic segments of the community. In reality, not all farmers are inclined or able to build ponds (Molnar et al., 1985). Aquaculture must be economically viable for those who do undertake the activity if the enterprise is to realize the promise of income improvement and a wider distribution of benefits (Hatch et al., 1995).

Other constraints limit participation in aquaculture to those able to make productive use of their time and resources in the activity. A small number of landless poor may benefit from wage labor on larger operations. Nevertheless, fish farming can improve the array of locally based opportunities for food production and income generation that benefits many residents in different ways (Smith and Peterson, 1982).

The social costs of aquaculture are often connected to conflicts linked to the loss of access to resources (Bailey et al., 1996). Fish farming may accelerate the enclosure of formerly open access lands or coastal waters. Private fish ponds may divert water from formerly shared uses; effluent from ponds may alter the quality of water for other users. When the expansion of aquaculture limits opportunities or livelihoods for other community residents, social sustainability may be questioned. Aquaculture is institutionally sustainable when the services and subsidies required to build and continue the industry do not exceed the fiscal capacity of the state. Ultimately, sustainability is achieved when subsidies cease and state services become minimally necessary to aquaculture's viability as a widely practiced farm enterprise. It should be noted that the primary influence of PD/A CRSP activities is exerted through the institutional context of the research sites and the network of students, extensionists, technicians, and host country scientists that collaborate with PD/A CRSP scientists.

Livelihood activities such as aquaculture are embedded in a structure of social relations—among farmers as well as between farmers and larger systems. Harrison (1995) found that one of the principal constraints faced by nonadopters of aquaculture in Zambia was security of land tenure, a constraint felt most forcefully by women. Rothe and his colleagues (1992) concluded that tenure security was necessary but not sufficient for the adoption of productivity-enhancing technology in agriculture. As long as constraints on access to input and output markets limit incentives to innovate and invest, tenure security itself does not represent a binding constraint on technology adoption. Because pond construction represents direct capital investment in the land, tenure security may be the larger factor in farmer decisions than other kinds of productivity-enhancing technology.

Access to labor for pond construction was a primary barrier to participation in aquaculture for women in Zambia (Harrison, 1995; 1991). Engle (1987) reviewed the role of women in aquacultural training and extension. In Rwanda, women were consistently more likely to cite role conflicts or hardships associated with fish culture as an addition to their repertoire of activities (Molnar et al., 1994). Responsibilities and burdens of feeding, monitoring, harvesting, and preparing the fish may not coincide with the nutrition, cash, and other benefits accruing to fish harvests and marketing.

Materials and Methods

A sample of tilapia farmers was interviewed in each of four PD/A CRSP countries; Rwanda, Honduras, Thailand, and the Philippines. The following sections detail the procedures employed in each locale and the approach used to analyze the data (Molnar et al., 1996).

Rwanda

Data were obtained from a sample of 121 active Rwandan fish farmers in eight local administrative districts (communes) during the Winter of 1991 and early Spring of 1992.[1] The interview schedule used in Rwanda in 1992 was revised and adapted for each of the three PD/A CRSP countries surveyed in 1993-95.

[1] The 141 *communes* (or counties) are the basic units of administration in Rwanda. Several communes were chosen to represent diversity in the nation's regions; others were selected randomly. Interviews were conducted with 115 active fish farmers randomly selected from National Fish Culture Service (SPN) extension rolls. About 45 percent of the respondents were women. To contact respondents, aquaculture *monitors* (extension representatives) were asked to organize meeting points and times with the farmers and the interviewer. The Rwandan interviewer conducted individual interviews in the native *Kinyarwanda* language using a standardized set of questions and response frameworks. Approximately 60 minutes were spent with each farmer. An additional 16 active farmers who had not received extension assistance were interviewed. These emulator farmers had independently adopted fish culture as a farm enterprise. They were selected in a two-step process. First, fish farmers in areas not receiving extension assistance were identified through network sampling procedures and local informants (Casley and Kumar, 1988). General agricultural extension agents then provided information about individuals who had constructed fish ponds. Local residents also made referrals to farmers who had ponds, and neighbors provided information about the owners of ponds visible from the roadside.

Honduras

Data were obtained from a sample of 51 active Honduran fish farmers in nine of 15 Honduras departments during Fall, 1993. The survey instrument was translated and all interviews were conducted in Spanish. Tilapia farmers were identified through referrals made by Peace Corps volunteers working in fish culture, Honduran extension personnel, and by farmers identifying neighbors raising tilapia. The departments were chosen to represent the major tilapia production regions in the country.

Philippines

Data were obtained from a sample of Philippine fish farmers in four of 15 provinces on the main island of Luzon during Winter of 1994. Tilapia farm operators in Bulacan, Nueva Ecija, Pampanga, and Tarlac provinces were interviewed. The survey was revised and adapted, then translated into the Tagalog language. Tilapia farmers were identified by sampling lists of farmers purchasing fingerlings at the Freshwater Aquaculture Center at Central Luzon State University in Muñoz. Sample farmers were asked to identify neighbors raising tilapia who also were approached for interviews. The provinces were chosen to represent the major tilapia production region in the country. Interviews were conducted with 51 active fish farmers.

Thailand

Data were obtained from a sample of 51 active Thai fish farmers in three of 75 Thai provinces during Winter, 1994. Tilapia farm operators in Ayutthaya, Pathum Thani, and Nakhom Pathom provinces in Central Thailand were interviewed. The survey was revised and adapted, then translated into the Thai language. All interviews were conducted in Thai. Tilapia farmers were identified through referrals made by Department of Fisheries extension personnel, knowledgeable local individuals, and by fish farmers giving identifying neighbors raising tilapia. The provinces were chosen to represent major tilapia production regions in south Central Thailand, the major aquaculture region in the country.

Analysis

In each country, the interview schedules were edited to reconcile missing data, ambiguous answers, and exceptional cases[2]. The data were keypunched according to precoded numerical response categories on the printed questionnaire that did not require translation. Open-ended questions eliciting responses that were transcribed verbatim were cumulated in a separate process (Casley and Kumar, 1988).[3] The tables tabulate survey responses by farm size expressed in terms of pond area operated.

Farm pond area, as a measure of farm size, is expressed in three categories—small, medium, and large. The category boundaries vary depending on the range reported in the surveys for each country.[4] These categories correspond well with production intensity levels and allow cross-country and intra-country pond area comparisons. Pond area has a close correspondence to subsistence, small-scale, and commercial levels of aquaculture production (Hatch and Hanson, 1991). Rwanda

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[2] The 1992 Rwanda sample is more representative than the samples drawn in the other countries. It is nationwide, a larger number of interviews was obtained, and the range of variability in the population of fish farmers is smaller in Rwanda. In Rwanda, the 121 farmers in the sample represent 3.9 percent of the 3,102 (1,950 group and 1,152 individual) ponds in the country in 1990. Women are 24 percent of the fish farmers in Rwanda and 43 percent of the sample (Moehl and Molnar, 1995). Women were oversampled in the 1992 study. Molnar et al. (1993) previously examined the Rwanda data in detail, but the aggregate findings are presented here to allow comparative analysis across four PD/A CRSP sites.

[3] Certain cautions are in order. There are limits to the ability of these data to extrapolate to wider populations of fish farmers and other regions of the selected nations. In comparison to Rwanda, the 1993 samples in Thailand and the Philippines are smaller and represent a subset of provinces in one key production area in the country. In Honduras, the sample is drawn from a diverse set of locales across the tilapia producing areas of the country. The number of farmers in each sample are inadequate for statistical estimation of population parameters; they do, however, provide information about practicing fish farmers where none is otherwise available.

[4] The small pond area grouping is less than or equal to 0.11, 0.65, and 0.96 hectares in Honduras, the Philippines, and Thailand. The medium pond-area groupings in Honduras, the Philippines, and Thailand are 0.12 to 0.65, 0.66 to 3.0, and 0.97 to 1.76 hectares, respectively. The large pond area groupings are greater than 0.65, 3.0, and 1.76 hectares in Honduras, the Philippines, and Thailand, respectively.

Table 1. Production cycle length, crops per year, average harvest weight, and harvest strategy according to pond area in the Philippines, Honduras, and Thailand, 1994.

Country and Size Category	Production Cycle	Tilapia Crops Per Year			Average Harvested	Harvesting Strategy[1]		
	No. of Days	*One (%)*	*Two (%)*	*Three (%)*	*Fish Weight (g)*	*Partial (%)*	*Partial+1 (%)*	*Single (%)*
PHILIPPINES								
Small	145	39	61	0	173	80	13	7
Medium	149	21	68	11	199	74	16	11
Large	139	13	69	19	179	50	36	14
HONDURAS								
Small	194	41	53	6	274	24	35	41
Medium	263	67	27	7	275	33	13	53
Large	235	53	40	7	570	47	20	33
THAILAND								
Small	307	83	17	0	328	0	13	87
Medium	346	100	0	0	301	0	15	85
Large	358	100	0	0	411	12	24	65

[1] Harvest strategies include: Partial—partial-harvesting; Partial+1—partial-harvesting and one large harvest at end of the cycle; Single—one large harvest at the end of the cycle and no partial-harvesting.

data were reported in the "small" pond area category because of the country's homogeneous low-intensity type of tilapia production, regardless of actual pond area. Perceptions of marketing problems and constraints were aggregated across size categories.

Results

Production Cycle Characteristics

Length of the tilapia production cycle, harvesting strategy, and sizes of final product within the surveyed CRSP countries were indicators of production cycle characteristics and market demands (Table 1). Production cycles were the shortest in the Philippines, ranging from 139 to 149 days, and two crops per year were usually produced. However, the fish produced were smaller, ranging from 173 to 199 grams, than in the other two countries. These data were not obtained in Rwanda.

Growing small fish is an ideal production strategy if the consumer will accept a tilapia in the 100 to 200 gram range. It is much more efficient to produce large numbers of small fish than it is to produce the same number of larger fish. Honduran farmers had production cycles ranging from 194 to 263 days and one to two crops per year (Table 2). The average fish produced ranged from 274 to 570 grams. In this country, partial harvesting, partial harvesting along with one large harvest, and one harvest only were used.

Thailand had the longest production cycle of the three countries. It ranged from 307 to 358 days (Table 1). The longer cycles resulted in larger fish for the small and large farms. Medium area farms had intermediate values when culture period and fish size were compared.

One large harvest by pond draining at the end of the culture period was the most frequent approach. Less partial-harvesting was used in Thailand, where one large harvest at the end of the production cycle was preferred by nearly all respondents.

Relative Prices of Fish

Prices received for tilapia are related to the final size of the fish, consumer size preference, and available market outlets. In this survey, the prices for tilapia were lowest in Thailand and comparable in the Philippines and Honduras (Table 2).

Table 2. Average price and range of prices received for tilapia in the Philippines, Honduras, and Thailand, 1993-1994.

Country and Pond Area	Average Price Received ($/kg)	Range of Prices Received ($/kg)
PHILIPPINES		
Small	1.70	0.97 - 2.34
Medium	1.86	1.27 - 2.34
Large	1.80	1.50 - 2.06
HONDURAS		
Small	1.25	0.68 - 1.94
Medium	1.23	0.84 - 1.94
Large	1.28	0.84 - 1.65
THAILAND		
Small	0.45	0.22 - 0.99
Medium	0.42	0.12 - 0.60
Large	0.51	0.32 - 0.68

Consumers in the Philippines paid prices ranging from $0.97 to $2.34 per kilogram for tilapia; one kilogram of fish is equivalent to 5-6 smaller fish. Often this meant one fish for each family member. In comparison, the price for fish in Honduras ranged from $0.68 to $1.65 per kilogram of fish; one kilogram of fish equivalent to three bigger fish. Honduran and Thai consumers preferred a larger fish than purchasers in the Philippines.

In Thailand, tilapia prices were much lower than in the Philippines or Honduras. Tilapia prices ranged from $0.12 to $0.99 per kilogram of fish; one kilogram of tilapia is two or three fish. Tilapia in Thailand are ubiquitous and supply is abundant. This may account for the low price range. Additionally, the sale of tilapia to middlemen who harvest the fish results in a lower price to the farmer. The cost of labor to harvest is reflected in a reduced tilapia purchase price.

Prices received by Honduran tilapia farmers had the most variation. Some low-intensity, rural farmers had little opportunity for marketing their fish, and the prices they obtained were low. The predominant tilapia size harvested in Honduras was in the 200 to 300 gram range for producers with small and medium-area ponds and greater than 500 grams for larger farms. The largest Honduran farms grew larger tilapia primarily for export of frozen and fresh fillets.

Market Constraints

Identifying the market in which the cultured tilapia are to be sold is an essential element in determining production-marketing viability (Table 3). An understanding of the product characteristics and consumer preferences associated with the selected market is fundamental in developing the appropriate production technology.

Where aquaculture is a new enterprise, there may be little or no organized fish marketing. Development of marketing infrastructure for aquacultural inputs and outputs will often be as important as soil, water, climate, and nutrients to the economic viability of aquaculture.

Small-scale farmers who consume most of their fish harvest or sell it locally have a restricted need for marketing information. The farmer may be personally acquainted with most of the final consumers of his product. As the percent of home consumption decreases and distance to final consumer increases, however, marketing channels become more important. Specific information on

Table 3. Composition of tilapia according to pond area in Honduras, the Philippines, and Thailand, 1994.[1]

Item	All	Honduras			Philippines			Thailand		
	(%)	Small (%)	Medium (%)	Large (%)	Small (%)	Medium (%)	Large (%)	Small (%)	Medium (%)	Large (%)
Sold Tilapia Last Harvest	87	80	88	100	94	100	100	100	100	100
Sold to:										
Middlemen	69	19	50	80	55	84	100	93	93	93
Restaurants	13	13	31	47	--	5	19	7	--	--
Marketplace	14	13	--	13	39	32	19	7	--	--
Other buyers	70	88	75	87	89	63	69	79	50	50
(Number)	(11)	(15)	(16)	(15)	(18)	(19)	(16)	(14)	(14)	(15)

[1] Column percentages will be greater than 100 because of multiple responses given by each respondent.

consumer and product characteristics is crucial to expanding markets and maintaining a favorable price.

Sixty percent of the Rwandan farmers did not sell any fish from their last harvest. In the small and medium categories, Honduran respondents kept higher percentages of their harvested fish for home consumption, 20 and 12%, respectively, than respondents in the Philippines or Thailand. The percentage of farmers keeping some tilapia for home consumption decreased as pond area increased, suggesting that increased pond area was associated with increased entry into the cash market economy.

In the Philippines, small pond operators did not sell all their fish and kept some for home consumption. Medium and large pond owners sold 100% of their harvests. No Thai respondents, at any pond area, kept fish for home consumption; all were sold.

Rwandan farmers sold fish to other buyers—teachers, civil servants, and others making direct purchases; family members also sold fish in the marketplace. Thai, Philippine, and Honduran fish were sold mainly to intermediaries, other buyers, and restaurants or by family members in the marketplace. Between 5 and 19% of the Philippine farmers were able to sell their fish to restaurants. About 13 to 47% of the Honduran farmers sold fish to restaurants, but only a few Thai farmers reported sales to restaurants. Honduran restaurant sales were much higher than in any other country. Few Thai and Honduran farmers personally sold any fish in the marketplace.

Problems in Marketing Tilapia

More than two-thirds of the people surveyed said they had no problem marketing tilapia (Table 4). There was concern in Thailand by the farmers that they were not getting the price they wanted. Many also responded that they could not sell their fish even when they lowered their prices. Similar comments were also made by Philippine and Honduran tilapia farmers.

Approximately one-third of the farmers in Rwanda did not eat fish. In a study of people practicing aquaculture in Rwanda, Molnar et al. (1991) found that fish were considered a recent entry into traditional diets, except in some lake areas. No cultural taboos toward eating fish were discovered although knowledge of fish preparation methods was limited. Consumers exhibited a clear size preference for marketed tilapia. In Rwanda, fish greater than 120 grams sold quickly at $2.00/kg, but fish weighing less than 100 grams would not be purchased, even at reduced prices. However, this size bias changed by region, with consumers in some lake regions accepting smaller fish. A 120-gram fish was attainable in 7 to 9 months by farmers that followed recommended management practices.

Three-quarters of the Rwandan farmers felt a larger fish would be easier to sell. In Thailand and

Table 4. Marketing problems of tilapia farmers in Rwanda, the Philippines, Honduras, and Thailand, 1994.

	Rwanda	Honduras	Philippines	Thailand
	Pct.	*Pct.*	*Pct.*	*Pct.*
Did you have trouble selling your tilapia?				
No	79	82	100	69
Yes	21	18	0	31
Had problems selling at price you want?				
No	77	90	100	44
Yes	23	10	0	56
Even if you cannot get the price wanted, can you usually sell at a lower price?				
No	27	36	76	50
Yes	13	64	24	50
Some people in area do not like to eat tilapia?				
No	66	84	100	85
Yes	34	16	0	15
Larger tilapia would be easier to sell?				
No	28	58	15	4
Yes	72	42	85	96
Sold fingerlings to other farmers?				
No	49	84	74	94
Yes	51	16	26	6
Did you have trouble selling fingerlings?				
No, did not sell	42	84	70	94
Had no problems	31	16	30	4
Yes, problems	27	0	0	2
(Number)	(136)	(51)	(50)	(56)

the Philippines, almost all of the respondents felt larger fish would sell more easily. In Honduras, approximately half the operators felt a larger fish would sell more easily.

Conclusion

Marketing strategies for tilapia varied from primarily home consumption to widely distributed markets. Marketing channels for these farmers were not investigated fully. Much more can be done to improve these channels not only for fish distribution but also for production inputs to the farmers.

The many institutional actors working in aquaculture perhaps should be considered the primary audience for a global research project such as the PD/A CRSP. Some level of direct farmer contact and training is necessary for keeping PD/A CRSP scientists in touch with the direct experiences and problems of fish farmers. Nonetheless, the impacts and influence of the PD/A CRSP may be greater if institutions and industry are understood to be the primary consumers of PD/A CRSP outcomes.

Thus, seminars for nongovernmental organizations (NGOs) that maintain extensive and long-term relationships with villages and small-scale farmers may be the most important mechanism for reaching this constituency rather than direct intervention by the PD/A CRSP. As long as small- and medium-scale farmers remain a central target segment for PD/A CRSP research, the development of a continuing network of contacts with representatives of these groups will be a significant objective for the research network. The NGOs may be more effective at stimulating interest and reaching small-scale farmers than governmental organizations or the limited and sporadic activities of PD/A CRSP personnel (Kaimowitz, 1993).

To gain greater leverage for PD/A CRSP activities, a number of strategies might be consciously highlighted for PD/A CRSP scientists. These include instructing NGO trainers, encouraging NGOs to adopt aquaculture as part of their repertoire of assistance activities, and helping national institutions organize seminars and training programs for NGOs. These and other means may be used for wholesaling PD/A CRSP technology to actors closer to village life who will be there when PD/A CRSP is not.

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