Impact of Integrated Fish Culture on Resource Limited Farms in Guatemala and Panamá

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EXECUTIVE SUMMARY

English

The study evaluated the status of fish culture projects initiated in the 1980s on resource-poor farms in Guatemala and Panamá. In both places, USAID provided financial assistance and Auburn University provided technical support to the respective governments. The study examined the impact of aquaculture technology, extension services, local socio-economic conditions, and policy environments on the projects. The evaluation team (an aquaculturalist, an agricultural economist and a social anthropologist) had a rare opportunity to evaluate sustainability of two different types of fish farming projects. Other ex-post evaluations of aquaculture projects occur shortly after external support has ended, rather than after 14 and 9 years as was the case in Panama and Guatemala.

The projects in Guatemala and Panamá were designed to improve the nutrition and income of poor farmers, and participants were to become self-sufficient pond managers by the end of the project. The critical difference is that in Guatemala fish ponds were managed by individual families on their farms, and in Panamá more complex fish pond modules were managed by organized groups of farmers.

In central and eastern Guatemala, the team visited 37 family and 2 cooperative fish pond projects between 9 and 19 June, 1998. After the team left, a household survey was administered to these 37 families and another 9 families. So far as was possible, households were randomly selected from a list of 651 farm families known to have had functioning fish ponds when external financing was withdrawn in 1989. The team found that 39.0% of the ponds are abandoned, 48.0% are under-utilized; and 13.0% are well-managed. The fish ponds did not have the intended impact on household nutrition and income for a combination of technical, domestic, economic, social and broad political reasons. These include problematic water supplies to the ponds, lack of sufficient nutrients entering ponds to increase fish yield, theft, inconsistent technical assistance because of civil unrest and changing policy environments, and changing participant priorities linked to changes in household needs over the years.

In Panamá, the team visited 21 cooperative fish pond projects between 20 June and 3 July, 1998. After the team left, a household survey was administered to 115 current or former project members. The team found that 6 projects had been completely abandoned, and 15 were being used to grow rice and/or fish. Only two projects still in use were well-managed. Fish ponds did not have the intended impact on household nutrition and income for a combination of technical, domestic, economic, social and broad political reasons. These include too little water to maintain pond water level during the dry season, lack of sufficient nutrients entering ponds to increase fish yield, inconsistent technical assistance related to changing government strategies, a lack of managerial and business skills on the part of project group leaders, over-dependence on local elites and/or government for various types of assistance, and macrosocial and political changes.

Typically, abandonment or poor performance resulted from a combination of technical, economic and social factors, each playing on and amplifying the other. In both countries, many project participants who maintained their ponds did so to irrigate gardens, water animals, or as flooded rice paddies. Thus, although the projects did not meet intended goals related to fish culture, participants found ways to benefit from the existence of the ponds. In Panamá 15 of 21 cooperatively managed pond projects and in Guatemala 28 of 46 individual household pond projects are still used at some level of proficiency.

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RESUMEN EJECUTIVO

Español

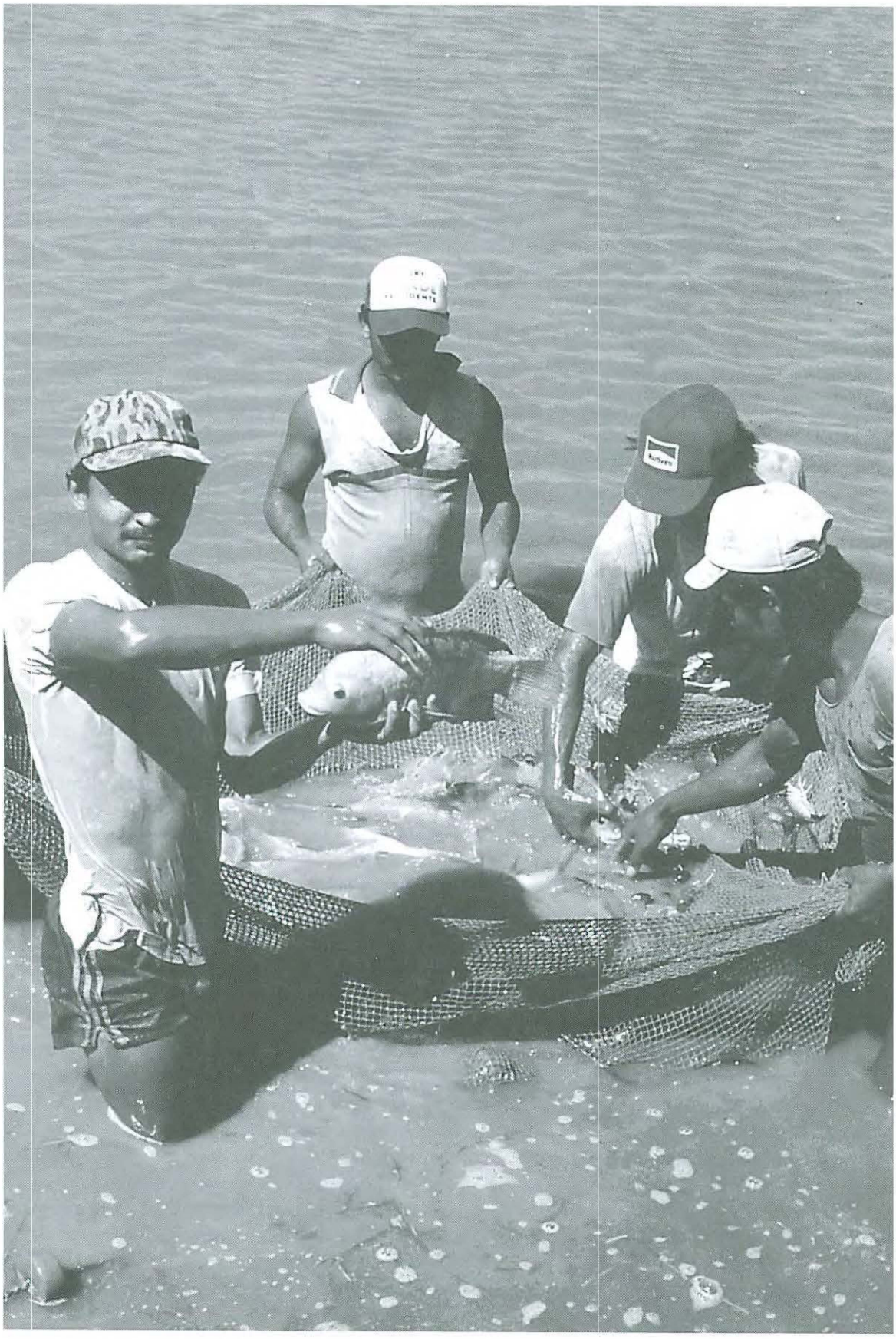
El estudio que presentamos evaluó el estado actual de dos proyectos de peces en estanques iniciado en los años ochenta, en granjas de bajos recursos en Guatemala y Panamá. En los dos paises el proyecto fue apoyado financieramente por la Agencia para el Desarrollo Internacional de los Estados Unidos, USAID, y técnicamente por la Universidad de Auburn. El estudio averiguó y evaluó el impacto de la tecnología acuicola, el servicio de extensión, las condiciones socioeconómicas y la política ambiental en el proyecto. El equipo de evaluación (formado por un especialista en acuicultura, un economista agrícola y un antropólogo) tuvo la oportunidad que raras veces tienen los investigadores de evaluar la sostenibilidad de los dos tipos de proyectos de cultivo de peces. Otras evaluaciones de post-proyecto referente a la acuicultura se incieron un poco después de terminar el apoyo externo del mismo. En contraste este estudio se realizó a los 14 y 9 años en Panamá y Guatemala respetivamente después de terminar el apoyo externo de los mismos.

En Guatemala y Panamá, el proyecto tenía como objetivo mejorar el aspecto nutricional e incrementar los ingresos de pequeños agricultores de escasos recursos. De igual forma, se buscaba que los mismos pudieran manejar los estanques de producción por si solos al final del proyecto. La principal diferencia de los dos proyectos fue que en el de Guatemala se trabajó con proyectos tipo familiar, construidos en sus propias fincas y en Panamá se trabajó con la utilización de módulos más complejos, manejado por grupos de agricultores organizados.

En la parte este y central de Guatemala, el equipo visitó 37 estanques familiares y 2 estanques de cooperativas, del 9 al 19 de junio de 1998. Después que el equipo finalizó su visita a las áreas se le realizó una encuesta a las 37 familias y a 9 familias adicionales. En cuanto fue posible, la selección de estas familias fue realizada al azar, de una lista de 651 familias conocidas que siguieron trabajando los estanques cuando el financiamiento externo se retiró en 1989. El equipo encontró que el 39.0% de los estanques estaban abandonados, 48.0% estaban sub - utilizados, y el 13.0% se estaban llevando bien. El cultivo de peces no presentó el impacto esperado, de nutrición y económico de las familias, por múltiples combinaciones de razones, técnicas, domesticas, económicas, sociales y políticas. Esto incluye problemas relacionados con el suministro de agua a los estanques, falta de nutrientes en el estanque que pueda aumentar el rendimiento de los peces, robo, asistencia técnica inconsistente, relacionado con la guerra interna y el desasosiego, cambios en políticas ambientales y cambios en las prioridades de los participantes relacionadas con el ciclo doméstico.

En Panamá, el equipo visitó 21 proyectos de estanques cooperativos entre el 20 de junio y el 3 de julio de 1998. Después que el equipo se retiró se realizó una encuesta a 115 miembros y ex-miembros de los proyectos. El equipo encontró que 6 proyectos estaban totalmente abandonados y 15 estaban siendo utilizados en producción de arroz y/o peces. Solo dos de los estanque que se estaban utilizando, se mantenían bien utilizados en el sistema establecido al inicio del proyecto. Los estanques no causaron el impacto esperado en los aspectos relacionados con la nutrición y entradas económicas de las familias, por múltiples combinaciones de razones, técnicas, domésticas, económicas, sociales y políticos. Esto incluye poco agua para mantener el nivel del agua durante la estación seca, falta de nutrientes en los estanques para incrementar los rendimientos de los peces, asistencia técnica inconsistente, relacionado con cambios en las estrategias gubernamentales, falta de habilidad en los negocios de los lideres del proyecto, sobre dependencia de los líderes locales o gubernamentales por varios tipos de asistencia y cambios políticos y macrosociales.

Normalmente, los estanques abandonados o mal manejados, fueron el resultado de una combinación de factores técnicos, económicos y sociales, cada uno de ellos causando un incremento del otro. En ambos países, muchos proyectos, son mantenidos por los participantes solo para el riego de hortalizas, almacenamiento de agua para los animales, o para el cultivo de arroz bajo riego. Así que, aunque el proyecto no lograra sus metas relacionadas con el cultivo de peces, los participantes encontraron vías para lograr beneficios económicos de los estanques construidos. En Panamá 15 de los 21 proyectos cooperativos y en Guatemala 28 de 46 proyectos familiares se mantienen en uso, con algún nivel de entrada económica y en algún nivel de habilidad.



Fish harvest in Panamá, 1984.

Impacts of Integrated Fish Culture on Resource Limited Farms in Guatemala and Panamá

LEONARD L. LOVSHIN[1], NORMAN B. SCHWARTZ[2] AND UPTON HATCH[3]

INTRODUCTION

The purpose of this study was to evaluate and to account for the current status of fish pond projects initiated in the 1980s by the governments of Guatemala (GOG) and Panamá (GOP), with financial support from the United States Agency for International Development (USAID). The study also is the basis for recommendations designed to enhance the effectiveness of aquaculture projects on limited resource farms. This evaluation was unusual in that most evaluations of aquaculture projects occur within several years after external support has ended, rather than after fourteen years and nine years as are the cases for Panamá and Guatemala, respectively.

This project presented the authors with an unusual opportunity to assess the ability of project participants to sustain fish culture on limited resource farms. Sustainability is a critical issue in development projects. Cernea (1993) pointed out that in far too many cases projects are abandoned within six to twenty-four months after consultants have left and/or external funding has ended. Understanding how and why some projects become self-sustaining and others quickly fall apart is important for practical as well as research purposes. But evaluators may have to wait some time to gain this understanding. "The payoff to research in terms of production and incomes may take a decade or more" (Hobgood et al. 1980). Hobgood et al. continue (in their ex-post evaluation of agricultural research projects), " If one waits this long ... there arises the analytic problem of attribution - of all the changes noticed over a decade; which one can really be attributed to a specific amount of research? ".

This study faced the same situation. There have been many significant changes in Panamá and Guatemala since the 1980s, which complicate problems of attribution. Nonetheless, the authors believe that they have learned several lessons about why certain types of aquaculture projects succeed or fail.

BACKGROUND

GUATEMALA

Project History

In Guatemala the integrated fish pond project was initiated in 1982 and external funding ended in 1989 (Castillo et al. 1992). The project was a collaborative effort, involving the National Directorate for Livestock Services (DIGESEPE), American Co-Operative Agency for Relief Everywhere (CARE), USAID/ Guatemala and the U.S. Peace Corps. Auburn University provided technical assistance in fish culture to the government of Guatemala and CARE. The budget for the project was US$953,000, not including Peace Corps contributions and the salaries DIGESEPE paid for 32 local extension agents and 7 part-time supervisors. DIGESEPE also provided logistic and administrative

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support. The Peace Corps assigned 73 volunteers to the project, though not all were in the field at the same time. Volunteers worked directly with project participants, and identified local people who could be employed by DIGESEPE as local extension agents. Subsequently, the volunteers provided one-on-one technical training to their Guatemalan counterparts. (Castillo et al. 1992).

The project was designed to improve nutrition and income for poor farm families in eastern, coastal and northern Guatemala (Figure 1). To do so, the project promoted small-scale fish culture on small, individually owned farms. Initially, 100- to 200-m^2 hand dug ponds were fed and fertilized with available nutrients found on-farm, such as manures, table scraps and agricultural by-products. During the final 3 years of the project some ponds were integrated with livestock. The manure was used to fertilize the pond waters to increase fish yields. New ponds were initially stocked at no cost to participating farmers, but later they had to buy or produce their own fingerlings. Most ponds were stocked with mixed-sex Nile tilapia (*Oreochromus niloticus*), common carp (*Cyprinus carpio*) and snails. Participants were taught to produce their own tilapia fingerlings by retaining offspring, spawned in the fattening pond, at harvest for restocking to produce the next crop. Common carp fingerlings were purchased from government hatcheries for restocking ponds (Castillo et al. 1992). By 1989, 1,200 ponds had been built or renovated, about 15% of the ponds were integrated with animals, usually poultry in enclosures suspended over the ponds, and 21% were integrated with vegetable gardens (Castillo et al. 1992). On average, a pond of 120m^2 produced about 48 kg (4,000 kg/ha) of fish annually, of which about 48% was consumed by the household, 42% sold, and 10% given to neighbors or used for restocking ponds (Castillo et al 1992). Families preferred tilapia of at least 15 cm but all tilapia were consumed. Sixty percent of the harvest consisted of tilapia 15 cm or above. Fish consumption among participants went from 0.5 kg prior to the project, to 3.3 kg per capita by 1989.

Early evaluation studies concluded that low-nutrient, non-integrated fish ponds are low-risk, financially viable operations (Castillo et al. 1992). Adding animals and/or gardens increased demands for labor and increased risk but also increased return on investment. By 1989, when the project came to an end, it seemed to be reaching its goals - participating households had improved their nutrition and had increased their meager incomes. An early ex-post evaluation concluded that several lessons had been learned from the Guatemala project, including the following:

1. multi-year continuity of field staff was critical; it was best if the extension agent or promoter was a local person;

2. the best type of local person was a farmer enthusiastic about food production, but with no more than six years of formal schooling - in other words, a more or less average and well-respected farmer with some vision;

3. where people contributed their own labor to the project, they made greater commitments to it, which in turn led to superior pond management, higher fish production and greater farmer satisfaction (Castillo et al. 1992).

Figure 1. Map of Guatemala showing evaluation area.

Target Population

The project targeted poor farmers with usually less than 2 hectares of land and an annual income of no more than US$ 925 (Castillo et al. 1992). Average land holdings were 0.9 hectares per household and average total annual income was about US$ 700. Many households owned fowl but rarely pigs or cattle. Most project participants lived in houses with dirt floors and thatch or corrugated zinc sheet roofs. The major household luxury item often was a radio. Average household size was seven people. Literacy rates were low, 18% for Maya and 44% for Ladinos (Castillo et al. 1992). The majority of traditional Maya live in the western highlands of Guatemala. The counterpart to the Maya are the Ladinos. In modern Guatemala, Ladinos tend to be of Hispanic cultural orientation and are usually of Maya and European and, at times, African descent.

A survey of 62 participating households "revealed that for more than 50 percent of participating families, the most compelling reason for fish farming was to improve their diet" and for 30% income generation was equally important. Net annual income from fish sales "were modest" (US$28) but had significant financial impact given the poverty of the average participating household. The "net cash value of the fish crop was equivalent to approximately 2 months of wages as a rural laborer" (Popma et al. 1995; Hatch et al. 1995).

Political History

The project was implemented in a macrosocial context marked by political violence, increasing immiseration of the rural poor and disruption of many government supply services. The 1980s were the worst years of Guatemala's long civil war, which began in the 1960s and ended with the Peace Accords of December 1996. A popular myth in Guatemala is that the civil war had little impact on eastern Guatemala, where many of the ponds were located. No doubt the violence was worse in the western highlands, but there also was a good deal of violence and disruption in the east (Elías Gramajo 1998; Metz 1998). The war disrupted the economy, deepened the poverty of the lower sectors and further skewed already grossly unequal land distribution.

Since 1996, despite initial steps toward democratizing the political process, economic hardship has persisted and common delinquency has increased. By 1994 the Guatemalan government was flying the flag of neoliberalism and globalization. The government began to privatize many government services. Official policy as well as common crime and economic adversity have curtailed delivery of government supply services to many rural inhabitants.

Panamá

Project History

The integrated fish pond project was initiated in 1980 and external funding ended in 1984. USAID/Panamá granted the Government of Panamá US$ 1,420,000 to mount a 4-year pilot fish culture project. The Panamanian National Directorate of Aquaculture (DINAAC), a bureau in the Ministry of Agriculture and Livestock Development (MIDA), implemented the project. Auburn University provided technical assistance in fish culture to DINAAC. All the extension persons were government employees, most of them from DINAAC.

The project was designed to teach organized groups of poor farmers how to manage by themselves integrated modules, assemblages of 2, 3, or 4 machine-dug ponds and animals and, in some places, gardens and trees. Project members were trained to produce their own Nile tilapia seed in spawning and nursery ponds to assure a timely supply for the growout pond. Tilapia broodstock and fingerlings to stock the growout pond for the first time were donated by the government. Most projects were stocked with visually selected male tilapia, but some ponds were stocked with mixed-sex tilapia and the piscivorous guapote tigre, *Cichlasoma managuense*, to control tilapia offspring in the growout ponds and permit the harvest of tilapia larger than 200g. Chinese carps and common carp were added to the fish ponds to increase fish production. Small carps for stocking ponds were obtained from government hatcheries. Average annual fish yield from growout ponds averaging 2,600m^2 and fertilized with either pig, chicken, duck or cattle manure was 2,177 kg/ha. External technical support was to continue for about 24 months, after which the groups were to be largely self-sufficient, with minimal but continuous support from extension. Production of fish, garden produce, livestock and trees were to benefit the groups by improving their nutrition and by providing them with additional income. (Lovshin et al. 1986; Schwartz et al. 1988).

The modules were managed by organized project groups, a type of rural producers' cooperative. As part of the plan for self-sufficiency, each project group selected two men who received technical training at Divisa, DINAAC's training and fish seed production center. During the tenure of the project, 21 modules were built,

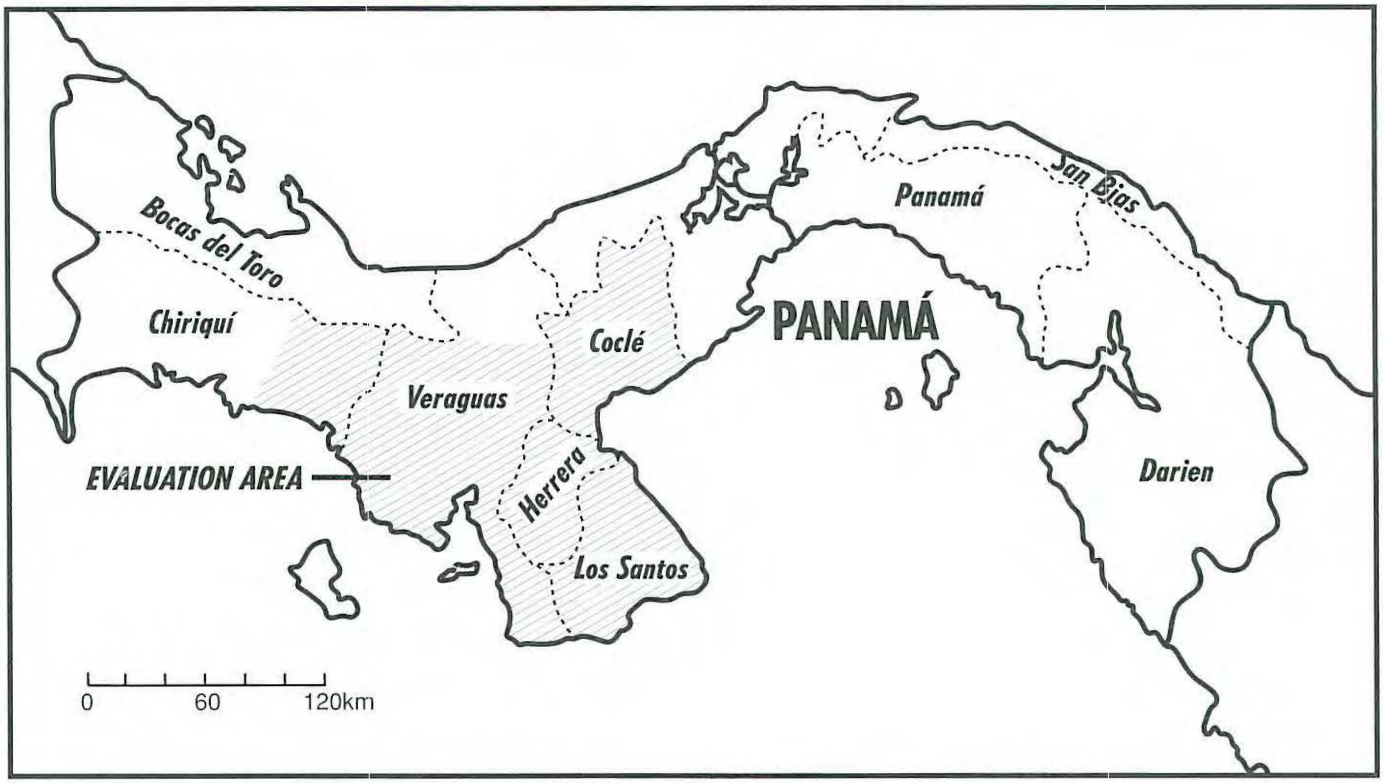

Figure 2. Map of Panamá showing evaluation area.

usually with some labor contribution from the beneficiary group. One of the projects was located at the Centro Misional Jésus Obrero founded in 1970 in Tolé, Chiriquí. Catholic priests direct the Center which serves, among other things, to train Ngobe Indians (formerly called Guaymí) in aquaculture and other productive technologies. The project located at the Centro Misional Jésus Obrero was the only project not managed by community inhabitants.

Panamanians participated in the project to improve their nutrition and income. Early evaluations indicated that whether they were or were not project participants, people in villages with modules were consuming more fish at lower cost than people in villages without fish ponds. The Panamanian project differed from the Guatemalan one (see above) in several ways. The most important difference was that the Panamá project was based on organized groups rather than individual households. Nor were Peace Corps volunteers assigned to the Panamá project, as they were in Guatemala. Except for collective farms which own their own land, modules were built on land donated to project groups rather than on individually owned plots. The land was transferred from the donor to the project group by means of a "social contract." Given the constraints within which the project worked, there was not enough time to make this a transfer of legal ownership, and perhaps even with all the time in the world, few donors would have agreed to a legal deed transfer.

Studies indicated that the modules were economically viable for poor farmers (Lovshin et al. 1986) Chicken-fish combinations yielded higher net returns than cattle-, duck- or pig-fish combinations. Socio-economic studies were conducted in 14 of 21 communities in which modules were constructed. Given the time constraints, socio-economic studies had to be initiated after an appropriate site had been identified in technical terms. In other words, socio-economic studies were carried out concurrently with construction of a module and training of participants. For this reason, it was not possible to carry out social studies in all 21 communities.

When the project ended in 1984, it seemed to be reaching the goal of improving nutrition and income among project participants. Although project groups varied in their technical proficiency, it seemed as if some of them were moving in the direction of self-sufficiency. Several lessons had been learned from the Panamanian project, including the following:

1. Project groups did best when the community was not highly stratified economically;

2. Project groups did best when the community had relatively few public and private commercial services; this probably reflected the limited internal

stratification and relative equality of need in the community;

3. Project groups did best when they were led by local people who were esteemed by their peers but not substantially wealthier or more politically powerful than their peers;

4. Although local elites could mobilize people to assist a project group, this tended to encourage dependency, and was counter-productive for self-sufficiency. Commitment seemed greater when local people contributed labor to the project and were not dependent on a powerful local director (Lovshin et al. 1986).

Target Population

Project groups were located in the provinces of Los Santos, Herrera, Coclé, Veraguas and eastern Chiriquí, all in central Panamá (Figure 2.) Median annual household cash income among participating families was about US$ 500, but in some villages it was far less. Although per capita income is higher in Panamá than in many other Latin American countries, this is due to high wages paid in Panamá City. Most rural farmers were impoverished. Most male heads of household had no more than three years of formal schooling, and most villages had limited access to health and other basic services (Lovshin, et al. 1986; Schwartz et al. 1988).

Political History

When the project began, the government and many sectors of the civil society, including the Catholic Church, favored cooperatives and communal approaches to the solution of problems facing the rural poor, such as basic nutrition. As a solution to problems of rural poverty and skewed land distribution, the government promoted communal farms, which, for a variety of reasons, have never thrived. Communal farms lacked secure access to credit and suffered from internal management problems. In the 1970s communal farm members were earning an average of US$ 248, which prompted migration to Panamá City (Dirección Nacional de Desarrollo Social 1979). Nonetheless, the government was committed to a communal strategy to improve the lot of the rural poor.

In 1989 the removal of Noriega from power led to the disruption of government supply services, including extension, to the countryside. Many elements of the commercial middle class and the landed elite had always opposed communal approaches to development, which involved agrarian reform and expropriation of large estates. After 1989 the new government led by President Guillermo Endara initiated the neoliberal and privatization approach now sweeping through Latin American. President Ernesto Pérez Balladares, elected in 1994, has continued the policy of privatization, which involves reductions in delivery of services to the rural poor. For purposes of this report it is important to note that all this led to changes in the status of the communal farms. Further, the "social contracts" by means of which an individual donated land to a project group now are easily rescinded.

If the rural poor seem as poor as ever, several middle-class social sectors in Panamá have prospered in the 1990s. In 1992, "real GDP growth was an impressive 8 percent; and most sectors of the economy ... moved forward" (Goodwin 1998). But distribution of wealth is markedly skewed, and pulls rural youth to the cities.

METHODS AND SAMPLE POPULATION

During June and July 1998 the authors visited 37 family and 2 cooperatively managed fish ponds in Guatemala, and 20 group project sites and a Catholic Church managed site (Tolé) in Panamá. Host country personnel in both countries involved with the projects in the 1980s coordinated the on-site visits. In Guatemala families with fish ponds were selected from a list compiled by CARE of 651 families known to have functioning fish ponds when the project ended in 1989. The Guatemalan extension person in charge of providing technical assistance to fish pond owners in each department (roughly equivalent to a state or province) assisted with the selection of families visited. An effort was made to select families randomly. However, distance traveled to visit a family and civil unrest in some areas removed names from the list of families whose ponds could be evaluated. Extension agents were told to include all families on the list minus the exceptions noted above. An effort was made to include families with functioning and abandoned ponds. Even with these precautions, visits to four families during one day were biased because the extension agent who accompanied the evaluation team assumed the team wanted to see successful fish ponds and nothing else and selected families accordingly. The evaluation team tried to correct for this bias by having the extension agent obtain survey data (see below) from several additional, random-

Table 1. Pond Sites in Panamá and Guatemala

Panamá: Communities and Provinces

Community	Province	Number of interviews
Majarillas	Herrera	6
Guayabito	Herrera	6
Los Higos	Herrera	6
La Arena	Herrera	6
Pitaloza	Herrera	6
Mogollón	Los Santos	6
Bayano	Los Santos	6
La Miel	Los Santos	6
Las Trancas	Los Santos	6
El Barrero	Veraguas	6
Espavacito	Veraguas	6
Montañita de Boro	Veraguas	6
Pedregoso	Veraguas	6
Mata Palo	Veraguas	4
San José	Veraguas	5
Pino del Cobre	Veraguas	4
Remedios	Chiriquí	5
Tolé	Chiriquí	1
Cascajal	Coclé	6
Chumical	Coclé	6
Las Peñitas	Coclé	6

Guatemala: Departments

Department	Number of interviews
Jalapa	10
Santa Rosa	9
Chiquimula	9
Zacapa	8
Baja Verapaz	10

ly selected families from the same area. The evaluation team made a rapid evaluation of the pond site and attempted to interview either the husband or wife at each site to obtain information on species cultured, source of small fish for stocking, fish care, harvest and utilization, and reasons for pond abandonment. One cooperative project was completely abandoned, with no one present to interview. At another pond project, only the wife of the caretaker, with little knowledge of the fish pond, was present to answer questions as the owners no longer lived on the farm.

Ponds were classified as abandoned, under-utilized or well utilized for fish culture in Guatemala. Abandoned ponds had no water and bottoms overgrown with grasses and weeds, or were partially filled with water but full of aquatic weeds. Under-utilized ponds contained water and a few fish but were poorly cared for as evidenced by clear or muddy water color, pond banks overgrown with weeds, little noticeable fish activity on the water surface or along the pond margin, and general lack of interest in the pond voiced by owners during the visit. Well-utilized ponds had a green water color, generally well-kept pond banks, observable fish activity in the pond, and the pond owner showed pride and a knowledge of fish culture during the interview. Other observations included the integration of animal husbandry and vegetable gardens with the fish pond(s) and secondary utilization of the pond water for irrigating crops or watering livestock.

In Panamá, the team made a rapid evaluation of the pond sites and attempted to interview at least one, and often more, participants or ex-participants to obtain information on fish species cultured, source of small fish for stocking, fish care, harvest and utilization, and reasons for pond abandonment. Projects were classified as abandoned or utilized. Projects were classified as abandoned if the ponds contained no water and their bottoms were overgrown with grasses and weeds, or if the ponds were partially filled with water but full of aquatic weeds. They were considered utilized if at least one pond was used for growing fish or an agricultural crop, even if remaining ponds were abandoned. Utilized ponds were further classified into 3 groups - a. culture of rice only in at least one pond, b. culture of fish only in at least one pond, or c. fish culture integrated with animal husbandry.

During the site visits in Panamá, the team collected data on project group communities, local economic conditions and diffusion of fish culture technology. Unfortunately, participants have not recorded fish harvest data in Guatemala or in Panamá. Nor, given the disruption of government supply services noted above, are such data available from the extension services. Thus, fish harvest data are not available for cost/benefit analysis.

During July and August, host country personnel coordinated the administration of a follow-up household survey with active and non-active project participants, selected on a random basis. In Guatemala 46 household interviews were obtained in four eastern departments and in the central highland department of Baja Verapaz. In Panamá 114 household interviews (plus one interview in Tolé) were obtained in 20 communities located in five provinces (Table 1). The surveys were administered to heads of household or spouses by extension workers who had worked in the original projects. The survey was adjusted to take account of differences between the Panamá and Guatemala projects. Additionally, 25 participants in 10 projects in Panamá still growing fish were interviewed regarding their preferred fish species for culture, source of small fish for stocking, and opinions on the quality of fish harvests.

RESULTS AND DISCUSSION

GUATEMALA

Technical Component

It is important to note that the following discussion is based on data collected during the evaluation team's site visits during June 9 to 19, 1998. After the team left the field, the extension agents collected household interviews, which are included in the socio-economic section of this report (the socio-economic section does not deal with the two cooperative ponds discussed here). Thus, there are some minor differences in the numbers reported in the technical and the socio-economic sections. The differences do not affect the statistics on abandoned, under-utilized and well-utilized family fish ponds, and thus do not affect conclusions and recommendations reached in either the technical or socio-economic sections of the report.

Project status

Upon visiting 37 family and 2 cooperative fish pond projects in Guatemala, the team found 14 were abandoned (36 %), 20 under-utilized (51%) and 5 were well utilized (13%). Both cooperative projects were abandoned. Three of the 5 well-utilized ponds were visited on the day that the Guatemalan extension person who accompanied the evaluation team selected what he considered to be good fish ponds for evaluation. Reasons for abandoning fish culture in 14 projects varied. Seven families said they abandoned their ponds because of problems with the water source, and one family each responded that abandonment was because the pond did not hold water, lack of fingerlings for restocking, land ownership dispute, potential public health problem, no market for fish, too many small tilapia at harvest, death or illness of husband, fear of young children drowning, land was donated to a cooperative, group problems, and theft. The reason for abandoning fish ponds was undetermined in one cooperative project. Reasons for abandonment or under-utilization are difficult to determine and are likely a combination of civil unrest, poor extension assistance by the government, change in family needs and priorities over time (see socio-economic section below) and technical problems related to fish culture.

Seven families said that lack of an adequate water supply was the reason they abandoned fish culture. Ponds were filled with run-off from rainfall and/or by diverting a spring or stream. All ponds were filled with water supplied by gravity. Often, site selection is made during the rainy season or during a wet year when water is plentiful. No records are available to determine seasonal high or low water flows from springs and small streams. The fish culture specialist selecting a pond site must depend on the knowledge of the land owner to determine if adequate water is available to maintain ponds full year round. A land-owner, through ignorance or because he wants a fish pond, will confirm that water is plentiful. The specialist often wants to please the eager land owner and, thus selects a marginal pond site knowing that future problems may occur. Or, the fish culture specialist may be poorly trained and not able to make a wise decision concerning site selection. Thus, ponds are built on sites with an inadequate water supply. There are other times when insufficient water is not due to poor site selection but due to climatic change or deforestation, both normally uncontrollable by the pond owner or extension specialist. Whatever the reason, ponds that can only be filled during the rainy season and are dry during the period of little rainfall are difficult to manage. Fingerlings can not be produced on-farm as ponds holding brood stock and fingerlings dry. Fattening ponds are often harvested at the end of the rainy season before stocked fish reach a size preferred by consumers. Fish growers who want to restock their ponds when the rainy season begins must obtain or purchase fingerlings from the government or a neighbor. However, fingerlings often are not available when needed at the start of the rainy season, or are too costly for impoverished pond owners. Little can be done to correct poor pond location, especially by resource-poor land owners. Ponds with insufficient water to maintain water levels are usually abandoned.

Culture Fish and Fingerling Source

Twenty-four of the 25 projects with well-utilized and under-utilized ponds are stocked with mixed-sex tilapia. Stocking male and female tilapia in the same pond results in reproduction 3 to 5 months after stocking. Offspring accumulate and fish growth slows due to competition between adults and offspring for food if ponds are not harvested in a timely manner. However, offspring can be stockpiled at harvest and restocked into freshly filled ponds for further growth, thus providing a source of on-farm fingerlings. None of the projects reported stocking only male tilapia to reduce or eliminate tilapia reproduction. Nine of 25 projects still growing fish reported stocking guapote tigre. However, a

Family fish pond integrated with layer chickens in Guatemala, 1989. Facing page, abandoned family fish pond in Guatemala, 1998.

number of fish farmers reported that they did not like guapote tigre in their ponds because they ate all the tilapia offspring and none remained for restocking. Six of 25 projects reported stocking common carp which normally do not reproduce in farmers ponds and reach a larger harvest weight. Twelve farmers reported stocking a snail which reproduces in the ponds and reaches a large size with little care. Thirteen of the projects with under-utilized ponds and all 5 of the projects with well-utilized ponds noted that small tilapia for restocking were obtained from their own ponds or neighbors' ponds. Seven farmers reported obtaining small tilapia from government hatcheries. Five of the 6 farmers stocking common carp responded that they acquired fingerlings from government hatcheries.

Given the limited financial resources and fish culture knowledge of families growing fish, selection of mixed-sex tilapia appears correct for this group of farmers in Guatemala. Tilapia grow well on planktonic plants and animals produced in fertilized fish ponds. Enriching pond waters with fertilizers and supplementing natural pond foods with feeds will increase fish growth and yield. Nile tilapia reach maturity 4 to 5 months after hatch and will reproduce in the fattening pond. Tilapia that grow slowly will reproduce at a small size and the pond will fill with offspring that compete for food with the stocked fish. Fish harvests are often disappointing because fish are small and the total weight captured is low. However, small tilapia can be stored in a container, net enclosure or another small pond and restocked in the fattening pond after it has been drained, fish removed and refilled with water. On-farm production of tilapia fingerlings is important to the success of resource-limited family fish ponds because the only other source of fingerlings is usually government hatcheries or neighbors. Sixty-eight percent of the farmers still growing fish reported that they produced their own tilapia fingerlings. Government hatcheries have a difficult time stocking fingerlings in a large number of widely dispersed family fish ponds on a timely basis. Even when fingerlings are available, the government has difficulty transporting the fingerlings to the countryside, while most impoverished farmers do not have the means to travel to the hatcheries to obtain fingerlings. Only one government hatchery remained in operation in the five-department region visited, while two other government hatcheries in the region were closed because of inadequate funding.

Although selection of mixed-sex tilapia appears to be correct for resource-limited farmers in Guatemala, stocking mixed-sex tilapia often results in the harvest of fish less than 15 cm (100 g). Most impoverished families do not seem to mind eating small fish (Castillo et al. 1992). Families not satisfied with small fish can stock guapote tigre with the mixed-sex tilapia to reduce or eliminate tilapia offspring and allow stocked fish to grow larger. However, stocking guapote is a two-edged sword. Guapote that are not stocked at the correct density can eliminate all tilapia offspring, so that no tilapia are left for restocking when the pond is harvested. Families with no small tilapia to restock turn to the government or neighbors to restock their ponds. Farmers stocking guapote tigre must be certain that a secure source of small tilapia is available for restocking before deciding to use this method of fish density control.

Many pond owners like to stock common carp because they normally do not reproduce in the fattening pond and grow to larger sizes. Even pond owners with small ponds and few resources like to show-off a few big fish at harvest. However, common carp requires close attention to reproduce well in small fish ponds, and in Guatemala the government is the sole supplier of common carp fingerlings.

Integration with Animals and Gardens

Farm animals, mostly broiler and layer chickens at 10 to100/100^{2}m pond, were integrated with some fish ponds during the last 3 years of the project (Castillo et al. 1992). Daily additions of chicken manure enrich pond waters and increase fish yields. Thirty-eight own-

ers of fish ponds were asked if their ponds were ever associated with animal husbandry activities, to use the manure to fertilize pond waters. Sixteen (42%) reported that they grew animals next to or over their ponds at some time during the project while 22 (58%) responded negatively. Presently only 3 of the 16 farmers have ponds associated with animal husbandry activities. One farmer continues to raise a couple of pigs on the edge of his fish pond even though the pond has been abandoned for many years. The 2 projects with animals and fish use beef or dairy cattle, permitting the manure from corrals to flow into the ponds. Reasons for abandoning animal husbandry were unprofitable (5 respondents), not enough labor (3 respondents), and one response each for fish tasted bad, group problems, husband died, lost interest, stopped growing fish, and theft. Integrating fish ponds with animals has not been a successful strategy to increase fish yields in Guatemala.

Some of the 25 families still growing fish use their fish ponds to water livestock and irrigate vegetable gardens. Five farmers use their fish ponds to water cattle during the dry season. Ten of 12 families growing vegetables depend on water from their fish ponds to irrigate their gardens during the dry season. The need for water during the dry season for irrigation and stock watering was a strong motive to retain an active fish pond, even if poorly utilized. Eight of 20 farmers with poorly utilized fish ponds and 3 of 5 projects with well-utilized ponds had irrigated gardens. Most farmers had their irrigated gardens on land which received water by government controlled irrigation canals. Water was rationed during the dry season and farmers had permission to receive water once every two to three weeks. Thus, fish ponds were filled to capacity when water was available and water was dispensed as needed over the period when irrigation canal water was unavailable. Without the fish pond, vegetable production would be impossible or restricted during the dry season. Obviously, fish ponds had more importance for storing water than producing fish, and many ponds probably would have been abandoned if not for their association with irrigated vegetable production and livestock watering.

Fish Feeding, Harvest and Consumption

Feeding fish is a common practice in Guatemala. Of the 25 projects still growing fish, 14 feed fish with kitchen and table scraps, 12 feed with grains and other by-products produced on the farm, 8 feed with fresh vegetation, and 8 purchase commercially produced feed. Purchased feed consisted mostly of diets for chickens. Six farmers purchase chemical fertilizers and 12 farmers obtain manures from sources other than animals located next to fish ponds to enrich pond waters.

A lack of fertilizers to enrich pond water and/or a lack of fish feeds to increase yields normally results in poor fish harvests. Eighty-eight percent of the owners of the 25 projects still utilizing their ponds fed their fish, 24% also used purchased chemical fertilizers and 48% also used manures from sources other than animals located next to the fish ponds to improve fish yields. Thus, addition of nutrients to fish ponds to improve fish yields is practiced in Guatemala. However, without harvest data the quality and quantity of fish harvests can not be confirmed. Based on a rapid evaluation and visits with family members, fish yields appear low. Thus, the quantity of feeds and fertilizers added to ponds is probably low. Roughly half the farmers interviewed fed fish kitchen and table scraps and/or grains and agricultural by-products produced on the farm. Impoverished families usually lack a consistent supply of large amounts of household scraps and grains to feed fish the daily quantity needed for fast growth.

Fish ponds are harvested partially with nets or by hook and line without draining the pond, or are totally harvested by draining the pond and removing all the fish. Owners of 11 of 25 projects growing fish harvest fish partially and rarely drain their ponds. Owners of the 14 remaining projects use both partial harvest combined with pond draining once or twice a year to capture fish. No participants use pond draining exclusively to harvest fish. Participants in 14 of 25 projects growing fish harvest fish as needed, 5 harvest fish twice a year, 4 harvest fish once a year and 2 harvest fish less than once a year.

Participants were asked to indicate their method of capturing fish. Twenty-one responded that they use a castnet and 4 use a seine net. Three respondents also use a baited hook and line together with a net to harvest fish.

Fourteen of 25 pond owners still growing fish responded "yes" when asked if fish theft was a problem. Farmers also demonstrated that theft was a problem by placing barbed-wire or sharp stakes under the water surface to discourage thieves from stealing fish with castnets. Many fish ponds were not easily observed from the house, which makes theft more difficult to control, especially in households where no active young man is in residence. Moreover, unlike Panamá, castnets are a familiar fishing implement in rural Guatemala and make stealing fish by an individual easy. Although hook and line can be used to steal fish, large amounts of fish are difficult to remove from a pond in a few minutes, as is possible with a castnet. Fish theft was considered a strong deterrent to efficient utilization of fish ponds.

Ninety-six percent of the pond owners still raising fish consumed some or all of their fish at home, 48% sold some of their fish harvest to neighbors, and only one farmer said he sold his entire fish harvest.

Socio-economic Component

Introduction

Guatemala has, in 1998, an estimated population of 11,278,000 people, 62% of whom live in rural areas. Although per capita income is US$ 480, the distribution is decisively skewed (Goodwin 1998; Comision Centroamericana de Ambiente y Desarrollo 1998). The Catholic Church in Guatemala has pointed out that up to 80% of the population may be living beneath the poverty line. Mismanagement of the economy, the "internal" war and unequal land distribution help to account for the economic situation. With the election of a civilian to the presidency in 1986 and again in 1990, there was some economic recovery which has continued under subsequent regimes. For example, by the end of 1991, runaway inflation had been reduced to 10% and GDP grew by 3.5%, but 87% of the population were still living in poverty (Dosal 1995). The Peace Accords of 1996 and continuing efforts to cope with racial discrimination, to reduce injustice and to increase economic welfare have not yet realized their promise. There is, moreover, no assurance that the current emphasis on exports, neoliberalism and privatization of what had been government services will benefit the rural poor in the short- or the median-run. Unequal distribution of wealth and of land and racial or ethnic cleavages still prevail.

In view of all this, it came as a surprise that the sample of project participants the evaluation team visited seem, on average, to be doing more or less well. True, most of them are poor by conventional standards, but they were hardly the poorest of the poor by Guatemalan standards. On the one hand, the curtailment of extension services, which must have been impeded by the constant threat of civil war and then crime on the roads, may have had a negative impact on the project. On the other hand, for several reasons, at least some project participants in 1998 may no longer have the same pressing, not to say desperate, need for extra food supplies that they had in the 1980s.

Respondent Profile

In Guatemala, the project worked with poor,individual householders who owned (with or without formal title) their own land. In 1998, the median age of heads of household is 48.5 years, several years younger than the Panamanian sample. The Guatemalan sample is less literate than the Panamanian one. However, 71.7% of the Guatemala sample are literate, and this is considerably higher than the national adult literacy rate of 55% (Goodwin 1998). Three factors probably account for the high rate of literacy in the sample. (i) Most of the respondents (87.0%) are Ladinos, who usually have more education than Mayas; (ii) many of the respondents live close enough to town to get an education; and (iii) as a group they are economically better off than most Guatemalans. Median and mean household size

Guatemalan family enjoying a meal of fish harvested from their pond, 1989. Facing page, fish pond located next to a cattle corral in Guatemala, 1989. Cattle manure fertilizes pond water.

Table 2. Socio-Demographic Profile of Heads of Household, Guatemala 1998.

Age: males	Average age	50.6 years
	Median age	48.5 years
Literacy:	Males	71.7%
Ethnicity:	Ladino	87.0%
	Maya	13.0%
Language:	Spanish	89.1%
	Spanish and Chorti	10.9%
Persons/household:		
	Average	5.7
	Median	5.0

Table 3. Years of Formal Education Completed by Head of Household, Guatemala 1998

	Number	Percent
No formal education	13	28.3
1-3 grade	18	39.1
4-6 grade	12	26.1
7th grade and over	3	4.5
Total	46	100.0

Table 4. Annual Household Income, Guatemala 1998

Amount in US dollars	Number	Percent
0-465	1	2.2
466-837	7	15.2
838-1,116	7	15.2
1,117-1,674	4	8.7
1,675-2,232	8	17.4
2,233-2,791	7	15.2
2,792-3,721	2	4.3
3,722-5,581	6	13.0
above 5,581	3	6.5
Not determined	1	2.2
Total	46	99.9

Table 5. Land and Cattle Ownership, Guatemala 1998

Land ownership:	Average	14.4 hectares
	Median	2.1 hectares
	Mode	2.1 hectares
	Range	0.4 -186 hectares
Land tenure:	Private title	35 (76.1)
	Private, no title	7 (15.2)
	Municipal commons	3 (6.5)
	NA/ND	1 (2.2)
Cattle ownership:[a]		
	Average	5.5 head
	Median	12.1 head
	Mode	3.0 head
	Range	1-51 head

ND/NA = not determined/not applicable.

[a] Twenty respondents (43.5% of the total) reported owning cattle.

are 5.0 and 5.7 persons, respectively, typical for Guatemala but larger than in Panamá. (Tables 2 and 3).

Because it is almost always difficult to get reliable responses on income in Guatemala, the survey asked about the range into which annual household income fell (Table 4).The respondents seem better off than most rural Guatemalans. For example, US$ 3.10 per day is a distinctly high wage for a rural worker. If the worker were on salary, s/he would be entitled to the equivalent of 14 months of salary, or US$ 1,042 per year, and 67.4% of the sample population had annual household incomes of over US$ 1,116. In 1987, some 71% of all rural dwellers in Guatemala lived in poverty (Latin American Regional Reports 1987). In short, our sample is doing well, particularly given their education level (Table 3).

In other words, the description of project participants found in various early reports (Castillo et al.1992; Hatch et al. 1995; Popma et al. 1995) does not match what is reflected in Table 4. There are two possible explanations for the discrepancy. (i) The sample may not be representative of the participant population, and this may be an artifact of not having visited Alta Verapaz, for the Q'eqchi' there are quite poor. (ii) Or, project participants are better off now than they were in the 1980s, and, in fact, the extensionists who accompanied the evaluation team said they noticed improvements in living standards for 25 (54.3%) of respondents in the sample.

Another indication of the socio-economic status of the sample is land ownership. The average land holding was 14.4 hectares, with a median and a mode of 2.1 hectares (Table 5). In 1979, 41.1% of all farms in the country were 0.7 hectares or less, and the situation has deteriorated since then, owing to a prolonged recession, civil war and demographic growth. Earlier reports said the target population usually had less than 2 hectares of land and that the average holding was 0.9 hectares (see the Introduction). These figures are only roughly consistent with what the current survey found. Once again, the explanation may be poor sampling, increased wealth among project participants, or, earlier reports may have been dealing with maize plots, whereas the current survey included all forms of land holding, including backyard gardens. Even so, the current sample, as Table 5 demonstrates, included some large landowners who simply do not fit the early descriptions of participants.

The Guatemalan and Panamanian samples are sim-

Table 6. Occupation and Sources of Household Income, Guatemala 1998

	Primary occupation	Sources of household income	
		Primary	Secondary
	N = 46	N = 46	N = 46
Farming	73.9	67.4	34.8
Farm labor	4.3	8.7	10.9
Ranching	4.3	–	2.2
Remittances	–	4.3	6.5
Civil service	–	4.3	2.2
Commerce	6.6	6.5	10.9
Other	6.6	8.7	17.4
None	–	–	15.2
ND	4.3	–	–
Total	100.0	99.9	100.1

Figures given in percentages; errors due to rounding.

Table 7. Recalled Reasons for Initially Entering a Project Group, Guatemala 1998

Reason[a]	Responses
To obtain more food	25
To improve children's diet	16
Enjoy collaborating with others	–
Saw that the project worked well	1
Invited to join by companions	–
To earn more money	10

Errors due to rounding.
[a]Respondents were asked to give the major reason, but apparently some gave more than one.

Table 8. Division of Labor, Guatemala 1998.

Labor task	Person(s) responsible for task					
	Head of house	Head of house and sons	Hired labor	Head of house, wife and sons	Women of house	Total responses
Feeding fish	11	8	2	14	9	44
Harvesting pond	11	9	2	15	6	43
Caring for livestock	7	3	4	14	4	32
Cleaning ponds	11	7	4	15	5	42
Restocking ponds	9	7	2	13	3	34
Selling fish	3	7	1	14	6	31

Table 9. What Would Be The Most Important Way to Improve Profit From Ponds or Increase Pond Production, Guatemala 1998.

Most important way	Number	Percent
More technical assistance	13	28.3
More time to manage ponds	12	26.1
Better source of fingerlings	9	19.6
Better source of water for ponds	6	13.0
Fewer problems with theft	4	8.7
Better price for fish	1	2.2
Other	1	2.2
Total	46	100.1

Error due to rounding.
Respondents were asked to reply even if they had abandoned their pond(s).

ilar in that about the same numbers are primarily farmers by occupation. However, whereas 67.4% of the former list farming as their primary source of income, only 53.0% of the latter do (Tables 6 and 14). In neither country do many respondents recall entering the project to earn more income, but instead most recall they wanted to increase food supply (Tables 7 and 15).

Women seem to play a much larger role in pond management in Guatemala than in Panamá (Tables 8 and 17). Women played a significant role in pond management in about 50% of households in Guatemala. Gender difference between Panamá and Guatemala is difficult to account for. However, women may play larger roles in small, family-sized ponds than in the more complex, multiple pond system used in Panamá.

When asked how pond production and profit from ponds might be improved, relatively few (13, or 28.3%) of the Guatemalan respondents chose "more technical assistance." Almost as many (12, or 26.1%) chose "more time to manage ponds." Others made what might be termed technical choices, such as source for fry, water for ponds and so on (Table 9). Few chose "reducing theft" when responding to the survey, but it is clear from conversations with local people, from their familiarity with cast-nets, and, perhaps most of all, from the methods they use to combat theft (see technical section above), that theft is a problem.

Reasons why Guatemalan farmers have abandoned, under-utilize or manage their ponds well can be gleaned from Tables 10 and 11. To the degree that the sample is roughly representative of the situation, 39.1% of the ponds have been abandoned, another 47.8% are under-used, and only 13.0% are well-managed. There are few significant differences among the three sets of householders (abandoned, under-used, well-managed). They are roughly of the same age, have about the same number of persons in the household, the same median income and so on (Table 10). However, there is a significant difference among the three sets with reference to adaptive strategies. A higher percentage (44.5%) of those who under-use their ponds and a higher percentage (33.3%) of those with well-tended ponds have gardens than do those who abandoned their ponds (16.7%). About the same picture emerges when gardens and coffee plots are taken together, and also when cattle ownership is considered (Table 11). Generally, project participants tend to use their ponds as a source of water for gardens or animals.Thus, although farmers may be under-using their ponds from the perspective of an aquaculture specialist, they may be usefully deploying

Table 10. Socio-Economic Comparisons Among Those Households That Have Abandoned, Underuse, and Well Manage Their Ponds, Guatemala 1998

Dimensions	Abandoned	Underused	Well Managed	Total Comparison
Number[a]	18 (39.1)	22 (47.8)	6 (13.0)	46 (99.9)
Median age of head of household	44	50	45	–
Median number of persons/household	5	5	5.5	–
Median amount of land "owned" in hectares	2.1	3.0	3.9	–

Error due to rounding.
[a] numbers in parentheses are percentages

Table 11. Possession of Gardens and Cattle Among Those Households That Have Abandoned, Underuse, and Well Manage Their Ponds, Guatemala, 1998

	Abandoned	Underused	Well Managed
Number of projects	18	22	6
Projects with gardens	3 (16.7)*	10 (45.5)	2 (33.3)
Projects with gardens and/or coffee	4 (22.2)	13 (59.1)	2 (33.3)
Projects with cattle	6 (33.3)	11 (50.0)	3 (50.0)

*Percentages in parentheses.

them from their perspective. From the perspective of the farmer, it makes sense to use and maintain the ponds primarily as sources of water for gardens and animals, and only secondarily use them for fish farming.

The identity of extension workers also may play a role in the success or failure of fish ponds. Poor farmers often view extensionists as potential patrons. After all, the agent is usually wealthier and better connected than the farmers, one indication of the agent's useful connections being that s/he works directly with foreign consultants. Extensionists may not be well paid in Guatemala, but they are far better off than ordinary farmers. Peace Corps volunteers, despite living more or less at the level of whatever group they accompany, also tend to be seen as potential patrons. From what observers in Baja and Alta Verapaz say (Field notes 1998), in addition to being potential patrons, the Peace Corps volunteers impressed the farmers with their willingness to travel to remote areas to promote the ponds. In response, farmers may have adopted the ponds not only for the direct benefits the ponds would bring them but also as a way to establish positive reciprocal relations with volunteers whom they thought might be useful and humane patrons. However, when the perceived patron, for whatever reason, withdraws from the scene, a certain amount of interest in the ponds may be lost, unless they prove too profitable to neglect under any condition. In addition, even self-reliant, technically proficient fish-farmers may need reassurance or occasional technical advice from an extension agent. When extension services are cut back too much, this may lead a project participant to abandon or under-utilize the ponds.

Abandonment by itself need not be read as project failure. In several cases, the participants were older people, some of them in poor health, whose children lived in urban areas. Their need for the ponds was less in 1998 than it had been in the 1980s, and they had less labor at home to manage the ponds. In one notable instance, adult children hold down well-paying secure jobs in urban areas and remit money to their aged parents, further reducing the parents' need for the ponds. Abandoning the ponds seemed, in a few cases, to indicate the household had increased its economic status enough to forego the benefits of small-scale fish farming.

Panamá

Technical Component

Project status

Six of the 21 projects evaluated (29 %) were considered abandoned. Four projects had members which listed lack of water to fill ponds in the dry season as a reason for abandonment. Members in 3 projects also listed group problems, in 2 projects they listed land ownership disputes, and in 1 project leaking ponds were given as additional reasons for abandoning ponds. The remaining 15 projects (71 %) still grew fish or rice in at least one pond. Four projects had abandoned fish culture and only planted paddy rice in some of their fish ponds. Eleven projects still had fish stocked in at least one pond. Thus, 52% of the 21 projects installed by 1984 still raised fish in at least 1 pond. Of the 11 projects still growing fish, 9 also had at least one pond planted with paddy rice. Only 2 projects still in use had not added rice as a component of their integrated project.

When constructed, projects consisted of a large fattening pond and 1, 2 or 3 smaller ponds for spawning tilapia and nursing tilapia and carp fingerlings. Five projects had 4 ponds, eleven projects 3 ponds and five projects 2 ponds (Lovshin et al. 1986). Only 3 projects, one controlled by a church school, stocked fish in all their ponds. The remaining 8 projects still growing fish stocked fish in only one pond, usually the fattening

pond. The remaining ponds were abandoned or planted in rice. Reasons for abandonment or poor utilization of the fish ponds are varied and include group failure, lack of consistent technical assistance and land disputes (see the socio-economic section below), poor site selection resulting in pond seepage and failure of the water source during the dry season, and poor fish harvests.

As in Guatemala, one of the criteria for project site selection was a permanent water source that could be diverted to fill ponds by gravity flow. Extension specialists selecting pond sites depended on community members to assure that a water source was permanent. Lack of water to fill ponds in the dry season and construction of ponds on soils with poor water-holding capacity were serious constraints to proper pond utilization. Upon project completion in 1984, 2 projects were known to have water problems during the dry season and another project had a problem with water seepage from ponds. One of the 2 projects with water supply problems was able to overcome the problem by finding an alternative water supply. At the time of this evaluation 14 years later, 9 additional projects listed lack of water during the dry season as a reason for abandonment or for not stocking fish in some ponds. One additional project also listed seepage as a reason for not stocking fish in some ponds. Yet, all but one project had enough water for year-round operation in 1983, an El Niño year of exceptionally low rainfall (Lovshin et al. 1986). The increase in water supply problems may be due to climatic change, deforestation and water withdrawal for domestic and/or agriculture use higher in the watershed. Water shortages due to the above reasons are unpredictable. Moreover, 4 diversion dams built with a bulldozer across small streams to increase water levels and divert stream water to ponds by gravity were washed out during heavy rainfall. The diversion dams were well constructed and were thought to have adequate spillways. The chance of diversion dams washing out on streams that receive heavy runoff should be considered when selecting a site to build ponds in areas of heavy rainfall. None of the dams were rebuilt due to lack of funds or interest by project members.

Culture Fish and Fingerling source

Farmers prefer to stock tilapia in their ponds. Of the 11 projects still raising fish, 4 stocked mixed-sex tilapia and 7 stocked male tilapia, 8 stocked common, bighead and/or silver carp, and 7 stocked guapote tigre. Unlike Guatemala, project developers in Panamá felt that project members would need a tilapia greater than 200 g at harvest to maintain their interest in the project. All 21 projects were designed to grow 200 g tilapia, either by visually separating males from females and only growing the males, or by polyculturing mixed-sex tilapia with guapote tigre. Presently, 2 projects grow only mixed–sex tilapia, which normally assures that harvests will consist of mostly small tilapia. Before the project ended in 1984, one community growing mixed-sex tilapia, perhaps the poorest and most isolated of all the project communities, had demonstrated a preference for growing male and female tilapia together without a predator. While small fish are harvested, raising mixed-sex tilapia normally assures that fingerlings are available for restocking, and the technology required to produce the fingerlings and to grow them to a larger size is undemanding. Seven projects are stocking guapote to control tilapia reproduction. Two of the 7 projects were stocking mixed-sex tilapia and guapote in 1984 and continue with the same culture strategy today. The remaining 5 projects stocked only male tilapia in their fattening ponds but have included guapote at some time since 1984. Fattening ponds are rarely stocked only with male tilapia. Some females may gain entrance to the pond, usually due to mistaking females for males during visual selection. The females will reproduce and if the pond is not harvested in a timely fashion, tilapia will overpopulate the pond and cause fish to stunt. Commonly, fattening ponds stocked with male tilapia are not managed properly. Tilapia harvest is delayed or ponds are not drained completely, perhaps because of seasonal water supply restrictions, and tilapia offspring multiply and slow fish growth.

Two-pond module with fish and ducks in La Rena, Panamá in 1984. Facing page, two-pond module in La Arena, Panamá in 1998. Fish are no longer grown and the larger pond (background) is used for flooded rice culture.

Guapote have been added to the male tilapia fattening ponds to control tilapia offspring and eliminate the need to harvest and to drain fattening ponds on a rigid time table. However, using guapote usually means that no small tilapia are available in the fattening pond for restocking. Only 2 projects continue to grow male tilapia without guapote in their fattening ponds.

A principal objective of the project was to teach project members to produce their own mixed-sex tilapia fingerlings or male fingerlings by visual separation of males and females (Lovshin et al. 1986). Although projects were provided with additional ponds for spawning and nursing tilapia and project members were trained to produce male tilapia fingerlings, only 1 project produced all their small tilapia on-farm and 1 project obtained small tilapia both on-farm and from the government. The remaining 9 projects obtain their tilapia fingerlings from a government hatchery. All the projects stocking the carps must obtain fingerlings from the government hatchery. The Panamanian government has been able to continue to produce and to supply fish fingerlings to rural fish ponds since 1984. Unfortunately, fingerlings are not always available when requested and delivery is further delayed by unreliable transportation. Nonetheless, the government has been a reliable enough supplier of fingerlings so that most projects still prefer to obtain fingerlings from them rather than produce their own fingerlings. Government continues to donate rather than to sell the fingerlings in most cases, and this invites continued dependence on the government and deters the development of private sector hatcheries. When asked why they did not produce their own male tilapia fingerlings, more than half the respondents said they thought that the method used to produce them was too difficult. As in Guatemala, project members like to stock carps in their fattening ponds because they reach a large size, even though the government is the only supplier of fingerlings.

Self-sufficiency in male tilapia fingerling production was not accomplished for several reasons, including continued government donation of fingerlings to fish pond project members, problems with water supply to and water seepage from spawning and nursery ponds, and a method to produce male tilapia fingerlings that was too difficult or laborious for many project members to learn.

Integration with Animals, Gardens and Trees

As in Guatemala, poor fish harvests from ponds managed by resource-limited farmers are commonly due to lack of fish feeds or fertilizers to enrich pond waters. Initially, projects were associated with animal husbandry to assure a source of manure to fertilize pond waters and increase fish yields. In 1984, 10 projects were associated with pigs, 3 projects with broiler chickens, 2 with ducks, 3 with cattle, and 3 with cattle and chicken manure (Lovshin et al. 1986) Presently, 9 of the 11 projects still raising fish are associated with animals. Eight projects have pigs, 5 projects have chickens, 1 has ducks, and 1 has goats. Four of the projects raise more than one animal. Cattle are no longer used to manure fish ponds. Of 6 projects that had cattle associated with fish ponds, at present 3 are abandoned, 2 plant only rice in some ponds, and 1 project grows rice and fish together in association with pigs and chickens. None of the 15 active projects reported feeding fish or using chemical fertilizers, and only 3 reported that they fertilized with manures obtained outside the project. Thus, the sole source of nutrients entering fish ponds is from animal manures, mostly from animals connected with the fish ponds.

The amount of manure entering ponds is related to the number and size of animals raised next to the ponds. However, only the Tolé project, administered by the Catholic Church, had an adequate number of animals and, thus, adequate manure entering its fish ponds. A second project had pigs that were well-cared for but had an inadequate number of them to provide sufficient manure for good fish production. Of the remaining 6 projects with pigs, 5 had no pigs in their sties at the time of the evaluation team's on-site visit, and one had an insufficient number of poorly nourished pigs that could not supply the fish pond with enough manure for good fish production.No records are available to confirm the amount of fish harvested from fish ponds since 1984. However, based on the experience of the aquaculturist

on the evaluation team, there is reason to believe that most ponds growing fish, even those associated with animals, are performing below production levels recorded in 1983 and 1984 (Lovshin et al. 1986).

A major obstacle to successful animal husbandry activities appears to be difficulty obtaining financial assistance to purchase young animals and feeds. Five of 9 projects raising animals were unable to do so without financial assistance from governmental or non-governmental organizations. These projects have not learned to save money from animal sales to finance the purchase of small animals and feeds. The projects have to wait until money is donated or loaned to them to raise animals. Four projects were apparently able to self-finance the purchase of animals and feeds. The Church-run project at Tolé uses meat from animals and fish to feed students at their school. The Church has enough money to finance animal husbandry activities, although the Church also may profit financially from animal sales. A second project also had saved enough money from previous sales to purchase piglets, small chickens and feeds. The group was under the influence of a local governmental official who helped the group administer their money. The government official recognized the value of the project site as a leisure area for the community and worked to assure that the project was well run and financially secure. The other 2 projects not requiring loans to raise animals probably struggled to feed their pigs. As noted above, 1 project not needing financial assistance had some poorly nourished pigs in an enclosure, although the team did notice that the pig sty had been enlarged since project termination in 1984. The fourth project reporting that no financial assistance was needed had no pigs in their sty. In this case, project members reported that the last harvest consisted of three pigs which had been raised on locally grown grains, tubers, fruits and vegetation. Three pigs is well under the number needed to properly fertilize their fish pond. Transportation of animals and feeds to the projects, and transportation of large animals to slaughter is not a serious problem for most projects because roads into most projects have improved since 1984. Feed companies will transport pig feeds into project sites if enough feed is purchased to make the trip profitable. Projects requiring lesser quantities of feeds can get drivers of public transport to pickup the feeds at a store in a nearby town and deliver the feeds to the project site. Pig processors will also pick up pigs for slaughter if the number warrants the trip. Pigs can be raised without depending on government transportation of animals and feeds, as was the case for most projects in 1984. The numbers of chickens, ducks and goats raised next to the fish ponds were small enough that local sale was possible.

Seven of the 15 projects still functioning in 1998 had vegetable gardens in 1984. Presently, only 2 of the 7 projects with gardens in 1984 continue to plant gardens. However, paddy rice has been an important addition to the 15 projects still in use and in many cases has surpassed fish as a benefit to project members. Thirteen of the 15 operational projects plant paddy rice in one or more fish ponds. The insertion of paddy rice into fish ponds was a planned effort by the government in the late 1980s to improve the productivity of the fish pond projects. Early efforts were directed at teaching project members to grow rice and fish together in the same pond. However, only 2 projects appear to be growing rice and fish together, and the remainder of the projects monoculture rice. Rice is an important staple in the Panamanian diet and is planted widely for home consumption, usually on non-irrigated lands. However, introduction of flooded rice on irrigated land has increased rice yields compared with yields from non-irrigated land. With minor reworking of the pond bottom, fish ponds are easily adapted to the culture of paddy rice.

Trees are planted on land surrounding fish ponds in 5 of the 15 projects still in use. The leucaena, eucalyptus and Caribbean pine trees are mature stands and provide project members with poles for house construction and fences, firewood for cooking and wood products that can be sold to neighboring communities.

Fish Harvest and Consumption

Most projects harvested fish once a year with a seine net during Easter week. Four of the 11 projects harvesting fish had their own seine net; the remaining projects borrowed a net from the government to harvest fish. Members of 6 projects drained their ponds after seining, while 5 purposely did not drain ponds to allow small tilapia to remain in the pond and grow to a larger size during the next culture cycle. Members of 10 projects still growing fish were asked 3 questions concerning their fish harvests. Thirteen of 22 respondents answered "yes" when asked if total weight of fish harvested was too small. Twenty of 24 persons questioned thought that fish harvests were too infrequent, and 12 of 21 persons thought that fish size was too small at harvest. Members from 13 of 15 functioning projects did not consider theft a serious constraint to culturing fish. Members of the 11 projects growing fish responded that fish were used for home consumption. Only 4 projects had enough fish at harvest to consider sales of fish to neighbors for additional income.

Socio-economic Component

Introduction

Panamá today has a population of 2,681,000 people, 45% of whom are rural. Although yearly per capita income at $US 2,850 is relatively high for Central America, distribution of income and wealth is markedly skewed. Perhaps as much as 40 percent of the population is often unable to meet basic household needs (Panamá y la Ninez 1998; Goodwin 1998).

Since 1989, Panamá has experienced economic recovery under neoliberal governments committed to a free market economy. Although governments have curtailed support for communial farms, they also have invested in infrastructure development such as road construction, as the evaluation team found at almost every site it visited. However, communities in which the modules are located generally have not shared in the economic recovery. Two important facts are apparent.

In general, there has been little population growth in the project communities, an artifact of youth emigrating to urban areas in search of improved life chances. For example, rural wages vary from about US$ 2.00 per day plus lunch to US$ 5.00 without lunch. In contrast, in the small city of Aguadulce, a worker in a shrimp processing factory can make US$ 18.40 on a ten-hour shift (Field notes, July 1998).

Rural poverty is as harsh as ever. To take one example, median annual income across project community households has not changed over the last 15 years. In 1983 median income across the communities was about US$ 1,500 and in 1998 it was US$ 1,480 (Table 12). In 1998 per capita income in Panamá as a whole was US$ 4,670 (Goodwin 1998), and in our sample it was US$ 253 (Table 12). Our 1998 sample was too small for definitive conclusions, but the figures are consistent with the impression left by site visits and reports from experienced aquaculture extensionists to the effect that the rural poor have not improved their life chances.

Respondent Profile

Heads of household in the sample population were more often middle-aged than young, with the median age for males being 55 years and 49.1 years for women (Table 12). Householders commonly report that for want of opportunities in the countryside, the youth move to the cities. Literacy for heads of household was 80.9%, lower than the national average (89%) but high for a Latin American rural population. However, since it takes about four years of formal education to retain the benefits of schooling, probably no more than 50% of the sample population can really read and write (Table 13; Williams 1965). Except for the small community of Pedregoso, most of the population is Catholic. The median number of persons per household is 4.0, probably an artifact of emigration of youth to cities. Annual self-reported household income, as noted, is low, with a mean of US$ 1,154 and a median of US$ 480, pretty much what it was in the early 1980s (Table 12). Housing is superior to what is found in rural areas elsewhere in Central American, owing in part to a variety of government programs. Although most heads of household give their primary occupation as farmer, no more than 53.0% give farming as their primary source of income (Table 14). In short, the sample population is middle-aged, generally undereducated, poor and often impoverished. In 1998 as in 1980, they need additional income and apparently additional sources of food, such as can be offered by an integrated garden-fish pond-animal project. Self-reported reasons for initially joining the project were to obtain more food for home or children (Table 15). Adding to income was not as important, a datum consistent with the poverty of the project participants in that the first

Table 12. Socio-Demographic Profile of Heads of Household, Panamá 1998

Age: Males	Average age 53.5 years Median age 55.0 years[a]
Literacy: Males	80.9%
Religion: Catholic Other	90.4% 9.6%
Persons/household	Average 4.6 Median 4.0
Annual household income	Average US/ 1,154 Median US/ 480 Range US/ 60 to 12,012 Per capita income US/ 253

[a] For wives of heads of household average and median age = 49.1 years

Table 13. Years of Formal Education Completed by Head of Household, Panamá, 1998

	Number	Percent
No formal education	11	10.5
1-3 grade	33	31.4
4-6 grade	58	55.2
10th and over	2	1.9
ND/NR	11	9.6
Total	115	100.0

ND/NR = not determined or no response.

Table 14. Occupation and Sources of Household Income, Panamá 1998

	Primary occupation	Sources of household income	
		Primary	Secondary
	N = 115	N = 115	N = 115
Farming	77.1	53.0	–
Farm/cane labor	–	7.8	34.8
Ranching	6.4	13.9	13.0
Remittances	–	5.2	13.9
Civil service	1.7	8.7	0.9
Other	14.8	11.3	16.5
None	–	–	20.9
Total	00.0	99.9	100.0

Figures given in percentages; errors due to rounding.

Project members with fish harvest in Mata Palo, Panamá in 1984. Facing page, project members in Pedregoso, Panamá in 1998. Members grow mixed-sex tilapia and flooded rice in their 2 ponds. Pigs are integrated with the fish ponds.

goal of poor farmers is usually securing their food supply (Kusterer 1989).

The most common reasons for leaving a project were (i) disagreement among project group members and (ii) that some project group members invested more labor than others in the ponds, but received the same dividends of fish or income (Table 16). Respondents' comments indicate that the tendency to distribute benefits equally among participants irrespective of labor input was a major problem. Although project group members tend not to blame elected project group officers for this, an observer may infer that cultural and managerial factors are in play here. Cultural in that despite a tradition of helping each other with farm chores, rural Panamanians also have strong traditions of individualism and a desire to avoid "envy", and managerial in that project group officers found it difficult to impose discipline on project group members. As several extensionists observed, the project did not invest enough in managerial training.

An attempt was made to determine if women help with the daily care of fish and livestock. To judge from responses to survey questions, in no more than 11.5% of households, do women participate (Table 17). Yet, women were observed to have a more active role than is reflected on the survey in some communities.

As for major decisions concerning ponds, 54.9% of respondents said that these were or are made by project group officers (Tables 18 and 19). Extension played less of a role than expected. In a sense, this may suggest that a degree of self-sufficiency was attained, but this does not necessarily imply excellent or proficient managerial performance.

A drop in number of beneficiaries served by the projects was found. To avoid guess work, the figures given here refer to 14 communities for which there were complete data in the 1980s. In 1981, when the project began, 353 heads of household enrolled in the project in these 14 communities, each head of household representing a family of about 6 persons at that time. Across the 14 communities, the average number of heads of household per project was 25.2, with a median of 24.0, and a range of 20 to 38. Average size of the fattening pond in the 14 communities was 2,830 m^2 so that each of the 25 heads of household had 1/25 or 113 m^2 of the fattening pond to grow fish for his family. By 1984, the total number of heads of household had dropped 31% and was 244, with an average of 17.4 heads of household per project, a median of 16.5 and a range of 8 to 37. In 1998, there were 113 heads of household in 9 projects because 5 had been abandoned, with an average of 8.1 heads of household per project group, a median of 6.0, and a range of 1 to 21. Average size of the fattening pond in the 9 projects was 3,009 m^2 and each head of household had 1/9 or 376 m^2 of the fattening pond from which to harvest fish. Thus, between 1984 and 1998, membership in the project groups in 14 communities had decreased 69%.

In the 9 on-going projects mentioned above, 2 have become the property of a single owner (La Miel and

Table 15. Recalled Reasons for Initially Entering a Project Group, Panamá

Reason[a]	Affirmative responses	Negative responses
To obtain more food	107	2
To improve children's diet	95	12
Enjoy collaborating with others	84	14
Saw that the project worked well	83	12
Invited to join by companions	69	31
To earn more money	56	40

[a] Respondents could give more than one answer. A total of 114 respondents gave answers to this question.

Table 16. Reasons Given for Leaving the Project, Panamá 1998

Reason selected for leaving project [a]	Number
Disagreement among members of project group	41
Some project group members work more than others	33
Disagreement with project group officers	25
Unequal distribution of benefits	23
The powerful try to dominate others	22
Insufficient benefits	17
Had other work to do	14
Work was too hard	2

[a] Respondents could give more than one answer. Seventy-seven (67.0%) respondents out of the total sample gave answers to this question.

Bayano), and 5 (Las Peñitas, Mata Palo, Chumical, Montañito de Boro and San José) are more or less owned and operated by several related families. In La Arena, 3 unrelated men manage the project. Pedregoso continues to be managed by numerous unrelated heads of household. Observations about project group size and ownership by related families also appear to apply to the remaining projects (Majarilla, Pitaloza, El Barrero, Pino del Cobre and Mogollón), although we lack precise data for the 1980s. In Pino del Cobre and Mogollón, the project is now owned by a single individual.

Community Profiles

In the 1980s, survey data and enthnographic field studies(Lovshin et al. 1986) indicated that several factors in combination seemed to account for the variation in project group technical performance. To repeat what has been said before, project group performance was improved when:

1. the community was not steeply stratified economically;

2. a project group was led by a socially esteemed leader with some vision but not one who was much richer or politically more powerful than ordinary project group members, and it helped if the members of the project group were linked by ties of kinship.

3. although local elites could mobilize people to assist a project group, this tended to encourage dependency, and was counter-productive for self-sufficiency. Commitment seemed greater when local people contributed labor to the project and were not dependent on a powerful local director.

In 1998 there was hardly time to rank order project group technical proficiency with the sort of confidence with which this was done in the 1980s. Aside from lack of time, fish and livestock production records were not available. However, the 1998 site visits offered some suggestive leads (Table 20). If the seven best project groups as of 1984 are examined, it turns out that two of them have abandoned their ponds, and the other five still maintain them. In the case of Las Peñitas this is due in large measure to the intervention of a local politician who, interestingly enough, is not a resident of the community. Conversely, if the seven worst project groups as of 1984 are examined, it turns out three have abandoned their ponds, one (La Arena) is functioning but its performance is rated as "poor", and two (La Miel and Bayano) are not used for fish production and each is owned by a single, wealthy individual (Table 20). Thus if the evaluation team had predicted what the situation would be like in 1998 on the basis of the 1984 rankings, they would have come close to what the site visits revealed in 1998.

This is not to suggest that 1998 simply replicates 1984. As remarked in several places, although the general socio-economic situation at the community level has changed little, there are differences. Road access is almost universally better, and there is more out-migration from communities. That communal farms are in decline is related to the changing policy environment in

Table 17. Who Manages or Managed the Fish Pond Project, Panamá, 1998

	Number	Percent
Male head of household	75	66.4
Male head of household and sons	20	17.7
Male head of household, sons and wife	13	11.5
Women of the household	2	.7
Other	3	2.7
Total	113	100.0

Table 19. Who Should or Can Best Resolve Pond-Related Problems, Panamá, 1998

	Number	Percent
Project group officers	46	40.4
Extension and project group members	26	22.8
Project group members	22	19.3
Local politician	8	7.0
Project group officers and members	7	6.1
Extension alone [a]	2	1.8
No response	3	2.6
Total	114	100.0

[a] 76 respondents (66.7%) said an extensionist had not visited the pond in 1998; 38 (33.3%) said an extensionist had visited in 1998.

Table 18. Who Makes or Made Decisions Concerning Fish Pond Tasks, Panamá, 1998

	Number	Percent
Project group officer	62	54.9
Extension, with or without project group members	29	25.7
Members by themselves	21	18.6
Other	1	0.9
Total	113	100.1

Error due to rounding.

Table 20. Rank Order of Project Group Managerial Proficiency in 1984 and Status of Project in 1998

Community, in rank order of project group proficiency in 1984	Status of project in 1998	Alternate and/or additional use of ponds in 1998	Ponds used with animals in 1998
1 Guayabito	abandoned	–	–
2 Las Peñitas	good	–	yes
3 Mata Palo	fair	–	yes
4 M. de Boro	fair	to grow rice	yes
5 Chumical	fair	to grow rice	yes
6 Pedregoso	fair	to grow rice	yes
7 Remedios	abandoned	–	–
8 San José	fair	–	yes
9 La Miel	not used for fish	to grow rice	–
10 Los Higos	abandoned	–	–
11 La Arena	poor	to grow rice	–
12 Espavacito	abandoned	–	–
13 Bayano	not used for fish	to grow rice	–
14 Las Trancas	abandoned	–	–

Note that with the additional information collected by extension personnel after the evaluation team left the field, the corresponding figures for "abandoned" are 39%, for "under- utilized" are 48 %, and for "well-utilized" are 13 %.

Panamá, rather than the internal social make-up of project groups on the collectives.

Nor is the suggestion that social factors alone can account for continuation or abandonment of modules. In some places, strictly technical problems with water loss from ponds (as in Pitaloza) or water source problems (as in Guayabito or Las Trancas) may discourage and even overwhelm project groups (see section on technology). Similarly, problems with bank loans may defeat a project group, or financial returns from the modules may be such that project group members see no point in continuing with the project. Even the best organized and best managed project group will have to abandon the modules if the land donor rescinds his/her donation to the project group, as occurred in Guayabito, La Miel and Mogollón.

Moreover, in some cases, the emigrating youth may leave behind older people who find it difficult to manage the ponds, as seems to be a factor in Remedios. Or, better job opportunities may emerge and take away time and labor from the project. For example, a number of men from San José apparently work in the expanding construction industry in Santiago de Veraguas. For them, the opportunity costs of contributing labor to the project group may be too high.

In other words, community and project group social systems qualify the impact of technical, financial, national policy and similar factors. Taken one by one, technical, financial and policy factors usually do not have enough weight so that simply by themselves they can make or break a project group. A project group that meets the conditions mentioned above, particularly if it is well-managed, can withstand a good deal of pressure. Guayabito is a case in point. Despite problems with its water source and difficulty getting bank loans, its project group functioned well, until the land donor rescinded his land donation. When the land was rescinded, the modules were abandoned, but not until then.

At other times the socio-cultural system of project planners and consultants may be problematic. For example, one of the major problems the project groups face or faced has to do with unequal contributions of labor to the project combined with equal shares of dividends from it. Unequal contributions of labor to a project is in part, a cultural matter but also a managerial problem.Yet, more time and effort went into pond construction than into project group managerial training. Similarly, more time was invested up-front identifying sites that met the technical criteria for pond construction than went into identifying communities whose internal social systems were compatible with rural production cooperatives, although this was necessarily so given the time constraints placed on the project.

CONCLUSIONS

Guatemala

Fish culture did not have the impact on family nutrition and financial well-being envisioned when the project was planned. The final report in 1992 (Castillo et al.) to USAID and the Guatemalan agencies participating in the project did not reflect this circumstance. However, nine years after the project was terminated, most fish ponds evaluated were abandoned or under-utilized. Whatever the reasons for abandonment or under-utilization, in most cases fish ponds are not well-cared for, and this suggests that fish do not or may not play an important role in family nutrition or financial well being. Incentives to properly manage the fish ponds are not present.

Integrating animals with fish ponds to improve fish yields failed. For reasons not fully understood but likely related to unprofitability or cost of inputs, broiler and layer chickens associated with fish ponds were abandoned. Cattle and milk cows are the only animals that continued to be associated with fish ponds. Owners who do use cattle and milk cows in association with fish ponds are financially secure, have large herds and feed

their animals on pasture grass. Without a consistent source of manures to fertilize fish ponds, producers resort to kitchen and table scraps, and on-farm by-products to feed fish. Most families with fish ponds are resource-poor and do not have enough feed to provide the fish with a nutritious diet, and this results in slow fish growth and low yields. Even farmers with the financial means to purchase feed for their fish are reluctant to purchase sufficient quantities to adequately feed their fish. Fish simply do not provide the nutritional or financial return to justify the expense of purchased feeds. In the absence of a predator, lack of tilapia fingerlings did not seem to be a major constraint to growing fish. The culture of mixed-sex tilapia without a predator permitted producers to obtain small tilapia from their fattening ponds at fish harvest.

The most beneficial aspect of the fish ponds appear to be their ability to store water during the dry season to irrigate vegetables and water livestock. Many of the ponds used to store water are not well utilized for growing fish but do play an important role in the nutritional and financial well-being of their owners in other ways. Without the fish pond, farmers would be unable to plant a garden or raise livestock during the dry season. What an observer may designate as "under-utilized" may be quite profitably utilized from the perspective of the pond owner.

Abandoning or under-utilizing a small-scale family pond may be an artifact of changes in the domestic cycle. As children become adults and move away from home, particularly if they find relatively well-paying jobs in urban areas and remit funds home, project participants simply have less need for the ponds. In this context, it is useful to recall that most participants entered the project to secure more food. As households become smaller they have less need for additional food, especially in cases where adult children help to support parents and/or in cases where the older person is not as healthy or as strong as she/he was when the project began. The ponds, having done their job, now become part of the past.

Extension agents provide not only technical support but also may be or may become useful economic or political connections for limited-resource farmers, and lack of extension continuity and constancy may dampen commitment to the ponds. Simply being able to touch base, so to speak, with an extension agent may maintain interest in the ponds.The employment of local farmers to act as extension agents may have been beneficial when the project was active. However, the government's failure to continue to pay local extension agents after the project terminated and the exit of Peace Corp volunteers left farmers without technical assistance except for government workers located at fish hatcheries.

Panamá

As in Guatemala, most fish ponds were abandoned or poorly utilized for growing fish. Fish culture did not have the anticipated economic and nutritional impact on participant families. Levels of fish, animal and vegetable production recorded in 1984 (Lovshin et al. 1986) were apparently not sustained. Whatever the reasons for pond abandonment or poor utilization, in most cases fish ponds are not well cared for, and this suggests that fish do not or may not play an important role in family nutrition or financial well being. Incentives to properly manage the fish ponds are not present.

Tilapia continue to be the principal culture fish, although carps are appreciated by some project members. Few project groups were able to learn or were sufficiently motivated to produce their own tilapia fingerlings. A government hatchery was able to provide fingerlings for most projects still growing fish, though supply was often sporadic. Most project members preferred to purchase fingerlings or to receive them free from the government. Self-sufficiency in tilapia fingerling production was not accomplished, though this was a principal goal of the project.

Most projects still growing fish continue to raise animals close to their fish ponds. Although the number of animals raised is below recommended levels for good fish yield, animal manures are the only source of nutrients entering fish ponds. Project members do not provide fish with on-farm or purchased feeds. Although the concept of integrating animals with fish ponds has been retained, lack of cash and the difficulty obtaining loans from banks, government and non-governmental organizations hinders the ability of project members to raise animals in a manner that will effectively fertilize the fish pond to increase fish yields. Only in a few cases has animal husbandry developed into a self-sustaining activity.

As in Guatemala, fish ponds have been used in a manner unforeseen when the project was designed and implemented. Many ponds have been adapted to plant irrigated rice. The Panamanian government actively promoted the conversion of fish ponds into rice paddies. At first, fish were grown together with the rice. However, for unknown reasons, fish have slowly disappeared from the rice ponds, and farmers prefer to grow the rice alone. Still, the fish ponds are used to produce food and income for project families. In many cases, rice

Farmer irrigating vegetables with water taken from family fish pond in Guatemala, 1998. Facing page, three-pond module located in Mogollón, Panamá in 1998. Ponds are used to grow flooded rice. Pig sty (right) and storage shed (left) are abandoned.

has provided a greater benefit to project members than fish and has replaced fish as the primary project activity.

Land on which to plant trees is often difficult to obtain in areas where cattle ranching is the primary activity. Cattle will eat young trees, and mature trees compete with pasture grasses for nutrients and sunlight. Also, economic benefits to project members from trees take years to realize. However, in projects planted with trees benefits to project members from the trees are probably equal to or greater than any other activity. If participants are willing to wait until trees reach maturity, trees make a good addition to community projects as they provide participants with both environmental and economic benefits.

More time identifying communities whose social system was compatible with the demands of rural producers' cooperative prior to pond construction was needed. Since this is not the place for an extended discussion of donor agency policy, perhaps it will suffice to note that donor agencies operate with fixed, relatively short-term time scales, about three years in the case of Panamá. Moreover, donors require "specified objectives ... to be achieved by `carefully budgeted' and regularly scheduled activities and expenditures" (Dyson-Hudson 1985). This is entirely proper given the need for accountability and the organizational culture of donor agencies. This reasonable enough way of doing things, nonetheless, puts pressure on consultants and recipient agencies like DINAAC to concentrate efforts on the most readily monitored components of a project, such as formally organized groups, numbers of people trained, physical infra-structure and so on.

However understandable, it probably makes more sense to invest time up-front on social analysis. The cost of making socio-cultural studies secondary to technical ones can be high. As an analysis of ex post evaluations of World Bank and USAID projects indicated, the average economic rate of return for rural development projects which have incorporated sociocultural analysis was more than double that for projects which had been poorly appraised from a sociological viewpoint (Cernea 1991; Schwartz and Deruyttere 1996). Socio-cultural analyses are not easy, they are always site-specific, and they take time. But they should be carried out prior to building infrastructure rather than concurrently with that activity. No two communities in this or any other project were or are exactly alike. Prior understanding of the particularities of each community, though this takes time, might have made some problems more manageable.

Table 20 is itself a concluding statement. If a project group is located in a community characterized by equality of need (i.e., is not steeply stratified economically) and is led by a person who is first among equals so to say and is a good manager, then it can withstand all but the most overwhelming policy, technical and financial shocks. Although the data summarized on Table 20 are hardly conclusive, they do provide evidence for the conclusion.

Finally, most development projects must not be seen primarily as either social, cultural, technical, economic or political, but rather as a subtle interplay of all these factors. Putting this in writing may be banal, but it is unfortunately not commonplace in action.

General

The evidence suggests that the projects in Guatemala and Panamá have had some success, although it has been limited. There are two major reasons for this conclusion.

First, some of the individual projects in Guatemala and some of the group projects in Panamá have passed what Tendler et al. (1983) call the "acid" test. That is, they have survived a full nine and fourteen years, respectively after donor funding ended and despite uneven technical assistance from extension services. In Guatemala about 61% of the ponds in the sample are still utilized at some level of proficiency. In Panamá, excluding the special case of the Church-sponsored

project in Tolé, 71% of the projects still exist. Although performance levels are generally low, the sheer fact of endurance should not be slighted.

Second, from the perspective of the beneficiaries, the ponds are useful. To be sure, from the perspective of the donors, the projects in both Guatemala and Panamá have had limited success at best, and from the perspective of aquaculturalists the projects have not realized their intended goals. But the ponds were never intended to be used by donors or professional specialists in aquaculture. They were intended for the use of beneficiaries. Except for instances of complete abandonment, many ponds are used, though not as originally intended.

The record of the projects, then, is mixed and certainly needs to be improved. It can be improved, provided that donors and experts learn to cooperate with intended beneficiaries in project design, implementation and evaluation. In the case of this evaluation, the beneficiaries have taught the outside experts something about how local people learn to adapt fish ponds to their own uses. Given the record of many planned interventions, perhaps it is sufficient that the ponds are of use to beneficiaries and therefore endure. In this sense the beneficiaries have provided an important lesson for project planners.

LESSONS LEARNED

Generally, the team found that project failure was due a combination of linked causes, rather than to any single cause. Abandonment or poor performance results from a combination of technical, economic and social factors, each playing on and amplifying the other. This conclusion is reflected in the following recommendations about fish pond projects designed for limited-resource farmers.

(1) **Choice of fish species:** Where tilapia are cultured, mixed-sex tilapia is the method of choice even though harvested fish are usually less than 100 g. Where a larger tilapia is needed to satisfy consumers, culture of mixed-sex tilapia with a predator can be employed. However, the predator often consumes all the small fish, and none are left for restocking. On-farm production of male tilapia fingerlings by visual selection and their culture to 200 g or larger was not successful in Panama. Inexperienced tilapia producers do not easily grasp methods to produce male tilapia fingerlings. A great deal of extension effort is needed to train participants to produce male tilapia fingerlings and sustain the activity. If long-term technical assistance by government extension agents is not possible, then the best and perhaps the only alternative for sustained on-farm tilapia fingerling production is culturing mixed-sexed tilapia.

(2) **Pond site selection:** Ponds should be constructed on land owned by the family or project group. Perceptions that the land can be rescinded may dilute the incentive to invest time and effort in the project. Careful study is needed to assure that land has access to a permanent source of flowing water that can be directed to the ponds by gravity. Pond soils should have enough clay to hold pond water. Ponds that dried during the year were abandoned or poorly utilized for fish culture.

(3) **Project strategy:** In Guatemala and Panamá, fish culture was unable to maintain the nutritional and economic benefits to limited-resource farmers that was documented at project termination (Lovshin et al. 1986; Castillo et al. 1992). Based on this study, subsistence fish culture by limited-resource farmers with no experience growing fish is unlikely to have positive impacts on the standard of living of practitioners in Central America and quite possibly, the remainder of Latin America. Donor agencies promoting fish culture in Latin America should consider focusing on the needs of middle and high income farmers interested in commercial fish farming for domestic and export markets instead of subsistance fish culture.

Projects directed at limitied-resource farmers should concentrate on the harvesting of water for multi-task

use as selected by project participants. Perhaps the most unanticipated and most useful finding of this study is that project participants in both Guatemala and Panamá were using their ponds for multiple ends, with fish production taking second place to the use of ponds to grow rice or as a source of water for gardens and/or livestock. Ethnographic studies should be carried out during project planning, to assure that the project meets the felt needs of potential beneficiaries and is compatible with their survival strategies, including their total farming system, their definitions of gender roles in farm operations, and their priorities.

(4) **Group size and composition:** In the case of cooperatively or group managed fish pond projects, some care must be taken to balance group size against potential dividends from the project. Extension agents need to work closely and carefully with local farmers to assure that the size of the group is manageable and that benefits meet expectations to warrant a commitment from members to sustain the project. Lovshin et al. (1986) suggested that at least 350 m^2 of fattening pond per family was needed to provided a family of 5 with one meal of fish a week in Panamá.

(5) **Policy environment:** Unless a government or at least one of its line ministries is committed to providing technical and financial support to fish farmers for at least 10 years, promoting fish farming among resource-limited farmers should be avoided. Neither Panama nor Guatemala were able to sustain effective technical assistance because of unstable political environments and changes in philosophies concerning economic development. Participant self-sufficiency and ability to sustain the projects was a goal in Guatemala and Panama. However, self-sufficiency does not mean that project participants should have no contact at all with extension services or will not need small bank loans for an extended period of time. Reliable, effective technical assistance does not mean constant handholding. It does mean that when needed, extension services will prove reliable, effective and impartial.

(7) **Integrated socio-technical models:** We need better models of how technical, economic and social variables are mutually related, or at least, we need to pay more attention to existing models when designing fish farming projects. Aquaculture is a socially embedded activity and cannot be understood apart from the full context of social, economic, political and ecological circumstances within which fish production occurs (Peterson 1982). A corollary is that rather than the usual method of placing an agricultural economist, a biologist or an anthropologist in charge of a project, the role of each specialist should be clearly defined before a project begins and equal weight should be given to the contribution of each. Of course, some person has to be the project leader, but there must be some clear commitment that the role of each specialist will be given equal weight in the design, implementation and evaluation of the project. What the team would add to this oft-repeated recommendation is that local people be included on the team. They are the experts when it comes to identifying the particularities of their own needs, priorities and local environments.

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