56586

Agriculture and Rural Development Discussion Paper 44

The World Bank

Gender Analysis of Aquaculture Value Chain in Northeast Vietnam and Nigeria

Atdhe Veliu
Nebiyeluel Gessese
Catherine Ragasa
Christine Okali

The World Bank

Agriculture and Rural Development
Discussion Paper 44

Gender Analysis of Aquaculture Value Chain in Northeast Vietnam and Nigeria

Atdhe Veliu
Nebiyeluel Gessese
Catherine Ragasa
Christine Okali

1818 H Street, NW
Washington, DC 20433
Telephone 202-473-1000
Internet www.worldbank.org/rural
E-mail ard@worldbank.org

Cover photo: Atdhe Veliu - woman farmer transporting inputs to a family shrimp farm, Quang Ninh Province, Vietnam.

Table of Contents

Annexes

List of Tables

List of Figures

List of Boxes

Acronyms and Abbreviations

ADA	Agricultural Development Agency (Nigeria)
AIFP	Aquaculture and Inland Fisheries Project (Nigeria)
AGRIBANK	Vietnam Bank for Agriculture and Rural Development
ARAC	African Regional Aquaculture Center
ARD	Agriculture and Rural Development Department (Vietnam)
CBNRM	community-based natural resource management
CEDAW	Convention on the Elimination of all Forms of Discrimination against Women
COREMAP	Coral Reef Rehabilitation and Management Program
DANIDA	Danish International Development Agency
DFID	Department for International Development (UK)
ENV	Vietnam Electricity
FAO	Food and Agriculture Organization of the United Nations
FCR	feed conversation ratio
FDF	Federal Department of Fisheries (Vietnam)
FMWA	Federal Women's Affairs
GSO	General Statistics Office (Vietnam)
IVCA	integrated value chain analysis
LACAFA	Lagos State Catfish Farmers Association
LSADA	Lagos State Agricultural Development Authority
LSMAC	Lagos State Ministry of Agriculture and Cooperatives (Nigeria)
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MOFI	Ministry of Fisheries (Vietnam)
NAFEC	National Aquaculture and Fishery Extension Center (Vietnam)
NIOMR	Nigerian Institute for Oceanography and Marine Research
NSPFS	National Special Program for Food Security (Nigeria)
nei	not elsewhere included
PHCN	Power Holding Cooperation Nigeria
PL	postlarval shrimp
RCAS	Research Center for Aquatic Sciences (Vietnam)
RIA1	Research Institute for Aquaculture 1 (Vietnam)
SDF	State Departments of Fisheries (Nigeria)
SFLP	Sustainable Fisheries Livelihoods Programme
SOC	state-owned cooperative
VND	Vietnamese dong
WRS	water recirculation system
WTO	World Trade Organization
WUA	Women's United Association (Vietnam)

Acknowledgments

The report is an initiative of the Agriculture and Rural Development Department (ARD) of the World Bank, with funding from Japanese Trust Fund and Gender Action Plan. It is written by Atdhe Veliu, Nebiyeluel Gessese (Japan Development Institute), Catherine Ragasa (World Bank), and Christine Okali (international consultant). The task team leader is Eija Pehu (World Bank). Overall guidance was provided by Lucas Kolawole Akapa (World Bank, Abuja office); Douglas I. Graham (World Bank, Hanoi office); Kieran Kelleher (World Bank, ARD), and Yasuo Konishi (Japan Development Institute).

Several local consultants provided substantial help collecting data and information and writing the report: Ajani Bunmi, Mai Van Tai, Thu Cuc, and Luu Ngoc Hieu. Several country experts and facilitators helped link the team to relevant stakeholders in the country and provided inputs on the concept note and several drafts: Dao Giap (World Bank, Hanoi office), Vincent Amire (Federal Ministry of Agriculture and Water Resources, Abuja), Akintunde Atanda (National Program for Food Security, Abuja), Olayiwole Onasanya (Lagos State Fadama Development Office), Olajide Basorun (Lagos State Agricultural Development Authority), Idowu Onafowote (Commercial Agriculture Development Project, Lagos), Abimbola A. Adubi (World Bank, Abuja office), and Chukwudi H. Okafor (World Bank, Abuja office).

The team would like to thank the reviewers of the concept note and several drafts of the report: Lucas Kolawole Akapa, Vincent Amire, Akintunde Atanda, Grahame Dixie, Tran Thi Dung, Than Thi Hien, Kieran Kelleher, Ghulam Kibria, Oleg Martens, Tran Thi Minh Ngoc, and Meryl Williams.

Last but not least, the team is very grateful for the stakeholders in Vietnam and Nigeria who attended the stakeholder meetings and provided invaluable inputs, especially during the research design. Special thanks to the more than 300 people who agreed to be interviewed, who are the sources of the information compiled, integrated, and presented in this report.

Executive Summary

Aquaculture is the fastest-growing food sector in the world and is expected to contribute more than 50 percent of total fish consumption by 2020. Just over 90 percent of aquaculture production originates in Asia, and nearly 70 percent in China alone. Efforts to expand aquaculture production to meet the ever-increasing worldwide demand for seafood continue. Although the boom in international demand for shrimp has drawn attention to this sector, the development potential of aquaculture stems partly from the variety of products (such as catfish, tilapia, grouper, scallops or lobster culture, and seaweed), production systems, and scales of production it covers. In comparison with the dominance of large-scale coastal aquaculture systems in Latin America, North America, and Europe, the vast majority of aquaculture production in Asia is carried out in rural areas, is integrated into existing farming systems, takes places on a small scale, depends on the cooperation of family members, and involves large numbers of the rural population. In the case of shrimp production in Bangladesh, for example, as many as 1.2 million individuals are reported to be directly involved, with a further 4.8 million household members indirectly dependent on it for their livelihoods (Gammage et al. 2006). Aquaculture has yet to play a major role in any African economy. To date, there has been limited aquaculture activity in Africa, but studies suggest huge potential of aquaculture as a pathway toward economic growth, food security, environmental sustainability, and poverty reduction in that region.

Aquaculture is a promising business venture in many contexts, and the private sector drives and plays a major role in this. However, for aquaculture to fulfill its development objectives, the public sector also plays a key role by creating an enabling environment for private sector engagement, which requires a favorable business climate and regulations and institutions in place for markets to work. The public sector also has a role in facilitating and ensuring equity and environmental sustainability. Ensuring equity entails effective targeting for service provision and capacity development and requires laws and regulations to curtail different forms of discrimination and inequalities at all levels. There have been many relevant development projects and programs (for example, aquaculture projects with social and gender dimension and projects that focus on women's economic empowerment through aquaculture). Numerous lessons can be learned from the successes and failures of these endeavors. One important lesson is that success in achieving development objectives through aquaculture depends on contextual realities, mechanisms, and structures in place to ensure equity and environmental sustainability.

The aim of this study is to guide two potential World Bank operations in Vietnam and Nigeria with the aquaculture value chain as their focus. These two operations recognize the important role of aquaculture in the development objectives of these countries. This paper describes the specific contexts of Vietnam and Nigeria and recommends concrete project entry points and actions

for gender integration, applying the lessons learned from past experiences. Two aspects were examined in order to suggest concrete ways to ensure gender equity while improving food security and reducing poverty: (1) assessing the aquaculture value chain and suggesting how to develop the sector and (2) assessing differences in women's and men's roles, access, and decision making, as well as differences in the constraints and opportunities for women and men.The paper employs an integrated value chain analysis that critically assesses the constraints and opportunities at different nodes or stages of the chain from policy, institutional, market, sociocultural, and gender perspectives.

Nigeria and Vietnam represent two very different experiences in relation to aquaculture. Vietnam, as one of the global leaders in seafood production and exports, has one of the fastest-growing aquaculture sectors. Driven by the goals of promoting aquaculture growth for export since the 1980s, government at all levels has contributed significant resources to strengthening the sector's performance. Although much of the driving force for this growth has been world demand, especially for shrimp production, the diversity in species and farming systems in Vietnam help build a strong agricultural sector both in terms of employment and in its contribution to GDP. The systems of shrimp production detailed in this report are located in northeast Vietnam within a region of small family farms created from a collectivized system of farming in the late 1980s, a geographical area that has not been studied much in the past. Most existing literature focuses on the Mekong Delta, where majority of aquaculture activities takes place and where an estimated 2 million farmers involved directly in the shrimp industry alone are located. Nevertheless, as much as possible, incomes are diversified and include both farm and nonfarm sources; this partly reflects the success of the policies of the late 1990s that supported increased rural employment, small farm productivity, diversified rural livelihoods, and improved rural infrastructure. Although the rural population remains large (80% of the population), poverty has increased and underemployment remains a problem in rural areas. Consequently, rural-to-urban migration is increasing and includes both women and men. Some suggest that the numbers for women are greater than those for men.

In all these respects, Vietnam contrasts dramatically with Nigeria, which is entering its fifth decade of economic dependence on oil (95% of exports). Traditionally, Nigeria relied on export crops of rubber, cocoa, groundnuts, and annual grains grown mainly on small farms within customary tenure systems. During the period of oil dependency, there has been limited government interest in and support for the agricultural sector, although this has shifted recently as oil income has declined and concerns about food availability have increased. Aquaculture in Nigeria is still a new sector with a small number of species and systems and thus far remains focused on satisfying local demand. The case of catfish production included in this paper is centered on the two major cities of Kaduna and Lagos. However, as the case study demonstrates, the development of local catfish production is heavily constrained in a national context where infrastructure development, especially the supply of power, is poor.

Significant differences also exist in terms of gender relations, with Vietnam situated generally within what Kabeer (1994) refers to as a "region of weaker patriarchies" characterized by no or limited cultural prohibitions on women's

mobility,[1] signifying weaker distinctions between the public and private domains, the organization of households along corporate lines (often around the conjugal unit) with each member contributing to a common purse managed by women, and less clear divisions of labor by sex. The case study from Vietnam shows men and women working together (that is, providing capital, labor, and expertise) to establish a joint enterprise that will contribute to their diverse livelihoods portfolio regardless of who is listed as the owner.[2] This contrasts with the two Nigerian settings. Kaduna is situated in the north within a predominantly, although not entirely, Muslim Hausa area with strong cultural prohibitions on women's mobility, possibly accompanied by *purdah* (female seclusion). Households are integrated into wider lineage networks where the conjugal unit is less cohesive and polygamy may be practiced. Lagos, the old capital of Nigeria and still the largest city, has long attracted migrants from all over the country and therefore has a very diverse population. As in a number of other sub-Saharan countries, spouses generally do not share a common purse, although this should not always be interpreted to mean that there is no joint decision making between spouses, and clearly these customary institutions are no longer universal.

Nevertheless, similarities between these two countries are evident in the challenges they face to develop aquaculture and create gender equity. Government policies support modern farming (in Vietnam: intensive farming) to a certain extent; however, statistics on aquaculture farms exclude the smaller units, and the formal banking system does not provide financial capital to them. In neither country do the credit terms enable the growth of these smaller units. Following structural adjustments, both governments have withdrawn (are still withdrawing in Vietnam) from direct participation in the economy, and information, as well as inputs, is expected to be provided by the private sector. Funds for research are considered to be insufficient. Gender norms support the involvement of individual women and men in the wider economy in both countries; yet in Vietnam, farms are almost always registered by communes in the name of men (to represent households), and customary male-dominated patterns of control over land remain a constraint for women in Nigeria. In Nigeria, Muslim women have more rights to land than non-Muslim women (which has implications for credit access), and, at least in urban and peri-urban areas, there is a market for land ownership and development. Finally, in both countries it is, in fact, labor burdens relating to the needs of women to earn an independent income while continuing to perform their domestic responsibilities that prescribe the contributions women can make to the sector.

How are these two aquaculture activities organized in terms of roles, resource access, and representation between women and men?

Both parts of this study suggest that the contributions of women (along with children) are frequently underreported (perhaps because they do not receive a wage and are not registered owners). However, the available data suggest that women are less likely to be directly involved in hatcheries in both countries but are more visible in the grow-out and farming stages, and play key roles in processing and marketing.

In both countries, evidence of land ownership is regarded as a problem for women wishing to engage on their own in aquaculture. In Nigeria, reference is made to their inability to participate as owners of earthen ponds for catfish rearing because of restrictions onland access, although 40 percent of aquaculture farms are owned by women in Lagos State, and 20 percent in Kaduna State. Another factor that may contribute to this difference in farm ownership in both countries is women's limited access to capital, which is essential for engaging in aquaculture due to the need for expensive imported inputs, such as feed, fish farming chemicals, and improved technology for smoking fish. Nevertheless, the largest trader group in feed in northern Vietnam are women. In Nigeria, there has been a major return to marketing both fresh and smoked fish, and in Lagos State these ventures are almost entirely in the hands of women. Men control the smoking operations in Kaduna State and are involved more in marketing.This may reflect higher levels of female exclusion in this state, although Muslim and non-Muslim Hausa women are able to engage more generally in food processing and trade even while living in purdah.

The status and position of women involved in marketing are significantly different in Vietnam and Nigeria. In Vietnam, the bargaining skills of women are openly praised and often viewed by people in the industry as positive and desirable for family production systems. In Nigeria, on the other hand, where the women involved in marketing are organized and able to influence the market to their advantage, they are regarded as a relatively unacceptable powerful lobby. However, male aquaculture farmers have also organized themselves and have started bypassing the female traders, selling directly to wholesalers and consumers, and government has initiated the establishment of trading centers. Overall, women's role in ensuring the efficient operation of the market does not appear to be acknowledged in Nigeria.

Apart from the case of the Nigerian female traders, women are not seen to exercise power in these two aquaculture chains; they are poorly represented in the management of enterprises, cooperatives, and associations in both countries, although women are employed in the banking sector. In Vietnam's shrimp farming activities, but perhaps more widely, the main areas of women's formal employment are in the processing and packaging factories. As is true in many other countries, the majority of the labor force in these factories is female. Although there are laws protecting these workers, their implementation is poorly monitored. Table 1 presents key similarities and differences of the roles, resource access, and representation between women and men in Vietnam and Nigeria.

Is the low representation of women in the two chains (in hatcheries) a problem?

In Nigeria, women operating independently tend not to operate hatcheries because of time constraints, and these women therefore depend on the market for fingerlings for their own farms. They also incur losses during transportation from hatcheries to farms. Shrimp losses in Vietnam, regardless of who manages or owns the enterprise, are also large but for another reason: the poor quality of shrimp seeds. Also relevant for answering this question is the evidence that,

although profits canbe made in aquaculture, in many instances these may be small (due in the case of shrimp farming in Vietnam to reduced production resulting from disease and/or low prices resulting from gluts in the market). The Vietnam report suggests that the evident volatility of shrimp production may explain the gaps in women's independent involvement: Women are presented as being risk averse. Another possible explanation is that this gap might simply reflect a choice being made by women (and their husbands, at least in northeast Vietnam), with pressure on their time and marketing their almost exclusive concern, and income under their control. The same explanation may account for the limited involvement in hatcheries by women in both countries. Although neither report tells us much about the funding of processing and marketing operations run by women, and even fish feed preparation in Nigeria (which women dominate), clearly these activities also contain elements of risk.

Is there an adequate enabling environment for both women and men to engage in aquaculture?

First, it is important to acknowledge the official commitment that has been made to address gender inequality in both countries, especially in making some targeted extension services. In Vietnam, the government provides financial support to the Women's Union, a pivotal advocacy group for women, for women's training (albeit heavily critiqued in this report for its lack of practical focus). In Nigeria, there is a dedicated department for women within the governmental body responsible for aquaculture. Credit availability is more difficult for women, with some provisions made by the Women's Union in Vietnam. Even so, credit is a universal problem for both men and women wishing to start an aquaculture farm in both countries as well as for those wishing to upgrade their existing operations. Women in Vietnam are presented as lacking adequate networks that would allow them access to alternative credit sources that men have at their disposal.[3] The importance of both knowledge and credit for engaging in aquaculture is made very clear: Poor management leads to poor bio-safety in ponds, thus increasing the risk of disease. Additionally, the producers with limited capital assets are unable to access safer seeds.

Recommendations

Following are a number of recommendations on how gender issues identified in these two aquaculture programs might be addressed. They build on the learning from past and ongoing gender equity programs and on the comparisons made between the two programs themselves. Before making gender-specific recommendations, reference is made to a number of recommendations on technical and input issues raised in the case study documents. These issues potentially reinforce gender and poverty disadvantages as they increase the risk of engaging in aquaculture, especially for small-scale farmers and women.

1. Technical Recommendations

Address the problem of seed quality

Both studies of shrimp and catfish farming raise a common concern of poor quality seed available locally (most of the shrimp produced on small farms

Table 1 Key Characteristics of the Aquaculture Sectors of Northeast Vietnam and Nigeria

	Hatchery/Nursery		Grow-Out/ Farming		Marketing/ Processing	
Key Issues	**Vietnam**	**Nigeria**	**Vietnam**	**Nigeria**	**Vietnam**	**Nigeria**
Women/Men Predominance in:						
Labor Force						
Small Scale*	Both	Men	Both	Men	Women	Women
Medium, Large Scale*	Men	Men	Men	Men	Women	Women
Management/Ownership						
Small Scale	Men	Men	Both	Both	Both	Women
Medium/Large Scale	Men	Men	Men	Men	Men	Women
Women's/Men's Access to:						
Credit (small scale)	Low for both	Low for women	Low for both	Low for women	Medium for both	Low for women
Credit (medium/large scale)	Less for women	Low for women	Less for women	Low for women	High for both	Low for women
Land (small scale)	Medium for both	Low for women	Medium for both	Low for women	Medium for both	Low for women
Land (large/medium scale)	Medium for both	Low for women	Low for both	Low for women	High for both	Low for women
Technology, training and advisory services:						
Small Scale	Low for women	Low for both	Less for women	Less for both	Low for both	Low for women
Medium/Large Scale	Low for women	Low for both	Medium for both	Less for women	Medium for both	Low for women
Degree of Association/Lobbying	Medium	Low	Low	Low	Medium	High for women
Degree of Management in Associations/ Cooperatives	Very low for women		Very low for women		Low for women	High for women
Cultured/Processed Species' Diversity	High	Low	High	Low	High	Low

**Scale refers to the size of firm/farm/economic activity.*

Source: Authors' interviews.

does not undergo quality testing by the veterinary control system), as well as problems with imported seed (due to minimal controls and frequent quarantines) and poor, or even absence of, traceability of fingerlings.

Addressing these problems is an issue that lies at the core of many global food chains. These problems need to be addressed at different levels, both international and national, and will need multi-stakeholder involvement if they are to be successfully resolved. In undertaking this task, it is imperative that the needs of small-scale systems that dominate the aquaculture production in a number of countries be specifically addressed. It is also important that commitment be made to ensure that regulations are practical and understood by everyone, and that their implementation and enforcement costs are not unduly placed on small-scale farmers. Because there is some evidence from the two aquaculture programs detailed here that women are less likely than men to be in a position to produce their own seed, women should be enabled to participate in important decision-making meetings to ensure that their position relative to other players in the chain does not deteriorate. This participation may be achieved through their membership in a support organization that has demonstrated that its ability to serve women's aquaculture interests.

Address infrastructure problems—water irrigation systems in Vietnam and power supply in Nigeria

The supply of water in Vietnam (to avoid cross-pond pollution and spread of diseases) andelectricity through the national grid in Nigeria have long been highlighted as constraints on development of aquaculture. For businesses that rely on a continuous supply of power, this has resulted in the need to make additional capital investments in generators. For a growing aquaculture sector such as one in Nigeria, the absence of a reliable cold chain is likely to remain a problem for a long time to come. Sub-Saharan Africa has well-established small businesses involved in processing, including drying, of fish and other perishable products. Ensuring the health and safety of these products should be a concern of those with a serious interest in the sector's growth. A relevant promising project is the Lake Chad and Chari River project that is designed to enhance the quality of fish products by introducing "community technological platforms," providing fish preservation and processing facilities, equipment, and advice relating to the products of fisheries and aquaculture to men and women (World Bank, FAO, and IFAD 2008). If well managed, these types of projects get around the problem of individuals needing to invest in separate power arrangements that could be expensive facilities, by providing an environment that adheres to specified food safety regulations.

Because women dominate processing and marketing in many countries (notably this is not the case in the Kaduna case study presented here), women are expected to have more to gain than men from these facilities.

2. Recommendations Relating Directly to Gender Issues

Increase the scope and quality of gender-disaggregated data

One of the first priorities is to address the gaps in gender-disaggregated data available in both countries. The successes of the numerous international

agreements on gender over the recent years have facilitated the availabilityof gender-disaggregated data. However, at the level of specific development sectors, including the natural resources sectors, the data remain inadequate. This situation may reflect to some extent the largely technical agenda of these sectors as well as their strong commitments to increasing production and productivity. Even though well-being and improved livelihoods might be referenced in policy and project documents, achieving these has proved to be difficult.

Although in some respects increasing the availability of gender-disaggregated data appears to be a comparatively simple task, it is imperative that all stakeholders be involved in discussions about what information to collect, and its value in planning, monitoring, and evaluation. Those responsible for data analysis need sufficient context-specific information on gender to be able to interpret the data.

Data collection and analysis is very expensive, and thus alternative options for data collection and analysis that are cost-effective and innovative are essential. All projects should be required to assemble a set of gender-disaggregated data to enable gender analysis. This would seem to be a minimum commitment that all organizations could make to the gender project.

Although not usually evident under the existing data requirements, from the information available in this study, there are clearly differences in levels of employment in the private sector between women and men. Although some information is given in the Vietnam report about the value to women and men of these different opportunities for work (formal public, private, and then informal sector work), given the dramatic increase in the operations of private (for-profit) services within rural areas, it is recommended that some investment be made in broadening the focus of data collection to covering the practices of the private sector. These data should allow some gender analysis of conditions of service on which codes of conduct could be built.

Move to gender analysis from data on women

It should be clarified that information on women's roles and resources access and control, with limited or no information on who these women are (beyond possibly their economic status, and sometimes their marital status), is insufficient to undertake a gender analysis and can and does lead to spurious conclusions about the individuals involved. Data on men and some household data are essential for achieving a holistic picture of how households are addressing their livelihood needs (see notes on the Oxbow Lake Project, Bangladesh).

Identify and support organizations that might best serve women's aquaculture interests, which should go beyond production and cover processing and marketing, as well as serve as advocates on specific gender issues at all levels

The Sustainable Fisheries Livelihoods Programme (SFLP)'s experience on gender mainstreaming (FAO 2006) places organizations such as these at the meso level and emphasizes the need for their continued support. The role of the Women's Union in Vietnam in ensuring access to credit by women is an interesting case of the kind of support that they can give to women. The

Nigeria report suggests that meso-level organizations could intervene between small-scale producers/processors/traders and the formal banking sector to provide sufficient credit to enable these stakeholders to increase the scale of their activities. In addition to seeking out existing organizations, it is also recommended in the Nigeria report that small-scale producers and traders be supported to form cooperatives in order to improve credit and information accessibility. However, both reports warn of moving to increase credit access before issues around bio-safety and related fish mortalities have been addressed.

Promote more gender-responsive information delivery

The continuing dilemma of services delivery in rural areas to a large population that may also, especially in sub-Saharan Africa, be widely dispersed raises the question of communication methods as a whole. Although it has been demonstrated delivering technical messages to rural people using a person-to-person approach is possible (see the notes on the World Bank Fourth Fisheries Project), and even reaching disadvantaged or invisible groups (especially women and poor households), there is little evidence that sufficient extension agents will be made available to achieve the objectives of providing services to everyone. The call to hire more female agents in order to ensure gender equity in service delivery has not resulted in significant changes in the gender composition of these services in most countries. Due to these poor results, the extension departments, following structural adjustments, have been dismantled in many countries long before privatized services have been organized. Identifying and increasing the use of alternative communication channels is important.[4] An example of how communications have changed for the better presents itself in the Nigerian catfish case study, where reference is made to the use of mobile phones by women traders.

In the case of fisheries and aquaculture, the key question for this recommendation is, Where might these communication initiatives be located? Even though departments of fisheries and aquaculture are largely responsible for project implementation, they are not necessarily the best location for this kind of activity. Where they are found, and found to be innovative, they are often directly linked with specific projects such as the SFLP implemented by Food and Agriculture Organization (FAO) and funded by the Department for International Development (DFID).

Regardless of who coordinates information preparation and delivery, ensuring that the information provided to women increases their ability to engage in all aspects of aquaculture systems is essential.

Protect the gender specific interests of women working in processing factories

As reported in an earlier policy document produced by the SFLP, "the gender lens has hardly focused on industrial fisheries in low-income countries. Where it has, one sees that large scale commercial fish processing plants operate as gendered workplaces where women are given irregular and short-term work, often with no health, safety, or other protection or benefits that would enable

them to combine paid employment with family tasks" (FAO 2006, p. 6). Poor work conditions must be tackled with codes of conduct, and while there may be a sense on the part of some that this will not be acceptable to the private sector, there is growing evidence that this sector and these companies are open to making changes because they can see the resultant benefits to their business. Protecting these workers may mean both supporting the women's organizations and strengthening ways in which women express their own views within organizations involving both women and men (refer to Coral Reef Rehabilitation and Management Program [COREMAP] II).

1. Introduction

Aquaculture has been the focus of development investment in rural areas since the 1980s and is now the fastest growing food sector in the world. It is expected to contribute more than 50 percent of total fish consumption by 2020. Although just over 90 percent of this production originates in Asia, and nearly 70 percent in China alone, there are continuing efforts to expand production into new areas, such as sub-Saharan Africa, where to date, production has been minimal. Aquaculture is being promoted as a means of achieving food self-sufficiency as well as providing an alternative and sustainable income source to those involved in capture fisheries and agriculture, as long as environmental and disease-control issues can be addressed (World Bank 2006; also see Belton and Little 2008). There also appears to be some agreement that it is a suitable activity for the rural poor with limited assets and even for landless poor (see especially Bangladesh poverty-focused programs). Aquaculture activities are viewed as being especially attractive to rural women, who in many locations are constrained in independent income-earning activities by limited access to necessary resources, their domestic responsibilities, restricted mobility in especially conservative locations, and biases in public resource provision by governments and even development agencies. At the same time, as in other agricultural and food sectors, although much of the production from small-scale producers is consumed locally and might meet food-security objectives, there is a growing interest among some donors and national governments in enabling smaller players access to new, including global, markets for their products. This is a challenge in the face of existing policies that tend to support large-scale actors in food chains. These policies are underpinned by an assumption about the inevitable decline of small-scale, frequently family, systems of production.

The large majority of farmers involved in many important aquaculture-producing countries such as China, India, Thailand, and Vietnam operate on a small scale and depend on the cooperation of family members and only to a limited extent on hired labor. Although there is considerable variation in task allocations, management, and control of operations, it is widely reported in many countries that in smallholder family systems, women undertake the most time-consuming and arduous tasksand complete more hours of workwhile having little or no control over the benefits from their work. At the same time, even in situations where women are expected to contribute to meeting family responsibilities, they may have limited access to land, ponds, labor, capital, and technical knowledge. Reports abound that women are not able to participate independently in aquaculture production beyond meeting their responsibilities for home consumption and household provisioning (Prahdan and Flaherty 2008; Nandeesha 2007; Bennett 2005; Brugere et al. 2001; Kusabe and Kelkar 2001). Within value chains for specific products, even

though both men and women might be involved, women often participate in parts of the chain that are regarded as especially insecure and receive less for their work than their male coworkers in factories, as the following example from Bangladesh demonstrates:

> The shrimp value chain in Bangladesh is a highly sex-segmented labor market with women and men receiving different wages along the chain for the work they do. Women fry catchers and sorters earn about 64 percent of what male fry catchers and sorters earn for example and these differences are linked directly with women's domestic roles. Women are also found in the most insecure nodes of the shrimp chain—working as fry catchers. The evidence supports the view that the fry catchers are the most vulnerable workers along the chain, often locked in a cycle of debt with others higher up in the chain, although this is not to say that indebtedness does not appear elsewhere in the chain. Finally, profits that are generated from shrimp exports are not broadly shared throughout the chain as intermediaries and exporters realize more than farmers and fry catchers. (Gammage et al. 2006)

As the system becomes more commercialized and production more intensive and complex, the situation of women is believed to deteriorate first and more dramatically than that of men, even though everyone in the community stands to lose as larger players move in.[5] Women are regarded as the greatest losers in family systems, where their labor burdens increase, and also as owners of independent operations, where they are excluded from the more profitable markets and enterprises.[6] Finally, although women are reported as benefiting more than men from employment in processing factories worldwide (Gammage et al. 2006; De Silva and Yamao 2006; Markussen 2002; Josupeit 2004), the majority of the women employed in these factories are described as holding the lowest-paying jobs without contracts or conditions that would allow them to fulfill their domestic child care and cooking obligations; men hold the jobs that are more secure, responsible, and senior.

Where there are gains beyond direct household consumption from all the activities in aquaculture, the control over income is considered to be vital for ensuring gender equity in the distribution of benefits. In China and other southeastern Asian countries where women and men are active in aquaculture, both women and men benefit, whereas in South Asia (India, Bangladesh, and Malaysia), women lose out, partly because they are not involved in marketing. In large parts of Vietnam (and Thailand), even if the earnings can be attributable to men, it is the women who receive the money—they are described as "looking after the money"—and their social identity is tied to their ability to handle it and to build up the household resources by selling the aquaculture products.

Although aquaculture is less developed in sub-Saharan Africa, in some parts of the continent, such as West Africa, women are widely respected for their roles in processing and marketing fish and their ability to build capital in this way. In some societies, women are also expected to invest these resources in

boats, nets, and even engines, for men as well as for themselves, and/or in processing and marketing activities. Caution must be exercised in gender analyses so as not to promote a view that men and women operate separately and in competition, and to avoid suggestion that differences in tasks and resources are in themselves significant gender issues or that filling these "gaps" will achieve equity.

Concerns about the weaker claims of women to resources and benefits as well as the extent to which women are involved in management decisions in both domestic and other spheres are as significant in reports on the aquaculture and capture fisheries sector as in other natural resource sectors. However, these claims vary considerably by location and production system. Nevertheless, women invariably play key roles in processing, and possibly marketing, and it is widely agreed that their earnings make a significant contribution to household livelihoods. At the same time, women often remain invisible in the sector and frequently lose out in information and skill training, especially in new techniques and products in aquaculture. Women are also excluded from new institutions set up to address problems of resource-based deterioration because they are not viewed as being directly concerned; their interests are assumed to be represented by men; or they are just too busy at the time when meetings are held (World Bank, FAO, and IFAD 2008). Overall, this situation has led to women being more constrained than men in their ability to protect their interests in the sector and influence its development, all of which has significant implications for household survival as women find themselves unable to fulfill their responsibilities.

1.1 Learning from Past and Ongoing Gender-Responsive Programs

Only a small portion of projects addresses gender issues in their design and implementation. In the World Bank, out of 26 completed projects from 1990 through 2007 that were reviewed, only 5 projects (20%) explicitly discuss gender implications of the project (Hoshino 2008). However, there are some examples of investments designed to address some or all of these poverty and gender issues within aquaculture while retaining the objective of creating a more productive sector by harnessing the capabilities of everyone involved. The interest in these examples is to learn more about the issues and how they present so that improvements can be made to future development initiatives. Programs vary from those that have a large and complex agenda, such as coastal development, within which gender and other social issues are a small component, and others, within which these social issues represent the core interests of the organizations and programs concerned. Several successful cases are on record, although there are projects that attempted to integrate gender issues but did not attain their objectives. The following are some of the lessons learned:

Transforming Social Institutions: Addressing Women's Need for Skills and Information For over a decade, CARE Bangladesh has engaged in enhancing women's capabilities and challenging social inequalities by transforming extension information institutions. CARE Bangladesh (and ProFound in

Vietnam) piloted a family approach in its aquaculture extension programs to address failures in communication processes between service providers and their clients, specifically women, for which the usual remedy is considered to be the engagement of female agents (World Bank, FAO, and IFAD 2008). CARE Bangladesh challenged gender norms about the use of public space by women and men by (1) adopting an affirmative action policy in staff hiring, staff training, and work practices (changing behavior and ensuring male and female staff work with family members of both sexes), and (2) providing men and women, but especially husbands and wives, with information and skills. The program was successful in the sense that both male and female trainers were acceptable to both sexes. In Bangladesh, the projects achieved support from local authorities, who provided physical infrastructure and logistical support. In Vietnam, the Women's Union provided support without which the program would have had little chance of success.

Changing the Asset Status of Women to Increase Participation and Fish Production The primary work of the Oxbow Lakes Small-Scale Fishermen's Project in Bangladesh involved providing men from villages surrounding government-owned lakes with long-term access leases and helping them form lake management groups. The groups were large and experienced problems of conflict and lack of social cohesion. Women were not initially considered as recipients of publicly owned resources, and mixed groups were not considered socially acceptable. When women's equality was targeted, women formed groups for farming small ponds to access ponds on similar lease arrangements. These groups included widowed and divorced women, who were considered to be especially vulnerable and socially weak. None of the women's groups experienced problems of social cohesion, largely because of their size and the fact that members of each group came from the same community (Nathan and Apu 2004).

This project was unique in its attempt to give poor women group rights over public water bodies. Its success demonstrated how easily action to support women and poorer community members can be sabotaged. During the project, powerful men attempted to sabotage the work of the project and acquire the long-term leases for themselves, taking over selling fish and making purchases, especially of fingerlings, which are central to effective pool management. There were even reports of husbands who had earlier deserted their wives returning to seek benefits from them, as well as of husbands reducing their contributions to household needs once wives or other women household members began to earn income from their products (Nathan and Apu 1998, 2004). Of the 10 pond-farming groups formed, 5 were retained by the women themselves, 2 were taken over by men, and 3 were leased to men by the women.

Other projects failed to benefit women: the Fourth Fisheries Project in Bangladesh (2000–2007), funded by the World Bank, used an approach to asset building similar to that used in the Oxbow Lakes Project, and assessed outcomes were based on individual beneficiary targets. Overall, neither the poor men nor the women were able to achieve expected production targets. In the case of men, this is attributed to elite capture and the failure of the project to promote a technology that would be readily adopted by poorer men while being unattractive to wealthier individuals. In the case of women, although the targets

of women's participation were numerically reached, women did not benefit from the training as expected because they have less access to ponds and less control over household resources that could be inputs for fish farming.

In general, we learned that enabling groups of disadvantaged suppliers to access new markets is a long process that must be supported by other actions if the threats to their lives and livelihoods in existing markets are to be addressed. In addition, processes put in place to secure social and economic empowerment for women will need to be monitored to ensure that their interests are protected in contexts where they are likely to be the most vulnerable. In many locations, both young and adult women are especially vulnerable.

Engaging Women in New Systems of Production and Markets Programs to facilitate the engagement of women in new markets include supporting women's organizations such as cooperatives or supporting women's involvement in investments that are also accessible to men; ensuring women's access to sufficient capital and technical- and marketing-skill training; and ensuring the availability of essential insurance to enable these new ventures to survive in a risky marketing environment. Examples of these investments are few in number in aquaculture and fisheries. An early report refers to a shrimp farmers' association (with male and female members) in Tamil Nadu, India, that successfully used World Bank support (the India Shrimp and Fish Culture Project, 1992–2000) to introduce a voluntary code of conduct among its members, control the quality of inputs, monitor ponds, and use collective-bargaining skills to market their product (Kumaran et al. 2003).

Protecting Female Workers in Processing Factories Such protection might involve direct approaches, such as imposing and monitoring regulations on the terms under which women are hired and creating codes of conduct to protect women from sexual harassment. Indirect approaches to protection, such as supporting the organization of women for collective bargaining for their rights, can also be employed.

Codes of conduct serve a dual purpose: (1) providing a clear objective that civil organizations and governments, for example, can use to monitor performance and (2) informing different categories of workers, including women, of their rights (Barrientos, Dolan, and Tallontire 2003). The codes can help them understand the meaning of their rights and serve to engage them in discussions of the issues that must be addressed. This is essential if programs are supporting the associations of suppliers to bargain collectively for their rights because the success of this action will depend on all stakeholders being involved.

Creating Gender-Responsive Institutions for Managing and Accessing Resources The formation of gender-responsive user groups in fisheries and aquaculture—community-based natural resource management (CBNRM) groups and small groups of women for directly accessing resources—is regarded as ideal for achieving strategic changes in the status and position of women.

- **CBNRM group:** The major premise of community management is that sustainable resource management is best achieved when driven by those who rely on the resource for their survival. Within CBNRM, the need for gender-responsive action is based on the understanding that women who

may have a direct or indirect stake in the sector are more often than not excluded from participating in the activities of these groups or have only token representation; they are perceived by themselves and others as having no right to speak, and have no presence on major decision-making bodies (for fisheries, see Bennett 2005). The exclusion of women is justified on a number of grounds by local and nonlocal stakeholders: The assumption is that women's interests are taken care of by men, benefits are shared equitably within households, and challenging local norms that constrain women's public action is culturally insensitive and politically unacceptable. A relevant example is the Coral Reef Rehabilitation and Management Program (COREMAP) II in Indonesia. Although the goal of COREMAP II was to change fishing practices linked with the deterioration of coral reefs, it focused less on actual deliverables of resource redistribution and more on giving value to women's interests and contributions. This was done by "giving women a voice" in key institutions concerned with "mainstream development issues" and involving both men and women together. In practical terms, this meant (1) increasing the total number of women who participate in managing and implementing the program and (2) enhancing women's economic and social empowerment.

- **User groups for accessing resources:** The formation of women's user groups to enhance resource access rights and to receive targeted services is well established as good gender practice. Although both poor men and poor women have been organized into groups to access resources, it is women who are more commonly formed into small groups and for whom this practice is regarded as ideal given their socially weaker positions and limited mobility in public spaces in many societies. A relevant example is the Bangladesh Meghna-Dhanagoda Command Area Development Project, in which nongovernmental organizations were engaged to organize the poor (2,590 landless and marginal people, of whom 96% were women) into groups, provide them with access to ponds for fish farming through private lease arrangements, assist them with acquiring skills in fish farming and marketing, and provide them with microfinance services, including microcredit and savings facilities.

Addressing Gender Inequity Directly Although there is no lack of program examples, only a few programs address the issue of power and lack of it directly. Aquaculture for Community Development was a program started by FAO in 1986 in poor rural areas of Zimbabwe, Zambia, Tanzania, and Uganda that adopted a gender equity approach with the purpose of "transforming power relations between women and men" (Harrison 1997). Unfortunately, because this initiative was fairly unique at its time, at a 1990 gender workshop (after only four years), the equity approaches were dismissed as being too contentious and the redistribution of power as too difficult to implement and not politically acceptable.

As an alternative, the Japanese funders agreed to support a subproject to incorporate gender issues in inland fisheries and aquaculture development. Although the subproject aim remained the same as the parent project, the language of gender was transformed from reading "a redistribution of power,"

to reading "increasing efficiency and reducing poverty," and the outputs included guidelines and checklists for collecting gender-specific socioeconomic information and also included pilot projects to address specific issues. The experience highlighted important lessons learned:

- The interpretation of gender divisions of labor in households is complex; gender-disaggregated data must be complemented by gender-relations analysis both within and outside households and in communities, markets, and other institutions to formulate effective policies.
- Programs must effectively target specific groups of people, especially the poor.
- There must be a continuing presence of gender advocates to ensure that gender remains on program agendas and that a general agreement is reached as to the expected outcomes and therefore the meaning of a change in power relation.
- There is a need to address male identities in order to shed light on behavior that is almost always interpreted as female subordination.

The experiences above are a mix of successes and failures in integrating gender approaches into fisheries and aquaculture operations. The success depends mainly on the particular context and structures in place. It points to context-specificity of aquaculture development and gender equality promotion.

2. Objective of the Study

The aim of this paper is to guide two potential World Bank operations in Vietnam and Nigeria with aquaculture value chain focus or component. These two operations recognized the importance of aquaculture in the development objectives of these countries. This paper scopes the specific context of Vietnam and Nigeria and recommends concrete project entry points and actions for gender integration, applying the lessons learned from past experiences. Two activities are undertaken: (1) assessing the aquaculture value chain to recommend concrete ways of developing the sector and (2) assessing the roles, access, decision making over resources, and differences in constraints and opportunities between women and men to recommend concrete ways to ensure gender equity, with implications on food security and poverty reduction.

3. Methodology

The study employs an integrated value chain analysis (IVCA). It is a channel-mapping methodology of tracing a product flow through an entire channel from the point of product conception to the point of consumption. This process highlights the underlying patterns of inputs, constraints, and competitive advantages that a producer has. It also traces the path of all value-adding and nonvalue-adding activities associated with the production of a good and approximates costs involved at each stage. It looks at policy, institutions, markets, infrastructure, access, and representation issues that can influence the opportunities and constraints of actors in the value chain. The IVCA highlights the major challenges in the sector, with particular focus on gender dimensions. More specifically, the analysis sought to find out whether and to what extent benefits from aquaculture accrue to people involved in aquaculture with respect to their scale of production, gender, and social and economic background.

3.1 Integrated Value Chain Analysis

A principal challenge for developing credible industry and product-level market analysis in any country is the acute absence of reliable baseline data. As a result, much of the raw data required to analyze industries and markets must be compiled through rigorous local research and individual in-depth firm-level interviews.

Experience shows that intensive one-on-one interviews tend to yield the detailed data and information required to develop a representative value chain analysis. The IVCA does not rely on a survey mechanism because surveys do not yield the types and level of detail required to conduct an effective value chain analysis. In this context, it should be noted that the objective of a value chain analysis, unlike survey-based analyses, is to take a snapshot of a value structure representative of a particular product or industry.

The IVCA is a dynamic model where variables within a value chain can be adjusted to reflect changes in the market. To ensure that the analysis is adjusted for any data uncharacteristic of the market, emphasis is placed on cross-checking all firm-level data against other similar enterprises to help ensure that data used for the value chain analysis mirror realities facing local enterprises. The IVCA is a two-phased process involving (1) the fieldwork and (2) the data analysis, benchmarking, and report writing.

The fieldwork involves undertaking interviews at every point along the value chain. Experience working with the private sector in developing countries has allowed the authors to develop an approach to interviewing, in which selected interviewees will be forthcoming with the required information and data. For instance, experience has shown that interviewees, who also want to access the

benchmarking data available to the research team, will provide their data in return for the benchmarking data, which they have never had access to in the past. The final analysis could always be confirmed and validated by the private sector in an open forum once the analysis is complete.

3.2 Selection of Products

Considering the dominance of shrimp farming in the aquaculture sector of Vietnam, and in line with product selection proceedings during stakeholder meetings in the country, the Vietnam case places a greater focus on shrimp aquaculture, but additional value chain analyses relating to rice-cum-shrimp systems as well as fish farming and processing are provided in the study. In Nigeria, catfish is the predominant species in the aquaculture value chain, and the major focus of the Nigerian study, as per product selection discussions in the field, is on the catfish species.

3.3 Interview Methodology

The team employs a uniform interview strategy to help ensure consistency and representative results. The data collection process is not a survey-based approach but relies on in-depth interviews with stakeholders along the entire value chain, guided by a broad framework of critical issues. Such interviews are generally divided into three stages of questioning.

Stage 1: Exploratory Phase

The first day of interviews focuses on stakeholders from the public sector and associations to identify critical issues that uniquely define challenges facing the target sector. Interviews with the public sector generally include government officials from relevant ministries and statutory organizations and help identify key policy, regulatory, and institutional issues, as well as public-sector perception regarding challenges facing the target sector.

Members of associations are also interviewed during the exploratory phase to help identify sector-wide issues and to solicit contacts within the private sector that can shed light on such issues from a day-to-day operations perspective.

Interviews with the public sector and associations help define the parameters and scope of issues that must be highlighted in the interview process. Based on these initial findings, the second day is spent on interviews with private-sector stakeholders to begin flushing out a set of key issues facing the day-to-day operations of the target sector and to determine what, if anything, is being done to respond to these challenges.

Because the interviews are still in the exploratory phase, a discussion format, rather than a list of specific questions, is used to go through each stage of value addition to see whether specific issues arise along the entire value chain. The framework for this discovery process reflects our understanding of the sector and knowledge gained from interviews with public sector officials and associations members.

Stage 2: Emerging Issues

Experience shows that the discussion format used during the exploratory interviews is instrumental in flushing out critical issues along the entire value chain. After a number of such interviews, key questions and challenges facing stakeholders in the private sector begin to emerge. Thus, by the third day of interviews, key issues begin to emerge. Based on these findings, the team defines a set of interview questions to focus on.

At this point, the field team may elect to itemize all the emerging issues and begin to plot them along the value chain to determine whether certain challenges cluster heavily along specific sections of the value chain. For example, in the case of agricultural crops, if issues related to fertilizers and agrochemicals arise repeatedly during the interviews, then targeted interviews should be pursued with suppliers of agricultural inputs to determine the root cause of the problems identified along the value chain.

Stage 3: Validation Process

Once a set of issues is identified, the interview process continues until we begin to see an identifiable pattern in the response. Specifically, the value chain methodology applies a principle called the 10 percent rule. This rule reflects the level of deviation in the data set that private sector buyers of goods and services are willing to tolerate. For example, if the cost of a specific input such as fertilizers and chemicals and the usage of such inputs does not deviate more than 10 percent from one interview to the next, this suggests that the data reflect standard practice recognized by the stakeholders in the sector. In this context, the field team continues to interview stakeholders along the entire value chain until each variable along the value chain complies with the 10 percent rule. Generally, anywhere from 5 to as many as 50 interviews are required for each major segment of the value chain until the 10 percent rule can be achieved.

It should be noted that in some instances there is an acute absence of consistency and the 10 percent rule cannot be applied. Specifically, each response varies so widely that no pattern emerges from the interview process. While this is not a frequent occurrence, when this situation arises, the field team maps out the variances between each answer to determine whether the question is incorrect or the way the question is framed and asked is incorrect. If questions are not being presented in the right manner, the field team will frame the question in a number of different ways to see whether a pattern of answers emerges. In some instances, no pattern ever emerges, which reflects the lack of know-how and understanding among the stakeholders regarding best practice and that decision making along the value chain is ad hoc. This type of inconsistency in the interview data is often found when new crops or products are introduced into the market and there is no previous experience to help guide the stakeholder in the decision-making process.

4. Value Chain Analysis and Gender Dimension in Shrimp Aquaculture in Vietnam

4.1 Background

Vietnam is now the fifth-largest producer of shrimp in the world, and though the majority of production may come from large-scale and intensive production systems situated in the Mekong Delta area in the south of the country, the majority of producers operate on a small scale within family systems and are located in the northeast of the country. These small-scale producers can be characterized as risk takers because there are major problems for shrimp farming at this level in Vietnam. However, shrimp-related activities are not the only income-earning activities of those involved, and to appreciate the importance of shrimp farming for livelihoods as well as for the economy, the analysis must take into account the wider socioeconomic context in which the stakeholders operate.

The study of shrimp production provided here is situated within the context of a program of economic renovation called *doi moi*. This program was initiated in the late 1980s to shift the Vietnamese economy from a centrally planned one to a market-based economy, with the key goals of economic growth and social development. The reported achievements are substantial, with annual growth rates in GDP rising from a low of 2.3 percent in 1986 to 8 percent three years later; poverty levels declining from 70 to 53 percent of the population by 1993; and exports increasing by 30 percent and more per annum after 1988. On the other hand, the country continues to face substantial challenges with high population growth rates and low growth rates of output per capita growth, and, as observed in many parts of the world, increasing inequalities in growth rates. The main focus of this report is on rural areas, where poverty is most in evidence and where the majority of the population lives. Poverty is more pronounced in the north than in the south of the country where population densities are smaller.

In spite of the evident growth of certain agricultural activities since the 1980s, rural areas have been characterized by underemployment and out-migration from rural to urban areas, from the north to the south of the country, and away from agricultural activities.[7] Male out-migration was significant during the Vietnam war, with the more recent increase linked to the decline of state control over people's movements as well as the comparative lack of opportunities for employment in rural areas.[8] New in this scenario is the growth of female migration, even though men continue to dominate rural-to-urban migration patterns. Kabeer's characterization of Vietnam as being within a "region of weaker patriarchies" with limited cultural prohibitions on women's mobility suggests that the pattern for women should not be surprising (Kabeer 1994). In addition, given that there

are only around 10,000 square meters for rice cultivation per family (enough for one person) and that decollectivized farms in the north were almost entirely registered by communes in the name of men (to represent households), strong economic incentives exist for unmarried or married women (or even both parents) to find work in the city. Nevertheless, this does not mean that this pattern of migration is considered acceptable by everyone and is altogether beneficial for the individuals and families involved. In the more conservative parts of the country (as in much of the north of Vietnam), such moves are ostracized. However, there is also widespread agreement that maintaining strong family links continues to be a priority, and therefore those living outside their home areas frequently return and remit part of their earnings to family members remaining in the rural area. And in response to the argument that the position of women and gender relations have changed dramatically as a result of all the political and economic changes, others argue that women were always expected as wives, daughter-in-laws, and mothers to do productive work. What is new is that by the end of the twentieth century they were able to do this work outside the home, off the family farm, and independently within the growing labor market.

Nevertheless, socialism and the experience of war, particularly in the north, brought major changes emphasizing gender equality in gender relations within and beyond the family. As noted by Locke, Nguyen, and Nguyen (2008), this was evident in the rise of women to senior positions; the development of worker's rights; increased state and community responsibility for children, health, and education; and creation of the Vietnam Women's Union. These same policies were designed to modernize the family.

Although women in Vietnam have always played important productive roles within their families, including managing household budgets, they have always done the majority of domestic work and held the key responsibility for caring for other family members, especially children and their elderly in-laws, and more importantly, in a society where marriage is patrilocal, for their mothers-in-law. Even though there was a break in this pattern during the socialist period, emphasis was placed from the 1940s to the 1960s on the individual's productive roles and allegiance to the state rather than to the family. There is now increasing evidence of ambiguous changes in gender relations, with women losing some of the rights to gender equality that were enshrined under the Communist Party, such as "extensive access to maternity benefits and child care centers, access to education and employment" (UNDP 2009). At the same time, more traditional ideals of women's roles within the family have resumed prominence. In all of this, however, the importance attached to the conjugal unit remains very strong in Vietnam.

The marketization of social entitlements is also reported to have generated growing gaps between the poor and not poor in all settings. Although rural services remain predominantly public, the introduction of user fees is making it increasingly difficult for poorer families to gain access to these (Locke, Nguyen, and Nguyen 2008). Many would argue that it is frequently women who carry the burden of these changes in social entitlements.

4.1.1 Aquaculture Production in Vietnam

Vietnam is one of the global leaders in aquaculture production and one of the fastest-growing regions in the sector. By 2006, Vietnam produced 1.7 million tons of aquaculture products, more than a fourfold increase from 1996 (see Table 4.1). Vietnam had become the world's fifth-largest aquaculture-producing country by 2005 and maintained that position in 2006.

Vietnam's climb to one of the top market positions in world aquaculture production has come as a result of extraordinary growth rates in recent years. From 1996 to 2006, Vietnam's aquaculture production grew at rates unmatched by any other major producer. As Table 4.2 suggests, of all other major aquaculture-producing countries, none averaged more than a 16 percent annual growth rate in the 11 years from 1996 to 2006, while Vietnam achieved 45 percent average annual production growth during this span.

The Ministry of Agriculture and Rural Development (MARD) estimates the total value of Vietnamese aquaculture production in 2006 was US$3.3 billion, of which US$1.7 billion worth of aquaculture products were exported. By 2007, shrimp exports alone reached US$1.33 billion, followed by US$736 million of catfish. Total fisheries (capture and aquaculture) exports reached US$3.35 billion, a 59 percent increase from the previous year (US$2.1 billion).

Most of the aquaculture production in Vietnam was consumed in the country until the 1980s, when the commercial production in brackish waters of exportable giant tiger shrimp (*Penaeus monodon*) started taking off as a result of sharply increasing demand in the international market. Bodies of water suitable for aquaculture were increasingly used to accommodate growing production levels of brackish water shrimp as well as freshwater species, and an increasing number of farmers and processors became involved in aquaculture. By 2006, brackish water shrimp alongside freshwater fish remained the most-cultured species in Vietnam, and the total aquaculture farming area reached 984,000 hectares (see Table 4.3).

An estimated 34,402 aquaculture farms existed in Vietnam as of 2005, more farms than for any other type of agriculture (see Table 4.4). Southern Vietnam, mostly in the Mekong Delta, is where the bulk of aquaculture takes place in the country, followed by the northern region, where significant aquaculture takes place along the Red River Delta and the eastern part of the region.

It should be noted that the official farm statistics leave out many of the aquaculture farms included in this study. According to the criteria set by MARD and General Statistics Office (GSO), agricultural, forestry, and aquaculture households can be classified as farms if they meet two main criteria: (1) The average value of goods and services offered for sale in a year should reach at least VND40 million for farms in northern Vietnam and the central coastal region, and 50 million for farms in southern Vietnam and the central highlands;[9] and (2) the size of a farm and its produce should be superior to that of a farmer's household making the same produce for different sectors and economic regions, with specific criteria existing for various types of farms. According to these criteria, many smallholder aquaculture farmers

Table 4.1 Aquaculture Production Volumes, Vietnam, 1996–2006

Species	Type	Thousand Tons					Growth Rate (%)		
		1996	2003	2004	2005	2006	Cumulative ('96–'06)	Year on Year (2005)	Year on Year (2006)
Banana prawn	Brack.	9.2	40.0	40.0	40.0	40.0	334%	0%	0%
Freshwater crustaceans nei	Brack.	3.6	6.0	6.2	5.2	5.5	51%	–17%	5%
Freshwater fishes nei	Brack.	0.0	51.9	57.7	84.0	122.7	137%	45%	46%
Freshwater fishes nei	Fresh.	238.9	384.9	448.8	501.1	584.3	145%	12%	17%
Giant tiger prawn	Brack.	34.6	150.0	185.6	177.2	150.0	334%	–5%	–15%
Gracilaria seaweeds	Mar.	9.0	30.0	30.0	30.0	30.0	233%	0%	0%
Indian white prawn	Brack.	2.3	10.0	10.0	10.0	9.0	290%	0%	–10%
Marine mollusks nei	Mar.	10.7	100.0	155.2	143.8	146.2	1,273%	–7%	2%
Pangas catfishes nei	Fresh.	0.0	163.0	255.0	376.0	450.0	1,025%	47%	20%
Whiteleg shrimp	Brack.	0.0	31.7	40.0	100.0	150.0	1,400%	150%	50%
Total		**308**	**968**	**1,229**	**1,467**	**1,688**	**447%**	**19%**	**15%**

Source: Compiled by the authors from FAO Fishstat Plus.

Note: Harvest for ornamental purposes is not included in FAO data. The heading "Type" denotes farm environment as follows: Brack. = Brackish water; Fresh. = Fresh water; Mar. = Marine; nei = not elsewhere included.

Table 4.2 Leading Aquaculture Producers, 1996–2006

Country	Million Tons		Cumulative ('96–'06)	Average Annual ('96–'06)
	1996	2006		
China	22.21	45.30	104%	10%
India	1.76	3.13	78%	8%
Indonesia	0.88	2.22	152%	15%
Philippines	1.01	2.09	108%	11%
Vietnam	0.31	1.69	447%	45%
Thailand	0.56	1.39	149%	15%
Korea	0.90	1.28	43%	4%
Japan	1.35	1.22	–9%	–1%
Bangladesh	0.38	0.89	135%	14%
Chile	0.32	0.84	159%	16%

Source: Compiled by the authors from FAO Fishstat Plus.

Table 4.3 Aquaculture Farming Area by Culture, Vietnam, 2000–2006

	Thousand Hectares							
	2000	2001	2002	2003	2004	2005	2006	% (2006)
Brackish & Marine								
Fish culture	50.0	24.7	14.3	13.1	11.2	10.1	16.6	2%
Shrimp culture	**324.1**	**454.9**	**509.6**	**574.9**	**598.0**	**528.3**	**530.9**	**54%**
Mixed and other culture	22.5	22.4	31.9	24.5	32.7	122.2	131.4	13%
Nursing	0.5	0.2	0.3	0.3	0.4	0.4	0.3	0%
Subtotal	**397.1**	**502.2**	**556.1**	**612.8**	**642.3**	**661.0**	**679.2**	**69%**
Freshwater								
Fish culture	**225.4**	**228.9**	**232.3**	**245.9**	**267.4**	**281.7**	**294.8**	**30%**
Shrimp culture	16.4	21.8	6.6	5.5	6.4	4.9	5.5	1%
Mixed and other culture	2.2	0.5	0.4	1.0	1.1	1.6	1.5	0%
Nursing	0.8	1.8	2.3	2.4	2.9	3.5	3.4	0%
Subtotal	**244.8**	**253.0**	**241.6**	**254.8**	**277.8**	**291.6**	**305.2**	**31%**
TOTAL	**641.9**	**755.2**	**797.7**	**867.6**	**920.1**	**952.6**	**984.4**	**100%**

Source: Compiled by the authors, from Research Institute for Aquaculture 1(RIA1) data.

Note: 2006 data are estimates.

Table 4.4 Number of Farms by Activity and Region, Vietnam, 2005

Region	Annual Crops	Perennial Crops	Poultry/ Livestock	Aquaculture	Total	Share of Total
Red River Delta	305	22	7,562	3,072	**13,863**	**12.2%**
Northeast	98	127	1,000	1,019	**4,704**	**4.1%**
Northwest	38	44	201	36	**522**	**0.5%**
Central-North	1,881	1,115	1,046	1,233	**6,756**	**5.9%**
Central-South	3,003	878	578	2,323	**7,808**	**6.9%**
Central Highland	1,073	6,986	545	34	**8,785**	**7.7%**
South East	1,788	8,859	3,839	1,338	**16,867**	**14.8%**
Mekong Delta	24,425	175	1,937	25,147	**54,425**	**47.9%**
TOTAL	**32,611**	**18,206**	**16,708**	**34,202**	**113,730**	**100%**
Share of TOTAL	**28.7%**	**16.0%**	**14.7%**	**30.1%**	**100%**	

Source: Compiled by authors, from Research Institute for Aquaculture (RIA)1 data.

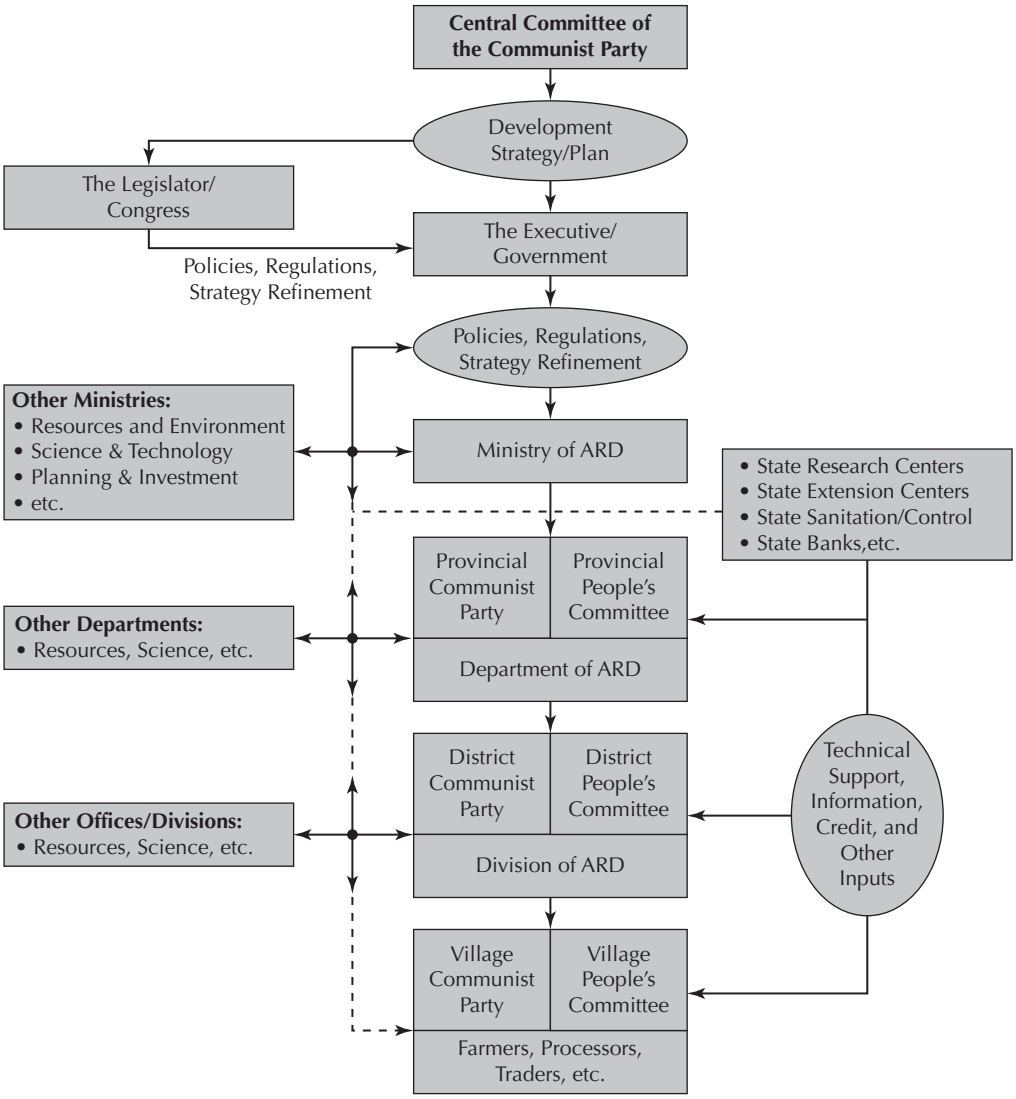
interviewed for this study do not meet the size or value of goods criteria for farms defined by MARD and are, therefore, not part of any official statistics.

4.1.2 Aquaculture Policy Environment

Up until the 1980s, a very centralized, top-down approach to policy making was followed in Vietnam in all economics sectors, including aquaculture. Following the *doi moi* reforms, provinces have been increasingly involved in policy discussions and planning, but the central government still holds a tight control over policy decisions. Up until July 2007, the ministry responsible for aquaculture (and fisheries) policy was the Ministry of Fisheries. On July 31, 2007, the Twelfth National Assembly passed the decree on government structure including the merging of the Ministry of Fisheries into MARD. It is too soon to evaluate the effects of this merger on the aquaculture policymaking process, but the process flow remains unchanged by this merger (see Figure 4.1).

Until the end of 1980s, fishery and aquaculture policy in Vietnam was mostly driven by goals of ensuring food self-sufficiency and household sustainability. In 1960, the National Department of Fisheries and Aquaculture was established under the Ministry of Agriculture and Forestry, and the Ministry of Marine Products was established in 1976. The development of the sector in the period from 1960 to 1980 depended on the war and postwar conditions in the country. By 1981, the government established the Sea Product Export Company as the monopolistic marketing board of sea product exports. This model of controlled opening toward the global seafood market proved successful, and under the *doi moi* reforms the sector was recognized as vital for the country's economy and was given a further policy boost. In 1993, the Communist Party identified the fisheries sector as one of the first industrial

Figure 4.1 Institutional framework, aquaculture sector, Vietnam, 2008



Source: Authors' Interviews.

Note: ARD stands for Agriculture and Rural Development.

priorities, and a number of administrative policies and divisions were created and developed. These policies and decisions helped to create a policy framework for the management of fishery sector. The policymaking process developed through a combination of top-down policies and regulations from the central or provincial governments as well as bottom-up through participation of local party committees.[10]

As the sector grew, the extent of issues that were targeted with specific policies also grew from broad development strategies and policies, down to the specific regulations on the supply of inputs, quality controls, operating standards, and so on. The most important legal documents relating to the

management of the fisheries sector, including aquaculture, can be grouped as policies directed toward the following:

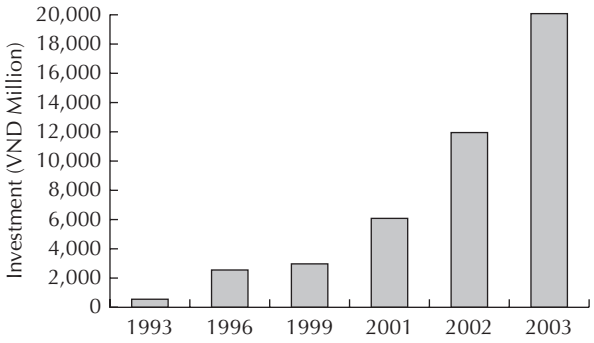
1. Development strategy of the sector
2. Use and management of land and water bodies for aquaculture
3. Exploitation and protection of aquatic resources, environmental management, and control of aquatic diseases
4. Credit supply
5. Extension and technical transfer
6. Seed, feed, and chemicals
7. Marketing of aquatic products
8. Quality, safety, and veterinary control of aquatic products
9. Standards and requirements for running a business in the sector
10. State and private management in aquaculture

Interviews with provincial policy makers in the field suggest that while development strategies exist in the form of 10-year plans, specific mechanisms for following up on progress of the established plans at provincial levels are weak. Very often, the central government demands provinces to adjust provincial development strategies and plans for many sectors and issues, including fisheries (and aquaculture). In 2004, the central government's decree 01/2004/NQ-CP asked provincial governments to check and revise their 10-year plans established in year 2000 to meet restructuring challenges. In this context, the policy environment in the fisheries sector (and the country in general) is characterized by the central government's and the party's drive to maintain the final say in policy issues in a top-down approach and at the same time to stimulate policy initiatives, economic planning, and leadership at the local/provincial level in a bottom-up approach (see Annex 1 for a summary of the main aquaculture policies in Vietnam up to 2004).

As concerns aquaculture extension policy, the central government recognizes the importance of providing impartial and quality advice, and its investment for extension support for aquaculture and fisheries increased from VND600 million in 1993 (US$52,000) to VND3 billion in 1997 (US$261,000). Investment further increased to VND6 billion in 2001 (US$400,000), coming from the restructuring of the agriculture and rural development plans. The government added VND10 billion (US$625,000) each year since the 2002 seed programs. In 2003, investment to enhance the sector's extension services was VND20 billion, with 50 percent for activities conducted by the National Aquaculture and Fishery Extension Center (NAFEC) at the central level and the other 50 percent for NAFEC extension activities at provincial levels (see Figure 4.2). The present extension system involves both public and private agents such as the following:

- Public extension workers from the National Aquaculture and Fishery Extension Center, which is the public institution responsible for provision of extension in the sector
- Private input suppliers and traders (for example, of feed and seed)

Figure 4.2 Extension investment for aquaculture and fisheries (1991–2003)



Source: World Bank 2004b.

- Processing companies
- Volunteer extension workers
- Employee organizations

Even though there are increased investments at the national level, delivery of extension support in the study area is lackluster.[11] The provincial extension center in the study area has an annual budget of VND200 million (US$12,750) and employs 17 people, of which 5 are women. Eleven employees are provincial field extension workers, of which 2 are women. At district levels, a reported limited but unspecified number of extension workers exists, and many of them are volunteers with limited training. The trained extension workers at the provincial or district level mostly occupy management positions, whereas the actual number of people who deliver extension service to farmers range between 20,000 and 30,000. The extension workers are either employed or volunteer extension workers who work at an estimated 10,000 communes in Vietnam. These extension workers have partial training in general agriculture or fisheries. The single aquaculture specialist who works at the provincial National Extension Center in the study area is the director of the center, who is paid VND1 million per month (US$63). As with many other government employees, his incentive to provide his full expert contribution to the job is minimal. In fact, as the following analysis of the cage culture value chain illustrates, the trained aquaculture specialist that manages the extension center spends half of his time managing the extension center and the other half on his own cage culture farm as the VND1 million-a-month salary does not bring enough food to a family's dining table in Vietnam.

As far as training is concerned, the Research Center for Aquatic Sciences (RCAS) is the key institution that delivers aquaculture training in the study area. RCAS receives an annual budget of VND400 million (US$25,000) from the provincial Department of Agriculture and Rural Development to provide training courses in the study area. RCAS trains between 1,000 and 2,000 farmers per year through 1-day courses and between 400 and 500 farmers through 3-month courses. An estimated 40 percent of participants were women.

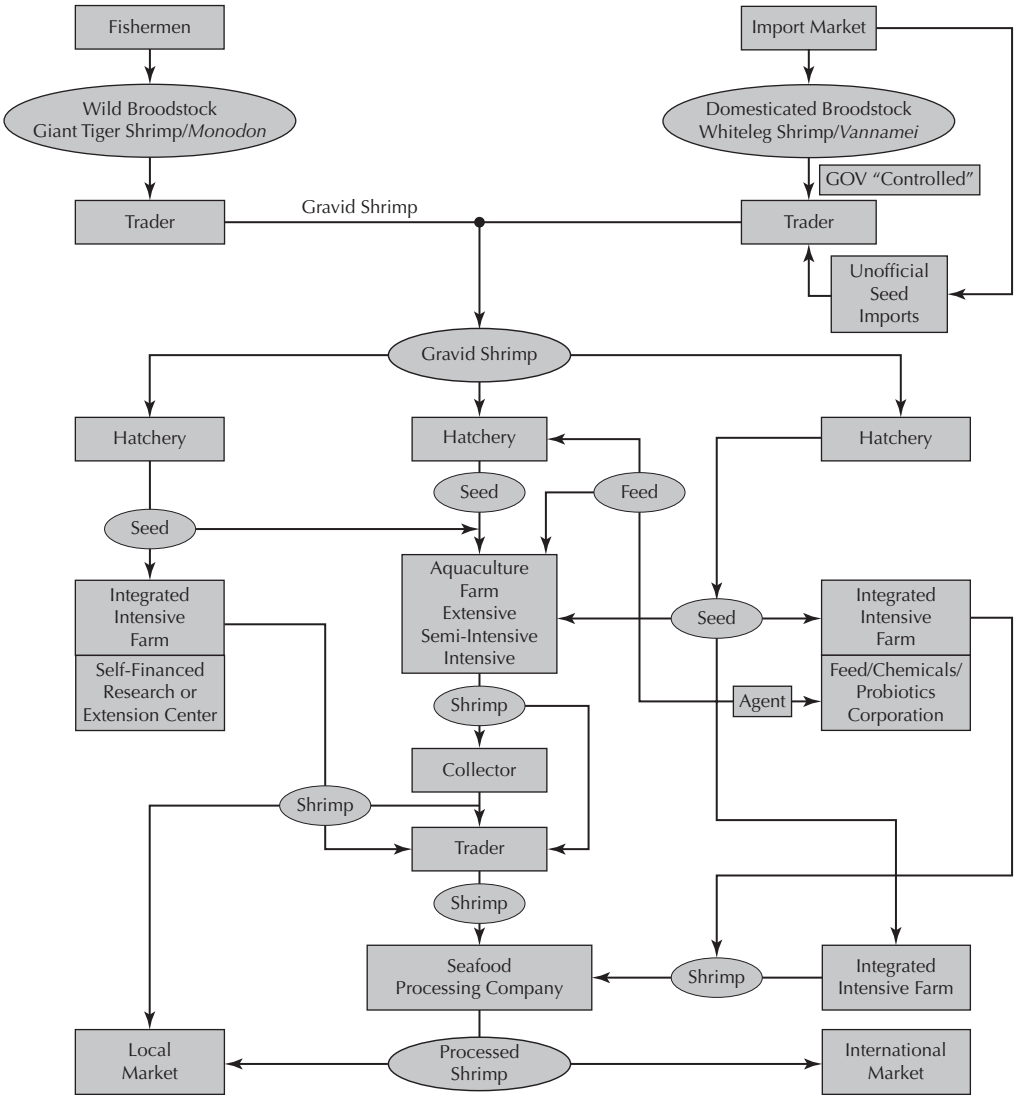
The 1-day training courses typically provide general information on a selected topic in aquaculture and do little to enhance the on-farm technical and management skills—such as pond preparation, feed and seed applications and methods, and postharvest handling—required by smallholder farmers. Even more problematic is that actual hands-on practical farm management training is not taking place during the 3-month sessions either. According to the management of RCAS, one of the biggest obstacles is its lack of funds. Presently, funding is provided by the government, which pays RCAS VND900,000 (US$56) per attendee per course, and by the Women's Union, which pays RCAS VND600,000 (US$38) per attendee per course. By 2009, however, RCAS is expected to be fully self-financed, so it is still learning how best to commercialize its services without government funding. RCAS has already made moves in this direction by virtually requiring farmers who receive free advice to purchase aquatic seeds from its hatcheries.

4.1.3. Market Structure and the Supply Chain

Aquaculture is a US$3.3 billion dollar industry in Vietnam with a complex supply chain in which thousands of economic agents participate. Whereas Figure 4.3 illustrates the aquaculture supply chain in Vietnam related to shrimp, most features of the shrimp supply chain are similar to aquaculture supply chains for other species. First, depending on shrimp species, gravid (ready-to-spawn) brood stock are either captured in the wild or held in captivity. Depending on a number of variables (temperature, species, size, wild/captive, and number of times previously spawned), they produce between 50,000 and 1,000,000 eggs. After one day, the eggs hatch into nauplii, the first larval stage, which then metamorphose into zoeae, the second larval stage. Zoeae then metamorphose into myses, the third and final larval stage. This stage lasts another three or four days, and then the myses metamorphose into postlarvae. Postlarvae look like adult shrimp and feed on zooplankton, detritus, and commercial feeds. Farmers refer to postlarvae as "PLs" and as each day passes, the stages are numbered PL-1, PL-2, and so on. When the postlarvae's gills become branched (PL-13 to PL-17), they can be moved to the farm. From hatching, it takes about 25 days to produce a PL-15. Hatcheries sell two products: nauplii and postlarvae (nauplii are sold to specialized hatcheries, which grow them to the postlarval stage).

The chain begins with the supply of seed stock from thousands of hatcheries that provide eggs, fingerlings, postlarval shrimp, and other aquatic species' seed stock to farmers who engage in extensive, semi-intensive, and intensive aquaculture farming (see Figure 4.3). After sourcing seed, farmers source feed either from commercial suppliers' agents or prepare and/or purchase homemade feeds in local markets. Farm output is sold to a network of collectors and agents that supply the processors catering to local and/or international markets. Some portion of farm output is consumed at the household level, with the exception of shrimp, which is exclusively a commercial species for all types of farmers. The peculiarity of the shrimp supply chain is that the supply of seed stock is dependent to a large extent on

Figure 4.3 Shrimp aquaculture supply chain, Vietnam



Source: Compiled by the authors.

Note: Seed refers to both nauplii (first larvae) and postlarvae.

the availability and quality of wild shrimp (brood stock). For fish species—such as carp, grouper, and tilapia—already established and well-functioning breed selection and multiplication stations in Vietnam supply hatcheries with the necessary brood stock needed for seed (egg) and fingerling production. By contrast, shrimp breeding is a rather recent development compared to fish breeding (as is the shrimp commercial farming industry).

An understanding of the global developments of the shrimp farming industry helps to explain this dependency on wild shrimp brood stock in Vietnam. The bulk of research and development on shrimp breeding/domestication was done in the Western Hemisphere on indigenous species. Efforts to domesticate

giant tiger shrimp (*Penaeus monodon*) also took place in many Asian countries as well as Australia, but by the early 1970s the species that showed best results was whiteleg shrimp (*Penaeus vannamei*), a nonnative species to Vietnam.[12] This species became the predominant cultured species in the Americas, the Pacific, and Asia, but not in Vietnam, where the government has been very cautious about introducing a nonnative species.

In Vietnam, until a recent trial introduction of the species in the northern part of the country, the *vannamei* culture was banned. Thus, currently over 80 percent of the entire shrimp production is based on undomesticated but native giant tiger shrimp. To date, significant efforts to domesticate *P. monodon* have largely failed, and *monodon*-based shrimp farming industries of Vietnam must therefore rely on wild brood stock.

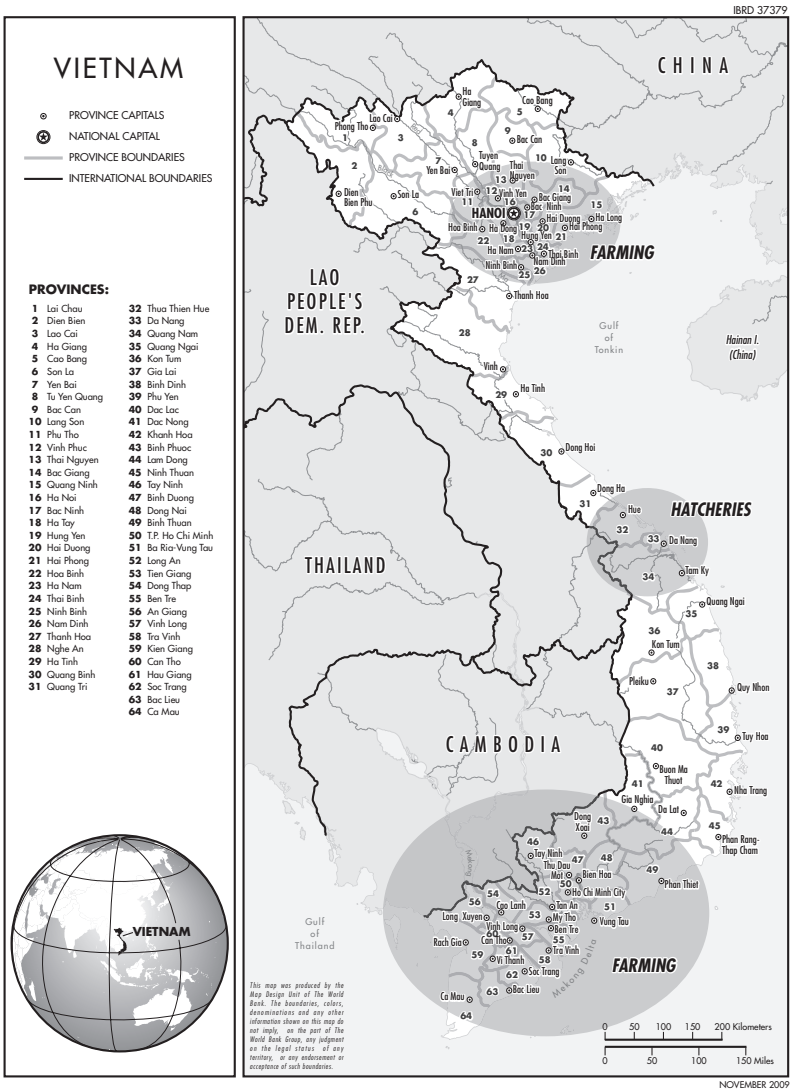
The dependence on wild brood stock has significant ramifications for the supply chain (and as shown in the following sections, it affects shrimp aquaculture value chains directly). First, the bulk of hatcheries are set up close to where most captures of wild brood stocks take place. In Vietnam, the most reliable sources of wild *monodon* are found in central Vietnam, near Nha Trang and Cam Ranh, and as a result most of the hatcheries are located there (see Figure 4.4). Most shrimp aquaculture, however, takes place hundreds (and in some cases thousands) of kilometers away along river deltas in the South and in the North. As a result, postlarval shrimp are moved via air and/or road from hatcheries to farms, thus impacting the farmers in terms of the cost of transporting PLs.

The transport of PLs is generally done efficiently, in oxygenated Styrofoam boxes, and is rarely reported by hatcheries and farmers to be a major quality issue in the supply chain. However, a major quality concern is the incidence of disease in postlarval shrimp that is often attributed to the wild provenance of brood stock. Wild-caught brood stock are often infected with shrimp viruses such as white spot virus, yellow head virus, and problems such as *monodon* slow growth syndrome. The industry's continued dependence on undomesticated and very often contaminated wild stocks of *Panaeus monodon* is, therefore, an important bottleneck in Vietnam's aquaculture supply chain, with significant ramifications on farm-level value chains for both the transaction costs of accessing brood stock and the costs associated with the quality of brood stock. This bottleneck is being addressed by the Research Institute for Aquaculture 1, which hopes to help reduce these costs—a detailed discussion on Research Institute for Aquaculture 1 (RIA1) is presented later. RIA1 is leading the scientific efforts toward *monodon* domestication in Vietnam and expects to fully commercialize its venture in partnership with a European research firm by the end of 2010.

4.1.4 Gender Aspects of the Supply Chain

At the national and regional levels, no gender-disaggregated data exist on individuals involved in the aquaculture supply chain in Vietnam. Interviews in the field suggest that the highest concentration of female employees is in the seafood processing subsector, with estimates ranging from 75 to 80 percent. Marketing and trading aquaculture fishery products from farmstofinal markets is done equally by men and women, with women playing a major role in the

Figure 4.4 Geographical distribution of aquaculture activities in Vietnam



Source: World Bank.

small-scale collection network. Both men and women farm fishery products, with men dominating the intensive farming systems as compared to extensive farming systems, where both women and men are equally represented. Intensive farming, as opposed to extensive farming, involves a high level of input use, such as feed and high stocking densities of aquatic feed.

The National Rural, Agricultural, and Fishery Census from 2001, provides some information on aggregate figures for fishery sector enterprises (which includes both aquaculture and capture fisheries) and on employment in these enterprises by gender. As Table 4.5 shows, 2,623 formal enterprises employing 41,925 people operated in the fishery sector of Vietnam. Only 3,036 people are reported as female laborers in the sector, or 7.2 percent of the total. These data,

Table 4.5 Profile of Fishery Enterprises, Vietnam, 2001

Fishery enterprises, Vietnam (2001)	Unit	Whole country	Red River Delta	Northeast	Northwest	North Central Coast	South Central Coast	Central Highlands	Southeast	Mekong River Delta
Total	Enterprises	**2,623**	**64**	**24**	**2**	**20**	**154**	**1**	**649**	**1,709**
Total of laborers	Person	**41,925**	**3,039**	**964**	**88**	**1,240**	**2,255**	**75**	**7,573**	**26,691**
Of which: Female	,,	3,036	864	337	35	426	218	25	426	705
By kind of contract										
Long time	,,	19,280	2,058	809	88	993	1,247	75	2,900	11,110
Short time	,,	19,591	820	138		202	951		3,815	13,665
By economic activity										
Agriculture	,,	592	128	56		200	39			169
Forestry	,,	115					86		6	23
Fishery	,,	38,799	2,734	841	88	994	2,084	75	7,403	24,580
Other	,,	2,419	177	67		46	46		164	1,919
Employed persons per enterprise	,,	16	47	40	44	62	15	75	12	16
Agriculture area of fishery enterprises										
Total	Hectare	41,895	4,546	1,112	8	406	1,302	22	32,863	1,635
Of which:										
Fish	,,	36,183	2,696	126	8	143	372	22	32,808	9
Shimp	,,	1,914	885	325		186	224		55	240
Others	,,	1,468	14	662		78	706			8
Mix	,,	2,330	952							1,378
Hatchery and nursery	,,	247	91	48	2	94	6	0	2	4

Source: General Statistics Office (GSO), Vietnam.

however, do not include informal aquaculture enterprises, which include many smallholders practicing extensive and semi-intensive aquaculture on their farms. According to RIA1, some two million farmers in Vietnam are estimated to be involved directly in aquaculture.

Considering the lack of specific gender-disaggregated farm-level data at national and/or regional levels, a more precise gender disaggregation of the supply chain is not possible at this time. However, the integrated value chain analyses in the following sections present insights into gender aspects of various aquaculture value chains in the northeastern provinces of Vietnam, which can be used to approximate the gender aspects of the northeastern Vietnam aquaculture supply chain, such as employment in and ownership of aquaculture firms.

4.2 Integrated Value Chain Analyses

4.2.1 Study Area

The case study area for this analysis consists of the coastal Quang Ninh Province, widely known as the Ha Long Bay area. This province is representative of the diversity of aquaculture in Vietnam and especially of northern Vietnam in terms of the structure of farming. Interviews with households in inland provinces of Hai Duong and Hung Yen were also undertaken for this study. This province was grouped together with Ha Noi in the early 1990s into a "Northern Growth Triangle" (Ha Noi, Hai Phong, Quang Ninh) and is considered by the government to be a pivotal economic zone in northern Vietnam.

Future development in Quang Ninh province is identified by the central and provincial government in the direction of "[forming] big centers serving as international exchange regions so as to support provinces in the southern part of the Red River Delta, to form big industrial centers, to develop high-tech industries such as electronics, informatics, new material production, consumption goods production, food processing, seaport economic development and take the lead in international cooperation and foreign investment attraction."[13] The province's gross domestic product, from 2001 to 2005, retained an impressive average growth rate of 12.5 percent per year, higher than most provinces in the country (see Table 4.6). The pace of growth increased in 2006 and 2007, with the year-on-year provincial GDP increasing 13 percent in 2006 and 3.2 percent in 2007. The study area has a diverse economy. Many firms are involved in light manufacturing and construction as well as in the services sector, such as tourism—some 3.7 million people visited Quang Ninh in 2007, including 1.5 million foreigners.

According to official statistics (see Table 4.7), in 2005 the northeast region of Vietnam had 184 formal agriculture, fishery (including aquaculture), and forestry enterprises employing 27,765 people, of which 12,476 were female (representing 45% of the total labor force in this sector). Fishery employment (which includes aquaculture) represented only 4 percent (1,044 people) of the total sector employment (agriculture, fishery, and forestry) in the northeast and recorded 18 formal aquaculture enterprises.

Table 4.6 Study Area Profile		
	Study Area	**% of Study Area**
Population	1,067,000	
Male	540,600	50.6%
Female	526,400	49.4%
Urban		43.0%
Rural		57.0%
Literacy rate (7 years and older)		91.0%
GDP annual growth (2001–2005)	12.5%	
GDP by Sector:		100%
Industry and Construction		46.5%
Agriculture-Forestry-Fishery		8.2%
Trade and Services		45.3%
Source: Compiled by authors from official national and provincial 2005 statistics.		

4.2.2 Shrimp Hatcheries

4.2.2.1 Sector Profile in Quang Ninh Province

The bulk of shrimp hatcheries in Vietnam are located in the central provinces. Quang Ninh province has two shrimp hatcheries. Nationwide, the demand for shrimp seed stock, estimated at 25 billion PLs in 2003 (see Figure 4.5), surpasses the supply capacity of local hatcheries, and most of the PLs are sourced from an estimated 4,000 shrimp hatcheries located in the central provinces. Quang Ninh is no exception. An estimated 1 billion PLs are demanded by shrimp farmers in the study area, with a maximum of 20 percent met by the two local shrimp hatcheries in the last few years.[14]

At least 70 percent of the province's demand is met by whiteleg shrimp seed stock imports from China, with the remaining 10 percent being met from other provinces.[15] Unlike in the south, in northern Vietnam the government allows the production of whiteleg shrimp on a trial basis.[16] Judging by the estimated trade flows of seed stock, it is evident that the preference for native giant tiger shrimp is losing out to that for whiteleg shrimp among shrimp farmers in Quang Ninh. As the following sections illustrate, although there are beneficial disease-resistant qualities of seed from domesticated brood stock, other production-related advantages to growing whiteleg shrimp, such as better feed conversion ratios compared to *monodon* shrimp, tend to yield good results for farmers.

4.2.2.2 Hatchery Value Chain Analysis

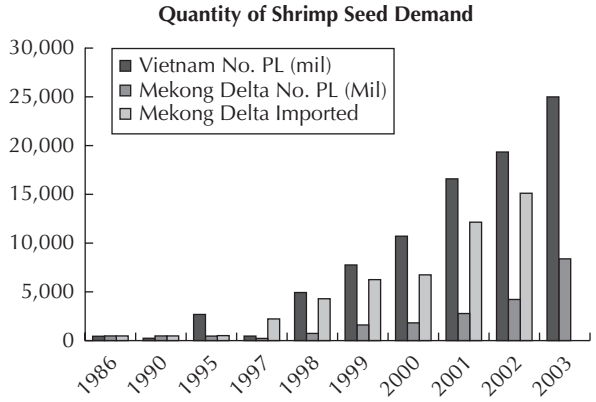
Due to the massive switch of intensive farms from giant tiger shrimp farming to whiteleg shrimp farming, a collapse of seed stock demand for giant tiger

Table 4.7 Agriculture, Fishery, and Forestry Enterprises, Study Area and Vietnam, 2005

	Unit	Vietnam	Northeast	% of Northeast	% of Vietnam
Number of enterprises	**Enterprise**	**3,599**	**184**		**5%**
By type					
State-farm enterprises	,,	190	28	15%	15%
Seed enterprises for cultivation	,,	186	20	11%	11%
Tractor stations	,,	25	2	1%	8%
Irrigation stations	,,	168	29	16%	17%
Other agricultural service	,,	28	3	2%	11%
Forestry farm	,,	304	65	35%	21%
Forestry service	,,	15	3	2%	20%
Aquaculture	,,	185	18	10%	10%
Catching	,,	2,397	6	3%	0%
Fishing service	,,	41			0%
Other	,,	60	10	5%	17%
By ownership					
State enterprise	,,	881	148		17%
Partnership company with state capital invested	,,	27	6	4%	22%
Partnership company without state capital invested	,,	19	6	4%	32%
Ministry of defense	,,	7			0%
Private	,,	2,525	9	6%	0%
Limited company	,,	69	4	3%	6%
Foreign invested	,,	50	3	2%	6%
Other	,,	21	8	5%	38%
Total Labor	Person	**289,001**	**27,765**		**10%**
Of which: Female	,,	113,309	12,476	45%	11%
By kind of contract					
Long time	,,	218,751	22,155	80%	10%
Short time	,,	63,843	4,604	17%	7%
By economic activity					
Agriculture	,,	193,091	11,221	40%	6%
Forestry	,,	30,432	10,222	37%	34%
Fishery	,,	40,613	1,044	4%	3%
Other	,,	24,865	5,278	19%	21%
Employed persons per enterprise	,,	80	151	1%	

Source: General Statistics Office (GSO), Vietnam.

Figure 4.5 Shrimp seed supply and demand, Vietnam, 1986–2003



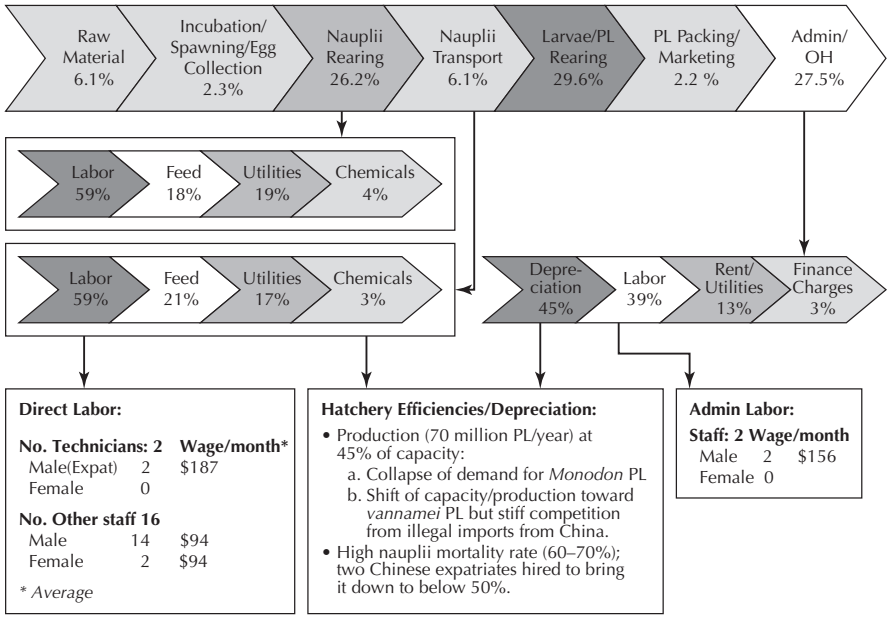
Source: Compiled by the authors from Environmental Management of Aquaculture Investments in Vietnam data.
Note: "Mekong Delta Imported" denotes interprovincial imports.

shrimp ensued in 2006, and the shrimp hatchery in Quang Ninh illustrated in the value chain analysis following shifted its hatchery production toward whiteleg shrimp (*vannamei*) PLs. According to hatchery managers, the shift toward whiteleg shrimp in the northeast is evident, and many hatcheries are adjusting toward meeting the increasing local demand for *vannamei* PLs, even though this adjustment is not smooth for many hatcheries. For example, the hatchery highlighted in this value chain analysis has been able to use only 45 percent of its 150 million PL capacity. As a result, the PL production value chain has a high share of costs associated with low capacity utilization, such as an oversized labor force and high depreciation costs for building/facility and equipment. The nauplii- and PL-rearing stages constitute 55.8 percent of *vannamei* PL production cost, followed by administration and overhead charges at 27.5 percent of total cost (see Figure 4.6).

Shrimp Hatcheries—A Male-Dominated Setup One hatchery studied for this report employs 20 people; 2 are female. Along with the other 14 general staff, these two women perform multiple tasks such as tank cleaning and moving, and packing of PLs, and there is no reported difference in pay: General staff are paid VND1.5 million per month (US$94). However, the most important tasks in this hatchery are performed by two managers and two technicians, and all four are men. The hatchery employs two Chinese expatriate managers and pays them VND3 million/month (US$187), and the local manager is paid US$156/month. The two technicians were hired in 2007 to reduce the nauplii mortality rate of up to 70 percent in 2007 to below 50 percent by 2008. This hatchery is owned by RCAS, which is currently transitioning from state-financed to a self-financed research, marketing, and production company.

Aquaculture technicians are in high demand in the study area, but they either run their own aquaculture businesses or work in government jobs or do both. The government-financed RCAS of Quang Ninh, which owns all other (four) aquatic hatcheries dedicated to fish species in the province, has a high representation of skilled female staff in its workforce (see Table 4.8).

Figure 4.6 *Vannamei* PL production value chain, Quang Ninh, Vietnam



Source: Compiled from authors' interviews.

Table 4.8 Gender Representation in the Hatcheries Workforce, Quang Ninh

Type (Number)	Ownership	Workforce	Men	% Men	Women	% Women
Shrimp Hatcheries (2)*	Private	20	18	90%	2	10%
Technicians/Researchers			2	100%	0	0%
Management/Admin			2	100%	0	0%
General			14	88%	2	0%
Fish Hatcheries (4)**	SOE	24	13	54%	11	46%
Technicians/Researchers			5	42%	7	58%
Management/Admin			4	67%	2	33%
General			4	67%	2	33%
Total* **		**48**	**31**	**73%**	**13**	**27%**

Source: Compiled from authors' interviews.

*Numbers pertain to one hatchery; the second of the two shrimp hatcheries in the study is reported to have been temporarily shut down.

**The Research Center for Aquatic Sciences (RCAS) has farms, hatcheries, and training components, and only the estimated number of staff dedicated to hatcheries is tabulated here, even though staff multitask across different activities.

***The totals include numbers for all hatcheries, except where indicated otherwise.

Interviews in the study area suggest that skilled and unskilled workers, and especially women, prefer government jobs that generally pay less than private sector jobs. The government jobs provide greater stability and are less strict about hours worked, allowing workers to earn additional income when the opportunity arises.

An example of this work practice is provided by the case of Ms. Thui,[17] an aquaculture specialist (with a BS degree in aquaculture) employed at the Research Center for Aquatic Sciences. Ms. Thui earns an average of US$63/month at her job, almost 50 percent less than a female (and male) general worker employed at the private hatchery. Her low salary is not a reflection of her female status but rather a function of her experience level.[18] What strikes her as particularly unfair is that the male cook employed by the center earns more (US$75/month) than she does. "And I have all this education," she says. The value chain analysis interviews suggest that the female aquaculture specialist is earning less than the male cook because she has less experience than he and that experience in government jobs in Vietnam is one of the main factors that determine public sector salaries. As a result, Ms. Thui spends considerable official work time working with her husband in their private shrimp farm, as do many other young people employed in institutions funded by the public purse. This practice makes the provision of technical know-how and extension support to the aquaculture sector difficult. The firms in the hatchery sector are not directly affected because they have the resources to attract and employ those with technical expertise. Unfortunately, the same cannot be said for smallholders involved in aquaculture.

Imported PLs Threaten Viability of Vannamei Shrimp Hatcheries As is the case with labor costs, the hatchery is stuck with high depreciation costs in a suboptimal PL production level. In the hope that it can increase production levels up to 120 million PLs in 2008, the hatchery keeps operating, but its prospects look bleak. Hatchery production cost per thousand *vannamei* PLs in 2007 was VND13,940 (US$0.9). By contrast, Chinese whiteleg shrimp PLs unofficially imported through the northern border with China at an estimated price of VND12,000 per thousand (US$0.8). When the cost of VND2,000 (US$0.13) per thousand PLs is added for transportation to main city centers, imported PLs from China can sell for VND14,000 per thousand (US$0.88), making it extremely difficult for other industry playersto compete.

Officially, the imports of nonnative *vannamei* PLs (as well as brood stock) are tightly controlled by the government, which has had an official ban on the species since June 2002 (see Box 4.1). In practice, however, illegal Chinese imports are flooding the Vietnamese market and the government is unable to control the flow. In the northeastern part alone, the demand for *vannamei* PLs is estimated at 1 billion PLs per year and growing. The high demand spurred by farmers' good results obtained in grow-out stages is actually keeping the *vannamei* PL prices relatively high compared to both local production costs and import prices of PLs. The market prices for Chinese *vannamei* PLs were in the range of VND25 to VND36 per PL while certified seed from the company CP Thailand, a Thai conglomerate in the feed, seed, and trading business, fetches VND42/PL when sourced directly from the producer and VND45/PL when sourced from the

Box 4.1 International and National Efforts in Controlling Alien Species Movement in Vietnam

"Vietnam Ban" Vietnam has had an official ban on the culture of *P. Vannamei* since June 2002, but some importations and culture have been permitted. They are currently conducting culture tests with this species in (supposedly) biosecure facilities in order to evaluate its positive and possibly negative impacts. In order to conduct these trials, since 2001, the Ministry of Fisheries (MOFI) has granted nine licenses to commercial companies, permitting the importation of up to 48.5 million PL and 5,900 broodstock *P. Vannamei*. These animals originated from the USA (Hawaii) and China, and are inspected by MOFI to ensure that they are disease-free before allowing their culture. However, current inspection protocols do not appear to be capable of definitively proving the disease status of the imported stocks (FAO correspondent, Vietnam).

The PL imported or produced by these companies may be either cultured by these companies or sold to third parties to culture (after being given permission by MOFI). Of the nine companies, only one to date has passed the trial period and is officially allowed to disseminate its products for culture, and even then only within the Mekong river delta (FAO correspondent, Vietnam).

However, while these quotas remain unfilled and open, *P. Vannamei* appeared to be cultured in North Vietnam, using PL illegally imported from Mainland China. Additionally, it has been estimated that during the first six months of 2003 alone, 2 billion PL were imported from Mainland China for culture within Vietnam (FAO correspondent, Vietnam).

Despite official restrictions, it is estimated that approximately 10 percent of the countries' 479,000 ha of shrimp ponds are now being used to culture *P. Vannamei*. This is driven by the scarcity and high price of PL P. Monodon, together with the low cost of mostly Chinese PL and the good results obtained in grow-out. The result is that Vietnam's estimated production in 2003 was 30,000 metric tonnes (FAO correspondent)."

Source: http://www.fao.org/docrep/007/ad505e/ad505e09.htm.

authorized agent for northern Vietnam. According to a manager in the northeast Vietnam, his hatchery's sales price rarely exceeds VND30/PL.

At these price levels, the producer's margin is a healthy 46 percent. The fact that profitability in the whiteleg shrimp PL production business is high does not escape potential competing investors. A state-of-the-art hatchery facility is being set up in the study area by CP Thailand; while this investment is not necessarily going to lead to lower prices for *vannamei* PLs in light of the robust market demand, it hopefully will lead to improved quality of PLs in the market.

Currently, the illegal imports of PLs from China threaten the quality of PLs in the market. First, the imported PLs themselves do not pass any official screening, and as the large variance in sales prices indicates, PLs are generally sold based on reputation for quality rather than actual certified quality. Shrimp hatcheries operate mainly outside the legal framework for quality control. Of all aquatic hatcheries, only 40 percent are reported to have registered legally; in the case of shrimp hatcheries only 12 percent have properly registered. Moreover, quality control of shrimp seeds has not been applied against more

than 50 percent of the total production of shrimp seed for years, and interviews in the field suggest that even this number is overly optimistic (World Bank 2004b). Second, local shrimp hatcheries themselves have to be nimble and employ various practices, such as sourcing cheaper Chinese *vannamei* brood stock as compared to Hawaiian brood stock, which are officially tested and supplied by a state-run trading company but are five times more expensive. (A Hawaiian *vannamei* brood stock costs VND75 million per couple (US$4,687) as compared to VND15 million (US$937) per couple of Chinese brood stock).[19]

In addition, as can be seen from the transportation costs of nauplii in the value chain analysis (6.1%), the hatchery has split nauplii-rearing and PL-rearing facilities. This split of the two facilities in two different locations would make sense in cases where a hatchery engages in nauplii sales in addition to PL production, which is not reported to be the case for this particular facility.[20] The nauplii facility is located in Mong Cai, some 200 kilometers from the PL production facility on the border with China where a booming trade of unofficial imports of *vannamei* nauplii and PLs takes place. The provenance of brood stock sourced and the quality of nauplii and PLs supplied by local hatcheries in this area is mostly outside official quality controls. In contrast, CP Thailand has PL, feed, and chemical production and trade operations in Vietnam with a good reputation for high-quality products, and its new investment in a hatchery plant is expected to improve the quality of *vannamei* PLs in the local market. CP already meets half of the annual *vannamei* PL demand in the study area (estimated at 200–250 million PLs) but in the words of many stakeholders in the province, some 100 million PLs are bought in the province each year from China at cheap prices.

Emerging but Incomplete Commercialization of Domesticated Monodon Breeding and Production Facilities Another avenue of intervention that can be pursued in conjunction with increased sanitary controls of imported seed stock is to provide support to the ongoing domesticated *monodon* breeding project undertaken by RIA1. *Monodon* shrimp cultivation collapsed in a chain reaction in country after country: Taiwan in the 1980s, China in the 1990s, and Thailand by early 2000. Giant tiger shrimp farming collapsed in the region due to widespread diseases of this largely undomesticated species that cannot be controlled for pathogens. Producers in these countries terminated the tiger shrimp cultivation and adopted *vannamei* for cultivation instead. As a result, the market share for *monodon* species, which generally fetches higher prices in international markets (but also has higher production costs), was dominated by countries in which *monodon* disease was not prevalent. Vietnam has successfully avoided the spread of the disease and today is one of the world's largest producers of the giant tiger shrimp. Yet, the country has not managed to domesticate the *monodon*, and for most farmers in Vietnam, including all of the smallholders in the study area, the risk of being hit by disease in their farms coming from captive brood stock is very real and ongoing.

In this context, efforts by RIA1 to break the reliance on wild shrimp and introduce domesticated shrimp seed in the market need to be supported. In particular, RIA1 began cooperation with INVE, a Belgium company, in 2004, with INVE's US$30 million dollar *monodon* domestication project MoanaRIA1's

goal is to meet 50 percent of the domestic demand (currently at 25 billion PLs) for *monodon* seed by 2012. Like many other institutions, RIA1 will have to be self-financing by the end of 2009 and will require external support until full commercialization of its seed business takes place.

4.2.3 Shrimp and Fish Farming

4.2.3.1 Sector Profile

Aquaculture is the predominant activity in the study area, where there were 761 farms in 2005 and only 149 farms involved in poultry/livestock. There was no annual or perennial cropping in the area. Detailed official statistics about the distribution of aquaculture farms across species farmed, gender composition of farm labor and ownership, or across farm intensity in the study area are not available. Interviews with hatcheries, farmers, traders, and processors suggest that aquaculture in this area is diverse from almost all perspectives, such as farming environment, farming intensity, and so on. With one exception, all aquaculture farms in this province are headed by men. According to the regional Department of Agriculture and Rural Development, only an estimated 2–3 percent of farms are headed by women (see Table 4.9).

The following sections present integrated value chain analyses for shrimp and fish farming, shrimp-rice and shrimp-fish rotation farming, and marine cage and freshwater mono and polyculture fish farming.

4.2.3.2 Shrimp Farming

Shrimp farms in Quang Ninh produced an estimated 4,481 tons of shrimp in 2006.[21] The bulk comes from semi-intensive and extensive smallholder farms that culture giant tiger shrimp. An estimated 150 intensive farms also contribute to shrimp farming, and by 2007 their shrimp production was almost exclusively oriented toward the nonnative whiteleg shrimp culture.

4.2.3.2.1 Intensive Shrimp Farming

Intensive farms typically employ modern on-farm practices and machinery and are generally considered best-practice cases for shrimp farming in the country (see Box 4.2). Since 1998, the central government policy has been to stimulate "the develop[ment] of shrimp farming to gradually move from extensive shrimp farming to improved intensive farming, semi-intensive farming and intensive farming."[22] The integrated value chain analyses for intensive shrimp farming in the study area suggest that intensive shrimp farms have many features of modern farming to which smallholders are encouraged to aspire, hence the analyses of shrimp farming will begin with the discussion of these modern farms.

Intensive shrimp farming in the study area involves the following stages:

- In April, PL-15 shrimp are sourced and stocked at densities between 25 and 100 PLs per square meter in already prepared ponds filled with seawater via pumps.
- Depending on culture, shrimp are fed two to three times a day for 90 days (whiteleg shrimp) to 150 days (giant tiger shrimp) with commercial feed and antimicrobial chemical compounds.

Table 4.9 Aquaculture Sector Profile, Quang Ninh, Vietnam, 2007

Ownership	**Total**	**Men**	**Women**
No. of Aquaculture Farms	~1,000		
Ownership		97–98%	2–3%
Labor force	**Total**	**Men**	**Women**
Freshwater Aquaculture (fish)		50–60%	40–50%
Brackish Water (shrimp, clam, etc.)		70–80%	20–30%
Marine Cage Cultures		85–90%	10–15%
Processing Firms		10–20%	80–90%
Aquaculture Farming Area and Production Volume	**Total Area (ha)**	**Total Volume (ton)**	**Aggreg. Yield (ton/ha)**
1995	8,300	2,248	0.271
2000	13,200	4,192	0.318
2006	18,700	19,305	1.032
% Change in 2006 over 1995	**225%**	**859%**	**381%**
Shrimp Aquaculture	**Total**	**Men**	**Women**
Intensive Farms*	150		
Ownership		148	2
Yield (ton/ha)	5–10		
Species Farmed	white shrimp (*vannamei*)		
Improved-Intensive/Extensive*	n.a.		
Ownership		n.a.	n.a
Yield (ton/ha)	0.1–1.0		
Species Farmed	giant tiger shrimp (*monodon*)		

Source: Authors' interviews.
*Official statistics.

- During the entire grow-out period, water in the pond is exchanged and aerated to maintain sufficient levels of oxygen.
- At the end of the grow-out stage, all the water in the ponds is treated and pumped out, the shrimp are harvested, and the sludge sediment, which is generally contaminated with chemicals such as nitrogen and phosphorus, is deposited in contained areas.
- Depending on the financial capabilities of the producer, a second crop can be grown for the vannamei culture immediately after the first crop is harvested.

Box 4.2 Major Characteristics of Shrimp Culture System in Vietnam

1. Improved extensive systems exist broadly in a range of different forms. This system accounted for 75% of total shrimp culture area and 66% of aquaculture production in the Mekong Delta. The system is without stocking or low stocking density of artificial shrimp postlarvae (less than 5/m^2). Natural food or/and supplemented feeds are often added into the farms. Average shrimp yield per crop per ha varies from 0.3–0.87 MT.
2. Semi-intensive system has been applied since the beginning of the 1990s in the Mekong Delta. This farming system has higher stocking densities of artificial seed (5–15 PL/m^2); commercial pellets are added; water exchange is controlled, mostly by pump; aeration is used sometimes. Average shrimp yield per crop per ha varies from 1.2–2.65 MT.
3. Intensive system has been developed recently. Shrimp PL15 are stocked in high density (20–40 PL/m^2); good control of the water environment including water exchange and treatment, feed supply and aeration are used. Average shrimp yield per crop per ha varies from 2.5–5.0 MT and some farms reach up to 7–10 MT.
4. The development of shrimp aquaculture in Vietnam has been going from extensive toward more intensified farms. Shrimp farming systems in Vietnam in 2003 comprised of 3% semi-intensive and intensive, 22% improved extensive and 75% extensive culture or semi-intensive. Of the total production (MT), the intensive culture produced around 10% and extensive culture could produce 60% of total shrimp production. The productivity of improved extensive, semi-intensive and intensive shrimp farming were 0.25–0.30 MT/ha/crop, 2.5–3 MT/ha/crop and 5–7 MT/ha/crop, respectively (MOFI, 2004 and 2005)."

Source: "Environmental Management of Aquaculture Investments in Vietnam," Institute for Fisheries Management and Coastal Community Development, RIA1, Network of Aquaculture Centers in Asia-Pacific, June 2006.

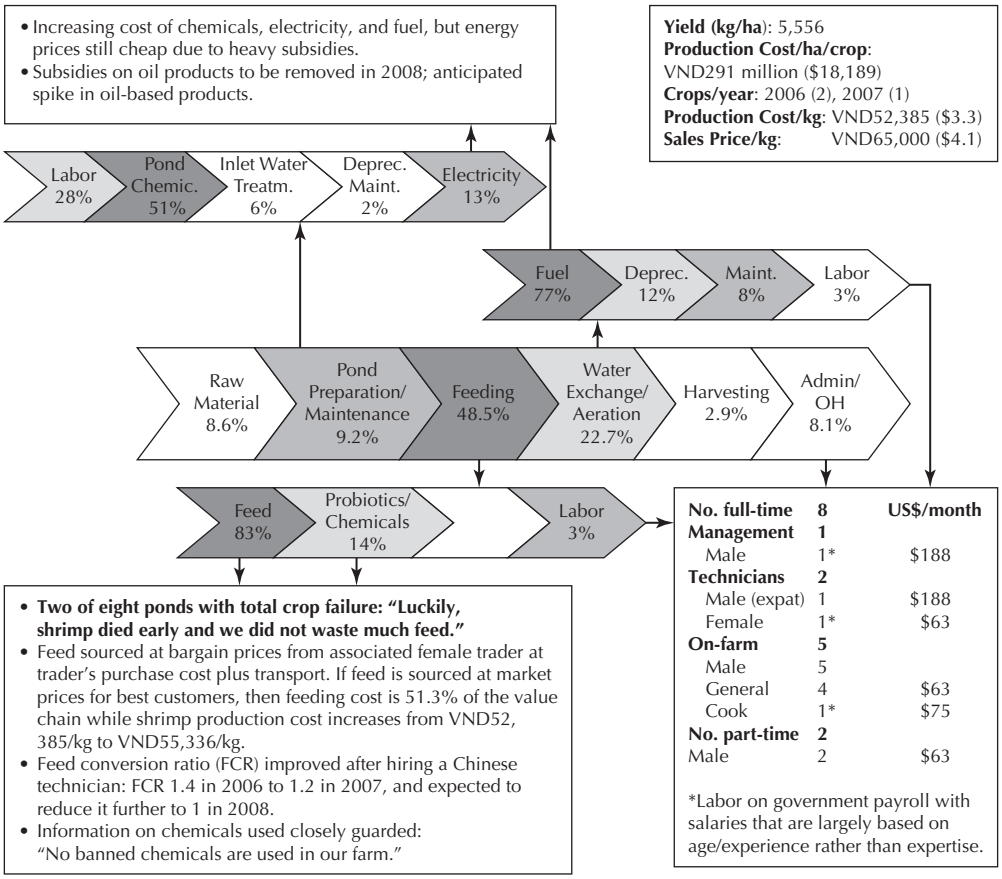
Not all farmers take the risk of growing the second crop due to monsoons and unpredictable hurricanes that can generate enough precipitation to change the pond chemistry and negatively affect water quality. By contrast, *monodon* intensive culture is generally done once a year.

The value chain analysis suggests that with a yield rate of 5,556 kg/ha/crop and a production cost of VND291 million (US$18,189) per hectare, the production cost of whiteleg shrimp in an intensive farm is approximately VND52,385/kg (US$3.27/kg).[23] The value chain analysis suggests that feeding is the highest cost component of the production value chain contributing 48.5 percent of the total, followed by water exchange and aeration (22.7%) and pond preparation and maintenance, 9.2 percent (see Figure 4.7).

Unknown PL Provenance and Quality Although the cost of PLs is the fourth-largest cost component, it is worth discussing the raw material component of the value chain first, because that is where the farming decision making starts. This 3.6-hectare farm, managed by Mr. Phuoc and owned by RCAS, reports that PLs are sourced from China, although the Quang Ninh hatchery highlighted earlier reports that it also supplies PLs to RCAS's intensive farm.

The reported stocking rate of 100 PL/m^2 and the total purchase price of raw material suggest that one PL is sourced at a price of VND25, which is in the

Figure 4.7 Whiteleg shrimp intensive farming value chain, Quang Ninh, Vietnam



Source: Compiled from authors' interviews.

price range of both Chinese imported PLs and locally produced PLs in Quang Ninh. How much seed stock has been sourced from where remains unclear, but it is clear that by sourcing uncertified PLs from China, Mr. Phuoc has taken significant risks. Interviews suggest that two of the eight ponds in his farm had complete crop failure in 2007 due to white spot virus. Considering the fact that the farm has well-maintained and separate inlet and outlet water channels for each of its 10 ponds, the crop failure in 2 ponds can at least in part be attributed to the poor quality of seed stock.

High Feed Costs—An Unavoidable but Controllable Variable "Never mind all the pond preparation, water exchange, and aeration energy costs that went for these two ponds. Luckily for us, the white spot hit the two ponds early and we did not lose much on feeding the shrimp," claimed the manager of the hatchery. As the value chain analysis suggests, the manager is well aware that the cost of feed makes or breaks the bottom line of intensive shrimp farms. In this particular case, feeding constituted 48.5 percent of the production costs, with feed (83%), probiotics and chemicals (14%), and labor (3%) being the three highest feeding-cost components.

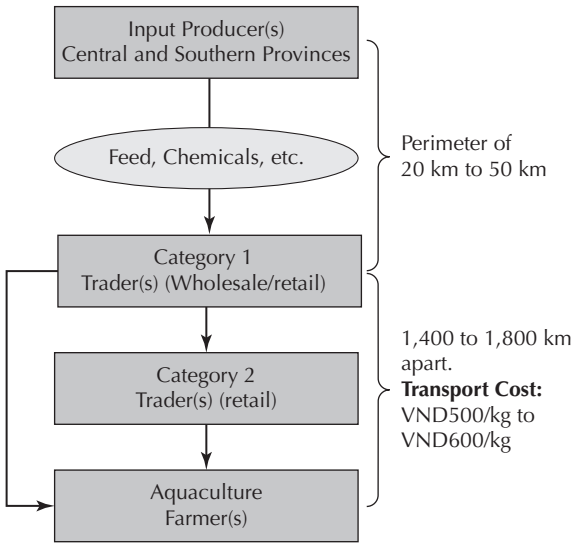
The hatchery has succeeded with the help of its Chinese technician to tightly control the amount of feed used without compromising farm yields. Its feed conversion ratio (FCR) fell from 1.4 in 2006 to 1.2 in 2007. A ratio of 1.0 is planned for 2008, which is internationally considered best-practice FCR for whiteleg shrimp. Also, the hatchery sources feed at competitive rates locally.

The trading company that supplies feed to the intensive shrimp farm is managed by a woman. She is a first-level agent for a Taiwanese feed mill based in southern Vietnam. A first-level agent, locally referred to as a category 1 agent, is typically one of few agents in a particular province who sources feed and other inputs at wholesale prices from a feed mill and then sells it at retail prices both directly from the storage centers and through his or her network of retail agents (see Figure 4.8).

For all practical purposes, it can be said the trader owns her trading business, although her trading license is tied to RCAS. In 2001, the management of RCAS selected a woman to run the feed trading business, while a man was chosen to manage the shrimp farming operations. The trader accepted the challenge, and agreed that RCAS could withhold her government-paid salary and charge her a nominal rent for the use of the center's facilities in return for her being able to use RCAS's trading license and start her trading business. She received support from her husband, and because she was seeking a loan higher than VND10 million (US$625), she mortgaged their house and provided a proof of land title to obtain a loan from the Vietnam Bank for Agriculture and Rural Development (AGRIBANK).

The value chain analysis for the feed trading business suggests that for an aggregate mix of four different types of feed that she carries on stock, her

Figure 4.8 Supply chain of a typical input trader in Quang Ninh



Source: Compiled from authors' interviews.

Figure 4.9 Feed trading value chain analysis, Quang Ninh, Vietnam

US$/Ton	Shrimp Feed Trading Cost $ 1.11					
Value	Raw Material	Transport	Storage	Marketing	Admin/ OH	TOTAL
Unit Value	0.97	0.03	0.01	0.04	0.06	$1.11
% of Total	87.2%	2.8%	1.0%	3.8%	5.1%	100%
VND/Ton	Shrimp Feed Trading Cost 17,766					
Value	Raw Material	Transport	Storage	Marketing	Admin/ OH	TOTAL
Unit Value	15,495	500	176	684	911	17,766
% of Total	87.2%	2.8%	1.0%	3.8%	5.1%	100%

Source: Compiled from authors' interviews.

average sourcing price of feed is VND15,495/kg (US$0.97/kg). After transport, storage, and marketing costs are accounted for, her breakeven (zero profit) price of feed at her store is VND17,786/kg (US$1.11/kg)(see Figure 4.9).[24]

She sells feed in a fully transparent fashion. Price lists are posted on the doors at her 30 m^2 store, where clients can see her sourcing prices and her network's sourcing prices, as well as retail prices. The average sales price for her aggregate mix of feeds sold is VND18,855/kg (US$1.18/kg), with a profit margin of 6 percent, or VND1,089/kg (US$0.07) (see Table 4.10). As a best-practice example, her store has been covered by local television and radio stations in an effort to promote transparent trading practices in the region. The trader, however, makes no money on feed sales to the intensive shrimp farm associated with RCAS. She supplies the farm with high-grade *vannamei* feed at purchase plus transport cost prices.

Is it therefore possible that this feed trader with relatively modest profit margins is at a disadvantage because of her gender when dealing with male managers of intensive farms? The value chain analysis suggests that while it is possible,

Table 4.10 Average Feed Sales Prices and Trade Margins, Quang Ninh

	VND/kg	US$/kg	
Purchase Price	15,495	$0.97	82%
COGS	2,271	$0.14	12%
Margin	1,089	$0.07	6%
Sales Price	18,855	$1.18	100%

Source: Compiled from authors' interviews.

it is unlikely. The fact that she sells feed at breakeven prices to the shrimp farm depicted in the value chain above is most likely related to the long-term relationship and affiliation that she has with RCAS. In fact, the trader says that she prefers male buyers to female ones: "Female buyers are too difficult to work with and pay very late. Male buyers buy 10 times more feed and respond much better to my threats of cutting them off my client list when overdue payments accumulate." Males account for 80 percent of her clients, females for 20 percent. It could be argued that women buy fewer quantities due to smaller size of their operations; tardy payments could be attributed to the difficulty of getting finances (e.g., bank loans, etc.) as outlined in the earlier parts of this study.

A closer look at this trader's sales mix reveals general directions of shrimp farming not only in terms of gender but also in terms of trends in the study area in relation to species farmed and farm intensity. Of the 70 tons total of feed that she sold in 2007, 60 percent of volume is high-protein-grade whiteleg shrimp feed, 30 percent is medium-grade whiteleg shrimp feed, and only 10 percent is low-grade giant tiger shrimp feed. This compares with the sales of the largest trader in the study area (annual sales of 3,000 tons, or 50 percent of the total feed market in the study area), which are all for whiteleg shrimp feed. This suggests that intensive farms in the study area are shifting en masse toward cultivating whiteleg shrimp, and only a limited number of semi-intensive farms still grow giant tiger shrimp.[25]

One of the major factors influencing this shift is that, under optimal conditions, *vannamei* is less expensive to feed both in terms of quantity of feed applied and of protein content of the feed (compare the FCR of 1.4 for *monodon* to 1.0 of *vannamei*). Moreover, *vannamei's* shorter growing period means that intensive farmers can potentially have two crops of *vannamei* per year; *monodon* generally has one crop per year. A range of other issues influence intensive farmers' decision to culture *vannamei* as opposed to *monodon*.

Energy—Highest Cost Driver after Feed The analysis suggests that farm profitability (estimated at 20% profit margin at current input prices) is considerably impacted by the cost of energy, which is the second-highest cost component for intensive shrimp farms. The energy cost comes from three main sources:

- Pumping water in and out of the pond during the pond preparation and harvesting stages
- Constant water exchange
- Constant aeration of the pond

Maintaining the quality of water in a densely stocked pond ecosystem is crucial. At stocking densities of 100 PLs/m^2 in an intensive farm, water exchange using electrical pumps and aeration using diesel-powered flaps constitute 22.7 percent of the production value chain, followed by pond preparation and maintenance (9.2%). The total energy expenditures in the 3.6 hectare farm are VND208.1 million (US$13,008), of which the electricity cost for water exchanges is VND125 million (US$7,812), and the diesel cost for aeration flaps is VND83 million (US$5,187). Although electricity prices of

US$0.06–0.11/kwh (off-peak/peak) are not high, the price of electricity charged by the state monopoly Vietnam Electricity (ENV) is expected to increase in 2008. ENV is not expected to be able to sustain the scheme of using the profit gained from hydropower plants to offset losses of its thermopower plants, especially as oil prices increase. Also, Vietnam plans to cancel state subsidies on all oil products, projected at nearly $1 billion in 2007, by the end of this year as it moves to liberalize the fuel market in line with its World Trade Organization (WTO) commitments. So, farmers can probably count on current diesel prices of US$0.9/liter for just one more crop, and by 2009 farm profitability will likely be significantly challenged by rising energy prices. In 2007, this particular farm had a net profit of US$16,470 (US$4,557/ha) on total farm revenues of US$81,250, with a respectable 20.3 percent profit margin.

Women's Challenges to Moving Up the Value Chain—Know-How, Finances, and Household Priorities Interviews suggest that the parts of the population in the study area that are enjoying relatively high profits from intensive farming are mostly male.[26] Of the estimated 150 intensive farms in the study area, only 2 are owned by women. Although interviews with these female farmers could not take place during visits in the study area, interviews with other stakeholders suggest that smallholder intensive shrimp farmers require aquaculture know-how and financial capabilities to be successful. One person that does have aquaculture know-how and who can potentially move from extensive to intensive farming is Ms. Thui, a typical female aquaculture specialist employee mentioned earlier in this report. She has a bachelor degree in aquaculture from a school in the central provinces, and her parents financed most of her 4-year education that cost VND20 million (US$1,250) in total.

Ms. Thui is employed by RCAS as an aquaculture technician alongside seven other women who work as researchers for other business/research units of the center. She has been assigned to work at the intensive shrimp ponds, where she is the only woman among nine men. Ms. Thui is learning much from the Chinese experts on feed efficiencies and other shrimp farming techniques, and could potentially have her own intensive farm one day. "I don't have the money, and it is too risky," she says. She earns US$63/month (VND1 million) as do most other men in the farm that are not on RCAS's government-funded payroll. One option for Ms. Thui is to establish her own small intensive farm. She and her husband already have a 720 m^2 semi-intensive shrimp pond that her husband manages. However, most of her savings that would be needed for her to even consider more intensive aquaculture were spent three years earlier to meet medical costs (VND9 million [US$562]). Her employer pays for her health insurance, which costs VND68,000 (US$4.25) per month, but because of her complicated medical conditions, she was treated at a facility not covered by her insurance. Though a more-detailed analysis of the functioning of the health care system and its impact on households in the study area is needed, all the farmers interviewed for this study are vulnerable to such risks. Poor and sometimes not-so-poor households are exposed to episodes of health care expenditures that are often catastrophic to their livelihoods.

Ms. Thui's income level and financial support from her parents has helped her avoid devastating health care–related debts. At the same time, however, she

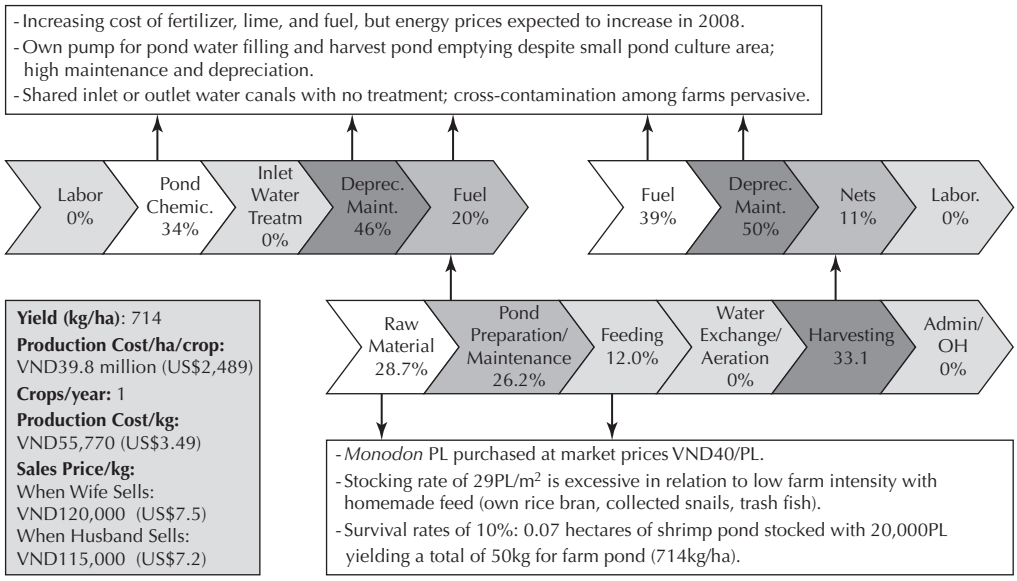
has no significant savings left to expand the family shrimp farming business. The option of borrowing from financial institutions exists, but she has not explored that route because her priority is to take care of her baby and because borrowing from financial institutions to shift from extensive to intensive aquaculture has many challenges. Having little to do with gender, these challenges are more related to how banks see Ms. Thui and her husband: as smallholder shrimp farmers. In the eyes of the banks, they are high-risk borrowers and there is generally a cap of VND10 million (US$625) that smallholders can borrow. Running costs per hectare of intensive shrimp farming run to hundreds of millions of Vietnamese dong, and funding at that level is limited.

Interviews with some of the major banks in the study area were undertaken to find out the prospects for people involved in aquaculture of borrowing money. AGRIBANK, possessing a 30 percent market share, is the biggest agricultural lender in the study area, with a portfolio of VND4 trillion (US$250 million). Interviews suggest that women are well represented in the bank's workforce (apart from executive positions) and that female borrowers do not face major barriers when dealing with banks. Most of the time, however, men apply for loans at AGRIBANK branches, whereas women, according to AGRIBANK officers interviewed, are more hesitant than men to apply for loans. Data from the bank suggest that no matter who applies, a limited amount of money is available to aquaculture farmers, both male and female. Only 4.2 percent of the bank's agricultural portfolio and only 2.5 percent of its total portfolio is composed of fishery industry loans (including aquaculture). According to bank officers, 2,500 households in the province are involved in aquaculture and not more than 25 percent of households are estimated to have borrowed money from any banks in the study area. Aquaculture loans are considered highly risky by all banks in the study area because the on-farm conditions are generally poor, crop losses are frequent, and the financial management capabilities of smallholders are reportedly low.

4.2.3.2.2 Improved Extensive Shrimp Farming

Improved Extensive Shrimp Aquaculture—A Limited Income Generator for Smallholders in the Study Area In a business environment where lending to smallholder aquaculture farmers is limited, some farmers borrow from loan sharks at interest rates of 5–10 percent per month (as opposed to 1.2–1.6% per month with the banks); other more fortunate smallholders who have a stable wage earner in the family rely on self-financing. Such is the case of a female small-scale extensive farmer of *monodon* shrimp in Hoang Tin district. Ms. Cuong is 50 years old and, typical for the study area, cultures the shrimp in a small plot (0.14 hectares). She has considered borrowing money from the bank but has given up because the most she could get is a VND10 million (US$625) loan with a 1-year term at a 1.3 percent monthly interest rate. Ms. Cuong, like all women interviewed for the study, is an exceptionally hard-working and entrepreneurial woman. She has a pig farm and rice farm besides her shrimp farming activities. Her husband works as a master mason in a booming construction sector and earns a respectable monthly salary of VND2.5 million

Figure 4.10 Giant tiger improved-extensive shrimp farming value chain, Northeast Vietnam



Source: Compiled from authors' interviews.

(US$156). With his savings, Ms. Cuong started the pig farm 10 years ago and gradually moved to other farming activities. She began shrimp cultivation three years ago.

Figure 4.10, typical for smallholders in the study area, suggests that shrimp farming for Ms. Cuong is a venture generating limited income. She cultures giant tiger shrimp in a 720 m^2 pond. As with all other families in Vietnam, the land is titled under her and her husband's name and was allocated to them by the commune on a household head-count basis. The entire family participates in shrimp farming activities. Her sons (ages 20 and 16) and her son-in-law (age 24), and her husband, when available, help during pond preparation and harvesting, collecting snails and trash fish that Mrs. Cuong then cooks together with rice bran, on a daily basis for at least three hours, and feeds to the shrimp two to three times per day.

Ms. Cuong's daughter (age 22) has recently given birth to a boy, and she looks after him and her younger brother (age 6) but also does the cooking for her extended family. The extended family, for the most part, lives in a 50 m^2 living compound adjacent to the pond.

At US$128, Ms. Cuong's income from her shrimp farming activities is not a significant source of revenue for the household. Ms. Cuong would not have been able to feed the family, pay for the children's education, or generate any savings from shrimp aquaculture if it were not for her husband's wages, livestock sales, and rice production that covers only part of the household's rice consumption. Ms. Cuong grows two crops of rice per year with contracted labor on her 1,440 m^2

plot adjacent to the shrimp pond. She gets a total of 1,600 kilograms from the of paddy in total (a yield of 5,556 kg/ha/crop) at a production cost of VND3,507/kg (US$0.22/kg). After all postharvest operations (such as thrashing, bagging, and milling) the household gets 1,120 kilograms of polished rice that is entirely consumed by the household. An additional 100 kilograms is purchased in the market.

Table 4.11 suggests that the rice farm makes a significant contribution to household expenditures, because Ms. Cuong and her husband purchase only a limited share of rice in the market, where rice prices are increasing. Prices rose from an average of VND8,000/kg (US$0.5/kg) in 2007 to VND12,000/kg (US$0.75/kg) by April 2008. The total annual cash expenditures for foodstuff, tobacco, and alcohol for her household of six (excluding the new born member) in 2007 was US$968.02, where as nonfood expenditures were US$946.25; both figures are significantly higher than the national average.[27]

By Vietnamese standards, therefore, Cuong's is a fairly well-to-do rural family. Yet, when per-household-member expenditure is considered, only US$0.44 per person per day is spent in the household for food and US$0.43 per person per day is spent on nonfood items such as education, health care, utilities, and so on. For many rural households, income from shrimp farming is not sufficient to meet even their generally low expenditures on food and nonfood items, and many farmers in the northeast cultivate other crops and/or raise livestock to diversify their sources of income and food.

In fact, in terms of revenue, the hog farm can be considered her primary farming activity, but when the level of effort in the farm is taken into account, Ms. Cuong spends at least half of the year in shrimp farming, where as the intensity of labor in the hog farm is fairly limited because hogs are entirely fed on commercial feeds. Yet the hog farm generates some VND30 million (US$1,875) in revenues (50% of family income).

The shrimp farm generates a meager 3 percent of her family's income, which suggests that due to poor farming practices and crop losses, aquaculture is for many families either a low-profit or a loss-making activity in the northeast. Data from the southern part of the country suggest that the situation there is similar (see Box 4.3).

As far as Ms. Cuong's family is concerned, there is very little doubt that having a good wage earner like her husband cushions any farm losses that she may have. Nevertheless, the household health care expenditure details reveal very few funds are left to meet emergencies of any kind (see Table 4.12). As is the case with many other families that are not insured in the national health insurance scheme, this particular rural household had out-of-pocket expenditures of VND3 million (US$187) for a throat surgery of the female head of household. For many rural households in Vietnam, such health emergencies strain their budgets significantly.

Small Farm with High Fixed and Increasing Running Costs The value chain analysis suggests that with a total production cost of VND38.9 million/ha (US$2,431) and a yield of 714 kg/ha, Ms. Cuong's production cost per kilogram of giant tiger shrimp is VND55,770 (US$3.49), with harvesting constituting 33 percent,

Table 4.11 Household Economic Profile of an Aquaculture Farmer in Northeast Vietnam

Household Economic Profile of an Aquaculture Farmer Family in Hoang Tin, Hai Duong Province, Vietnam			
Household Revenue	**VND**	**US$**	
Wage/month	2,500,000	$156.25	
No. of wage job workers/household	1		
Total annual household income from wage labor	30,000,000	$1,875.00	
Total household income from shrimp sales	2,063,333	$128.96	
Total household income from rice sales	0	$0.00	
Total household income from secondary farm sales—hogs	30,000,000	$1,875.00	
Total household income	***62,063,333***	***$3,878.96***	
Consumption Pattern			
Rice	**VND**	**$**	**% of Total**
kg/household/day	3.3		
No. household size (family members)	6		
price/kg—own production*	3,507	$0.22	
price/kg—market*	8,000	$0.50	
Rice cost/year (VND)	***4,704,329***	***$294.02***	***15.4%***
Other Consumables			
Vegetables per household (VND/week)	20,000	$1.25	
Total vegetable purchased per household (VND/year)	***1,040,000***	***$65.00***	***3.4%***
Rice Noodles and Eggs			
Noodles per household (1 kg/week)	12,000	$0.75	
Eggs per household (20/week)	30,000		
Total noodles and eggs (VND/year)	***2,184,000***	***$136.50***	***7.1%***
Meat (kg/household/week)	1.00		
Meat price (VND/kg)	70,000	$4.38	
Total meat cost (VND/month)	280,000	$17.50	
Total meat cost (VND/year)	***3,360,000***	***$210.00***	***11.0%***
Fish			
Fresh fish price—purchased at market (VND/kg)	10,000		
Consumption (kg/household/month)	20		
Total fresh fish cost/household (VND/year)*	***2,400,000***	***$150.00***	***7.8%***
Fish Sauce			
Fish sauce price/liter	10,000		
Consumption (kg/household/month)	3		
Total fish sauce cost/household (VND/year)	***360,000***	***$22.50***	***1.2%***
Tobacco and alcohol (VND/household/year)	***1,800,000***	***$112.50***	***5.9%***
Total Other Consumables Purchased (VND/year)	***10,784,000***	***$674.00***	***35.2%***
Total Consumables Purchased (VND/year)	**15,488,329**	**$968.02**	**50.6%**
Other Annual Expenditures			
Education	9,000,000	$562.50	***29.4%***
Health Insurance (school children)	140,000	$8.75	***0.5%***
Transportation	1,440,000	$90.00	***4.7%***
Utilities	150,000	$9.38	***0.5%***
Health Care/Medicine	3,500,000	$218.75	***11.4%***
Clothing	700,000	$43.75	***2.3%***
Other*	210,000	$13.13	***0.7%***
Total Expenditure	**30,628,329**	**$1,914.27**	***100%***
Net Household Profit	**31,435,005**	**$1,964.69**	
Net Household Profit without Livestock Sales	**1,435,005**	**$89.69**	
Net Household Profit without Wages and Livestock Sales	**28,564,995**	**−$1,785.31**	

Source: Compiled from authors' interviews.
Notes: *Own production covers only 92% of family needs; the rest is purchased at market.

Box 4.3 Role of Shrimp Farming in the Mekong Delta

"Shrimp contribute significantly to economic development in coastal rural regions. The exported value of shrimp product was US$662 millions in 2000 and US$1.3 billion in 2004. In Mekong Delta, 63.5% of households got better income from shrimp culture compared with five years ago. However, 22.5% of households were worse-off and 14% of this number could not improve their lives. [Shrimp] culture also ha[s] a number of negative impacts such a[s] increased gap in wealth and poverty levels in coastal communities. 61.6% of shrimp households were indebted from loans, average 22.6 VND millions (US$1,413) per household, 51.6% of indebted households went bankrupt in 2004; it caused high risk for bank activities. Recent studies show that 100% of intensive and semi-intensive shrimp farmer's livelihoods [are] based on shrimp culture, and shrimp play[s] an important role in the coastal communities of the Mekong delta. According to Newspaper of Vietnam Education, 15% of children in Vinh Chau district Soc Trang province dropped out of school because of failures in shrimp culture. They have to work for shrimp farming activities of their household or other farmers. The poor were often lost in shrimp culture due to low investment; they could not adapt technical requests. Many shrimp farmers were indebted by unsuccessful shrimp farming. They had not [had] an opportunity to loan from banks for shrimp production."

Source: "Environmental Management of Aquaculture Investments in Vietnam," Institute for Fisheries Management and Coastal Community Development, RIA1, Network of Aquaculture Centers in Asia-Pacific, June 2006.

PL seed 28.7 percent and pond preparation and maintenance 26.2 percent of total costs. Unlike intensive shrimp farming, semi-intensive and extensive farming do not involve aeration and water exchange. Nonetheless, the costs of pumping water into the pond, treating it with lime, and fertilizing it, as well as emptying the pond during harvest, are significant.

Table 4.12 Health Care and Education Spending Profile, Rural Aquaculture Household, Northeast Vietnam, 2007

Household Member (age)	Health Insurance (HI)	HI Cost (VND/ Year)	Doctor/Dentist Visit Freq/ Lifetime	Education Level	Education Spending/ Year VND
Wife (50)	No	265,000	1 per Year/ Never	Secondary	0
Husband (50)	No	265,000	Never/3	Secondary	
Son (20)*	Yes	85,000	Never/Never	Secondary	4,500,000
Son (16)*	Yes	85,000	Never/Never	Secondary	4,500,000
Daughter (22)	No	n.a.	Once/Never	Secondary	0
Grandson (<1)*	Yes	n.a.	Once/Never		0
Son-in-law	No	0	Never/Never	Secondary	0

Source: Compiled from authors' interviews.

*School children are insured through the school system fees, and children up to age of six get free health insurance.

Even though Ms. Cuong has a relatively small shrimp farming area, she owns her pump, for which she paid VND3 million (US$187), and maintains it on a yearly basis. Yearly maintenance increases her costs (50% of harvesting and 43% of pond preparation costs), especially because she lends the pump to her neighbors to use at no cost, although she maintains the pump herself. Moreover, the energy cost of running the pumps is significant (20% of pond preparation and 39% of harvesting cost) and is expected to increase once the government liberalizes the market for oil-based products. Although perhaps contracting a pump on usage basis instead of owning it may reduce the shrimp farming costs, Ms. Cuong has generally done what everyone else involved in shrimp farming has to do as far as pond preparation and harvesting are concerned. As is explained in the next section, however, the value chain analysis suggests that, as is typically the case for many smallholders, this particular farmer has incurred a higher cost of PL stocking than necessary.

Poor On-Farm Management Skills Ms. Cuong has stocked her 0.07-hectare shrimp pond with 20,000 PL-15s at a density of 28 PL/m^2. Although this stocking rate is appropriate for intensive farms that provide shrimp with concentrated feed and exchange and aerate water constantly, it is three to five times higher than the usual rate of stocking for extensive farms that typically stock from 5–10 PL per square meter. As a result of overstocking, Ms. Cuong not only increased her production cost by buying more PLs than she should have, but she also over stressed the shrimp environment and lost most of her crop—she got a total yield of 50 kilograms of shrimp and lost an estimated 200 kilograms. According to her, the level of pH in the farm fell too low and the shrimp died. "Our uncle, who operates a backyard hatchery, came one day with his salinity and pH meter and said we had to quickly harvest the shrimp as the shrimp are dying due to the low pH levels."

Last year Ms. Cuong attended a 1-day training course on livestock and aquaculture organized by the Women's United Association (WUA) but, like most other smallholder aquaculture farmers interviewed for this study, she would not know how to use a pH or salinity meter even if she had one. Typically, for women who receive some training in the study area, these courses are short and provide general knowledge regarding livestock and aquaculture farming. It did not provide her with much specific on-farm knowledge. Most of what she knows about shrimp farming comes from exchanges she has had with other farmers and from an 8-page booklet given to her by her uncle.

Women's Aquaculture Training Programs Exist but Are of Limited Duration and Coverage of Farming Population The two women heading the WUA in Quang Ninh were interviewed for this study in order to find out what type of aquaculture training in the study area is being provided to women like Ms. Cuong. WUA is a government-sponsored association that has 192,000 members who pay an annual membership fee of VND6,000 (US$0.3) to use its services.

The management of the association believes that women play an important role in the economy, including agriculture, but that only an estimated

20 percent of women in the study area have received some sort of training in agricultural practices. Some 78,000 WUA members participated in training courses, of which 13,000 members are involved in aquaculture. The bulk of the training is in the form of 1-day information dissemination courses (60% theoretical and 40% practical demonstrations). Longer-term courses delivered by the Research Center for Aquatic Sciences are provided to only a few members. WUA pays RCAS for the 3-month courses an estimated cost of VND600,000 per course per attendee (US$36). In the last three years, the association organized four 3-month aquaculture courses in which a total of 160 women, or 1.2 percent of WUA's member farmers involved in aquaculture, participated. Priority for these courses was given to members in remote areas. At VND600,000 per course per year, very few women can afford 3-month courses and neither WUA nor RCAS reports to have had any attendee that has paid for the course out of her own pocket.

Although no data exist on the total number of women engaged in aquaculture in the study area (no women's association of aquaculture producers exists), the research suggests that very few of them have received hands-on training that would increase their capacity to maximize returns. In conformity with government policy, WUA would like to move its aquaculture farming members from extensive to intensive farming. It supports its members by assisting with their loan applications at the Social Policy Bank that lends up to VND10 million (US$625) to WUA members. According to the WUA director, "WUA encourages women to participate in aquaculture because we find that it is always more beneficial than other farming activities, with the exception of disease outbreaks and crop losses for shrimp culture."

Smallholder Aquaculture out of the Government Sanitary Control System Interviews with the local veterinary station responsible for veterinary control in the study area suggest that the administrative capacity to control and certify the quality of smallholder shrimp is extremely low. Even though each farmer is required to have a veterinary/sanitary certificate before marketing their shrimp, due to the veterinary station's limited human and technical resources only very few farmers are issued such certificates. This suggests that smallholders are by and large cut off from the exporters' supply chain. Currently, the price of giant tiger shrimp that farmers get in the local supply chain is superior to the price offered by exporters. However, relying entirely on local demand for shrimp, which is concentrated in big cities and tourism centers, puts the farmers at risk of their produce being displaced by substitutes such as pork and other meats. Moreover, the adoption of whiteleg shrimp by intensive farms is expected to bring increased efficiencies to these farms (with yields of 15 tons/ha already achieved in some of them).

Increased efficiency on these intensive farms with whiteleg (*Vannamei*) shrimp will result in substantially lower production costs than smallholders with *monodon* shrimp, thus potentially crowding out demand for their product, not only from the exporters' supply chain but from the local supply chain as well. In this context, smallholder farmers' competitiveness is increasingly eroded by changes occurring in the marketplace.

Fish Aquaculture Less Risky than Shrimp Aquaculture for Smallholders For many smallholders, to increase their competitiveness is virtually impossible without (1) a quality supply of *monodon* seed (PL) and (2) improving their on-farm management. Take, for example, the case of Mr. Nguyen. A typical extensive shrimp farmer in the Yeng Hun District of Quang Ninh, he spontaneously entered shrimp aquaculture three years ago but has never made a profit from it. Nguyen then attended a 3-month training course on rice-cum-fish farming organized by Danish International Development Agency (DANIDA). He has financed his aquaculture activities via a 3-year term loan from the Social Policy Bank at a 0.65 percent monthly interest rate, which he finally repaid in 2007 after three years of servicing.

However, because he failed to get a new loan in 2008, he has applied for a new VND10 million (US$625) 3-year term loan with AGRIBANK at 1.45 percent monthly interest, but has not heard from the bank yet. As there is no association for men similar to WUA that could help him borrow money from financial institutions, by April 2008 his only hope of funding was from the War Veteran's Association, although he had not heard from them yet and the "shrimp need feed."

The value chain analysis of his shrimp and fish farm suggest that while Mr. Nguyen can rely on fairly good seed for his farmed carp, the same cannot be said for his giant tiger shrimp. He used his own pump to fill the limed pond with water. He knows how to use a salinity meter and borrowed one from the local backyard hatchery. He reported to the hatchery that the salinity level at his pond was 4ppt and the hatchery, in turn, acclimatized the *monodon* PL to Mr. Nguyen's pond-level salinity. After five days, he got a call to come pick up the PLs. He went to the hatchery (14 km from his farm) with his motorbike to pick up the PLs, already stored in oxygenated plastic bags and packed in a Styrofoam box. He purchased his PL at a price of VND40/PL (the price in 2008 increased to VND45/PL) and stocked his pond.[28]

Smallholder Poor On-Farm Management Cuts across Gender—Excessive Stocking in Male-Headed Farms Table 4.13 suggests that feeding constitutes 50.2 percent of the production value chain, followed by raw material cost (21.0%) and harvesting (11.2%). Although Mr. Nguyen used a significant amount of commercial feed (350 kg purchased at an average price of VND20,000/kg [US$1.25]) as well as homemade feed, he reports to have stocked his 0.35ha shrimp pond with 80,000 PL-15s, or 22.8 PL/m^2. This stocking level is typical for intensive farms but is unusually high for improved-extensive farms that use no water exchange or aeration (indeed, 23 PL/m^2 is a high stocking rate even for semi-intensive farms that use some form of water exchange and/or aeration). As was the case with Ms. Cuong, Mr. Nguyen's overstocking of the pond suggests that the on-farm practices of both male and female aquaculture farmers reveal a lack of understanding of some of the basic principles of shrimp farming, such as determining appropriate stock density. Shrimp are complex organisms to culture, and without a focused effort to provide extension services to smallholder shrimp farmers, the farmers' suboptimal on-farm decision-making processes, combined with poor on-farm management,

Table 4.13 Value Chain for Smallholder Aquaculture, Shrimp and Fish, Northeast Vietnam							
Shrimp—*Monodon*—Major Crop Failure, 2007							
US$/Ha/crop	**Shrimp Farming Cost $2,725.87/ha/crop**						
Value	**Raw Material**	**Pond Preparation/ Maintenance**	**Fertilizing**	**Feeding**	**Harvesting**	**Admin/OH**	**TOTAL**
Unit Value	$571.43	$279.59	$98.21	$1,367.86	$304.85	$103.93	**$2,725.87**
% of Total	21.0%	10.3%	3.6%	50.2%	11.2%	3.8%	**100%**
US$/Kg	**Shrimp Farming Cost $13.63/kg**						
Value	**Raw Material**	**Pond Preparation/ Maintenance**	**Fertilizing**	**Feeding**	**Harvesting**	**Admin/OH**	**TOTAL**
Unit Value	$2.86	$1.40	$0.49	$6.84	$1.52	$0.52	**$13.63**
% of Total	21.0%	10.3%	3.6%	50.2%	11.2%	3.8%	**100%**
VND/Kg	**Shrimp Farming Cost $218.069/kg**						
Value	**Raw Material**	**Pond Preparation/ Maintenance**	**Fertilizing**	**Feeding**	**Harvesting**	**Admin/OH**	**TOTAL**
Unit Value	45,714	22,367	7,857	109,429	24,388	8,314	**218,069**
% of Total	21.0%	10.3%	3.6%	50.2%	11.2%	3.8%	**100%**

Table 4.13 Value Chain for Smallholder Aquaculture, Shrimp and Fish, Northeast Vietnam (*Continued*)							
Fish—*Carp*, 2007							
US$/Ha	**Fish Farming Cost $755.64/ha**						
Value	**Raw Material**	**Pond Preparation/ Maintenance**	**Fertilizing**	**Feeding**	**Harvesting**	**Admin/OH**	**TOTAL**
Unit Value	$535.71	$107.14	$-	$-	$27.42	$85.36	**$755,64**
% of Total	70.9%	14.2%	0.0%	0.0%	3.6%	11.3%	**100%**
US$/Kg	**Fish Farming Cost $0.20/kg**						
Value	**Raw Material**	**Pond Preparation/ Maintenance**	**Fertilizing**	**Feeding**	**Harvesting**	**Admin/OH**	**TOTAL**
Unit Value	$0.14	$0.03	$-	$-	$0.01	$0.02	**$0.20**
% of Total	70.9%	14.2%	0.0%	0.0%	3.6%	11.3%	**100%**
VND/Kg	**Fish Farming Cost 3,134.50/kg**						
Value	**Raw Material**	**Pond Preparation/ Maintenance**	**Fertilizing**	**Feeding**	**Harvesting**	**Admin/OH**	**TOTAL**
Unit Value	2,222.22	444.44	-	-	113.76	354.07	**3,134.50**
% of Total	70.9%	14.2%	0.0%	0.0%	3.6%	11.3%	**100%**

Source: Compiled from authors' interviews.

very often lead to major crop losses that substantially hurt their household economies.

Major Crop Failure Due to Disease without Skills to Address Key Challenges Typical for smallholder farmers, Mr. Nguyen does not know what disease struck his shrimp pond in early June, but his description of having seen necrotized black shrimp suggests that black gill disease or black shell disease may have been at fault. He harvested 70 kilograms of shrimp (or 200 kg/ha) from his farm, and by his estimation, another 250 kilograms of dead, diseased shrimp were at the bottom of the pond. Dead or diseased shrimp are not easily observed in a pond, and farmers very often do not learn that their shrimp have died until harvesting, when they find only a few shrimp left in the pond. Nguyen, however, sampled his shrimp regularly and knew disease had struck by early June, which is why he stopped feeding the shrimp. "Luckily for me, the shrimp died one month before harvest and I did not spend more feed on them," says Mr. Nguyen. Unluckily for him, he did not know what disease struck his shrimp nor did he know how to treat it. What was potentially devastating for his neighboring farmers is that Nguyen's outlet water canal is commonly shared with all other farmers in his village, and when he harvested what he could of his shrimp in late June, he could have been passing on whatever disease struck his farm to other farmers. Although we have no data to correlate neighboring farms' losses with Nguyen's practice, this behavior at smallholder level is pervasive. Moreover, Mr. Nguyen actually never removed the diseased shrimp from the bottom but just left them there as his farm has no sludge treatment and deposit area.

The previous two years, Mr. Nguyen had also suffered major losses due to white spot disease, and when asked whether he thinks the PL quality is responsible for his continuous crop losses and inability to turn a profit, Nguyen does not have any particular opinion on the PL apart from its rising price. Interviews suggest that although Mr. Nguyen sourced PL from the same local backyard hatchery for three consecutive years, he still failed to inquire about their quality, a behavior replicated by the other farmers. As many aquaculture specialists suggested, even if Mr. Nguyen and other farmers had the best possible shrimp seed, this would not be a sufficient condition for operating a successful farm. Without a system of on-farm, bio-safety controls, pathogen-resistant or pathogen-free seed stock is of very little use.

In fact, like many of the smallholders interviewed, Mr. Nguyen's management of his farm is sloppy. The pond's structure, particularly the bottom, is poorly managed, thereby creating ideal conditions for parasites, the accumulation of debris in shrimp gills, and spread of fungus. Moreover, the contamination of water inputs from the discharges of other farms is very likely. Not only are untreated water discharges common for many ponds and rice fields, but also in many cases farmers discharge water in hazardously close proximity to each other's farm inlet water. The interviews, for example, illustrate one farmer's decision to empty his pond by extracting water with a hose, and then to place the hose over the common irrigation canal and dump water in a ditch on the other side of the canal. Some water lands in the ditch and some water inevitably

ends up seeping into the canal. However, no neighboring farmer seems to mind this practice as everybody else does it.

In such a context, domesticated *monodon* seed stock that is resistant to some pathogens could be potentially helpful for farmers to avoid crop losses. However, pathogen-resistant seed stock cannot be considered a panacea for the current smallholder farming environment in Vietnam. Due to their poor on-farm management skills, smallholder farmers in Vietnam degrade their farms' bio-safety as much as, if not more than, pathogen-carrying seed stock. As the value chain analysis in the above pages suggests, due to his nearly complete crop failure Mr. Nguyen's production cost of shrimp was VND218,069/kg, or US$13.63/kg. At this cost level, he inevitably faced significant financial losses.

As the farmer's household economic profile in Table 4.14 shows, the family had to liquidate its assets in the form of two cows in order to maintain expenditures on food, children's education, and other household needs.

Table 4.14 suggests that 32.5 percent of household expenditures are for rice, 20.0 percent for education, and 10.7 percent for the family's limited meat consumption. Mr. Nguyen also farms carp in his 0.35-hectare pond that yields a total of 1,350 kilograms of fish, 150 of which are for household consumption, with the remaining 1,200 for sale in the market. Fish aquaculture for him is, therefore, a major contributor to both the food intake and income of his household. Shrimp aquaculture in the study area, on the other hand, is never undertaken for consumption purposes (at sales prices of VND80,000 (US$5) to VND120,000 (US$7.5) per kilogram, shrimp is too expensive to consume) but is purely an income-generating crop. However, income generation from shrimp aquaculture is far from certain as it entails a significant risk of crop failure that can quickly throw farmers like Nguyen into poverty and debt.[29]

Given the risks associated with it, the puzzling aspect is why smallholder farmers continue to cultivate shrimp. The value chain analysis suggests that barring any major crop failures, the economics of shrimp farming are compelling for farmers. At a price level of VND52,078/kg (US$3.25/kg), farmer's profits can be as high as US$1,358 per year (see Table 4.15).

In reality, however, Mr. Nguyen had neither a disease-free crop nor the highest price for his shrimp. As a result, his losses were substantial (see Table 4.16).

Limited Training and Extension Services Cut across Gender—Male-Headed Farms Have Poor Access to Training and Extension The second variable is disease leading to major production losses. Although Mr. Nguyen has not experienced such losses in the previous three years, interviews suggest that the odds of getting a bumper crop are stacked against smallholders like him, male or female. With a disease-free crop, his costs of production could be reduced to VND52,078/kg (US$3.25), but this does not take into account the costs of improving his and his neighbors' farm management skills as well as of sourcing pathogen-resistant *monodon* seed, the two key prerequisites for a failure-free crop.

Table 4.14 Household Economic Profile, Shrimp and Fish Farmer, Northeast Vietnam

Household Economic Profile of an Aquaculture Household in Yeng Hun District of Quang Ninh			
Household Revenue (2007)	**VND**	**US$**	
Market Wage/day (physical labor)	40,000	$2.50	
No. of days worked/year/person	0	$-	
No. of wage job workers/household	0	$-	
Total household income from wage labor	0	$-	
Total household income from crop sales	1,403,571	$87.72	
Shrimp	(9,664,857)	$(604.05)	
Fish	8,968,429	$560.53	
Total household income from secondary farm sales - two cows, 20			
chicken	22,000,000	$1,375,00	
Total household income	***22,707,143***	***$1,419.20***	
Consumption Pattern (2007)			
Rice	**VND**	**$**	**% of Total**
kg/household/day	2		
No. household size (family members)	5		
price/kg (VND)	8,000		
Rice cost/year (VND)	***5,840,000***	***$365.00***	***32.5%***
Other Consumables			
Vegetables per household (VND/week)	35,000		
Total vegetable purchase per household (VND/year)	***1,820,000***	***$113.75***	***10.1%***
Rice Noodles and Eggs			
Noodles per household (1 kg/week)	12,000		
Eggs per household (5/week)	8,000		
Total noodles and eggs (VND/year)	***1,040,000***	***$65.00***	***5.8%***
Meat (kg/household/week)	1		
Meat price (kg)	40,000		
Total meat cost (month)	160,000		
Total meat cost (VND/year)	***1,920,000***	***$120.00***	***10.7%***
Fish			
Fresh fish price—purchased at market (VND/kg)*	10,000		
Fresh fish price—own production cost (VND/kg)*	3,134		
Consumption (kg/household/month)	12		
Total fresh fish cost/household (VND/year)**	***451,368***	***$28.21***	***2.5%***
Fish Sauce			
Fish sauce price/liter	9,000		
Consumption (kg/household/month)	3		
Total fish sauce cost/household (VND/year)**	***324,000***	***$20.25***	***1.8%***
Tobacco and alcohol (VND/household/year)	***240,000***	***$15.00***	***1.3%***
Total Non-Rice Consumables Purchased (VND/year)	***5,795,368***	***$362.21***	***32.2%***
Total Consumables Purchased (VND/year)	**11,635,368**	***$727.21***	***64.7%***
Other Annual Expenditures			
Education	3,600,000	$225.00	***20.0%***
Health Insurance (school children)	150,000	$9.38	***0.8%***
Transportation	1,200,000	$75.00	***6.7%***
Utilities	480,000	$30.00	***2.7%***
Health Care/Medicine	200,000	$12.50	***1.1%***
Clothing	500,000	$31.25	***2.8%***
Other	210,000	$13.13	***1.2%***
Total Expenditure	**17,975,368**	**$1,123.46**	**100%**
Net Household Profit	**4,731,755**	**$295.74**	
Net Household Profit without Secondary Farm Sales	**(17,268,225)**	**$(1,079.26)**	

Source: Compiled from authors' interviews.
Notes: *All fish needs met from own production.

Table 4.15 Potential Income for a Smallholder from Shrimp Aquaculture, Northeast Vietnam

Household Economic Profile of an Aquaculture Farmer						
	In VND per year		In US$ per year		Sales Price (VND/kg)	
Sales/Year	Low Price	High Price	Low	High	Low Price	High Price
Shrimp	25,600,000	38,400,000	$1,600.00	$2,400.00	80,000	120,000
Fish	12,000,000	13,200,000	$750.00	$825.00	10,000	11,000
Gross Profit (VND/year)	**37,600,000**	**51,600,000**	**$2,350.00**	**$3,225.00**		
Production Cost/Year	**Production Cost (VND/year)**					
Shrimp	16,664,857		$1,041.55			
Fish	4,231,571		$264.47			
Total Production Cost/Year	**20,896,429**		**$1,306.03**			
Net Profit/Year						
Shrimp	8,935,143	21,735,143	$558.45	$1,358.45		
Fish	7,768,429	8,968,429	$485.53	$560.53		
Total Net Profit/Year	**16,703,571**	**30,703,571**	**$1,043.97**	**$1,918.97**		

Source: Compiled from authors' interviews.

Unable to contain diseases, smallholder shrimp farmers hope for, but very often fail to achieve, the full income potential of shrimp farming. In fact, the actual incomes from smallholder shrimp farming in Vietnam are typically low (see Table 4.16).

The acquisition of modern aquaculture on-farm management skills is beyond the reach of smallholders. As was illustrated earlier, extension advice and assistance from private input suppliers is often unreliable. Namely, both of the smallholder shrimp farmers highlighted above stocked excessive seed, and neither reported to have received advice to the contrary from their seed suppliers. A trained technician, local or expatriate, costs VND2–3 million per month to hire (US$125–187), which is well beyond smallholder financial resources. As a result, the latter are largely dependent on the public sector for support services—training and extension—to help them acquire on-farm management skills.

As discussed in the institutional support section of this report, the investment in public extension networks has increased but remains low, resulting in

Table 4.16 Actual Income for a Smallholder from Shrimp Aquaculture, Northeast Vietnam

Household Economic Profile of an Aquaculture Farmer						
	In VND per year		In US$ per year		Sales Price (VND/kg)	
Sales/Year	Low Price	High Price	Low	High	Low Price	High Price
Shrimp	$5,600,000	$7,700,000	$350.00	$481.25	−$80,000	$110,000
Fish	$12,000,000	$13,200,000	$750.00	$825.00	$10,000	$11,000
Gross Profit (VND/year)	**$17,600,000**	**$20,900,000**	**$1,100.00**	**$1,306.25**		
Production Cost/Year	**Production Cost (VND/year)**					
Shrimp	$15,264,857		$954.05			
Fish	$4,231,571		$264.47			
Total Production Cost/Year	**$19,496,429**		**$1,218.53**			
Net Profit/Year						
Shrimp	−$9,664,857	−$7,564,857	−$604.05	−$472.80		
Fish	$7,768,429	$8,968,429	$485.53	$560.53		
Total Net Profit/Year	**−$1,896,429**	**$1,403,571**	**−$118.53**	**$87.72**		

Source: Compiled from authors' interviews.

inadequate coverage of the farm population. It is no surprise that none of the smallholder farmers interviewed for this report have ever had a visit from an extension worker. As a result, farmers' aquaculture skills are as good as the skills of their neighbors in the village. Table 4.17 presents farmers' perceptions of the importance of related institutions in southern Vietnam (data for the study area are not available). The value chain analysis suggests that in respect to certain issues such as borrowing a pump or other tools, village-level support among farmers is important, but as far as on-farm management is concerned, relying on "common" village knowledge about aquaculture can be as counter productive, if not more so, as having no informed advice at all. In this context, government efforts to substantially increase the regional and district extension budgets and staffing is crucial for smallholder shrimp farmers to be able to make informed decisions about their farm activities.

Table 4.17 Farmers' Perceptions of the Related Institutions on the Coast from Travinh to Camau, South Vietnam

Institution	Ranking of the Importance Level (1 = First, 17 = Last)	Ranking of the Level of Relationship (1 = Very close, 2 = Medium, 3 = Far)
Neighbor	1	1
Hamlet/village officers	2	1
Bankers	3	3
Farmers' club	4	1
TV/radio	5	2
Farmers' cooperative/enterprise	6	2
Output traders	7	3
Women's union	8	3
Extension workers	9	3
Input providers (seed, feed, chemicals)	10	3
Development projects	11	3
Private lenders	12	3
Veteran's union	13	2
Youth union	14	3
Coast Guard station	15	2
Forest patrolling station	16	3
Pagoda	17	2

Source: Sinh 2004.

4.2.3.2.3 Extensive Shrimp Farming

In the Tieng Phong area of Quang Ninh, along one of the most beautiful bays in the world, some 1,000 hectares of mangroves are under large-scale extensive cultivation with native giant tiger shrimp. Individual farms range from 25 to 120 hectares, and 25 farmers lease this land every five years. All farm renters are men. Their first tenure was from 2002 to 2007 and they renewed their lease in 2008. Because they are local residents of the area, these farmers were given priority by the authorities to apply for and receive land tenure in 2002 and are given priority each time the latter is up for renewal. In 2008, 100 farmers applied to gain access to these farms and only one of them was a woman (from the neighboring province of Hai Phong). Tenure was awarded to the 25 incumbents who renewed their 5-year leases.

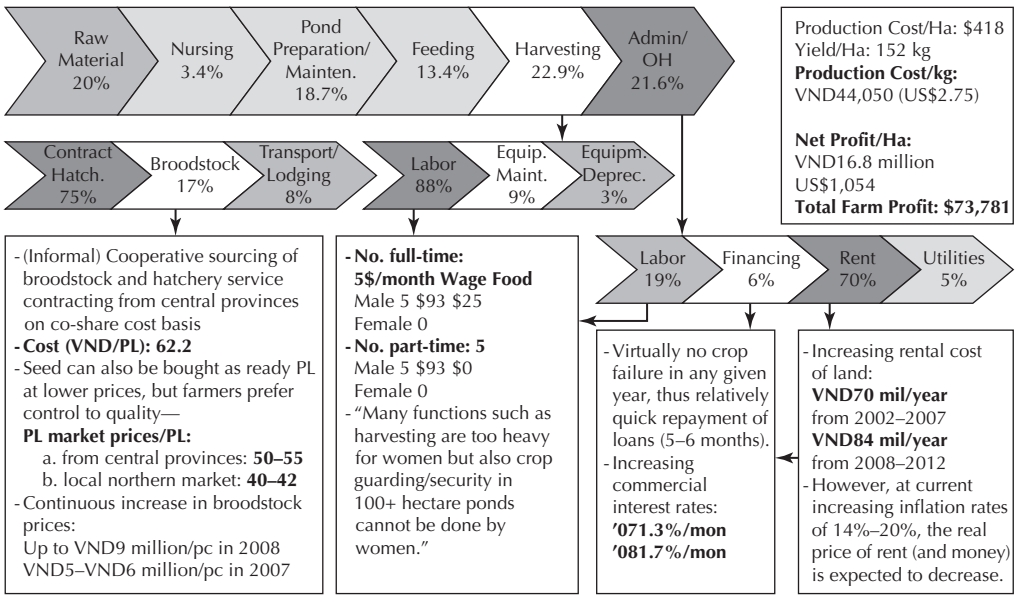
Large-Scale Extensive Shrimp Aquaculture—A Profitable Opportunity Available to a Few Incumbent Men When asked why women do not own large-scale farms in Tien Phong, male farmers there are generally bewildered by the question.

In their opinion, "What difference does it make who owns the farm? We all work here and the benefits are for the entire family." Interviews suggest that both women and men in the study area are equally involved in family-level decision making on essential household needs (children's education, food expenditures, etc.). At the same time, when and if additional disposable income is available from farming activities, generally the men decide where and how the additional funds will be allocated. When asked why women do not operate or manage large-scale extensive farms, the men have no trouble answering that question. Although both women and men work on these farms, according to one farmer, "For this type of extensive 50+ hectares large-scale farming, men are needed to protect against poaching as well as physical security. It's a hard job."

The value chain analysis of an extensive large-scale shrimp farm (see Figure 4.11) suggests that other issues than on-farm security make it difficult for women to engage in this type of aquaculture. Most of these bottlenecks, in fact, take place before the farming stage is ever reached. As can be seen from Figure 4.11, administration and overhead costs constitute the highest cost (21.6%) in the chain, followed by harvesting (22.9%) and raw materials (20.0%).

High Establishment and Running Costs beyond the Rural Women's Networking Capabilities The harvesting stage involves mostly male labor (88% of the harvesting cost), which can be hired equally by women and men in the labor market on a permanent or seasonal basis. But at the administrative and

Figure 4.11 Large-scale extensive *monodon* shrimp aquaculture



Source: Compiled from the authors' interviews.

raw material sourcing stages of the value chain in the extensive setups, disparities appear in the capacity of men and women to fulfill their tasks. Specifically, even before the farm lease is acquired, it costs VND20 million (US$1,250) just to apply for the lease. Assuming that one can get such a lease, it costs another VND84 million (US$5,250), or VND12 million (US$750) per hectare, with a year's rent having to be prepaid at the start of the year. Additionally, an informal association with surrounding farmers is required in order to set up electricity lines to connect these farms to the power grid. It costs an estimated VND10 million (US$625) per farmer to bring utility lines from the nearest utility switch to the farm. Likewise, from VND5 to 6 million per hectare (US$312–375) is needed to operate a farm, with these farms coming in large contiguous plots that have to be rented on an as-is basis (the smallest pond that could be rented in this area was 20 hectares). Thus, for a typical 50-hectare farm, VND250–300 million (US$15,625–18,750) is needed to operate the farm.

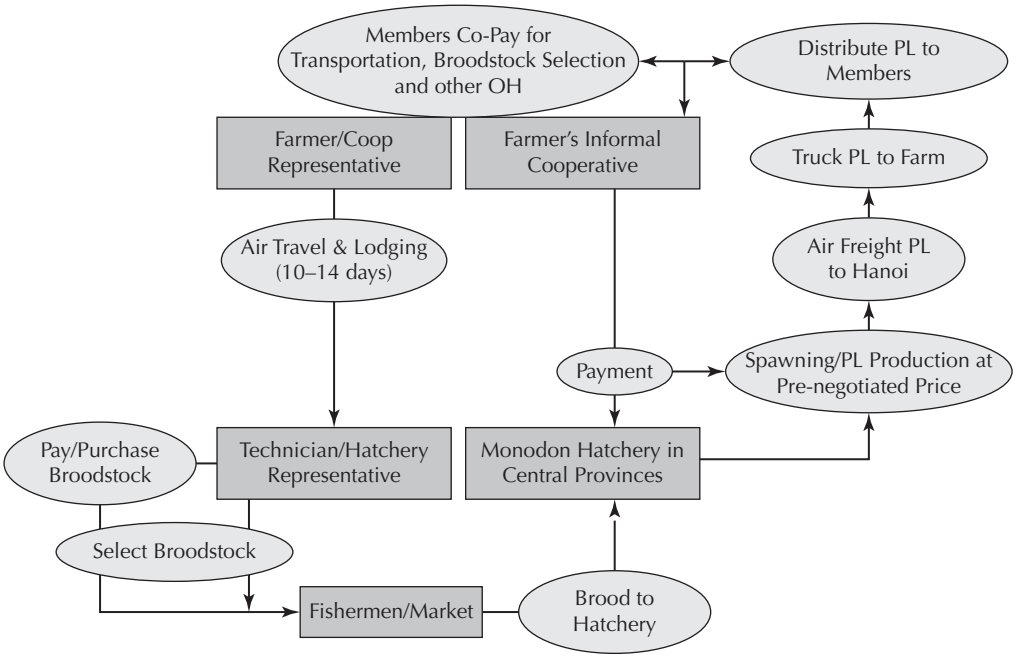
Interviews suggest that for this level of funding, for about 80 percent of farmers, a combination of commercial loans as well as informal borrowing from moneylenders and friends is needed. Knowing the managers of local banks is essential for getting a commercial loan in the order of hundreds of millions of Vietnamese dongs, and establishing networks with local moneylenders is equally important. In contrast to the men, the majority of the women interviewed for this study do not have these networks. Opportunities for women to get to know and establish working relationships with local bank managers who in most cases are male are few.

By the same token, accessing credit informally though moneylenders also requires the ability to create mutually beneficial relationships with thembased on trust and a long-term track record of credit worthiness. Interviews suggest that whereas female farmers very rarely borrow from informal sources, some female traders do tap into the network of informal credit, albeit most of the time for small amounts of funds required for short-term operations such as the daily or weekly funds needed for shrimp collection during peak seasons. But when bigger sums are involved, the informal borrowing network, like the formal one, remains a man-to-man business.

Well-established networks combined with mobility are what are needed at the raw material sourcing stage as well (20% of the value chain). Again, such networks are something that women in the study area lacked.[30] Specifically, even though the PL stocking rates are low (2–5 PLs/m^2), the farming areas at large-scale farms are expansive and require significant investments for sourcing PLs. In this particular example, 1.5 million PLs were stocked in 70 hectares. Large-scale intensive farmers report that they do not trust the local hatcheries or traders for the supply of *monodon* PLs and neither do they trust the traders sourcing from hatcheries in the central provinces. "If you want to get good seed, you go there [to central provinces] and get it yourself," says one farmer. In fact, that is what 12 farmers in Tien Phong have done (see Figure 4.12).

The farmers have created an informal association that selects one member to go to the central provinces and to contract both the selection of captive brood

Figure 4.12 Supply chain *monodon* PL from the central provinces to Northeast Vietnam



Source: Authors' interviews.

stock as well as the hatching service. The selected farmer spends 10–14 days in the central provinces, and once the PLs for all 12 farmers are ready, oversees the transportation of the PLs to Hanoi via air and from Hanoi to the farms via trucks. The costs associated with sourcing the PLs are then shared on an equal basis among the 12 farmers and, as the value chain analysis suggests, these costs constitute 8 percent of the raw material costs, in addition to the brood stock cost (17%), and the hatchery contracting cost (75%). The analysis also suggests that even though the PL cost per unit through direct farmers' involvement in the supply chain is higher than it would have been had they sourced the seed locally through traders or hatcheries (VND62.2/PL as opposed to VND40–55/PL, depending on source), the money was well spent. No farmer had any crop losses, and although per hectare yields were relatively low (400–500 kg) the cost of producing the shrimp involving relatively low natural feed inputs remained low at VND44,050/kg (US$2.75). The ability of large-scale farmers to control the quality of the seed through direct sourcing must be considered a key competitive advantage of this type of farming because it is based on collaborative sourcing of raw material.

Cooperatives Controlled by Men Because there were no women involved in this type of shrimp farming in the study area, one cannot tell whether women would be able to engage in direct sourcing of PL from the central provinces. Considering the fact that women's mobility in the reported area is much lower than that of men, women would most probably rely on local traders and

hatcheries rather than spend 10–14 days in the central provinces in order to contract PL production. But because large-scale extensive production does not take place in standalone one-farmer plots, but is done in continuous mangrove coastal areas alongside a group of farmers, women would be able to pool their resources for direct seed, contracting just the same as the 12 men illustrated in this case did. In fact, all large-scale extensive farmers interviewed for this report say that they would have nothing against co-sharing costs with women farmers in their informal cooperative, but one can only speculate about how and whether this cooperation would function.

The value chain associated with large-scale shrimp farming suggests that the ability of farmers, formally or informally, to associate in order to improve the quality of inputs such as seed and electricity yields better results than when farmers operate independently, as is the case with smallholder farmers cultivating improved-extensive shrimp. Yet, only a limited number of formal aquaculture cooperatives were established in the study area as of 2005. Quang Ninh has reported 16 such cooperatives out of a total of 132 cooperatives in the province, or 12 percent of the total. Countrywide, 7,310 cooperatives constituting 6.9 million members exist, of which 235 (or 3.2%) are aquaculture cooperatives. No gender-disaggregated data about the membership exist. One of the particularly striking features of the national statistics on cooperatives is that the Mekong Delta, responsible for 69 percent of the total volume of aquaculture production in Vietnam, had only 67 aquaculture cooperatives in 2005, which represents just 28 percent of the country's total.

Although no data exist on the number of men and women who belong to aquaculture cooperatives, field interviews suggest that men manage and control these cooperatives. The national census from 2001 identifies that of the 7,171 heads of agricultural cooperatives in Vietnam, only 165 of them (or 2.4%) were women. Northeast Vietnam reported the highest representation of women in the top management of cooperatives, although this was still very low at 5.6 percent of the total. In contrast to the pre-reform period when cooperatives were government-owned, participation in today's cooperatives is not based on centrally planned appointments. Members' willingness and ability to contribute to the cooperative in terms of providing equity and working capital, thus becoming shareholders in the cooperative, is an important factor in supporting the development of the latter.

As seen in Table 4.18, even though women were well represented in the workforce and management of publicly run cooperatives, their participation in the privately held cooperatives apparently decreased because they tended to be more cautious about the shift.

Today, Vietnamese cooperatives are fully member-owned and self-financed, and no government financing is involved. Membership is entirely voluntary and services are offered in return for membership fees. Irrigation, the most popular service, is offered by 81 percent of cooperatives,[31] followed by plant protection (57%) and inputs supply (46%). Some new services such as farm product processing and marketing, internal credit, clean water supply, and waste collection have been provided since the change.

Table 4.18 Shrimp Marketing Losses to a Smallholder—Wife vs. Husband Marketing of Shrimp	
Total Shrimp Sold (kg)	50
Shrimp Market Prices	**VND/kg**
Grade 1	120,000
Grade 2	80,000
Grade 3	60,000
Actual Sales Prices—Husband	**VND/kg**
Grade 1—70% of Volume	115,000
Grade 2—0% of Volume	75,000
Grade 3—30% of Volume	55,000
Total Revenue from Sales—VND	4,850,000
Total Revenue from Sales—USD	**$303.13**
Estimated True Market Value—VND	5,400,000
Estimated True Market Value—USD	**$337.50**
Suboptimal Marketing—Cost (USD)	$34.38
Suboptimal Marketing—% Value Lost	10.2%
Medical Treatment Cost, Wife	$187.50
Suboptimal Marketing Losses Husband	$34.38
Total Cost	**$221.88**
Source: Compiled from authors' interviews.	

4.2.3.3 Fish Farming

Fish farming is one of the fastest-growing aquaculture subsectors in Vietnam. Alongside shrimp, aquaculture of fish species in fresh and brackish water environments is the major contributor in Vietnam's aquaculture production volumes and exports (mainly catfish and carp species). Fish aquaculture production is growing faster than any other major farmed culture in Vietnam and has almost tripled from 2001 to 2006 (from 420,000 to 1,150,000 tons) compared to roughly doubling of shrimp production during the same period (from 160,000 to 350,000 tons in 2006). Many smallholder farmers, male and female, see good returns from fish aquaculture farms in their neighborhoods in the study area and takeup fish farming in increasing numbers. Fewer disease instances and high suitability for farming in mixed environments in combination with rice or other crops makes fish aquaculture a more lucrative activity.

4.2.3.3.1 Smallholder Fish Farming

A value chain analysis of a small-scale female fish farmer typical for the study area is presented in Table 4.19. As with many other smallholders interviewed,

Table 4.19 Value Chain for Smallholder Fish Polyculture Farming in Northeast Vietnam, 2008

Fish Polyculture—Smallholder							
US$/Ha	Fish Polyculture Farming Cost $1,094.38						
Value	Raw Material	Pond Preparation/Maintenance	Fertilizing	Feeding	Harvesting	Admin/OH	TOTAL
Unit Value	$312.50	$ -	$ -	$618.75	$28.13	$135.00	**$1,094.38**
% of Total	28.6%	0.0%	0.0%	56.5%	2.6%	12.3%	**100%**
US$/kg	Fish Polyculture Farming Cost $1.09						
Value	Raw Material	Pond Preparation/Maintenance	Fertilizing	Feeding	Harvesting	Admin/OH	TOTAL
Unit Value	$0.31	$ -	$ -	$0.62	$0.03	$0.14	**$1.09**
% of Total	28.6%	0.0%	0.0%	56.5%	2.6%	12.3%	**100%**
VND/kg	Fish Polyculture Farming Cost 17,510.00						
Value	Raw Material	Pond Preparation/Maintenance	Fertilizing	Feeding	Harvesting	Admin/OH	TOTAL
Unit Value	5,000	-	-	9,900	450	2,160	**17,510**
% of Total	28.6%	0.0%	0.0%	56.5%	2.6%	12.3%	**100%**

Source: Compiled from authors' interviews.

this particular smallholder had the ability to borrow money from local banks, but only in limited amounts. In this case, the female farmer secured a 2-year, VND15 million (US$937) loan from AGRIBANK (at a 1.2% interest rate per month) and VND5 million (US$312) through the Women's Union from the Social Policy Bank (at 0.5% per month).

This investment can result in an anticipated yield of 1,000 kg/ha of fish polyculture and a production cost of VND17,510/kg, or US$1.09. As a result, the farmer can potentially generate up to VND25 million (US$1,574) net profit in 2008 should the anticipated yields and average sales prices for her polyculture carp species of VND35,000/kg materialize. At this level of profit, fish farming for this farmer becomes a significant contributor to family income, unlike the cases of smallholder farmers highlighted in the section above who cultivate shrimp.

As seen in Table 4.20, a potential increase in aquaculture income plays a crucial role in the ability of the household to afford not only basic necessities but also to be able to fund education, healthcare and other essential expenditures. This smallholder farm is run by a woman who is a single mother of two. This family suffered a major loss in 2007 when the male head of the family was killed in a motorcycle traffic accident. As a result, the female head of the family struggles to makes ends meet. The farmer contracted labor in 2007 to grow one crop a year of paddy in her lowland 1.44 hectares, and also engages in fish trading. But, as Table 4.20 suggests, net income from rice cultivation is very limited at US$720 per year.

The farmer had already switched from rice to fish polyculture in 2008, with the hope of getting better profits than the US$720 she gets each year from rice. Until the fish is harvested, however, the family budget has to be complemented by children's economic activities. The farmer's 18-year-old daughter dropped out of high school upon the death of her father and helps with the family income by stitching fishing nets and sewing fashionable women's accessories for a local trader under contract. The child's work provides major support to the smallholder farmer/trader, and her contribution to the family's income is between 32 and 34 percent, depending on quantity of fish traded in the market.

Poor Farm-Management Perpetuated in Smallholder Fish Farming Somewhat similar to shrimp farming, smallholders that farm fish also exhibit poor on-farm management. Because fish polyculture involves stocking different species of fish in the same pond, successful farming for these systems depends on the ability to control/balance fish reproduction through introduction of cross-predatory species as well as other factors. This particular farmer does not keep records of what types of fish are stocked, and her choice of species is based on information from neighboring farms. Feeding and other maintenance decisions are mostly made on the criteria of fund availability. The value chain analysis suggests that feeding costs represent 56.5 percent of the total cost of producing fish, but not enough information is available to shed light on whether the optimal balance of feeding has been maintained on the farm.

Table 4.20 Household Economic Profile for a Single Female Head of Household with Two Children, 2007

Household Economic Profile of a Rice Farmer and Fish Trader					
	Sales Volume (VND/Year)		US$		
Sales/Year	**Low Price**	**High Price**	**Low**	**High**	
Rice Paddy	30,000,000	30,000,000	$1,875.00	$1,875.00	
Fish Trading	210,000,000	252,000,000	$13,125.00	$15,750.00	
Fish Nets	1,800,000	2,000,000	$112.50	$125.00	
Contract Sewing	12,000,000	12,000,000	$750.00	$750.00	
Gross Profit (VND/year)	**241,800,000**	**284,000,000**	**$15,112.50**	**$17,750.00**	
Production Cost/Year	Production Cost (VND/year)				
Paddy	18,470,400	18,470,400	$1,154.40	$1,154.40	
Fish Trading	203,500,000	243,500,000	$12,718.75	$15,218.75	
Fish Nets	1,000,000	1,000,000	$62.50	$62.50	
Contract Sewing	3,600,000	3,600,000	$225.00	$225.00	
Total Production Cost/Year	**226,570,400**	**266,570,400**	**$14,160.65**	**$16,660.65**	
Net Profit/Year					**% of total**
Paddy	11,529,600	11,529,600	$720.60	$720.60	39%
Fish Trading	6,500,000	8,500,000	$406.25	$531.25	29%
Fish Nets	800,000	1,000,000	$50.00	$62.50	3%
Contract Sewing	8,400,000	8,400,000	$525.00	$525.00	29%
Total Net Profit/Year	**20,729,600**	**20,929,600**	**$1,701.85**	**$1,839.35**	100%

Source: Compiled from authors' interviews.

In this context, the need for extension support of smallholder fish farmers is as pressing as for smallholder shrimp farming.

Lower Risk of Major Crop Losses than in Shrimp Farming According to field interviews, no major crop losses are reported in fish farms in the study area. In this particular smallholder farm, the full fish harvest is yet to be completed, and the precise mortality rate from stocking to harvest is yet to be determined. The farmer acknowledges some level of mortality has most probably taken place, but it is very unlikely the farmer will ever be able to establish the precise mortality rates. During the interviews, the farmer did not leave an impression that she is concerned with finding out precise mortality rates. What matters most to the farmer is that the intermittent fish yields appear to be good. According to the farmer who collects/trades fish as well, fish grows well in and around the area where she is based and no major diseases and other problems have occurred. Unlike shrimp farmers, fish farmers can rely on a relatively steady supply of seed stock in terms of quality from local hatcheries. The fish gene pool is well maintained and researched by the aquaculture research institutes.

The value chain analysis interviews suggest that availability of qualitative seed stock, combined with the fact that fish are generally less demanding to grow than shrimp in terms of on-farm bio-safety requirements, make fish farming for smallholders less risky than shrimp farming. Even though shrimp is more valuable than fish, the value chain suggests that unless major efforts are made to reduce the major risk factors such as unreliable seed stock quality and poor-on farm management, shrimp farming among smallholders is likely to decrease and be replaced with other crops, including fish.

Although the growth of shrimp aquaculture remains robust, its slower pace of growth compared to fish has created major disruptions in the processing side of the supply chain. As shrimp exports boomed, shrimp processing establishments mushroomed throughout the country. Now, most of these establishments have cut their output by 30–50 percent of capacity due to a shortage of raw materials. The shrimp industry has resorted to shrimp imports to increase capacity utilization and has asked the government to exempt shrimp imports from tariffs.

Reports suggest that fish processors are going through the same curve, with increased processing capacities to accommodate growing production and exports of fish, according to the Ministry of Agriculture and Rural Development. In 2008, the industry was believed to have exported 1.2 million tons of tra and basa catfish, netting roughly US$1.2 billion, up 20 percent over 2007. An eventual shortage of raw materials, however, could be even tougher on the catfish industry compared to the shrimp industry. Although Vietnam can import raw shrimp from nearby countries like Thailand, India, and China, it has no outside source for raw tra and basa catfish as the fish are native only to Vietnam. In this respect, sustaining the growth of fish farming by increasing access to credit and extension support is crucial.

Table 4.19 suggests that, alongside feeding and fingerling raw material costs, the third highest cost component of the female-operated smallholder fish farm is overhead costs. These overhead costs are entirely associated with the interest

payments on the farmer's AGRIBANK loan. Although accessing these loans was not reported to be particularly difficult on the part of the female farmers, one of the financing problems reported by the smallholders is that banks cap loans at VND5 million (if accessed via Women's Union) to VND10 million (US$312–624). Only in a few cases did smallholder farmers report VND15 million bank financing. As a result, expanding aquaculture farms to medium- and large-scale aquaculture is beyond most smallholders' abilities unless increased amounts of credit are provided through banks or other supporting institutions.

4.2.3.3.2 Large-Scale Fish Farming

As with shrimp farming, the value chain analysis shows that men are more likely than women to expand fish farms via a combination of informal and formal borrowing. The value chain analysis in Table 4.21 illustrates a male-ownedand-operated large-scale fish farm in the northeastern province of Ha Tay. Unlike the female smallholder farmer, this large-scale farmer employs modern on-farm management techniques and tools, uses industrial feed and exchanges, and aerates his ponds. Like the smallholders, however, this farmer has been able to access only short-term financing from banks. Even though the loan size is reported by large-scale farmers to be a problem (in this case a VND4 billion (US$250,000) loan was obtained with a VND6 billion (US$375,000) collateral), the bigger problem reported by aquaculture farmers is the short, 2-year term that banks offer for their loans. Equally troublesome for large-scale farming is the inability of farmers to secure land leases from local authorities beyond 5-year terms. As a result, large-scale farmers are unable to plan their growth and put up large investments in their farms beyond a few crop cycles.

With a yield of 10,960 kilograms of polyculturefish (mainly carp species) and production cost of US$13,815.97 per hectare, the production cost of fish at the large-scale farm is VND20,169/kg (US$1.26/kg). Compared to smallholders, the production cost of polyculture fish is higher, but the yield differential is also substantially higher.[32] Thus, although a smallholder fish farmer may generate up to US$1,500 annual net profit (at estimated yields of 1,000 kg/ha and average land size of one hectare), a large-scale farm illustrated in the value chain analysis above generates US$10,611 in net profit for each of its 12 hectares under polyculture ponds, or US$127,341 per polyculture fish farm per year.[33] This particular farmer has an additional four hectares of ponds in blackhead carp monoculture and is expanding his aquaculture as well as his fruit crop and ornamental tree farming.

According to the farmer, however, the expansion has been at a "slower pace than preferred." The farmer started aquaculture on five rented hectares in 1993, and it has taken him 15 years to reach his current 30 hectares of fish, fruit, and ornamental tree farms. Today, he employs 30 people (17 men and 13 women) who are paid an average VND1.4 million monthly salary (US$87), but "if I did not have shortage of land and external financing, I would have expanded faster and employed many more than 30 people sooner rather than later," says the farmer.

Table 4.21 Value Chain for Large-Scale Fish Polyculture Farming, Northeast Vietnam, 2008

Fish Polyculture — Largescale								
US$/Ha	Fish Polyculture Farming Cost $13,815.97/Ha							
Value	Raw Material	Nursing	Pond Preparation/ Maintenance	Feeding	Water Exchange/ Aeration	Harvesting	Admin/OH	TOTAL
Unit Value	$918.75	$405.00	$1,342.71	$6,693.75	$183.54	$433.75	$3,838.47	**$13,815.97**
% of Total	**6.7%**	**2.9%**	**9.7%**	**48.5%**	**1.3%**	**3.1%**	**27.8%**	**100%**
US$/kg	Fish Polyculture Farming Cost $1.26/kg							
Value	Raw Material	Nursing	Pond Preparation/ Maintenance	Feeding	Water Exchange/ Aeration	Harvesting	Admin/OH	TOTAL
Unit Value	$0.08	$0.04	$0.12	$0.61	$0.02	$0.04	$0.35	**$1.26**
% of Total	**6.7%**	**2.9%**	**9.7%**	**48.5%**	**1.3%**	**3.1%**	**27.8%**	**100%**
VND/kg	Fish Polyculture Farming Cost 20,169.30 VND/kg							
Value	Raw Material	Nursing	Pond Preparation/ Maintenance	Feeding	Water Exchange/ Aeration	Harvesting	Admin/OH	TOTAL
Unit Value	1,341	591	1,960	9,772	268	633	5,604	**20,169**
% of Total	**6.7%**	**2.9%**	**9.7%**	**48.5%**	**1.3%**	**3.1%**	**27.8%**	**100%**

Source: Compiled from authors' interviews.

The example of an individual largeholder farmer above suggests that the land lease and financing policies are hampering the growth and employment generation in the large-scale fish aquaculture sector in the study area. It is anticipated that improving access to land and credit to large-scale farmers will lead to increased investments and growth in large-scale fish aquaculture.[34]

4.2.3.3.3 Marine Cage Culture Farming

Marine cage culture in the study area of Quang Ninh developed rapidly into a cluster from one successful farmer cultivating pearl oyster in the 1990s. The popular type of cages used in the Quang Ninh, Hai Phong, Ba Ria-Vung Tau, and Kien Giang are plastic-based net cages measuring $3 \times 3 \times 3$ meters in size, although an increasing number of farmers use metal-based cages. Target species are mainly mollusks, grouper, cobia, lobster, snapper, sea bream, and sea perch. The cage culture has exhibited fast growth in recent years. The total number of lobster cages, for example, in 1999 in Vietnam was 7,289 (producing 425 tons) and increased to 17,215 in 2000 (with 921 tons produced). By 2005, this figure soared to 43,516 cages (including 3,061 hatching cages), with the production of 1,795 tons.[35]

The value chain analysis of a marine cage aquaculture producer in Van Don, presented in Table 4.22, is a typical illustration of how women in the study area can succeed in aquaculture, given the right tools and conditions. Ms. Tuyen is 34 years old and has a B.A. degree in Tourism and Hotel Administration. Prior to moving to Halong in Quang Ninh, she worked in Hanoi managing office spaces leased by a property agency in Hanoi and earned a base salary of $500–600 per month plus commissions when she brokered deals. In 2002, she married an aquaculture engineer who now manages the National Extension Center in the province. After giving birth, she came back to her native city of Halong and started a hotel with three other friends from Hanoi.

By 2003, the hotel was doing well, but Ms. Tuyen, who works long hours at the hotel, decided to make use of her husband's aquaculture training to start a grouper and snout otter clam marine culture in Bait Tu Long Bay. She and her husband, who is an aquaculture specialist, prepared the project, and the local government awarded them a rent/tax-free lease for a 4-hectare area for 30 years. With VND300 million (US$18,750) of her own funds and with her skills to negotiate credit terms with banks, she borrowed an additional VND200 million (US$12,500) through a local commercial bank on a 5-year fixed-term loan at 1.2 percent interest per month. Of all loans reported to have been taken by farmers, processors, traders, and other people interviewed during field visits, this is by far the best deal that anyone, male or female, received from a local bank. This suggests that the ability of aquaculture farmers to tap into the formal credit markets for large loans is not necessarily a function of the borrower's gender as it is a function of the ability of borrowers to provide a low-risk profile to lenders. This female farmer had both substantial collateral in the form of a hotel, as well as a credible business plan backed up by farm expertise through her husband.

Table 4.22 Marine Cage Aquaculture Value Chain, Northeast Vietnam

Marine Aquaculture—*Grouper*							
US$/ kg	Grouper Farming Cost $4.46/kg						
Value	Raw Material	Cage Construction	Seeding/ Stocking	Feeding	Harvesting	Admin/ OH	TOTAL
Unit Value	2.31	0.82	0.06	0.57	0.12	0.59	**$4.46**
% of Total	**51.8%**	**18.5%**	**1.3%**	**12.7%**	**2.6%**	**13.2%**	**100%**
VND/ kg	Grouper Farming Cost 71,330/kg						
Value	Raw Material	Cage Construction	Seeding/ Stocking	Feeding	Harvesting	Admin/ OH	TOTAL
Unit Value	36,933	13,183	924	9,054	1,848	9,388	**71,330**
% of Total	**51.8%**	**18.5%**	**1.3%**	**12.7%**	**2.6%**	**13.2%**	**100%**
Marine Aquaculture—*Mollusks*							
US$/ kg	Mollusks' Farming Cost $1.15/kg						
Value	Raw Material	Cage Construction	Seeding/ Stocking	Feeding	Harvesting	Admin/ OH	TOTAL
Unit Value	0.45	0.63	0.03	-	0.01	0.04	**$1.15**
% of Total	**38.8%**	**54.7%**	**2.6%**	**0.0%**	**0.6%**	**3.4%**	**100.0%**
VND/ kg	Mollusks' Farming Cost 18,439/kg						
Value	Raw Material	Cage Construction	Seeding/ Stocking	Feeding	Harvesting	Admin/ OH	TOTAL
Unit Value	7,152	10,081	475	-	106	625	**18,439**
% of Total	**38.8%**	**54.7%**	**2.6%**	**0.0%**	**0.6%**	**3.4%**	**100.0%**

Source: Compiled from authors' interviews.

Once she secured the funding, Ms. Tuyen set up the farm with the help of her husband. The farm (see Table 4.22 for productions costs) generates VND187 million (US$11,718) in gross revenues per crop for grouper and VND701 million (US$43,828) per crop for mollusks.[36] As Table 4.22 illustrates, the three main costs associated with marine cage farming are raw material (for example, seed stock), cage construction, and administrative overheads.

Steady and Qualitative Raw Material Supply with Limited Risk of Crop Failures The cost sharesin marine cage aquaculture vary depending on the type of culture farm. Seed stock and raw material costs constitute 52 percent of grouper farming costs compared to 39 percent for mollusks. Grouper stocking densities are much lower than those for mollusks (15.4 grouper fingerlings to 686 rice-grain-size mollusks per m^3), but the combination of the higher per unit price of seed stock and lower yield per cubic meter (on average 9–10 kg of grouper compared to 34–35 kg of oysters per m^3) makes the ultimate seed stock cost per unit of output higher for grouper than for mollusks marine cage aquaculture.

Notwithstanding the raw material price differences for various systems, one of the key success factors of marine cage aquaculture is the fact that crop failures are virtually nonexistent. Mortality rates in these systems are low (10% for mollusks and even lower than that for grouper, mostly in case of natural disasters, for example, typhoons). Availability of small fish, algae, and other natural foods in the marine environment makes marine cage culture growing environments safer than land-based ones. Feeding costs are significantly reduced in these systems as well; 13 percent of total costs of grouper farming costs are feed-related, and mollusk farming requires no feeding at all.

High Setup Costs—High Profitability One of the key disadvantages of marine cage cultures is that they are not financially viable for most households. In order to culture fish or mollusks in marine environments, cages must be constructed. Cages, which can be metal frames (for fish) or plastic trays (for mollusks), are sunk vertically into the sea and have a high cost of construction/purchase, maintenance (at least twice a year), and replacement (every three years). The value chain analysis suggests that the cost of cage construction (including maintenance and replacement costs) constitutes over half of mollusks farming cost and approximately one-fifth of grouper farming cost. Again, the difference in cage construction costs is related to the setup cost difference between the two different cultures (grouper cages are big 27 m^3 metal constructions, whereas mollusks cages are small 0.05 m^3 plastic trays). Also, mollusks have a longer cultivation period (15–16 months) than grouper (7–10 months) and higher cage replacement costs (both metal and plastic cages are replaced after three years).

Despite the high setup costs, marine cage cultures are highly profitable. Grouper sells for VND150,000 (US$9.4) per fish (average weight of 1.25 kg/fish) and provides VND80.5 million (US$5,031) in net profits for this particular farmer outlined in this study, or 43 percent profit margin. Mollusks generate VND 424.6 million (US$26,541) net profit per crop, thus providing a net profit margin of 61 percent. This suggests that for households in coastal areas, a consideration should be given to stimulating marine cage aquaculture.

4.2.4 Fish Marketing and Processing

4.2.4.1 Household Marketing of Farm Produce

Typical for the study area, women market aquaculture produce in a variety of ways: directly on the farm, off the farm through an intermediary, or at the final points of sale or consumption. The value chain analysis suggests that women play a crucial role both in terms of optimal marketing of aquaculture farm produce from the farm to the trader or collector, as well as in terms of maximizing sales revenues when produce is sold from the trader or collector to the intermediate or final customer. It should be particularly noted, smallholder aquaculture households lose income when men market produce, as opposed to women.

In the particular case that Table 4.22 illustrates, the wife had to attend the local clinic for a throat infection on the very day shrimp had to be harvested, and it fell upon her husband to market the shrimp. Due to his marketing in experience, the price he negotiated with a local collector was VND5,000 (US$0.31) less per kilogram than what his wife would have been able to negotiate. Interviews suggest that, among smallholders, women play a crucial role in the marketing of shrimp, fish, and other aquaculture produce. In this particular case, an estimated 10.2 percent of the farm gate value of shrimp was lost when the woman in the family could not market it.

4.2.4.2 Aquaculture Collectors/Traders

Women play an equally important role in collecting aquaculture produce from farms and selling it in the market, which is why rural farming households thoroughly depend on female members to deal with other women and successfully market farm produce. In this context, the expenditure data suggest that an overall improvement in terms of providing affordable health insurance to rural households and increased awareness about existing government-sponsored health insurance plans is anticipated to reduce the high burden of health care expenses for household members, as well as improve returns from product sales where the health of women is concerned.

A typical shrimp trader (referred to in Vietnam as a "collector") in the study area is a married couple with a motorbike, who generally collect aquaculture products within a 50 km radius of their residence. The husband usually drives the bike and provides physical security for the cash and collected seafood. The wife negotiates both the purchase prices at the farm(s) and the selling price at the market.

Table 4.23 suggests that the purchasing costs of between 100 (off-peak season between late June to October) and 400 kilograms (peak season between May and June) of *monodon* shrimp per day constitute the highest cost for the collector (90.3% of the value chain), followed by transportation costs (0.6%), and storage and cooling costs (0.5%).

One feature of the shrimp collection value chain is that the typical profit margin for collecting shrimp and delivering it to market vendors or restaurants

Table 4.23 Farm-to-Market Shrimp Collection/Trade Value Chain Analysis, Northeast Vietnam

US$/kg	Farm-To-Market Shrimp Price $4.84/kg *Monodon*						
Value	Raw Material	Storage/ Cooling	Transport	Quality Control	Marketing	OH/ Margin	TOTAL
Unit Value	4.38	0.02	0.03	-	-	0.42	**$4.84**
% of Total	**90.3%**	**0.5%**	**0.6%**	**0.0%**	**0.0%**	**8.6%**	**100%**
VND/kg	Farm-To-Market Shrimp Price 77,500/kg *Monodon*						
Value	Raw Material	Storage/ Cooling	Transport	Quality Control	Marketing	OH/ Margin	TOTAL
Unit Value	70,000	350	503	-	-	6,647	**77,500**
% of Total	**90.3%**	**0.5%**	**0.6%**	**0.0%**	**0.0%**	**8.6%**	**100%**

Source: Compiled from authors' interviews.

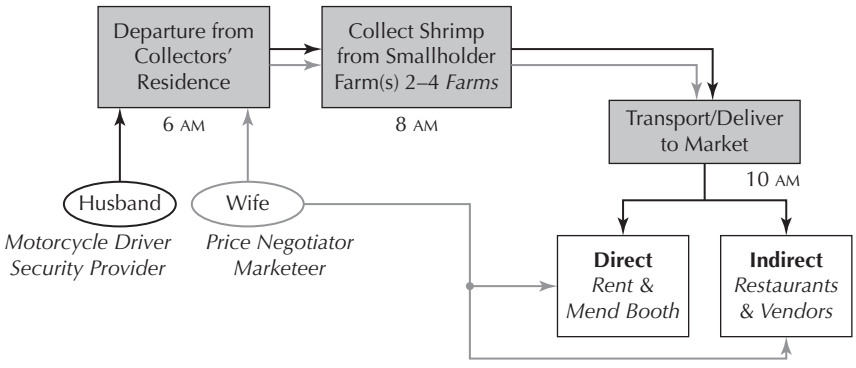
is relatively modest: approximately 8.6 percent.[37] Collectors thus perform a vital function of connecting smallholder farmers with the marketplace at a reasonable price (see Figure 4.13). However, there is no post harvest quality control system in place before the shrimp reaches the final customer, in this case a local restaurant, individual buyer at a seafood market, or small street or highway vendor.

4.2.4.3 Fish Processing

4.2.4.3.1 Women in the Labor Force/Management Structure

Most of the formal employment in aquaculture-related industries is in the fishery processing, where most of the employees are female; estimates indicate

Figure 4.13 Shrimp collector's supply chain



Source: Compiled from authors' interviews.

Table 4.24 Labor Structure and Pay, Seafood Processing Company, Northeast Vietnam				
Number of Employees	**400**		**Salary (VND/Month)**	
Managerial	**20**	% Of Total	**High**	**Low**
Male	13	65%	3,000,000	
Female	7	35%	3,000,000	
Direct	**380**			
Male	40	11%	2,500,000	1,000,000
Female	340	89%	2,500,000	1,000,000
Source: Compiled from authors' interviews.				

85–90 percent (see Table 4.24 for a seafood processing plant). However, as interviews suggest, women are not represented in the management structures of these firms.

The seafood processing and exporting companies interviewed in the study area were not willing to share much information about either their production or gender relations within their firms. According to the management of big seafood processing firms, women are unionized and their labor interests are well protected by the unions. However, secondary data suggest that labor is allowed to organize only under the auspices of government-run unions. In its drive to increase private domestic and foreign investment in the country, the government maintains tight control over the labor unions, which very often fail to maximize member benefits for fear of alienating investors. In an environment with double-digit inflation, employees in the industrial sector face significant reductions in their purchasing power and as a result, major disruptions in industrial activity occur throughout the country.

For example, the job of de-heading shrimp in the processing line, which is typically performed by female employees, provides an average wage of VND1 million per month (US$63) in 2007. Depending on the location, one could, on average, purchase 125 kilograms of rice, the staple food for most Vietnamese. Rice was selling at an average price of VND12,000 per kilogram in the study area in April–May 2008, and a salary of VND1 million could bring 83.3 kilograms of rice to the dining table (see Table 4.25). Although there is no information about whether any pay increases are fore seen in 2008 in this particular seafood processing plant, the purchasing power of the industrial workforce in the fishery processing sector, which is majority female, has continued to decline. Even though no labor disruptions have been reported in the study area, interviews suggest that without major pay increases, Northeast Vietnam will be swept by major labor disruptions that are already taking place in different industries in other parts of the country.

One processing plant that was willing to share extensive data for this study is a large fish sauce factory, a former state-owned cooperative (SOC) that was

Table 4.25 Declining Purchasing Power of Industrial Workers in Fishery Processing, 2007

	2007		2008	
	VND	US$	VND	US$
Rice Price/kg	8,000	$ 0.50	12,000	$ 0.75
Monthly Salary	1,000,000	$ 62.50	1,000,000	$ 62.50
Monthly Salary in kg Rice	125.00		83.33	
% difference in Rice Purchasing Power—No				
Pay Increase			−50%	
Estimated Pay Increase From Previous Year			<50%	

Source: Compiled from authors' interviews.

*No wage difference is reported between female and male workers, although the decline in purchasing power is mostly correlated with female workers who predominate in the workforce of fishery processing firms.

sold to its employees in 2000. Prior to the sale, women had held the vast majority of positions among the labor force and management, but there after it became a male-dominated company. As was typical for publicly owned cooperatives, at the time of sale, 25 employees were men (mostly collectors of fish from the local fishermen), 75 were women (mostly involved in processing), and the administration consisted of 13 people (7 women and 6 men).

In 2000, the government offered to privatize the cooperative with the following conditions:

- Existing employees had priority for ownership, if they could put together a bid.
- The value of the co-op was VND1 billion (US$62,500), and the government would reduce the sale price by VND700 million (US$43,750) if the employees placed a bid.
- The co-op would take all of the assets (building, land, equipment) and liabilities at the quoted price.
- Incumbent employees were granted severance pay of VND10 million (US$625).

Of the 100 employees who worked in the co-op prior to privatization, not many were keen to risk their own money by purchasing shares in it. Fish sauce stocks were low (it takes two years to replenish stock), and many employees preferred to retire early and receive the VND10 million (US$625) in compensation. Women, says Mr. Thao, the current CEO of the company, were particularly risk-averse and the company's chief accountant, deputy director, and many technicians eventually bailed out. Men were more willing to keep the co-op going, so in the end roughly 50 percent of all male employees (12 men) and only 20 percent of female employees (15 women) put up a bid and became joint stock owners of the company (27 people).

Mr. Tao's own career path to become a major stakeholder and CEO in the company is a telling example of some of the major challenges faced by women when aspiring to significant management and ownership roles in the fisheries sector. Mr. Tao had borrowed VND10 million (US$625) from friends at the time of privatization and put up some of his own savings, and he became one of the majority owners in the firm. From 2001 to 2007, he went to Nia Qan University in central Vietnam to take part-time courses in fishery processing "so that I could keep up with the new developments," he says. It cost him an estimated VND17 million (US$1,100) to upgrade his skills.

By 2006, Mr. Tao was elected CEO and Chair of the Executive Board, and further increased his ownership in the company through informal borrowing from his friends. Prior to privatization, there were five (three men and two women) Executive Board members, but after two female Board members chose not to join the new company, the Board was reduced to three male members. With their ability to borrow informally and their high mobility, men were clearly in a more advantageous position than women to obtain a controlling management and ownership stake in the new company.

The company today is a profitable business, and the value chain analysis presented in Table 4.26 suggests that issues such as the high cost of bottling material, brand name theft by informal low-quality fish sauce producers, and the significant price increases of captured fish (mackerel price increased from VND3,000/kg [US$0.19] in 2006 to VND13,000 [US$0.81] in 2008) remained major challenges for the company.

This case illustrates the general trend in Vietnam of low participation and ownership rates in cooperatives and other types of joint-ownership arrangements, which have emerged in the post-liberalization environment. However, as this example illustrates, male control of recently privatized fish processing companies and cooperatives was more a result of women's reluctance to take risks and invest money in the privatized enterprise than of any explicit effort on the part of their male coworkers to push them out of the ownership structure.

4.2.4.3.2 Women in the Supply Chain

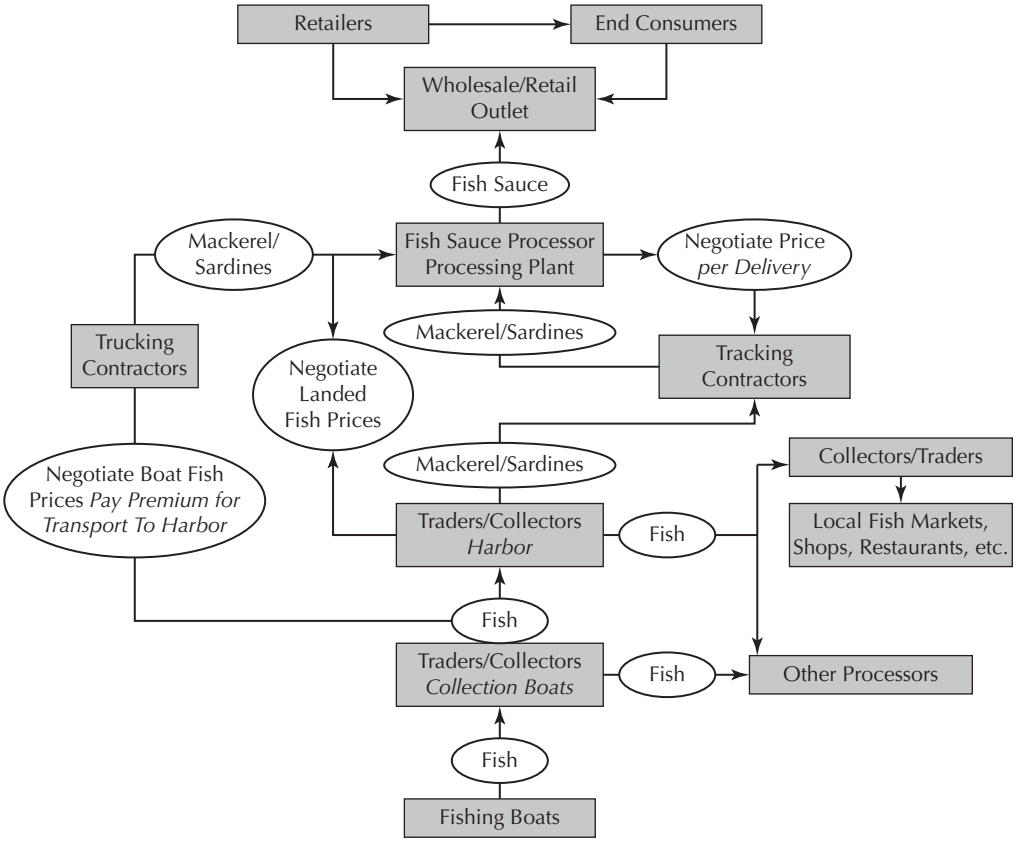
The supply chain for fish sauce processing is run by men: from the fishermen who catch fish (mackerel and sardines) and supply it to fish sauce companies, to harbor traders and trucking companies that trade and transport the captured fish (see Figure 4.14). Women can access the supply chain and establish their own fish sauce companies, but such access is generally limited to small backyard fish sauce processing that involves small quantities of sourced fish. For larger operations, the ability to rely on a network of contacts and information about the supply chain is crucial. For example, the ability to negotiate fish prices at the fishermen's boats before the catch is landed is crucial for sourcing fish at competitive prices, especially in an environment where captured fish prices are increasing almost exponentially. Unlike men, women do not appear to have these contacts with fishermen or harbor traders readily available to them.

Table 4.26 Value Chain for Fish Sauce Production, Northeast Vietnam, 2007

Premium Fish Sauce								
US$/Liter	Mackerel-Based Premium Fish Sauce $1.22/liter equivalent (sold in 0.65 l glass bottles)							
Value	Raw Material	Weighing/ Stirring	Fermenting/ Filtering	Storing	Packing/ Bottling	Transport/ Marketing	Admin/OH	TOTAL
Unit Value	0.56	0.01	0.04	0.00	0.56	0.04	0.02	**$1.24**
% of Total	**45.4%**	**0.4%**	**3.6%**	**0.3%**	**45.5%**	**3.6%**	**1.3%**	**100%**
VND/Liter	Mackerel-Based Premium Fish Sauce 19,580/liter equivalent (sold in 0.65 l glass bottles)							
Value	Raw Material	Weighing/ Stirring	Fermenting/ Filtering	Storing	Packing/ Bottling	Transport/ Marketing	Admin/OH	TOTAL
Unit Value	9,000	80	714	54	9,016	716	252	**19,832**
% of Total	**45.4%**	**0.4%**	**3.6%**	**0.3%**	**45.5%**	**3.6%**	**1.3%**	**100%**
Low-Grade Fish Sauce								
US$/Liter	Sardines-Based Low-Grade Fish Sauce $0.68/liter equivalent (sold in 1 l plastic bottles)							
Value	Raw Material	Weighing/ Stirring	Fermenting/ Filtering	Storing	Packing/ Bottling	Transport/ Marketing	Admin/OH	TOTAL
Unit Value	0.44	0.00	0.02	0.00	0.18	0.03	0.01	**$0.68**
% of Total	**64.1%**	**0.3%**	**3.5%**	**0.2%**	**25.9%**	**4.9%**	**1.0%**	**100.0%**
VND/Liter	Sardines-Based Low-Grade Fish Sauce 10,809/liter equivalent (sold in 1 l plastic bottles)							
Value	Raw Material	Weighing/ Stirring	Fermenting/ Filtering	Storing	Packing/ Bottling	Transport/ Marketing	Admin/OH	TOTAL
Unit Value	7,000	35	384	24	2,826	540	112	**10,921**
% of Total	**64.1%**	**0.3%**	**3.5%**	**0.2%**	**25.9%**	**4.9%**	**1.0%**	**100.0%**

Source: Compiled from authors' interviews.

Figure 4.14 Fish sauce processing supply chain, Northeast Vietnam



Source: Compiled from authors' interviews.

4.3 Conclusions and Recommendations

Local and central governments in Vietnam contributed significant time and resources in order to stimulate the aquaculture sector's growth. As this study shows, however, more planning systems, regulations, and sector support are needed to ensure the sector's continued growth, which benefits a wide range of stakeholders, and the eventual sustainability of this sector in Vietnam.

The resources listed here are needed to ensure comprehensive policies and regulatory enforcement in the following areas of aquaculture:

1. Improve seed quality testing of hatcheries. The current quality of the seed supplied to farmers is poor, which not only undermines farmers' ability to reap consistent benefits from aquaculture but also increases their risk profile vis-à-vis lending institutions because of the frequent crops losses. The government must make sure that all seed producers and suppliers operate within the set standards for the sector and that the responsibility for producing and supplying poor quality seed will not be tolerated.
2. The Research Institute for Aquaculture 1 is leading scientific efforts toward *monodon* domestication in Vietnam and expects to fully commercialize it in

partnership with a European research firm by the end of 2010. Although the central provinces are expected to remain key source locations for the supply of wild *monodon* brood stock, it is anticipated that the eventual commercialization of *monodon* domestication programs will reduce the dependence on the central provinces for the rest of the country. As a result, transaction costs of accessing brood stock and costs associated with its quality should decrease. RIA1 has so far received US$3 million support from the government for its domestication program and, in consultation with experts, made further recommendations for additional public funds.

3. Improve administration, staffing, and delivery of key public sector functions and services such as veterinary controls, quarantines, and maintenance of quality standards for shrimp and other cultured species output at farms. The growth prospects for the sector, and its ability to generate employment and income from exported produce, is being challenged due to increasing awareness and skepticism of subpar regulations on quality and traceability in the importing countries (for example, in Europe, the United States, and Japan). Currently, most of the shrimp in Vietnam is produced in smallholder farms whose production does not undergo quality testing by a veterinary control system. Thus, there is a significant risk that Vietnamese smallholders will be left out of an export supply chain that is increasingly driven by quality issues.

4. Increase investments in aquaculture infrastructure such as sustained water supply. Poor water supply systems represent one of the most important factors that increase the risk of shrimp farming in Vietnam, especially for smallholders. Irrigation systems in Vietnam, which are designed mainly for agriculture, do not meet the requirements for safe practices in aquaculture. Cross-pond pollution and the spread of diseases via the irrigation system arepervasive. The benefits from shrimp aquaculture can be significant when risks of crop failures are reduced through an improved bio-safety environment, something in which proper water supply plays a vital role. Accordingly, a strategic plan to encourage private and public investment in aquaculture water supply systems in Vietnam is needed.

5. It is strongly recommended that the government of Vietnam address the affordability and coverage aspects of rural households' access to the national health insurance scheme.

Specifically in terms of addressing gender equity and enabling all members of households to be involved in aquaculture, the following measures are recommended:

1. Stimulate small-scale producers, especially women, by establishing positive environment to start cooperatives and unions; assisting them with training and extension support; developing code of conduct; and simplifying access to credit. Most smallholders involved in shrimp farming in Vietnam rely on their own or neighboring farmers' experiences for on-farm management. Farmers' technical know-how is low and poor on-farm management

persists as a result. To enhance their performance, smallholders should be assisted in creating viable associations supported through training and extension support provision. Such assistance can be provided by setting up demonstration plots and regular visits by extension experts assisting best-practice farmers who in turn can help other farmers in the community. Once on-farm management is improved, community by community and cooperative by cooperative, not only are the benefits from aquaculture anticipated to increase, but the risk profile of smallholder aquaculture and access to credit for sustainable production growth is expected to improve. It should be noted that in the current setup, improving access to credit without providing farmers with adequate training and improved on-farm practices is not expected to positively impact smallholders and may only increase their indebtedness.

2. Increase public sector spending, both in terms of expanding the number of aquaculture specialists and improving their incentives by making their wages adequate. Additional ways through which male and female smallholders' on-farm management practices can be improved are by providing funding to existing research and extension institutions to organize on-farm visits and best-practice demonstrations for farmers in issues related to pond preparation, feed and seed applications and methods, and postharvest handling. Given the limited on-farm know-how exhibited by most smallholders interviewed, the VCA suggests that, in the absence of major support programs, smallholder aquaculture (and especially shrimp farming) is thought to provide only limited income potential and pose significant risks of failure.

   Programs that provide financial and organizational support to women's associations specifically will improve a woman's ability to engage in large-scale extensive shrimp farming. The value chain analysis suggests that men are able to establish, maintain, and leverage their networks with formal and informal lending institutions and seed stock suppliers. This puts them at a distinct advantage over women in terms of leasing and running large extensive shrimp farms, which entail high establishment and maintenance costs. The female members of large-scale extensive shrimp farming households assist in many activities such as the transportation of farm inputs and marketing and sales of farm produce, but issues such as their limited mobility outside households, lack of cooperative arrangements, and their limited ability to provide and manage physical security of large pond areas puts women at a disadvantage in managing large-scale extensive shrimp farms.

3. For households in coastal areas, consideration should be given to stimulating marine cage aquaculture in which women, albeit in limited numbers, already exhibit the potential for successful involvement.

4. A review of unionization rules that would increase the ability of workers to create their own independent unions is anticipated to increase the (predominantly female) workers' ability to protect their interests vis-à-vis their employers in terms of working conditions, wages, and the creation of

safety nets. Women represent the majority of the labor force in fishery processing firms, and yet economic benefits from their involvement, such as wages, appear to be diminishing in real terms. The value chain analysis also suggests that women are under represented in the management and ownership of firms in the fishery processing sector. Creating programs that will build women's capacity in these areas is strongly recommended in order to increase their participation in and ownership of processing and cooperative firms. Creating in-job training programs, funding scholarships for management and technical training, and helping women establish associations that promote their interests are potential avenues to help address the imbalance of women's voice and power in the fishery processing industry.

5. Value Chain Analysis and Gender Dimension in Catfish Aquaculture in Nigeria

5.1 Background

Nigeria is a resource-rich economy, with an abundant supply of high quality oil, yet over half of its population lives in poverty, particularly in rural areas and in the northern region. Since the mid to late 1960s, oil has contributed the largest share to GDP and was the main export commodity. However, the oil economy has not generated investment or employment and has failed to encourage the development of human capital in the country. Since 1999, greater attention has been given to combating the negative impacts of the oil economy while improving the institutional framework. However, in terms of poverty reduction, employment, and improving education and health of its population, the record is still poor. Nigeria has one of the highest records of both child and maternal mortality in the world. Policy shifts, especially structural adjustment, have had significant impacts on women's economic participation, largely increasing their participation but also placing more household welfare burden on them. The World Bank regional office describes Nigeria as a patriarchal society where men dominate all spheres of women's lives (World Bank 2004).

Unlike many other sub-Saharan countries, women are not major players in agricultural production in the north of the country (referred to by some as Hausaland, reflecting the dominance of this ethnic group in the region). There are few, if any, specifically women-only crops, and in large part women rely on nonfarm incomes through brewing beer (if their religion allows it), marketing crops, and engaging in petty trade. Non-Muslim women have no rights to inherit land and limited control over what incomes they can earn, while Muslim women exercise more control over land and personal incomes but have less freedom of movement. As early studies of Hausa women demonstrate, these women can still farm by proxy. However, their direct participation in farm work depends on the levels of seclusion practiced.

In line with international agreements, programs were launched in the 1980s to facilitate women's access to land and, through the provision of capital and capital equipment, to encourage them to form production cooperatives. Although Meagher (2000) records that many (especially wealthier women) responded to these incentives by engaging in irrigated farming in groups, poorer women continue to work in petty trade and as hired labor. Nevertheless, women's co-operative networks are reportedly weak among Muslim Hausa and, unlike other areas, rotating credit groups are often confined to women of the same household.

Urban-biased national policies favoring large-scale and modern production practices have increased the scale of operations and livelihood portfolios for some farmers, forcing many small-scale farmers to seek alternative earning opportunities. Both small- and large-scale farmers living in drier grain-deficient areas derive a large proportion of their incomes from nonfarm activities.

Some argue that as the economy has deteriorated, men (Hausa Muslim and non-Muslim) have attempted to increase the obligations of women, but rarely by providing labor for the farming operations of their spouses. Rather, they have engaged in cottage industries and food processing (Meagher 2000). The exceptions are women hired on irrigation systems (particularly in Sokoto and Kano) and these include even younger Muslim women. Although their wages are only one-third of men's, they are higher than those they could earn from other activities. It is also possible that this work is attractive because it takes place outside the family and households.

Although there appears to be little wage discrimination against women in government and private employment, women seem some what disadvantaged in accessing formal work. Except in the southwest (including in and around Lagos), female participation in employment is lower than male participation, and lowest in the northeast and northwest of Nigeria, especially in the private sector.

In relation to their independent economic activities, and specifically their agricultural activities, women are also strongly disadvantaged. Women appear to have less access to a range of productive assets—land, credit, technology, and skills training. Faced by these constraints, women engage in smaller-scale activities that require minimal resources. Perhaps more important, most self-employed women also deal with domestic work themselves, including taking care of the children, elderly, and sick members of the household. These burdens are often increased when basic services and infrastructure, especially water, power, and transportation, are inadequate, as is the case in Nigeria.

Finally, the impact of women on decision-making of the household, markets, and centers of political power varies greatly across the country. Although women are largely excluded from politics, their role in markets in the south of Nigeria is considerable and women traders dominate market associations. However, whether this allows them increased access to resources such as land and credit remains unclear and should be studied further.

5.1.1 Aquaculture Production in Nigeria

Sub-Saharan Africa is still a minor player in aquaculture, even though fish farming has been prohibited since the 1940s in Africa in earthen ponds (FAO2004). Although fish is a staple of more than 200 million Africans' diet, fish consumption in this region is lower than in other regions of the world and is declining. The annual per capita consumption of fish has declined by 2.1 kilograms over the last two decades as a result of the leveling off of capture fisheries production coupled with the rates of population growth.

Table 5.1 Fish Supply by Sector in Nigeria (1,000 tons)				
Sector	**1999**	**2003**	**2004**	**2005**
Local Fisheries Production	**480**	**511**	**509**	**580**
Artisanal Capture	427	446	435	491
Industrial Capture	31	34	30	33
Aquaculture	22	31	44	56
Aquaculture Share in Total	5%	6%	9%	10%
Imports	**4**	**663**	**648**	**611**
Source: Bello 2007.				

Although capture fisheries cannot meet the current market demand (6.6 kg per year per capita), aquaculture can play a pivotal role in maintaining the current level of consumption in many sub-Saharan countries. Nigeria is the lead country in the region in terms of fish production, with an output of about 580,000 tons, more than 42 percent of total Sub-Saharan Africa production in 2005 (see Table 5.1).

Aquaculture is considered a good opportunity for sustained livelihood of the poor. Forty percent of total dietary protein consumption in Nigeria (and as high as 80% for coastland and riverside communities) comes from fish. This potential to alleviate poverty and fight malnutrition is recognized by the government, which has instituted various initiatives to support aquaculture. Aquaculture activities have been gradually increasing (see Table 5.2) and contributed 6 percent of the total GDP in 2006.

Federal and state governments established institutional support infrastructure and defined national objectives with a goal of meeting 50 percent of the national demand for fish by 2010. The blueprint for Fisheries Development in Nigeria that was issued in 2005 by the Presidential Committee on Fisheries and Aquaculture set the following production targets for the next five years:

- Fish fingerlings: 2 billion
- Fish feed: 1.5 million tons
- Table-size fish: 1.0 million tons

High prices and an increase in demand are expected to stimulate the growth needed to reach these targets.

Nigeria has all the essential technologies and knowledge required to sustainably develop the aquaculture sector. New entrants can access technical support from both public and private sector institutions, and all inputs needed for aquaculture are available in the market. Together these elements provide an attractive business environment for aquaculture development, and the sector is growing at more than 10 percent per year.

Table 5.2 Aquaculture Production and Growth in Nigeria (1996–2006)

Species	Type	Thousand Tons				Growth		
		1996	2004	2005	2006	Cumulative ('96–'06)	YOY (2005)	YOY (2006)
Aba	Fresh	0.1	2.3	2.5	3.8	6366%	7%	50%
Bonytongues	Fresh.	0.3	1.1	1.3	1.9	597%	11%	50%
Characins	Fresh.	0.1	0.9	1.1	1.7	1183%	29%	50%
Citharinus	Fresh.	0.1	1.3	1.5	2.3	2425%	14%	50%
Cyprinids	Fresh.	7.3	0.0	0.1	0.1	–99%	27%	50%
Freshwater fish	Fresh.	1.5	0.2	0.3	0.4	–71%	29%	50%
Grass-eaters	Fresh.		1.0	1.3	1.9		29%	50%
Kafue pike	Fresh.		1.0	1.3	1.9		29%	50%
Nile perch	Fresh.		2.5	3.3	4.9		29%	50%
North African catfish	Fresh.		15.8	20.4	37.4		30%	83%
Reticulate knifefish	Fresh.		0.5	0.7	1.0		29%	50%
Snakeheads (murrels)	Fresh.		1.2	1.3	2.0		8%	50%
Tilapias nei	Fresh.	3.3	4.2	6.1	9.2	183%	47%	50%
Torpedo-shaped catfish	Fresh.	6.8	11.0	14.2	14.5	114%	29%	3%
Upside-down catfish	Fresh.	0.1	0.8	1.1	1.6	3098%	29%	50%
Total		**19.5**	**44.0**	**56.4**	**84.6**	**334%**	**28%**	**50%**

Source: Compiled from authors' interviews.

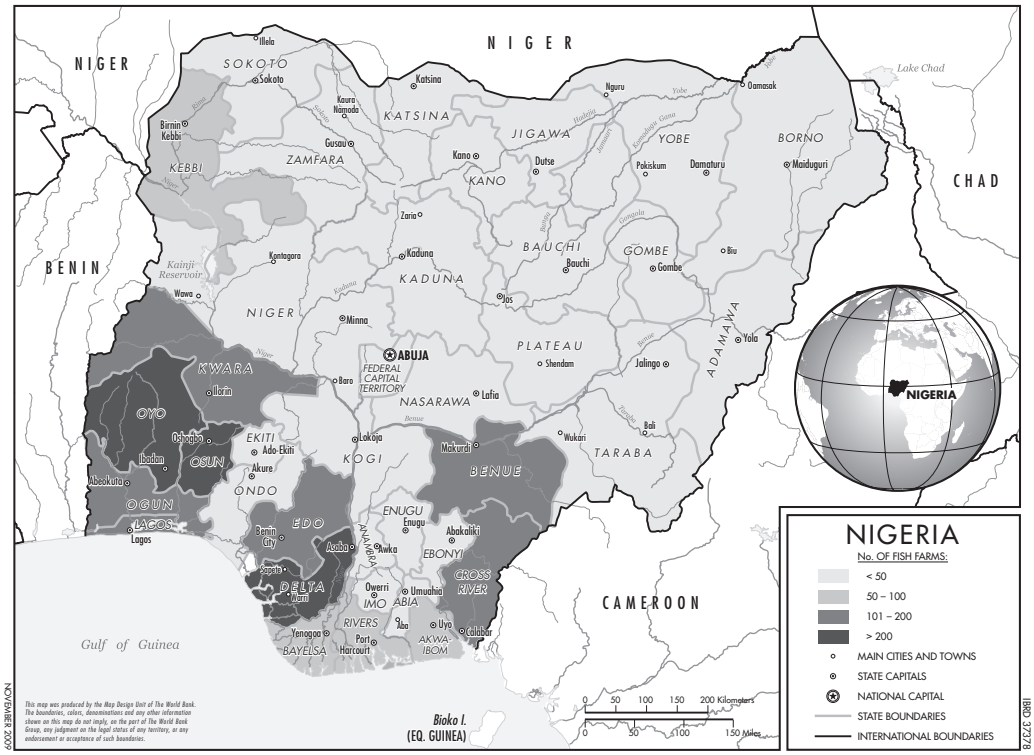
Notes: 1. YOY—Year on Year; 2. Harvest for ornamental purposes is not included in FAO data; 3. Fresh—freshwater; 4. FAO data for 2005 and 2006 suggest that no precise Nigerian production data for those years exist (a rounded growth rate of 50% in 2006 compared to 2005 is assumed by FAO for most aquaculture species).

Nigeria has 12 million hectares of inland water and land suitable for aquaculture, with inland water accounting for 22 percent of the total landmass in Lagos State. Along with its 180 km Atlantic Ocean coastline, this state has a comparative advantage over many others for fish production. Accordingly, the highest density of fish farms is found in the south of the country, around Ibadan and Lagos (see Figure 5.1).

5.1.2 Aquaculture Policy Environment at National and Lagos State Levels

Nigeria has no specific legislation on aquaculture at the national or state levels, but such legislation is under development. Despite the legislative gap, the government has been active in the development of aquaculture in the last 40 years through the establishment of demonstration fish farms and the extension of aquaculture technology. Government initiatives such as research and fish feed centers, and commercial fish farms helped promote aquaculture development in different parts of the country.

Figure 5.1 Aquaculture geographical distribution in Nigeria

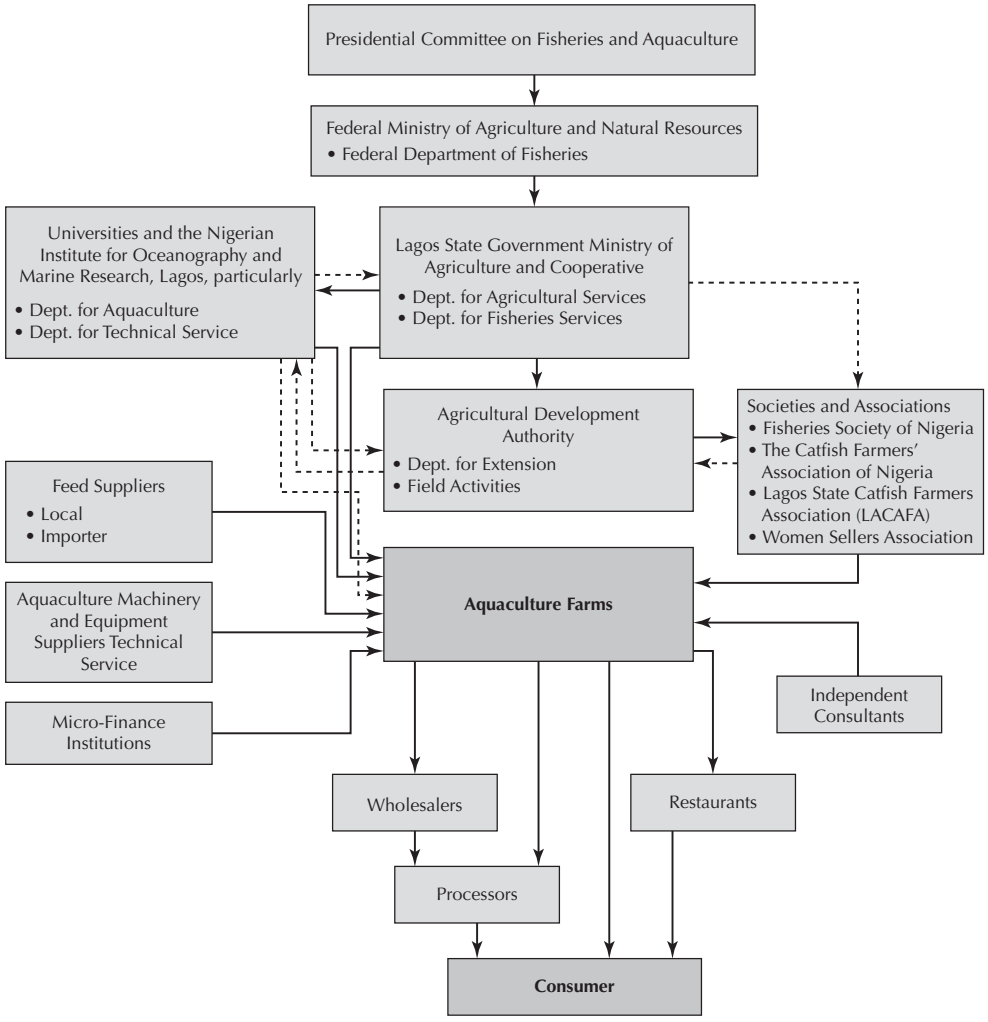


Source: FAO/National Special Programme for Food Security.

The research results of the Nigerian Institute for Oceanography and Marine Research (NIOMR) are currently being promoted through the Agricultural Development Agencies (ADAs) and the Aquaculture and Inland Fisheries Project (AIFP) of the National Special Program for Food Security (NSPFS), where technical assistance in all aspects of hatchery and grow-out technology is rendered on a sustainable basis. Under the previous government-led initiative in aquaculture, the major constraints confronting the development of the sector were the inadequate supply and poor quality of seed and feed, as well as poor on-farm management. Although these challenges continue to affect the sector, the government's new policy is to divest itself from the aquaculture sector, while at the same time stimulating private sector investments in fish production, hatchery, and feed production facilities.

Several pertinent stakeholders support the development of the aquaculture sector in Lagos State (see Figure 5.2). The Federal Department of Fisheries (FDF) under the Federal Ministry of Agriculture and Natural Resources is the federal authority mandated to manage fisheries and to prepare sectoral development policies and programs. FDF coordinates the federal policies and provides technical support to state departments of fisheries (SDFs). SDFs, in turn, provide support to local government authorities as well as training to farmers. Moreover,

Figure 5.2 Institutional framework, aquaculture sector, Lagos State



Source: Compiled from authors' interviews.

fisheries and aquaculture research is carried out by the Nigerian Institute for Oceanography and Marine Research and by the National Institute for Freshwater Fisheries Research. Aquaculture training is also provided by the African Regional Aquaculture Center (ARAC) and private training institutions.

Adequate food production and supply is one of the major concerns of the administration of Lagos State in relation to its increasing population. The Lagos State Ministry of Agriculture and Cooperatives (LSMAC) has been making great efforts through numerous programs to increase food production in the state. One such program is focused on encouraging private sector investments in fisheries development. In fact, fishing is the predominant occupation of the rural population in the state, which also has the largest

market for frozen fish in the country. As such, this state benefits from the country's largest concentration of cold storage facilities. Adding to this the fact that it harbors the country's largest industrial fishing fleet, this state is effectively the fish basket of the nation.

The LSMAC has formulated both fisheries and aquaculture development strategies. The aquaculture strategies are as follows:

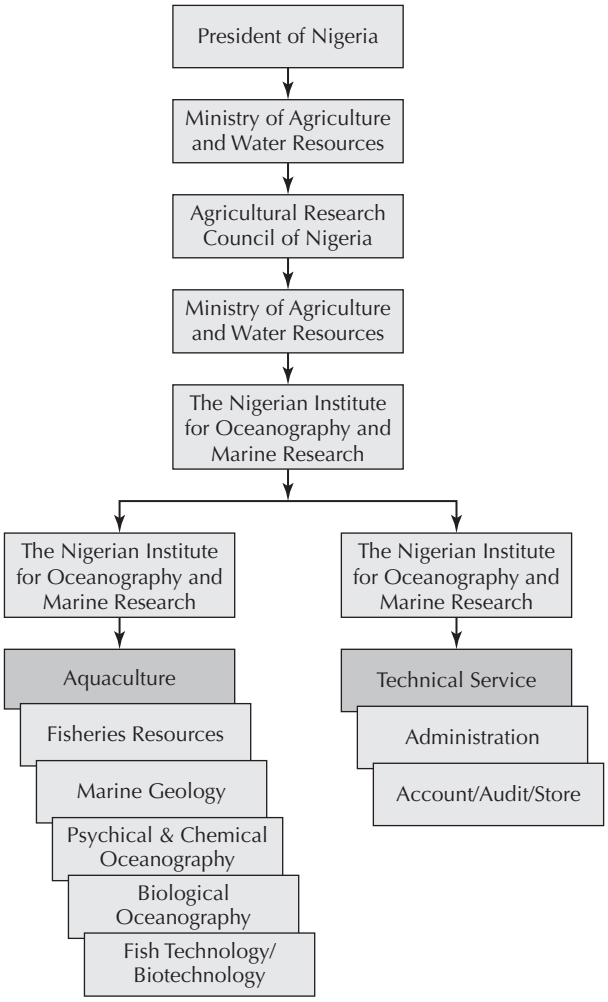
- Provision of extension services to existing fish farmers
- Provision of aquaculture training to would-be fish farmers
- Provision of quality fish seed and feed through private sector participation initiatives
- Provision of community fish farm estates to rural dwellers
- Popularization of homestead fish ponds
- Provision of support for fish farm estate initiatives

Two departments (Department for Agricultural Services and Department for Fisheries Services) and two parastatal bodies (Agricultural Development Authority and Fadama II) are the main entities engaged in the implementation of the aquaculture strategies of this state. The Lagos State Agricultural Development Authority (LSADA) is one of the key entities in terms of provision of extension support to farmers. LSADA has four extension departments, one of which is focused on meeting women's needs, the Department for Women in Agriculture.

In addition to policy extension and training institutions, government-funded research institutions in Nigeria support the fisheries/aquaculture sector in the country. One such institution is the Nigerian Institute for Oceanography and Marine Research (NIOMR), which was established in 1975 under the Research Institutes Establishment Order. The Institute (see Figure 5.3) has the mandate to conduct research on the resources and physical characteristics of Nigeria's territorial waters and the High Seas. Specifically, the Institute conducts research in the following areas:

- Abundance, distribution, and other biological characteristics of species of fish and other marine forms of life
- Practical methods of fish/marine resource rational exploitation and utilization
- Physical characteristics of the Nigerian territorial waters and the High Seas
- Effects of pollution in the Nigerian coastal waters and its prevention
- Improvement of brackish water fishing and fish culture through design and fabrication of simple fisheries implements and equipment
- The nature of the marine environment, including weather forecasting, seabed topography and characteristics, and deposits
- Fish utilization
- The socioeconomic problems of exploitation of the resources of the seas and brackish water[38]

Figure 5.3 The Nigerian Institute for Oceanography and Marine Research Lagos, Nigeria



It should be noted that despite the Nigerian government's efforts to establish legal and institutional framework to support the aquaculture sector, the system is still flawed. For instance, there is considerable lack of coordination and overlap among institutions responsible for the sector. As a result of varying and overlapping information from the different bodies, farmers often do not get the required knowledge and skills with regard to aquaculture technologies and general management skills to run their farms properly. Due to limited access to public agencies, some farmers fall prey to "quack" experts or charlatan consultants.

In contrast with this picture of government, the services provided by private aquaculture specialists/consultants are highly praised and valued by interviewed farmers who can afford such services.

5.1.3 Gender Policy and Strategies in Nigeria

The constitution of Nigeria provides to all its citizens freedom from discrimination and rights to acquire property. The necessary institutional structures are in place at all levels to regulate social aspects including gender relations.

In addition, Nigeria is also a signatory to many international conventions, for example, Convention on the Elimination of all Forms of Discrimination against Women (CEDAW), the Beijing Platform, and others, and has demonstrated some commitment to their adoption by mainstreaming them into its socioeconomic development endeavors. Moreover, in 2000 a National Policy on Women was formulated to address women's development. The Federal Women's Affairs (FMWA) is playing a vital role in addressing gender inequalities by recognizing that injustices to women slow down economic growth and hamper poverty alleviation.

Regrettably, a wide gap remains between the provisions of the law and its practical application. In fact, the legal framework in Nigeria varies greatly in different parts of the country. Three major legal systems operate in Nigeria, namely (1) statutory law (formal), (2) customary law, and (3) Sharia (religious) law with the statutory laws superseding both traditional and religious laws. However, certain communities do not adhere to that practice. For example, inheritance of land by women based on statutory law has been reversed through customary law in some communities.

On the other hand, evidence shows that the National Women's Policy has not delivered the desired outcomes due to its narrow focus only on women rather than addressing the gender issue at large. The development of an all-encompassing national gender policy is required in order to remedy the following:

- Inequality in social, legal, and economic rights
- Gender discrimination in access to and control of resources, economic opportunities
- Lack of power and political voice by women

5.2 Integrated Value Chain Analyses

5.2.1 Study Area

This study focuses on aquaculture in Lagos and Kaduna states. Lagos State, with an area of 3,568.6 km^2 and an estimated population of 17.5 million in 2006, is the smallest and most densely populated state in Nigeria. Kaduna, situated in the north of the country, is also a large state in terms of population, with an estimated 6 million inhabitants in 2006 (see Table 5.3).

The focus of this study is on table-size catfish, which is the dominant type of fish farmed under aquaculture in Nigeria and particularly in Lagos and Kaduna states. Table-size catfish can be marketed fresh or processed to retailers, restaurants, and consumers. Consumer preference is for fresh catfish, which generally must be sold within a day because of the shortage of cold

Table 5.3 Study Area Profile

	State	% of State	% of Study area
Total area of Lagos (km^2)	3,568.6		
Population of Lagos	17,552,942		
Male	9,115,041	52%	
Female	8,437,901	48%	
Urban	8,100,000	46%	22%
Rural	9,452,942	54%	78%
Total area of Kaduna (km^2)	46,053		
Population Kaduna	6,066,562		
Male	3,112,028	51%	
Female	2,964,534	49%	
Urban			
Rural			
GDP in 2007			
Nigeria total: Naira 20,475 billion			
Lagos: Naira 3,93 billion (19.2% of total)			
Kaduna: Naira 121 billion (0.6% of total)			

Source: Compiled from authors' interviews and national 2006 statistics.

storage facilities outside of Lagos. Unsold surplusis processed into smoked fish and can be sold over a longer period.

5.2.2 Catfish Hatcheries

5.2.2.1 Sector Profile

An estimated 321 hatcheries operate in Lagos State and only 10 hatcheries operate in Kaduna. Unlike Lagos, where women operate 20 percent of hatcheries, all hatcheries in Kaduna are reported to be operated by men (see Table 5.4).

The hatchery operation that produces fingerlings is the first stage of aquaculture farming. Hatching is started with spawning the eggs, the reproduction of eggs by the female and subsequent fertilization by the milt of the male catfish. Spawning requires selected brood stock of both female and male catfish. Farmers engaged in this process normally select from their own stock either a male or female that they believe is of a good breed and purchase the mate from an external source to avoid inbreeding. The cost of brood stock is 2,500 Naira (US$21.36)/fish. It is preferred that both the female and male brood fish each be above 1 kilogram in weight, to ensure their maturity. Usually both female and male brood stock are kept in the hatchery in a separate small pond, with water temperature above 22°C.

Table 5.4 Hatchery Sector Profile, Study Area, 2008			
	Total	**Men**	**Women**
1.0 Hatchery Operators—Lagos State	321		
1.1 Hatcheries' Labor Composition		79.8%	20.2%
2.0. Hatchery Operators—Kaduna State	10		
2.1 Hatcheries' Labor Composition		100%*	0%*

Source: Authors' interviews; Lagos State Government, Ministry of Agriculture and Cooperatives, Department of Fisheries, Lagos, 2008.

*Anecdotal evidence provided during stakeholder meetings (July 16, 2008, Abuja).

Fingerlings are sensitive to disease and require favorable conditions to survive. This stage therefore requires close follow-up: treatment of disease, regular aeration of the pond, and segregation of fingerlings that grow fast, in order to avoid cannibalism and ensure even feeding. As fingerlings grow, so does the feed particle size, and after six weeks (some fingerlings develop faster and mature early), fingerlings of about 5–10 grams can be harvested for stocking into nurseries for juvenile rearing internally or for selling—although some fingerlings develop faster and can mature early.

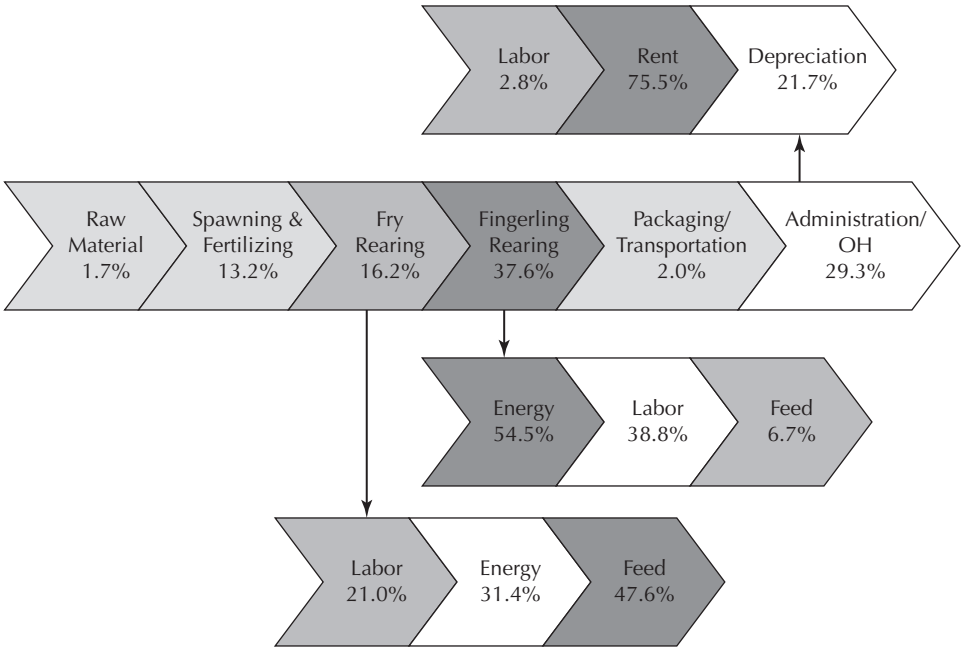
5.2.2.2 Hatchery Value Chain Analysis

The value chain analysis for a catfish hatchery in Lagos, where the number of aquaculture farms is comparatively high, is presented here. The hatchery is part of an integrated farm setup based on a scenario where a farm produces approximately 10,000 kilograms of table-size fish. To do so, the farm starts the hatchery process with 16,500 hatchlings, for production of about 14,000 fry that mature into 11,500 fingerlings that can then be stocked in nursery ponds.[39] The value chain analysis indicated that at a hatchery cost of Naira 7.7 per fingerling (US$0.065/fingerling), the highest production costs are fingerling rearing (37.6%), administration and overhead costs (29.3%), and fry rearing (16.2%) (see Figure 5.4).

High Energy Costs Driven by Inefficient National Grid Operator Energy is a recurring cost along all stages of the hatchery value chain (over 54% during the fingerling-rearing stage and over 31% during fry rearing). The cost of energy is exceptionally high due to the scarce availability of electricity from the national grid Power Holding Cooperation Nigeria (PHCN).[40] As a result, farmers must rely on diesel/petrol generators to produce their own electricity and ensure constant supply.

Labor Costs Increased by Constant Supervision against Theft and Poor Discipline Direct labor costs are also significant because specialized skills are required, constituting 38.8 percent and 21 percent of fingerling- and fry-rearing costs, respectively. Labor costs in are inflated further by the need for extensive supervision and engagement by administrative staff in the production process to mitigate losses due to theft, misappropriation, and carelessness.

Figure 5.4 Catfish hatcheries value chain, Nigeria



Source: Authors' interviews.

Poor Seed Stock Quality Farmers who operate hatcheries have limited access to proven brood stock for spawning. In cases where inbreeding can be avoided, a farmer would use his/her own adult fish and also purchase additional brood stock. However, there is no system by which the quality of purchased brood stock can be known in advance or its origin traced. The brood stock determines both fingerling yields and quality, which in turn determines the ultimate fish yields at a farm. Poor seed stock results in high mortality rates of fries and fingerlings (estimated at 30.4% at hatchery stage), and lower than expected individual fish weight at the farming stage (see Table 5.5).[41] In both instances, farmers end up incurring higher costs for feed, labor, and other farm-related costs for the number of fingerlings and fish that eventually die and are wasted.

There are situations, however, in which inbreeding cannot be avoided. Namely, due to uncertainties associated with purchased brood stock, hatchery operators are often tempted to inbreed their own adult fish. This tends to reduce the quality of brood stock over time and risks undermining overall fish yields. Unfortunately, farmers cannot count on NIOMR, which undertakes research on fisheries, because NIOMR has not released new breeds of catfish that could be used to improve the general brood stock in the current market.

Limited Skills of Hatchery Operators There is a gap in knowledge and skills of hatchery operators, particularly in the areas related to (1) spawning, (2) controlling bacterial diseases and fungus, and (3) water quality management (adjustment of pH and maintenance). Technical knowledge and skill

Table 5.5 Catfish Fingerling Survival Rates

Hatching Stage	Number of Fingerlings in Hatchery*	Type of Feed	Feed Size (mm)	Feeding Period (days)	Feed Consumption (kg/period/ hatchery)
Hatching/larvae	16,523	Artemia	0.1	14	1
Fry (1.5 g)	14,375	Coppen	0.3–0.8	14	2
Fingerling (5–10 g)	11,500	Coppen	0.8–1.2	14	4
Mortality Rate	**30.4%**	**Larvae to nursing pond fingerling survival rate 69.6%**			

Source: Compiled from authors' interviews.

*The number of larvae stocked is from a sample hatchery and is provided here to illustrate survival rates from larvae to fingerling stage; in the first stage the number refers to larvae.

development is provided mainly through the public extension system, which is limited in scope and only reaches a small proportion of farmers. Both private and public institutions (for example, Fisheries Department of the Lagos State Ministry of Agriculture and Cooperatives) provide training, for a fee, on various aspects of executive fish farming, including the hatchery stage. This is the main source of capacity building for both large and small fish farmers.

Limited Involvement of Women in Hatcheries Only 20.2 percent of hatchery operators are women in Lagos State and none in Kaduna State. Fingerling rearing requires close follow-up and attention. In many cases, the need for such intensive engagement in this area deters women from operating hatcheries as this competes with domestic labor requirements. Women's access to skill development services is limited due to a cultural bias against women interacting with male extension agents, and not enough female agents available. Their participation in executive training is also low (36% in Lagos State and only 13% in Kaduna State).

5.2.3 Catfish Nursery

5.2.3.1 Product Profile

Farmers either purchase fingerlings from hatcheries or may have an integrated farm established to produce their own fingerlings with which they stock nursery ponds at varying stocking rates (the recommended rate for stocking fingerlings for juvenile production is 6,000–9,000 per m^3). Fingerlings are kept for two weeks and fed with high-protein content floating feed (usually imported Coppen of 0.8–2 mm size) at the rate of 5–6 percent of their body weight, after which they achieve juvenile maturity and are ready to be stocked at farm ponds (see Table 5.6).

As in the case of fingerling rearing in hatcheries, growing juveniles in nursery ponds requires close attention and care to maintain favorable conditions (for example, constant water exchange and aeration are required) and to

Table 5.6 Catfish Nursing Pond Feed Requirements

Feed Type	Feed Size (mm)	Feeding Period (days)	Consumption* Kg/1,000 fish/day
Coppen	2–3	14	0.6 kg

Source: Authors' interviews.

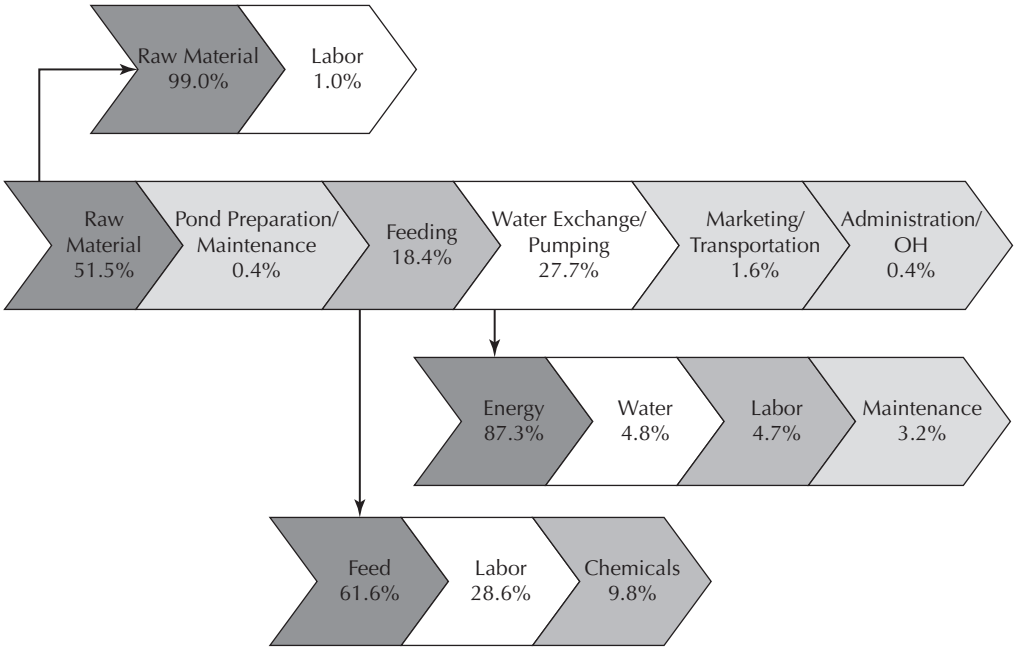
avoid losses due to disease and cannibalism. The average mortality rate is 10–15 percent. A typical small-scale farm of one hectare or less, with good management, obtains 10,500 juveniles from 11,500 fingerlings (91% survival rate) and produces 10,000 kilograms of table-size fishfrom out-growing ponds.[42]

5.2.3.2 Catfish Nursing Value Chain Analysis

With nursing costs of Naira 21.38 (US$0.18) per juvenile catfish, the value chain analysis suggests that costs associated with raw material (fingerling) sourcing dominate the catfish nursing costs (51%), followed by water exchange and pumping (28%) and feeding costs (18%) (see Figure 5.5).

Costly and Poor Quality Raw Material (Fingerlings) In cases when catfish farmers have their own integrated hatcheries from which they can source fingerlings, the raw material cost is Naira 7.7 (US$0.06) per fingerling. The catfish nursing value chain shows that when fingerlings are sourced in the marketplace, the cost of raw material is Naira 10 (US$0.09) per fingerling, or 30 percent higher

Figure 5.5 Catfish nursing value chain



Source: Authors' interviews.

than the production cost at hatcheries. Moreover, additional costs are incurred at the nursery stage, related to the high mortality rate of fingerlings during transportation (due to the use of inappropriate plastic jerry cans, long transport distances, and lack of aeration).

Because there is no system to establish proven quality of brood stock, the quality of fingerlings supplied to nurseries—whether purchased or produced on farm—is generally poor. Low-quality fingerlings result in longer growing periods (extending the time required to transfer to grow-out stage by up to two weeks), higher mortality rates of juveniles, and low juvenile productivity at the nursery stage. This suggests that production efficiencies and costs at catfish nurseries can be significantly improved if feed stock cost and quality are addressed at the hatchery stage of catfish aquaculture.

Scarce Electricity Supply from the Grid Forces Own Costly Generation of Power Water exchange/pumping is the second-highest cost component of the catfish nursery value chain at 28 percent. Over 87 percent of water exchange/pumping costs are energy costs associated with electricity generation. Cost of petrol for a generator at the farm site comprises more than 95 percent of the cost of energy. Gasoline, for Naira 70 (US$0.60) per liter, is preferred by farmers over diesel, which costs Naira 150 (US$1.28) per liter. Electricity is not cheap, costing Naira 16.25 (US$0.12) per kWh; however using it is significantly cheaper than generating one's own electricity. The cost of energy in the catfish nursing value chain would be 75 percent lower if pumps were powered solely with electricity from the national utility grid.

Grid electricity is rarely available on a consistent basis, and its availability is largely dependent on unofficial payments made to the PHCN personnel. As a result, the catfish nursery costs increase by 22.4 percent due to fuel costs for operating a generator (catfish nursing cost of Naira 17.46/fingerling as opposed to the current cost of Naira 21.38/fingerling would be achievable in this nursery if it had reliable on-grid electricity). Inadvertently, the higher cost of producing juvenile catfish at the nursery ripples down the subsequent value chain for catfish farming/grow-out via higher cost associated with sourcing catfish juveniles. Addressing the inefficiencies and bureaucracies of electricity rationing done by utility officials at their own discretion is therefore anticipated to significantly reduce the production costs along the catfish nursery and farming/grow-out value chains.

High Cost of Imported Feed The importance of feed increases as the fish increase in size during the growth cycle from juvenile to a fully mature catfish. At nursing stages, feeding is significant, although not as high a cost as at the grow-out stages of catfish farming. The cost of the feed constitutes 18 percent of nursing costs. Generally, catfish farmers rely on imported floating feed Coppen (refer to Section 5.24 on catfish farming for a detailed discussion on feed).

Lack of Skilled Labor and Knowledge Especially among Women Having knowledgeable and skilled workers to execute a timely segregation of fingerlings is essential at this stage; with timely segregation, mortality resulting from cannibalism and spread of disease is minimized. Not unlike for hatcheries,

limited extension services and training are provided to farmers, but not at sufficient levels. As a result, skill level at nursing ponds is low. Because so few female farmers are involved at the hatchery stage of the value chain, women engaged at the nursery stage of the value chain have no option but to purchase fingerlings from the open market. As a result, women involved in catfish nursing face higher cost for their raw material input. Women lack specialized knowledge and skills required for nursery operation, and must pay for additional extension support to have enough capacity to control technical parameters at nursery ponds. As is the case with hatcheries, external assistance from male extension workers delivered to women is restricted by cultural norms and in some cases is entirely prohibited.

5.2.4 Catfish Farming

Lagos State has the highest number of aquaculture farms in the country, numbering 1,200 earthen ponds (39%) and 1,920 concrete ponds (61%). Of these, 1,800 are concrete flow-through ponds (59.5% of total ponds), while the remaining 120 are recirculatory ponds (1.2%). Anecdotal evidence suggests that about 40 percent of aquaculture farms are owned by women (see Table 5.7).

Table 5.7 Aquaculture Sector Profile, Lagos State, Nigeria, 2008

	Total	Men	Women
1.0 Farm Ownership			
1.1. Number of aquaculture farms	3,120	60%*	40%*
1.1.1. Earthen pond	39.3%		
1.1.2. Concrete pond	60.7%		
1.1.2.1. Flow-through	59.5%		
1.1.2.2. Recirculatory	1.2%		
2.0 Farm Labor			
2.1. Earthen pond	1,200	65.4%	34.6%
2.2. Concrete pond	1,920		
2.2.1. Flow-through	1,800	88.7%	11.3%
2.2.2. Recirculatory	120	91.7%	8.3%
3.0. Number of Trainees (Executive fish farming training)	280	64.3%	35.7%
4.0. Number of fish farmers by production capacity			
Small (1–5 tons)	822		
Medium (5.5–10 tons)	588		
Large (>10.5 tons)	1,600		

Source: Lagos State Government, Ministry of Agriculture and Cooperatives, Department of Fisheries, Lagos, 2008.

*Anecdotal evidence provided during stakeholder meetings (July 16, 2008, Abuja).

However, workers at aquaculture farms are generally men. Women constitute over a third of the labor force (34.6%) in extensive earthen pond systems, but in Lagos State their participation in flow-through and recirculatory concrete ponds is only 12.3 percent and 8.3 percent, respectively.

Kaduna State has 136 aquaculture farms, of which 121 are earthen pond and 15 are concrete pond (13 flow-through and 2 recirculatory). An estimated 80 percent of all aquaculture farms in Kaduna are owned by men and the majority of the labor force is male (see Table 5.8).

5.2.4.2 Extensive Catfish Farming, Earthen Ponds

Earthen catfish ponds are typically extensive farms with the lowest juvenile fish stocking densities of all other catfish farming techniques practiced in the country. Because the water management in this type of farming is the most rudimentary compared to other systems, where by farmers ensure water flows in the pond through spring, stream, rain, or ground waters, typically not more than 40 juvenile catfish per square meter are stocked at

Table 5.8 Aquaculture Sector Profile, Kaduna State, Nigeria, 2008

	Total	Men	Women
1.0 Farm Ownership			
1.1. Number of aquaculture farms, of which:	136	80%*	20%*
1.1.1.Earthen pond	89.0%		
1.1.2. Concrete pond	11.0%		
1.1.2.1. Flow-through	9.5%		
1.1.2.2. Recirculatory	1.5%		
2.0 Farm Labor			
2.1. Earthen pond	121	70.2%	29.8%
2.2. Concrete pond	25		
2.2.1. Flow-through	23	56.5%	43.5%
2.2.2. Recirculatory	2	100%	0%
3.0. Number of Trainees (Executive fish farming training)	27	87.1%	12.9%
4.0. Number of fish farmers by production capacity			
Small (1–5 tons)	100		
Medium (5.5–10 tons)	20		
Large (10.5 tons and above)	1		

Source: Lagos State Government, Ministry of Agriculture and Cooperatives, Department of Fisheries, Lagos, 2008.

*Anecdotal evidence provided during stakeholder meetings (July 16, 2008, Abuja).

one time. Some farmers purchase juvenile catfish from other farmers' nursing ponds, but most farmers typically source juveniles from their own nursing ponds because most farmers practice two-stage aquaculture. For example, nursery and grow-out stages of aquaculture are often integrated within one farm. Advantages of a two-stage integrated farm come not only from the price differential of sourcing their own juveniles, which cost on average Naira 3.62 (US$0.02) per juvenile less than purchasing them on the market, but also from the fact that juvenile fish within an integrated farm setup are better acclimatized.

Juvenile catfish are kept for four months before they achieve maturity as table-size catfish. They are stocked in culture ponds and fed for four weeks with high-protein content floating feed, usually 2–3 mm imported Coppen. Starting from the fifth week until harvest, the fish are fed with locally manufactured, sinking, and pelletized 4–8 mm fish feed at an increasing feed rate in relation to their body weight. The feeding type and related expenses are summarized in Table 5.9.

According to 2007 research results at the University of Ibadan, an adult catfish can achieve 0.981 kilogramin weight in 154 days. This corroborates with first-hand information gathered from the field in Lagos State. It was found that on

Table 5.9 Type and Cost of Feed—from Juvenile to Table-Size Fish

Type of Feed	Size of Feed	Duration of Feeding	Cost per kg Feed	
			USD/kg	Naira/kg
Coppen	2 mm	1 week	2.56	300
Coppen	2 mm	1 week	2.56	300
Coppen	3 mm	1 week	2.56	300
Coppen	3 mm	1 week	2.56	300
Pelletized	4.5 mm	1 week	1.54	180
Pelletized	4.5 mm	1 week	1.54	180
Pelletized	4.5 mm	1 week	1.54	180
Pelletized	6 mm	1 week	1.54	180
Pelletized	6 mm	1 week	1.54	180
Pelletized	6 mm	1 week	1.54	180
Pelletized	6 mm	1 week	1.54	180
Pelletized	8 mm	1 week	1.54	180
Pelletized	8 mm	1 week	1.54	180
Pelletized	8 mm	1 week	1.54	180
Pelletized	8 mm	1 week	1.54	180
Pelletized	8 mm	1 week	1.54	180

Source: Compiled from authors' interviews.

average, farmers who started with 1,445 juveniles harvested the following stock after four months:

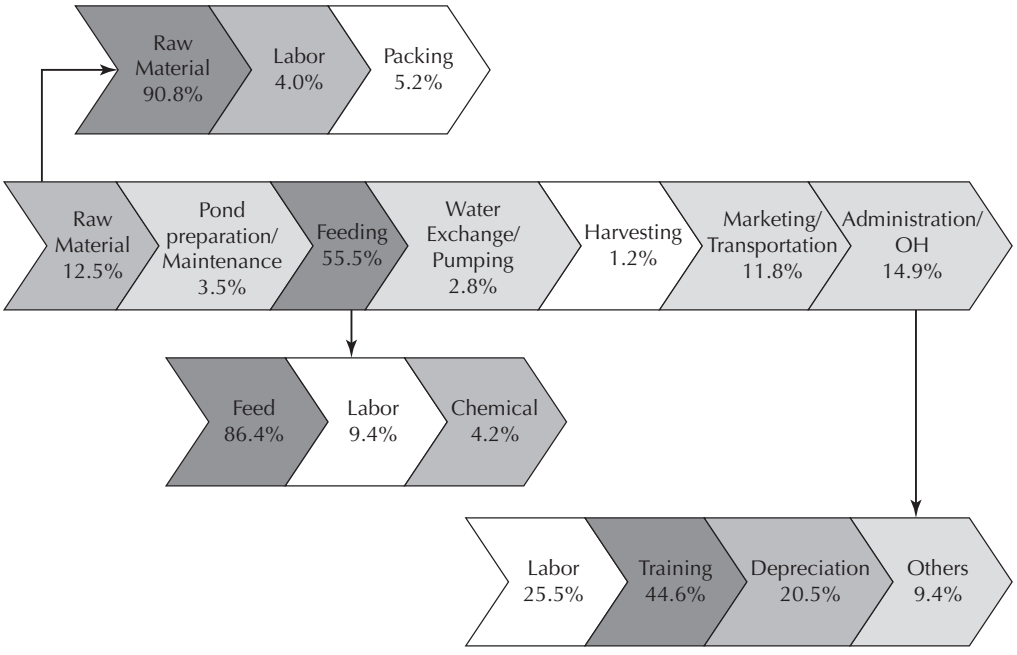
- 425 adult fish weighing above 1 kilogram
- 700 adult fish weighing between 0.8–0.9 kilogram
- 200 adult fish weighing below 0.8 kilogram
- 120 lost due to mortality and other causes

At this farm, the mortality rate was approximately 8 percent, which is higher than the average catfish farming mortality rate for Nigeria of 5 percent.

The value chain analysis suggests that at a production cost of Naira 234/kg (US$2/kg), feeding costs represents the highest cost component (53.5%) of the total production cost of catfish in earthen ponds, followed by administration and overhead (14.9%), and raw material costs (12.3%) (see Figure 5.6). The average farm gate selling price of a table-size fish is Naira 340/kg (US$2.90/kg), representing a high margin of 45 percent.

Over half the cost (53.5%) of raising catfish consists of feeding, of which the cost of the feed is the most important at 86.4 percent. At this grow-out stage, a mixture of fish meal, vitamins, pre-mixes, and others, are required as feed for growing juveniles into table-size fish. Although many of the ingredients are available locally, the quality (particularly of fish meal) is low. Many farmers therefore choose high-cost imported feed or formulate their own feed mixture.

Figure 5.6 Value chain for catfish farming, earthen pond



Source: Authors' interviews.

High Feed Costs As is the case for all catfish farming value chains in the study area, the cost of fish feed is the single highest cost component in catfish aquaculture in both Lagos and Kaduna States. The supply of locally produced fish feed falls far short of the demand by local catfish farmers and has become a constraining factor in the development of the sector.

According to the inventory taken by AIFP in 2005, there are 215 feed producers (millers) in Nigeria, most of them producing animal feed mainly for the poultry sector (3.5 million tons/year). Some mills produce fish meal as a side business, but at unsatisfactory levels in terms of quality necessary for fish farming. The annual demand for fish feed in Nigeria is estimated at 75,000–80,000 tons. The annual output of the fish feed industry in Nigeria by 2005 was estimated to be about 45,000 tons valued at Naira 5.4 billion (US$46.2 million). An estimated 6,000 tons/year of high-quality feed is imported for intensive aquaculture systems. The gap of 25,000–30,000 tons of feed per year is met by commercial fish farmers themselves, who formulate and produce fish feed on their own farms.

The raw materials used in fish feed production are mainly grain and by products of agro-processing; however, fish meal, a major component in the fish feed production process, is not available locally. The first commercial plant established by a company called ASTRA Food was not economically viable and went out of business. Virtually any fish or shellfish in the sea or inland waters can be used to make fish meal. Even though Nigeria has a great potential for sourcing raw materials for fish meal by making use of lantern fish that are abundantly available in its territorial waters, fish feed producers currently import all fish meal needs from abroad: an estimated 6,000 tons of high-quality fish meal is currently being imported mainly from Denmark, Norway, and Iceland. Other than fish meal, other vital ingredients for the fish feed formulation are fish oil, vitamins, and minerals, all of which must be imported. Table 5.10 shows that fish feed is formulated from several ingredients and the recipe for formulation varies from millertomiller and farmtofarm as there is no commonly shared standard for the fish feed formulation.[43]

The production cost of locally produced fish feed is estimated to range between Naira 120 and 150 per kilogram, depending on raw material inputs. The local feed millers' selling price of the local pelletized (sinking) fish feed is Naira 180/kg (see Table 5.11). Some aquaculture farmers buy the ingredients, formulate fish feed according to their own recipe, and take the material to the feed millers for processing. Feed millers charge farmers processing service fees per kilogram of feed processed as follows:

- Crushing, Naira 4 (US$0.03);
- Grinding, Naira 7 (US$0.06);
- Pelletizing, Naira 12–15 (US$0.10–0.13); and
- Drying, Naira 12 (US$0.10).

After all the processing stages, the farmers end up paying on average Naira 35–38 (US$0.33–0.34) per kilogram of processed feed. Considering that it costs approximately Naira 125 for input material to produce a kilogram of feed, the combined total feed cost for farmers that source and mix their own feed

Table 5.10 Feed Ingredient Prices, Lagos, 2008

Feed Ingredient	Naira/kg	Feed Ingredient	Naira/kg
Maize	62–65	Lysine	450–500
Indomine	62–65	Premix Fish	900–1350
GNC	45	Premix Fish (Classic)	700
Soya Bean	70–75	Premix Fish (Grower)	300
Fulfat Soya	90	Premix Fish (Broiler)	420
Palm kernel cake (PKC)	22	Premix Fish (Layer)	400
Wheat Offal	34–35	Coated Vitamin C	3,000–3,200
Corn Offal	45	Enzymes	4,200
Blood Meal	35	Myco Fix	500
Biscuit Waste	40	Myco Fix (Select)	800
Bone Meal	25	OTC	3,000
Oyster Shell	10–12	Aquamax	400
Calcium	150	D.C.P	150
Fishmeal 72%	290–310	Whole Wheat	45
Fishmeal 68%	150–160	Limestone	10
Methionine	750–880		

Source: A Tee Ess Integrated Farms Quarterly Publication, vol. 1, no. 1, 2008.

Table 5.11 Feed Milling Costs, Nigeria

	Naira/kg	US$/kg	Share in Production Cost
Input material*	125.0	1.07	90.4%
Labor	2.2	0.02	1.6%
Energy	3.0	0.03	2.2%
Packing material	2.0	0.02	1.4%
Administration/OH	4.3	0.04	3.1%
Depreciation	0.7	0.01	0.5%
Financing	1.1	0.01	0.8%
Total Production Cost	**138.3**	**1.18**	**100.0%**
Selling Price	**180**	**1.54**	

Source: Compiled from authors' interviews.

*Average price at mill gate (2 tons/day milling capacity), from Naira 100/kg to Naira 140/kg, depending on raw material input used.

preparation is approximately Naira 160–163 (US$1.36–1.39). This price is less than sourcing ready-made feed from millers, but whatever savings generated from their own feed input premixing tend to be lost at the feeding stage of catfish. Namely, a major disadvantage of locally pelletized feed is that it sinks to the pond floor relatively fast; thus catfish cannot feed on the sinking pellets long enough, and much of the feed lies wasted at the bottom of ponds.

If farmers can afford it, imported floating feed is preferred to locally pelletized sinking feed in order to increase feeding efficiency, and to keep the water cleaner. The cost of imported feed from the Netherlands ranges from Naira 216–230 (US$1.85–1.96) per kilogram and is sold in retail stores for Naira 250–300 (US$2.14–2.56) per kilogram.

Earthen Pond Farming Made Difficult by Limited Access to Land, Poaching, and Floods Land is a major input in an earthen pond system. Because there is no land lease and/or rental market in Nigeria, the cost does not figure in the overall cost of catfish production and is therefore not included in the above analysis. Nevertheless, access to land is a critical constraint to the adoption of this method of catfish production. Earthen pond farming is not accessible to farmers who do not have accessible land. Additionally, earthen ponds are exposed to poaching from humans as well as from animals such as large birds. Farmers with earthen ponds, therefore, incur losses, particularly at early stages of grow-out fish, and assume relatively high labor costs because of the need to guard their ponds. Earthen ponds are also exposed to flooding during heavy rains and swelling of streams. Damage and losses resulting from flooding arecommon, as ponds tend to be established on waterways, and can destroy the earthen ponds system, resulting in recurring losses.

5.2.4.3 Semi-Intensive and Intensive Catfish Farming, Concrete Ponds

Semi-intensive and intensive catfish farming involve high fish stock densities, and aredone in concrete ponds. In contrast to extensive earthen pond farming, water management in concrete ponds plays a crucial role in the farmers' ability to maximize stocking densities and fish yields. The actual recommended stocking rate is between 150–300 fish per cubic meter, depending on the water quality in the pond, which might differ according to the type of water management system used. The three different water management systems in concrete ponds are (1) raceway flow-through system, (2) cyclone flow-through system, and (3) recirculation system (see Table 5.12).

The cyclone flow-through system ponds have a better cleaning effect on water compared to the raceway flow-through, and thus 50 percent more fish can be stocked in the same type and size pond. The water recirculation ponds with filtration and sedimentation processes achieve high water cleanliness, allowing very high stock densities. This type of water management system can effectively accommodate 200 percent more stock density compared to a raceway flow-through system. Although earthen ponds take up a large land area (most farms in the study area were about 12 m $\times$ 6 m in surface, with water depth of 0.45 m) concrete ponds are much smaller (3.5 m $\times$ 3 m, with water depth of 0.5 m).

Table 5.12 Stocking Density According to the Type of Water Management System

Type of Pond	Water Management System (farm intensity)	Stocking Density (juvenile fish)	
		(fish/m^2)	(fish/m^3)
Concrete pond (semi-intensive and intensive)	Raceway flow-through system (semi-intensive)	79	133
	Cyclone flow-through system (intensive)	120	200
	Recirculation system (intensive/super intensive)	319	266
Earth pond (extensive)	Spring, stream rain water and dugout fed earthen pond (extensive)	39	88

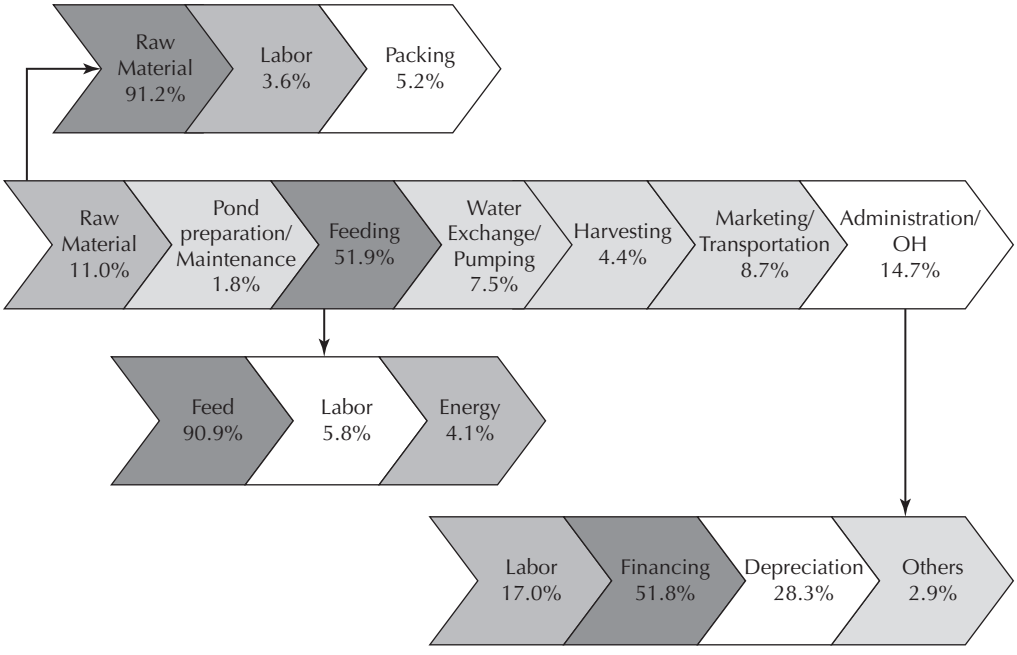
Source: Compiled from authors' interviews.

*Stocking densities are averages of farms interviewed.

5.2.4.4 Catfish Farming, Flow-Through Water Systems

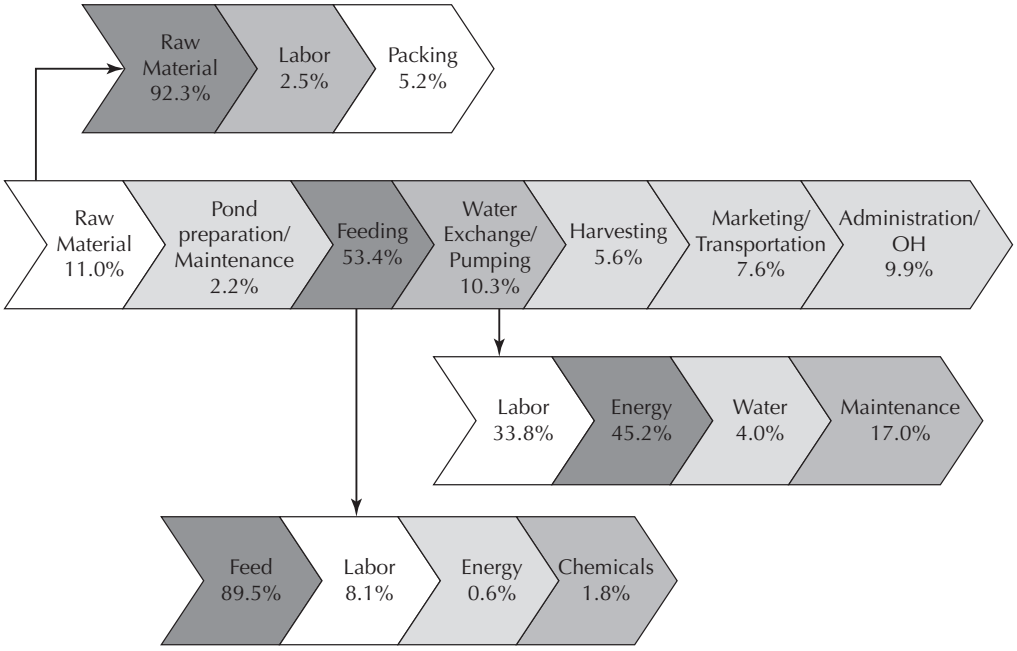
Catfish farming via flow-through water management systems can be done in two ways: raceway flow-through and cyclone flow-through of water. The value chain analysis suggests that catfish farming costs in these two different flow-through water systems are virtually identical: production costs are Naira 264.26 (US$2.26) per kilogram of catfish for the raceway flow-through system (see Figure 5.7) and Naira 258.71 (US$2.21) per kilogram of catfish for

Figure 5.7 Value chain for catfish farming, concrete pond, raceway flow-through



Source: Authors' interviews.

Figure 5.8 Value chain for catfish farming, concrete pond, cyclone flow-through



Source: Authors' interviews.

the cyclone flow-through system (see Figure 5.8). Catfish farming via flow-through water management systems can be done in two ways: raceway flow-through and cyclone flow-through of water. The value chain analysis suggests that catfish farming costs in these two different flow-through water systems are virtually identical: production costs are Naira 264.26 (US$2.26) per kilogram of catfish for the raceway flow-through system (see Figure 5.7) and Naira 258.71 (US$2.21) per kilogram of catfish for the cyclone flow-through system (see Figure 5.8). Catfish farming via flow-through water management systems can be done in two ways: raceway flow-through and cyclone flow-through of water. The value chain analysis suggests that catfish farming costs in these two different flow-through water systems are virtually identical: production costs are Naira 264.26 (US$2.26) per kilogram of catfish for the raceway flow-through system (see Figure 5.7) and Naira 258.71 (US$2.21) per kilogram of catfish for the cyclone flow-through system (see Figure 5.8).

The cost structure for the flow-through water management systems (both raceway and cyclone methods) is similar to that of the earthen pond system discussed above, with feeding, administration, overhead, and raw material costs contributing the most to overall costs, by order of importance:

- Feeding contributes to more than half the costs for both the raceway and cyclone methods (51.9% and 53.4%, respectively).

- Administration and overhead costs contribute 14.7 percent and 9.9 percent for the raceway and cyclone methods, respectively, primarily due to costs of financing and depreciation followed by payment of managerial staff.
- The cost of juvenile catfish stocked in ponds at grow-out stages contributes to 11 percent of total costs in the case of both methods. However, the stocking density for the cyclone flow-through system is higher by 50 percent when compared to the raceway system. This arises from the better maintenance of water quality due to the cyclone effect that makes it easy for waste collection and disposal.

Unreliable Grid Electricity Increases Production Costs A key difference from the earthen pond system is in the use of energy, which is minimal under the earthen pond water management system but contributes 2–3 percent of total costs in the flow-through systems. As already discussed, the supply of electricity from the grid is erratic. To ensure regular power supply for pumping water, farmers are forced to invest in generators that operate using gasoline or diesel, which increases both the investment and running costs. A farm with 100 cubic meters of pond water, using either of the flow-through techniques, must pump 60 cubic meters of makeup water per day, with energy-related costs of approximately Naira 700 (US$5.98) per day.[44] If farmers had had access to on-grid electricity, catfish farming energy costs would have come down to Naira 162.50 (US$1.39) per day, which is 76.8 percent less than what aquafarms pay presently.

Initial Investment Capital Difficult to Obtain Unlike the earthen pond systems, grow-out using the flow-through water management systems requires little land area (this is not reflected in the cost structure) but involves a relatively high initial capital out lay for the construction of concrete ponds and sophisticated water systems. Although credit facilities exist, access to credit is not straightforward and the prevailing interest rates are high (23%).[45] As a result of the relatively high investment cost of the flow-through water management, adoption of these systems tends to be limited to urban areas where access to even the smallest plots of land is limited and costly.

Poor Skills and On-Farm Knowledge among Farmers The flow-through water management systems are sophisticated techniques, and therefore require high skill level to operate effectively. Specialized training courses are available from both public and private institutions. However, currently there is not sufficient supply to meet the demand of the sector. The training costs range from Naira 30,000–120,00 (US$256–1,025).

5.2.4.5 Catfish Farming, Re-circulatory Water Systems

A water recirculation system (WRS) is the most intensive (high stocking density) fish-rearing system. It is a type of cultivation system in which effluents or used water from fish-rearing ponds is partially or completely recirculated in the system after it has been treated and reconditioned. Water usage is reduced by employing a water treatment unit, which includes mechanical and biological filtration, solid waste removal, water sterilization, and aeration. WRS can be

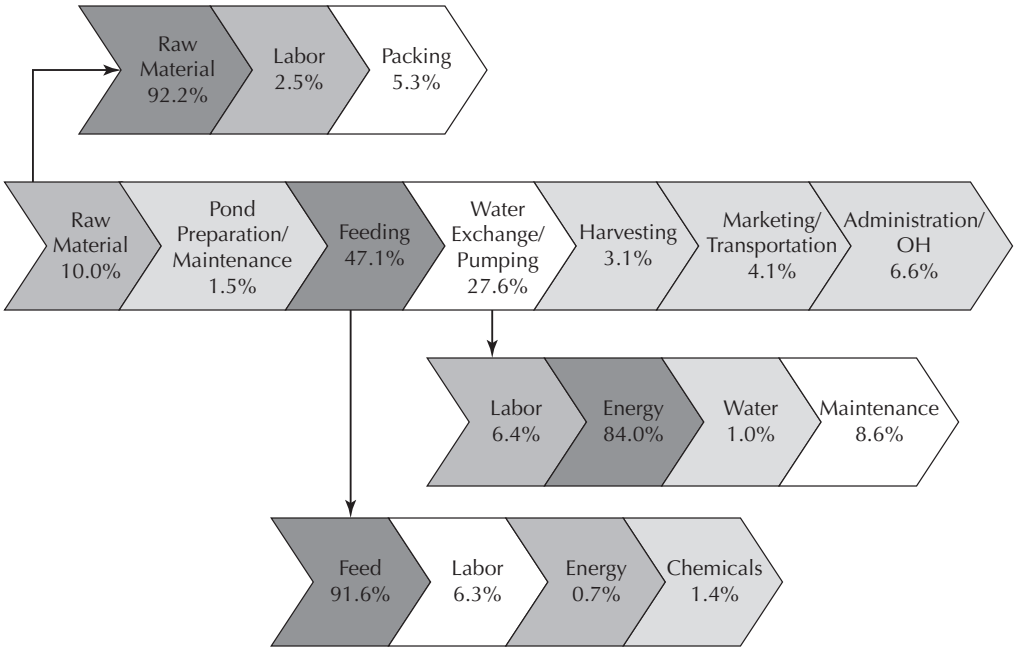
adapted to all ecological zones in Nigeria and is especially recommended for areas where pond culture is not feasible due to low rainfall, high water evaporation rates, loose soil types, and poor water retention characteristics. With WRS, it is possible to produce fish all year-round. WRS maximizes production in a relatively small area of land and uses a small volume of water (for example, 50 tons of fish can be produced annually in a 60 m^3 concrete pond). The WRS system is very effective in controlling poaching, which is prevalent in Nigerian aquaculture (and agriculture in general).

Because of the heavy investment required, farms adopting WRS are few and tend to be of medium production scale, producing about 40,000 kilograms of catfish per year (20,000 kg of fish per cycle). Typically, WRS aquaculture farms have four culturing ponds, each measuring 2.6 meters in width, 5.5 meters in length, and 1.8 meters in depth (1.5 mof water depth). In addition to rearing ponds, supporting ponds are built for sedimentation, bio-filtration, settling tanks, and elevated water reservoirs for recirculation. Each culturing pond of the above dimensions can stock up to 5,000 juvenile catfish, which means stocking densities of 230 fish per cubic meter, or 350 fish per square meter.

The value chain analysis (see Figure 5.9) suggests that at the production cost of Naira 286.37 (US$2.45) per kilogram of catfish, feeding costsdominate the overall WRS catfish farming cost (47.1%), followed by water exchanging and pumping costs (27.6%), and raw material/juvenile sourcing costs (10%).

Self-Generated Electricity Costs Hurt WRS Farmers Most In the case of the WRS management system, constant water exchange/pumping is needed. In this

Figure 5.9 Value chain for catfish farming, concrete pond, recirculation system



Source: Authors' interviews.

Table 5.13 Water and Energy Requirements of Different Water Management Systems

Type of Water Management System	Water Requirement	Daily Energy Requirement (pumping)
Earthen pond	32 m^3/100 m^3/day	Rarely needed
Concrete Raceway	60 m^3/100 m^3/day	700 Naira (US$5.98)/day (petrol) 162.5 Naira (US$1.39)/day (PHNC)
Concrete Cyclone	60 m^3/100 m^3/day	700 Naira (US$5.98)/day (petrol) 162.5 Naira (US$1.39)/day (PHCN)
Recirculation	6 m^3/100 m^3/day (makeup)	16,800 Naira (US$143.59)—own generator—petrol 36,000 Naira (US$307.69)—own generator—diesel 3,900 Naira (US$33.33) on-grid—PHCN

Source: Authors' interviews.

system, the entire water supply in the pond must be recycled every two hours 12 times a day. About 1 cubic meter of water is lost in the process for every 10 cubic meters of water recirculated in a day. Even though the water requirement is quite low, the energy consumption for recirculation of water is significant (see Table 5.13). As per the value chain analysis, energy costs constitute 84 percent of water exchange pumping costs. In this particular farm, recirculating 100 cubic meters of pond water 12 times a day costs approximately Naira 116,800 (US$143.59) per day because the farmer must generate electricity by using gasoline. If the farm had access to on-grid electricity from PHCN, its energy costs per day would only be Naira 3,900 (US$33.33). This amounts to a 333 percent higher cost for the farmer.

Low Participation of Women in Intensive Catfish Farming Women's participation in grow-out/farming stages is low, both in extensive earthen pond aquaculture and intensive concrete pond aquaculture. Land is a key input in the earthen pond system, but women's access to land is limited as few own land. Traditionally, inheritance of land favors men, and lack of land leasing and renting means that women cannot acquire land through other arrangements. Women's access to credit, important in varying degrees in all systems, is also limited, because credit from formal systems often demands land as collateral. For example, of the flow-through and recirculatory systems, only 12 percent and 8.3 percent, respectively, are operated by women in Lagos State. In Kaduna State, where only 11 percent of all farming systems are flow-through systems, 43.5 percent of the labor force for these systems are women and none of the recirculatory systems are operated by women. Women's participation in earthen pond operations is only 34 percent in Lagos and 30 percent in Kaduna State. According to information gathered from interviewees, theft is more pronounced against women farmers.

Table 5.14 Gender Participation and Farm Profitability, Catfish Aquaculture in Nigeria

	Earthen Pond	Flow-Through System		Recirculatory
		Raceway	Cyclone	
Fish production (kg)*	8,800	13,300	20,000	26,600
Cost of production (per kg)	234	262	258	286
Selling price (per kg at the farm gate)	340	340	340	340
Estimated investment and working capital	1,992,623	3,841,120	3,841,120	3,820,212
Return on Investment	46.8%	27%	43%	37.6%
Farms Operated or Owned by Women, Lagos	40%			
Female Labor Participation in Farms, Lagos	35%	12%		8%
Farms Operated or Owned by Women, Kaduna	20%			
Female Labor Participation in Farms, Kaduna	30%	44%		0%

Source: Authors' interviews.

*Based on 100 m^3 capacity ponds.

The profitability of using these systems differs because of different cost structures, scale of operation (stock density), and productivity. Table 5.14 illustrates that the return on investment is highest for extensive earthen pond catfish farms. Because this system is also where most women catfish farmers are concentrated, and because earthen ponds have one of the lowest capital requirements, it is anticipated that increasing women's participation in extensive earthen pond catfish farming through improved access to land and credit and on-farm management training could be one of the highest impact areas for policy intervention. Increasing women's participation in other forms of intensive farming is desirable but may not necessarily be the optimal solution considering the lower returns on investment and higher capital requirements.

Aquaculture farming is a capital-intensive activity compared to other forms of agricultural and livestock production, involving both a large investment outlay, particularly for the more sophisticated methods, and high operating costs for energy, and feed. It also requires skilled labor. Capital and skilled labor tend to be relatively scarce in Nigeria as in most low-income countries. Furthermore, the technology related to production and to key inputs such as fish meal is still not well developed and is not readily available in the country. Most farms tend to be smallscale and do not use the latest technology. These conditions tend to inflate the unit cost of aquaculture farming and

reduce competitiveness. The constraints are felt more deeply by women. As a result, their participation in the aquaculture farming is low. On the other hand, women's role in post harvest stages of the aquaculture value chain and in the parallel activity of fish feed preparation is much greater, as will be discussed in detail below.

5.2.5 Catfish Marketing

Table-size catfish aresold fresh from fish farm at farm gate to wholesalers, or in the form of smoked fish to retailers. Fresh catfish can also be sold directly to processors, consumers, or restaurants at the same price as it is sold to wholesalers. Consumers and restaurants buy catfish weighing more than 1 kilogram, whereas processors tend to purchase smaller fish. Large fish weighing more than 1 kilogram are generally worth Naira 379–450/kg (UD$3.24–3.85) at farm gate. Smaller catfish weighing 0.8–0.9 kilogram are sold to processors for smoking for about Naira 320–350 (US$20–22). Fish weighing less than 0.8 kilogram are sold to processors at Naira 280–300 (US$2.39–2.56) per kilogram (see Table 5.15).

5.2.5.1 Marketing Channels

There are three marketing channels for fresh and processed catfish.

Channel 1 Almost all wholesalers who buy fish from farmers and sell it to either retailers or to processors are women (99%). Some processors buy directly from the farms. Women sellers are processors themselves. Wholesalers buy fish from farmers at an average farm gate price of Naira 340 (US$2.90)/kg, and sell it to retailers and processors at Naira 400 (US$3.42)/kg. The difference is due to costs incurred by wholesalers for expenses such as these:

- Telephone communication,[46] Naira 0.21/kg fish
- Transportation, Naira 20/kg fish
- Association fee, registration Naira 10,000, and annual fee Naira 500/year, which is negligible per kilogramof fish

Wholesalers therefore make a margin of Naira 40–90 (US$0.34–0.77)/kg. These wholesalers do not possess cold storage and make direct sales either to retailers, processors, or restaurants. Retailers, who also do not have cold chain storage and gain the same cuts as do the wholesalers, sell the products to consumers, processors, or restaurants, earning a profit margin of Naira 25–75 (US$0.21–0.64)/kg. Processors sell smoked fish either to retailers at Naira 2,400 (US$20.51)/kg or to final consumers at Naira 2,500 (US$21.37)/kg.

Channel 2 This involves direct purchase of small quantities of catfish by consumers from fish farms for household consumption. Such consumers come from communities that live in the neighborhood of the fish farms. However, farmers prefer to sell fish in mass rather than in small numbers as the price they get is the same.

Table 5.15 Fish Prices, Study Areas

Average Selling Price of Table Fish			
Number of Fish*	Fish Weight (kg)	Average Price (Naira/kg)	Average Price (US$/kg)
425	>1	390	3.33
700	0.8–0.9	330	2.82
200	<0.8	280	2.39
120	Waste	-	0
Total 1,325		**340**	

Source: Authors' interviews.

*Fish harvest from a typical weight distribution of table-size fish yield.

Channel 3 Wholesalers buy fish at Naira 340 (US$ 2.90)/kg and sell it to retailers at Naira 400–450 (US$3.42–3.85)/kg. Retailers then sell the fish either to consumers or restaurants at Naira 475 (US$4.06)/fish. Some restaurants and fast food shops purchase fish directly from farms for Naira 340 (US$2.90). Restaurants and fast food shops sell catfish, typically as spicy soup dishes, at Naira 700–750 (US$5.98–6.41)/kg.

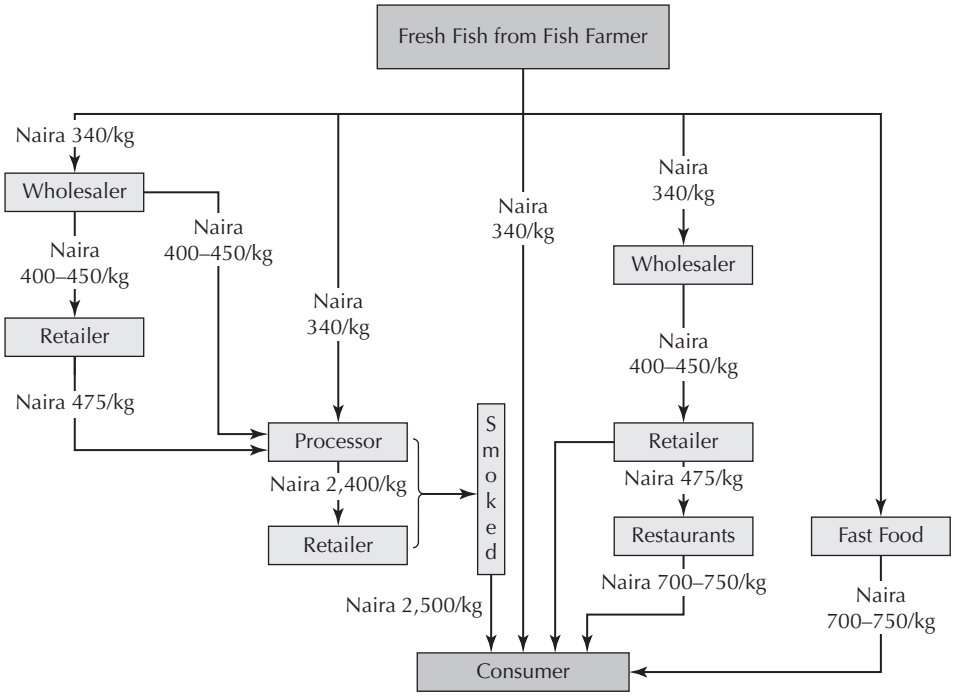
5.2.5.2 Key Gender Issues and Major Challenges

Lack of Product Diversity and Value Addition Throughout Nigeria, fish is generally sold in only two forms, fresh or smoked. These two products have limited market outlets to restaurants, retailers, and direct consumption (see Figure 5.10). In this context, new product development (for example, industrial processing such as canning) would help to create more economic opportunities for the aquaculture sector, and specifically, opportunities for women whose involvement in the market is concentrated around the postharvest segment of the aquaculture value chain.

Poor Linkage to the Cold Chain As fish is perishable, the potential for spoilage and loss is high. Currently, catfish is marketed mostly in fresh and live form. It is handled by wholesalers and retailers for a short period of time, and in most cases reaches the ultimate consumer within 12 hours. There is no system for effectively storing fish (unless smoked) to take advantage of changing market conditions and demand in distant markets. While a cold chain infrastructure does exist, particularly in Lagos State, which is the major entry point for frozen fish from industrial fishing or imports, it is not being used by the aquaculture sector due to a combination of cost, economies of scale, and consumer preference for fresh and smoked catfish.

The national goal of producing 1 million tons of table-size fish per year from aquaculture by 2010 calls for an appropriate storage and marketing strategy that would include the use of a cold chain system (cold stores, refrigerated

Figure 5.10 Catfish marketing chain, Lagos



Source: Compiled from authors' interviews.

vehicles, and their management). The constraints are felt equally among men and women.

Dominance of the Market by Women Sellers' Associations Sellers of final fish products tend to be women traders who are organized through a strong network that enables them to influence both the wholesale and retail price of fish. To counter act this, catfish farmers recently organized into associations (The Catfish Farmers' Association of Nigeria, Lagos State Catfish Farmers Association (LACAFA) formerly known as Lagos State Catfish and Allied Farmers' Association), and started selling directly to retailers and consumers, thus circumventing the traders. State governments have established trading centers to directly link farmers to retailers and consumers. Yet the traders provide a valuable service in terms of price discovery, arbitrage and conversion of unsold fresh fish into smoked fish. The inability of the different actors (suppliers, traders, government) to work together effectively to market catfish has the risk of introducing serious inefficiencies in the system. There is a need to develop a public–private partnership arrangement, initiated by the government, to handle this issue more efficiently.

5.2.6 Catfish Processing

5.2.6.1 Processing Methods

Once table-size fish is harvested, it may be marketed as fresh fish or processed into smoked fish before being sold to retailers, restaurants, and/or

Table 5.16 Catfish Processing Sector Profile

	Number of Firms	Men	Women
1.0 Lagos State		**Labor Force/Ownership**	
1.1 Fish processors	23,080	0.35%	99.65%
1.2 Traditional Smoking	70%		
1.3 Kiln Smoking	30%		
2.0 Kaduna State			
2.1 Fish processors	58	70%	30%

Source: Lagos State Government, Ministry of Agriculture and Cooperatives, Department of Fisheries, Lagos, 2008.

final consumers. There is no industrial processing of catfish in the study area. Rather, processing is done by simply smoking fish through either traditional methods or by using charcoal kilns. Processing is undertaken as a means of conserving slow- moving products; for example, fish of low weight (<1 kg) that does not have a ready demand by restaurants and final consumers. The smoking process is laborious and time-consuming. Operators are also not protected against respiratory diseases caused by extended exposure to smoke. An estimated 23,080 fish processors operate in Lagos and 58 processors operate in Kaduna (see Table 5.16). Under both methods, smoking is mostly undertaken in residential premises, following a simple process—weighing, sorting by size, rinsing in water, degutting, washing and soaking in brine water (156 g table salt/kg fish), drying for a few minutes, and actual smoking.

Under the traditional method, smoking is carried out over an open fire within a brick oven or half barrel (using wood or sawdust). Smoking is carried out in batches of 6–10 fish, preferably of equal size. Smoking duration varies with fish size; smaller fish less than 500 grams take only about an hour, and larger fish of above 1 kilogram take about 2.5 hours to smoke. About 70 percent of fish processors use the traditional method. The oven/half barrel used for smoking, with a capacity of 6–10 fish per batch, costs less than Naira 1,000 (US$8.54). Most processors would operate two or three such ovens. The fish are put on a rack, covered with a carton or paper, and wood is burned at the bottom in order to smoke the fish.

NIOMR has developed and introduced an improved charcoal kiln that allows more-efficient smoking; kilns have been distributed through LSADA. Kilns have different capacities for smoking, for example, 25–75 kilograms of fish (30–90 fish) per batch. Most processors who use the improved kilns (about 80%) own small kilns with a capacity of 25 kilograms of smoked fish per batch. About 15 percent of the processors own 50 kg capacity kilns and the remaining 5 percent use 75 kg capacity kilns. Energy consumption in the

improved kilns is lower and instead of wood (or sawdust) charcoal is used. However, this method does not generate much smoke and does not result in the taste and aroma normally associated with smoked fish in Nigeria. About 30 percent of the processors use improved charcoal kilns. The investment outlay for charcoal kilns is relatively high: Naira 12,000 (US$102) for the ADA kilns, and Naira 2,000,000 (US$1,709) for the insulated, galvanized kilns constructed by NIOMR. Their adoption is being promoted by LSADA and NIOMR through advisory services coupled with credit access from micro-finance institutes.

Processed catfish is sold directly to retailers in fish markets. During the actual sale, smoked fish are kept on open trays displayed for sale in an unhygienic manner. Only a few retailers pack the smoked fish wrapped in foil or vacuum-sealed to extend shelf life. The smoking process creates an accumulation of carbon on the body of the fish thatis directly consumed. Yet, the content of Benzo (A) Pyrene (BAP) in the smoked fish is not known and techniques remain rudimentary. NIOMR is currently undertaking research in this area with the expectation of introducing better smoking techniques that reduce content of toxic elements.

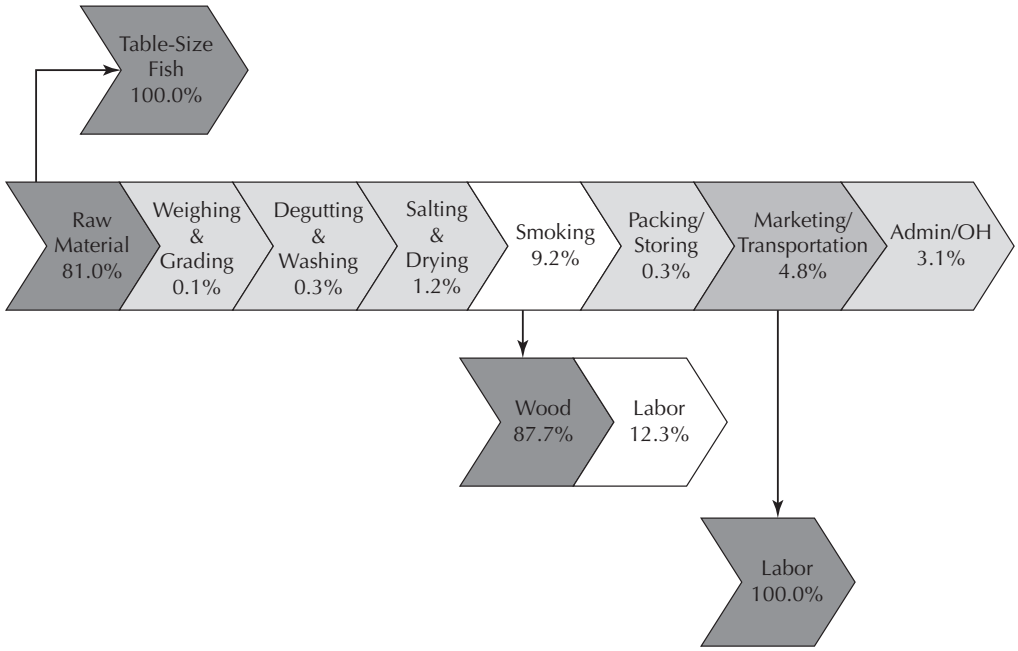
5.2.6.2 Traditionally Smoked Catfish

For a typical processing outfit producing 100 kilograms of smoked catfish per day using the traditional smoking method with wood as a fuel source, the value chain analysis suggests that the total cost of catfish processing is Naira 700 (US$5.98)/kg.

Figure 5.11 shows that the raw material input comprises the main cost element of the processing stage, contributing to over 80 percent of total costs. Processors buy fresh fish at 340 Naira 340 (US$16). About 40 percent of the weight of fresh fish is lost due to degutting and drying during smoking. Costs incurred during smoking are more significant (9.2%) although not major. Labor costs for transportation and marketing comprise about 4.8 percent.

Catfish Processing in Lagos Dominated by Women Working in Poor Conditions Women dominate catfish processing (99% of processors) in Lagos State. However, though few in number, in Kaduna State the majority (70%) of processors are men (see Table 5.11). Smoked catfish is sold on average for Naira 2,500 (US$21.37)/kg, providing women with exceptionally good profit margins of 72 percent. Through the women's sellers association, catfish processors have been able to dominate the market and sustain high margins. But catfish processing is a laborious process undertaken under hazardous health conditions. Catfish smoking is undertaken as a domestic activity (within processors' residential premises) together with household chores and care of children. The introduction of the improved kiln is a time-saving device that allows women to better manage the allocation of their labor among different domestic activities. However, limited access to capital is a constraint to the adoption of this processing method.

Figure 5.11 Value chain for wood-smoked catfish



Source: Authors' interviews.

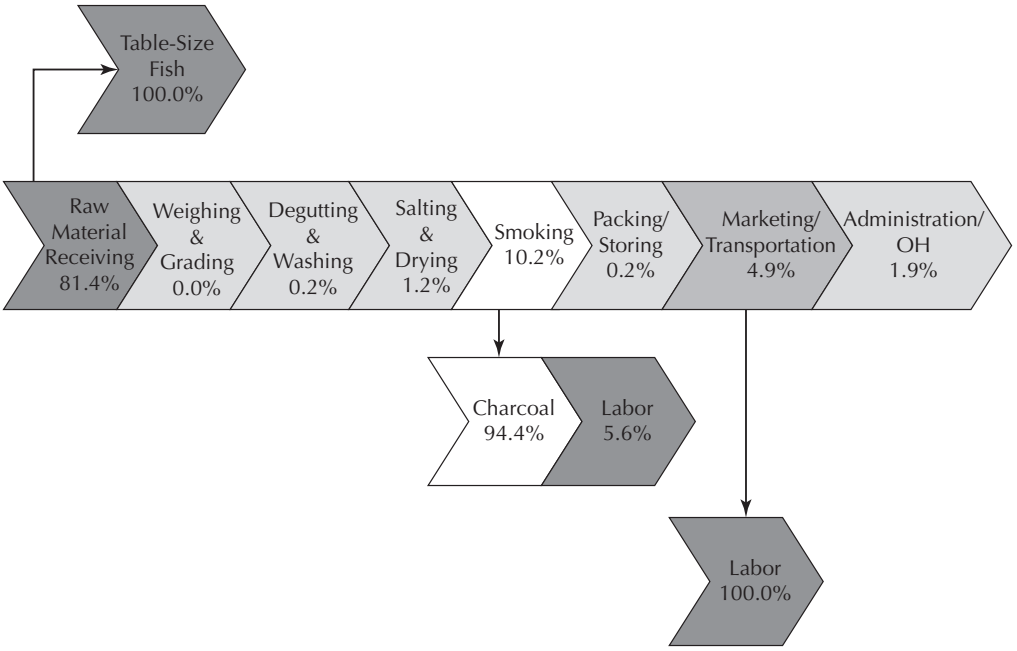
5.2.6.3 Kiln-Smoked Catfish

The total cost of producing smoked catfish using a charcoal kiln is Naira 695.84 (US$5.94)/kg. Although cost savings using this method are not very high, the production conditions are much better. Work is less tedious, health hazards are fewer, and the final product is more hygienic.

As in the case of the traditional method, the cost of raw material constitutes a major cost component (81.4%), followed by the cost of the smoking process (10.2%), and labor costs for marketing (4.9%) (see Figure 5.12). This method of smoking does, however, involve a higher capital outlay associated with the purchase of an improved kiln.

Lack of Capital Prevents Women from Upgrading to Kiln-Based Processing Most processors employ a traditional way of smoking using mud bricks and half-barrels beneath which wood is burned. Under this method, productivity is low, consumption of wood and/or sawdust is high, and the working environment is poor. This increases the cost of smoking fish, albeit only slightly, which is further exacerbated by limited availability of wood for smoking, especially in the rainy season when scarce sawdust must be sought. Although improved charcoal kilns are available, few processors use these as they require a relatively high outlay of capital (access to and cost of capital is a constraint) and because they do not impart the necessary aroma and taste on the smoked fish because they are more appropriate for drying rather than

Figure 5.12 Value chain for kiln-smoked catfish



Source: Authors' interviews.

smoking fish. The lack of improved kilns that combine wood and charcoal to both hot-smoke and dry fish as well as the relatively high cost of such new technologies is a challenge in the adoption of improved smoking techniques.

5.3 Conclusions and Recommendations

The following outlines interventions recommended at government, institutional, and firm levels in order to address the issues eroding the competitiveness of the aquaculture sector.

Increasing Participation of Women in the Aquaculture Sector

- **Capacity Building:** In order to engage women in the sector, create sector awareness and transfer of knowledge and skills with special focus on women through dedicated female extension agents. This approach is believed to reverse the low percentage of female participation in aquaculture-related training.
- **Capital:** Women are disadvantaged in accessing sources of finances required to enter the aquaculture business. The existing collateral base credit facility should be revisited so as to accept startup projects based on the strengths of the project document incorporating mechanism for credit extension through holding the project itself as collateral.

The availability of investment capital is expected to alleviate problems related to access to land for aquaculture farming, and improved technologies for processing.

Creation of Joint Forum for Stable Catfish Market The establishment of the catfish selling centers by the Department for Fisheries Service of the Lagos State Government (LSG) Agriculture and Cooperation and the Lagos State Catfish Farmers Association (LACAFA) with a view to curtail the strengths built up by the women sellers' association should be viewed with utmost caution. It is believed that it will eventually distort the catfish market, which may result in displacing women from economic activities in marketing. Instead of colluding against women sellers, it would be beneficial to form a joint public–private partnership forum in order to solve existing problems with a view toward creating a collaborative and conducive environment in the market. In this case, the state government should play a coordinating role and facilitate the establishment of a joint forum among the concerned stakeholders for resolving existing and future problems related to the catfish market.

Development of National Policy and Guidelines for Aquaculture Even though there are adequate numbers of institutions catering to aquaculture development in Nigeria, in Lagos and Kaduna states in particular, the lack of a national policy and related guidelines for implementation is creating duplication of efforts and ineffective relationships between the two major actors in the sector. The finalization of the national policy and pertaining guidelines under preparation is of paramount importance for streamlining aquaculture activities in a competitive manner.

Establishment of Specialized and Certified Hatcheries for Proven Quality Seedlings In order to ensure the availability of proven quality seedlings, the research institutions and the extension services should facilitate the trace ability of fingerlings from proven quality brood stocks through the encouragement of specialized hatcheries, which should be certified by a pertinent accredited body. Moreover, dissemination of fingerlings from unknown sources should be prohibited. This recommendation is not meant to limit the production of fingerlings but to focus on improving the quality and performance of aquaculture farmers.

Local Production of Fish Feed The cost of feed is the biggest cost component in the IVCA. This is mostly due to the underdevelopment of fish meal production in spite of existing resources in Nigeria. The government and concerned institutions should come up with special incentives and technical support that encourage investment in the fish meal and fish feed industry. With this, investors have to be made accountable for the fulfillment of standards of fish meal and fish feed, which also must be set by pertinent bodies. The availability of standardized fish meal would facilitate local production of standardized fish feed and increase the competitiveness of aquaculture.

Consistent Supply of Power from the National Grid At present, there is no shortage of electrical energy in Nigeria. The country can produce 5,287.4 MW (thermal 3,349 MW and hydro 1,938.4 MW). However, power supply from the grid is unreliable due to a high level of corruption. The power supply

problem is one of the major challenges in the aquaculture sector. This is an area where only government intervention can bring about positive changes.

Adequate Access to Cold Chain Cold chains are needed to cope with the envisaged increase in aquaculture production in order to ensure efficient utilization of the products, as well as to open up opportunities for more value-added processing of fish meat. Therefore, cold chains will ensure the sustainability of aquaculture and its overall development as such requires a proactive intervention in the immediate future by the concerned stakeholders.

Annex 1. Summary of Key Aquaculture Sector Policies in Vietnam

Development strategy	Resolution 44/1998/QD-TTg on the privatization of the state-owned enterprises.	Decision 237/1998/QD-TTg by the Prime Minister (PM) to approve the objective national program for clean water and rural environment.	Decision 224/TTg, dated Dec. 8, 1999, by the PM to approve the program for aquaculture development from 1999 to 2010.	Decision 104/2000/ QD-TTg to approve the national strategy on clean water and rural environment to 2020.
	Decree 09/NQ/CP, dated June 15, 2000, by the government about the transition of economic structure and consumption of agricultural products.	Decree 143/2001/QD-TTg, dated Sept. 27, 2001, by the PM to approve the objective program on the poverty, malnutrition, and occupations from 2001 to 2005.	Law of Fisheries, Law No.17/2003/QH11, dated Nov. 11, 2003, by the Congress of Vietnam. Chapter VIII represents the articles relating to management of the fishery sector.	
Use and management of land and water bodies for aquaculture	Resolution of the 5th party's Central Executive Committee on the transition of economic structure in agriculture and rural areas, 1993.	Decree 64/CP on the land use rights for the farm households (supplement to Decree 85/1999/ ND/CP, dated Aug. 28, 1999.	Business Law issued in 1999 Trade Law issued in 1997.	Decision 04/2002/QD-BTS by the Ministry of Fisheries (MoF) on the regulations to manage the environment in the concentrated shrimp farming areas.
	Land Law approved by the Congress of Vietnam in 2003 and in use from July 2004	Decision 264/2003/QD-TTg about some solutions on the use and management of the lands in the state-managed agricultural and forestry enterprises.	Law of Fisheries, Law No.17/2003/QH11. Chapter IV provides the articles relating to the management and use of lands and water for aquaculture.	Decree 81/2004/ND-CP provides the detailed guidelines for the implementation of new Land Law. Complemented by Decree 182/2004 on the fees charged for violations to land/water bodies' management.

Exploitation and protection of natural aquatic resources, environmental management, control of diseases of aquatic species	Decision 224/TTg to approve the program for aquaculture development from 1999 to 2010. Circular 01/2000/QD-BTS by the MoF to revise the documents on the protection and development of fisheries resources.	Decision 03/2002/QD-BTS by the MoF to regulate the use of chemicals/drugs in protection & treatment of aquatic products.	Law of Fisheries, dated Nov. 26, 2003, by the Congress of Vietnam. Environmental issues are mentioned and specified for each subsector such as planning, exploitation, and protection of aquatic resources, seed production, import/export of aquatic animals/products, aquaculture, and processing.	
	Decree 08/2003/QD-BTS dated Aug. 5, 2003, by the MoF on the function, responsibilities, and organization of the National Directorate of Aquatic Resources Exploitation and Protection.	Law of Fisheries, LawNo.17/2003/QH11 dated by the Congress of Vietnam. Chapter II and III provide the articles relating to the protection and development of aquatic resources.	Decrees by the MoF in 2003 on the establishment of the Center for Environmental Warning and Prevention and Treatment of Diseases on Aquatic Species in the Southern and Central region.	In July 2004, Protection and Development of Aquatic Resources Program to 2010 approved by PM
Credit supply	Decree 14/1993/CP by the PM provides regulations for provision of credit to farm households in agriculture, forestry, aquaculture and salt production. Law of the credit supply institutions (Dec. 12, 1997). Decision 324, dated Sept. 30, 1998, by the Governor of State Bank released the regulation to improve credit supply of the institutions under specific conditions.	PM released Decrees 67/QD-TTg (March 30, 1999), 148/QD-TTg (July 7, 1999), and 224/QD-TTg (Dec. 8, 1999) about the policies and procedures for credit provision to households in agriculture, forestry, aquaculture, and salt. Large farm households borrowing less than VND10 million do not have to give any collateral.	Decree 43/CP, dated June 29, 1999, by the government allows the owners of large farms in the difficult areas and the farmers conducting aquaculture toborrow money from the Investment Support Fund with the value of collaterals at least equal to or more than 50% of total money borrowed.	Circular 82/2000/TT-BTC, dated Aug. 8, 2000, by the Ministry of Finance to instruct the land and financial policies to encourage farming economy development. Decision 423/2000/QD-NHNN, dated Sept. 22, 2000, by the Governor of State Bank on the credit policy for farming economies.

Credit supply *(Continued)*	Decree 132/2001/QD-TTg, dated Sept. 7, 2001, by the PM on the financial mechanism for the implementation of the program to develop rural transportation, infrastructure for aquaculture, and rural occupations.	Decree 04/2003/TT-BTC by the Ministry of Finance to guide the financial solutions to encourage the trade of commercial firms using contracts following Decree 80/2002/QD-TTg (24/6/2002) by the PM.	Circular 03/2003/TT-NHNN by the Governor of State Bank released the regulation for guiding policies and procedure to provide noncollateral credits up to VND 30 million to households, 100 million to the cooperatives farming agriculture, forestry, aquaculture, and salt. For cooperatives producing export goods appropriate to the approved development plans of the local government, a total of up to VND 500 million in noncollateral credit can be obtained.	
Extension and technical transfer	Circular 13-CP, dated Mar. 2, 1993, by the government to regulate the extension activities.	Decree 590/2000/QD-BTS by the MoF on the establishment of the National Fisheries Extension Center.	Decision 103/2000/ QD-TTg by the PM about policies to encourage the development of seed production for aquaculture.	Decision 132/2000/ QD-TTg by the PM about some policies for development of occupations in rural areas.
	Decision 04/2002/QD-BTS by the MoF on the regulations to manage the environment in the concentrated shrimp farming areas.	Decree 18/2003/QD-BTS by the MoF on the function, responsibilities, and organization of the National Fisheries Extension Center.	Law of Fisheries, Law No.17/2003/QH11 by the Congress of Vietnam. Extension support mentioned broadly in the chapters relating to ongoing extension programs.	
Seed, feed, and chemicals' supply of aquatic species	-Decree 93/CP by the government to regulate the seed management of cultured and raised animals. -Decree 14/CP, dated Mar. 19, 1996, by the government to regulate the seed management of cultured and raised animals. -Direction 2/1998/CT-BTS by the MoF requiring cessation of injection of substances into aquatic products. - Direction 1/1998/CT-BTS, by the MoF, to ban the use of explosion, electricity, and toxic materials for exploitation of aquatic products.		-Sectoral standards on the brood stock and postlarvae of *monodon* shrimp 1998. -Sectoral standards on the brood stock and fingerlings, as well as grow-out systems of freshwater fish species 1998 to 2004. -Sectoral standards on the intensive grow-out system of *monodon* shrimp were issued in 2001. -Sectoral standards on the brood stock and fingerlings, as well as grow-out system of giant gouramy and pangasius catfish in 2002.	

Seed, feed and chemicals' supply of aquatic species *(Continued)*	- Sectoral standards applied to the processing facilities issued following Decree 732/1998/QD-BTS by the MoF. - Decision 103/2000/QD-TTg by the PM about policies to encourage the development of seed production for aquaculture. Circular 04/2000/TT-BTS by the MoF provides guidelines.	Decree 08/2000/QD-BTS by the MoF to regulate the inspection and approval of quality of aquatic products. Decree 90/2000/QD-BTC by the Ministry of Finance to issue the fees for management of the quality and safety of aquatic products.	Decree 86/2001/ND-CP by the government on the conditions for running businesses in fisheries and aquaculture. Decision 03/2002/QD-BTS by the MoF to regulate the use of chemicals and drugs in protection and treatment of aquatic products.	Law of Fisheries, Law No.17/2003/QH11 by the Congress of Vietnam. Articles 33 and 34 relate to the seed production, import, and export of aquatic species.
Marketing of aquatic products	Law of Trade issued in 1997 by the Congress of Vietnam.	Decree 178/1999/QD-TTg issued by the PM about the regulations on labeling of goods traded in domestic markets and imported/exported products. This was detailed by Circular 34/1999	Decree 95/2000/QD-TTg by the PM on the revision of regulations in Decree 178/1999/QD-TTg on the labeling of goods traded.	Decree 09/NQ/CP, dated June 15, 2000, by the government about the transition of economic structure and the marketing of agricultural products.
Quality, safety and veterinary of aquatic products, business standards and requirements	Law of human health protection and hygienic regulations under the Circular 23/ND-HDBT dated Jan. 24, 1991.	Decree 505/QD-BYT, dated Apr. 13, 1992, by the Ministry of Health on the standards of food safety.	Decree 86/1995/CP by the government establishing responsibility on the government for management of the quality of goods. Detailed for implementation through Circular 02/TT-LB, dated May 25, 1996, by the Ministers of Ministry of Science-Technology and Environment and MoF.	Decree 2482/1996/QD-BYT by the Ministry of Health on certificating of the quality and safety standard for agents.

Quality, safety and veterinary of aquatic products, business standards and requirements *(Continued)*	Decree 14/1999/QD-TTg by the PM on the establishment of the Division of Management of Quality and Food Safety under the Ministry of Health.	Decree 1091/1999/ QD-BKHCNMT by the Ministry of Science-Technology and Environment on the government inspection of imported and exported goods.	Decree 1010/2000/ QD-BYT issued by the Ministry of Health about the list of goods and feeds quality registration. Decree 08/2000/QD-BTS by the MoF to regulate the inspection and approval of aquatic product quality.	Decree 07/2003/QD-BTS by the MoF on the function, responsibilities, and organization of the National Fisheries Quality Assurance and Veterinary Directorate.
State and private management in aquaculture	Business Law issued on Dec. 21, 1990, by the Congress of Vietnam—in use from Apr. 14, 1991.	Decree 12/1993/CP by the government to regulate the restructuring of agricultural businesses.	Decision 83/1993/ QD-TTg by the PM to regulate the restructuring of agricultural businesses.	Document 84/1993/ CT-TTg dated Mar. 4, 1993, by the PM for the implementation of privatization and solutions for ownership diversification of state-owned enterprises.
	Resolution 44/1998/QD-TTg dated June 27, 1998, by the PM on the privatization of state-owned enterprises. Trade Law of 1997 by the Congress of Vietnam. Law of Cooperatives, dated June 20,1996, by the Congress of Vietnam. Business Law of 1999 by the Congress of Vietnam.	Circular 69/TTLT/BNN-TCTK on June 23, 2000, by the Ministry of Agriculture & Rural Development and National Directorate of Statistics provided criteria for farm economy. Circular 82/BTC dated Aug. 14, 2000, by the Ministry of Finance to guide the financial regulations applied to the farm economy.	Circular 61/ TT-BNNPTNT/ KH issued by the Ministry of Agriculture & Rural Development to guide the planning for farm economy. Decree 19/2000/QD-TTg dated Feb. 3, 2000, of the PM to eliminate permits and regulations not compatible to Business Law of 1999.	Decree 86/2001/ND-CP by the government on the conditions to operate the business in fisheries and aquaculture. Decree 129/2003/ND-CP by the government on regulations for the conditions to operate the business in fisheries and aquaculture.

Source: Compiled by the authors from Sinh (2004).

Annex 2. Summary of Key Issues Related to Gender in Aquaculture in Northeast Vietnam

The following matrix provides a summary of key issues related to gender in aquaculture in Northeast Vietnam.

1.0	Resource Access and Representation	Small-Scale/Household	1.0A	Resource Access and Representation	Medium/Large-Scale
1.1	Do women and the poor have equal access to inputs as men and incumbent beneficiaries?	Access to quality shrimp seed is more difficult for smallholders, women and men, than it is for large-scale farmers. Other inputs such as feed, fertilizer, etc., do not exhibit any gender or social status discrimination in access.	1.1A	Is the payscale different for women and men performing the same task?	No pay-scale difference in private enterprises is reported. State-owned institutions, however, index salaries according to experience/ seniority for both men and women, thus discouraging specialists—mostly young people—to work in government jobs; result: smallholder households deprived of services such as extension, etc.
1.2	Do women and the poor have equal access to markets as men and incumbent beneficiaries?	Smallholders, both men and women, are unable to fully tap into exporters' supply chains due to missing sanitary controls of smallholder produce.	1.2A	How many women are in management roles (% of total employees)?	Low proportion of women in the management of enterprises, cooperatives, associations, etc.
1.3	Do women and the poor have equal access to support services as men and incumbent beneficiaries?	See 1.2, 2.7 and 1.1.A.	1.3A	Do women get equal benefits and compensation compared to men?	No discrimination reported.

1.4	Are women and/or the poor in general able to command the same price in the market as others?	No. Men are at a disadvantage if their wives do not/are unable to market the produce.	1.4A	Are women allowed to return to their jobs following maternity?	Yes.
1.5	Is there a difference in income retention between women and men in aquaculture?	Not conclusive.	1.5A	What types and percentage of work areperformed by women as compared to men?	85–90% in seafood processing companies; less than 20% in large-scale intensive or extensive aquaculture farms.
1.6	What share of the work is performed by women?	100% in marketing of produce. Equal and many times higher share in farm management/work. 100% in household management.			
2.0	**Policy and Regulatory Structure**		**2.0A**	**Policy and Regulatory Structure**	
2.1	Do government policies include incentives and other provisions specifically designed to support women and the poor?	Yes. Credit facilitation for the poor through state-owned banks.	2.1A	Do existing regulations prohibit women from owning a business?	No.
2.2	Do land tenure regulations discourage or discriminate against ownership of land by women or the poor?	No	2.2A	Do labor regulations provide for proper protection for female workers? How are regulations applied?	On paper, Vietnam has some of the most labor-protective laws in the world, including provisions for women's protection, but the actual application of the laws in the aquaculture industry is lax.

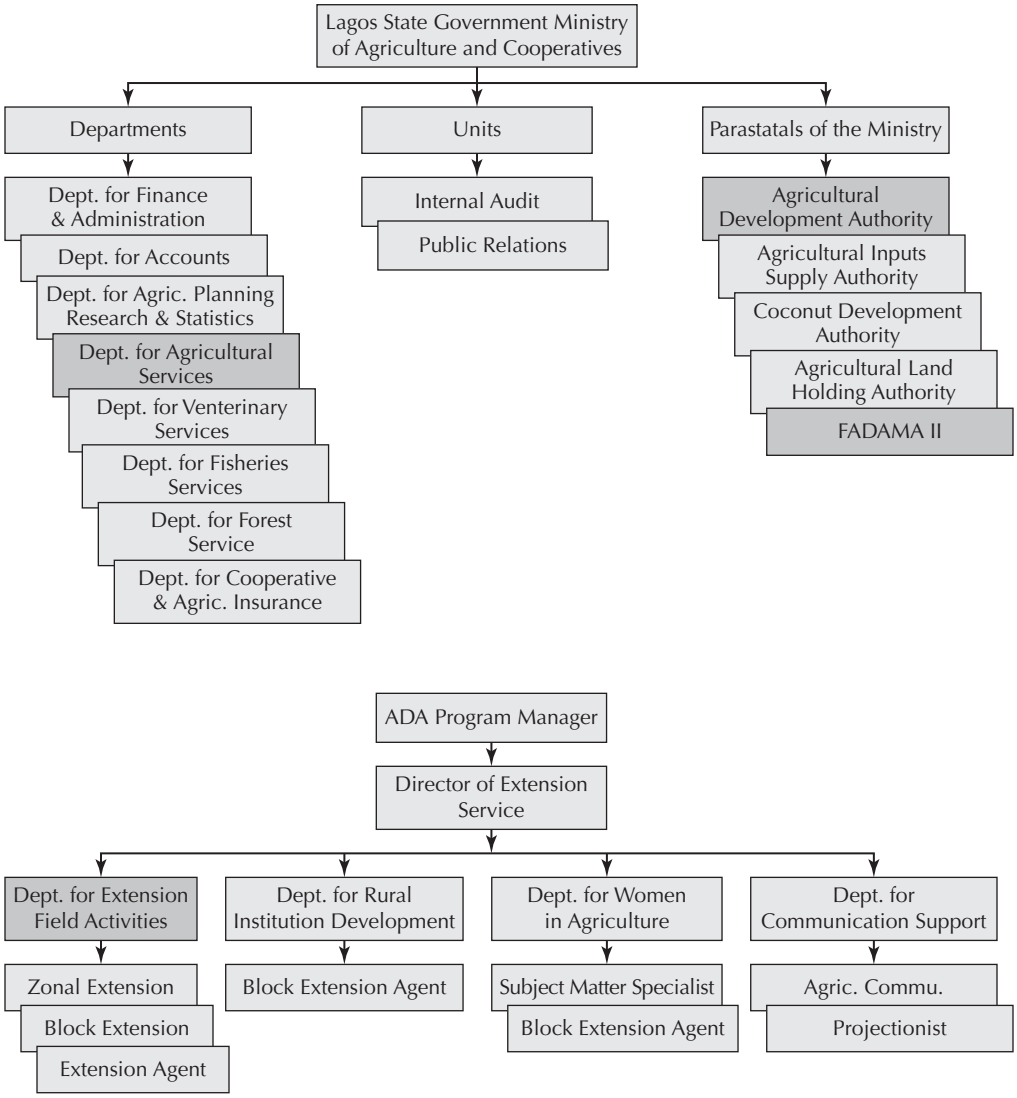
2.3	Are taxes, cost of licensing fees and permits prohibitive (as a % of income) for women and the poor?	No.	2.3A	Are workers allowed to unionize?	Yes, but only under government-run unions that negotiate pay increases and labor conditions on their behalf. The policy drive to increase domestic and foreign investments leaves workers very often with unions that side with investors as opposed to maximizing union members' benefits.
2.4	Are water access rights (and cost) different for women and the poor as compared to men?	No.			
2.5	Do conservation and environmental regulations discriminate against women or the poor?	No discrimination. However, with lax enforcement of environmental laws, women and men equally pollute each other's ponds and surroundings with untreated water discharges.			
2.6	Are inputs such as electricity priced less favorably to women and the poor in rural communities?	No.			

2.7	Are quality control regulations discriminatory toward women or the poor?	Quality controls are not performed for the bulk of rural households' aquaculture production. As a result, both women and men rely entirely on local markets that offer higher prices for their produce compared to prices offered in seafood exporters' supply chains.			
3.0	**Institutional Support Infrastructure**		**3.0A**	**Institutional Support Infrastructure**	
3.1	Do smallholder/household aquaculture farmers have their own advocacy group or association?	Limited advocacy groups for men; Women's Union a pivotal advocacy group for women.	3.1A	Are women allowed to have their own advocacy groups, associations, or unions?	Generally yes, but not for industrial unions that are government controlled.
3.2	Are there specialized institutions mandated to support women and the poor?	Yes.	3.2A	Do women have equal access to training and other technical support?	No.
3.3	Do women and the poor have equal access to training, technical advice, and other forms of support?	Limited support across the board, with smallholders dependent on (and disadvantaged by) limited extension support and training.			
3.4	Do trade promotion organizations have the capacity to support smallholder/household aquaculture farmers?	Limited.			

3.5	Do existing institutions promote socially and environmentally sustainable practices?	See 2.5.			
4.0	**Markets**		**4.0A**	**Markets**	
4.1	Do buyers exercise preferential pricing for suppliers able to offer bulk sales?	Yes.	4.1A	Do women with work experience have opportunities to expand their earning potential?	Limited.
4.2	Do women and the poor have equal access to market price information?	Women have better market price information than men.			
4.3	Do brokers along the supply chain favor organized commercial suppliers over individual smallholder/household suppliers?	Collectors deal mostly with smallholders while large-scale traders prefer to deal with commercial farms and offer discounted prices to extensive system farmers, small or large (see 2.7).			
4.4	Do women and the poor have equal access to cold chains and storage?	Yes, in so far as the collector's cold chain is concerned; no access, however, to exporter's cold chain.			
4.5	How does the supply chain for rural smallholder/ household suppliers differ from those for commercial suppliers?	See 2.7 and 4.3.			

Source: Authors' interviews.

Annex 3. Government Organizational Structure in Lagos State, Nigeria



Source: Author's interviews.

References

Barrientos, S., C. Dolan, and A. Tallontire. 2003. "Gendered Value Chain Approach to Codes of Conduct in African Horticulture. "*World Development* 31(9):1511–26.

Bello, Mallam Adamu. 2007. "Trade and Investment Opportunities in Nigeria's Agriculture."A paper presented at The India–Africa Agri Food Summit in New Delhi, on March 7-8, 2007.

Belton, B., and D. Little. 2008. "The Development of Aquaculture in Central Thailand: Domestic versus Export-Led Production."*Journal of Agrarian Change* 8(1):123–43.

Bennett, E. 2005. "Gender, Fisheries and Development."*Marine Policy* 29:451–459.

Brugere, C., M. Felsing, K. Kusakabe, and G. Kelkar. 2001. Women in Aquaculture. Final Report, Asia Pacific Economic Cooperation Project. FWG 03/99Asian Institute of Technology, Pathumthani, Thailand and Institute of Aquaculture, Stirling, UK.

De Silva, D. A. M., and M. Yamao. 2006. "The Involvement of Female Labour in Seafood Processing in Sri Lanka: The Impact of Organizational Fairness and Supervisor Evaluation on Employee Commitment." In Choo, P. S., S. J. Hall and M. J. Williams (eds.). 2006. Global Symposium on Gender and Fisheries: Seventh Asian Fisheries Forum, 2004. World Fish Center, Penang, Malaysia.

FAO. 2004. The State of World Fisheries and Aquaculture. Rome: FAO.

FAO. 2006. "Gender Policies for Responsible Fisheries—Policies to Support Gender Equity and Livelihoods in Small-Scale Fisheries." FAO Policy Brief on New Directions in Fisheries. No. 6. FAO, Rome.

Gammage, S., K. Swanberg, M. Khandkar, Md. Z. Hassan, Md. Zobair, and A. M. Muzareba. 2006. "A Pro-Poor Analysis of the Shrimp Sector in Bangladesh," Report prepared for the Office of Women and Development of the U.S. Agency for International Development, Dhaka, Bangladesh.

Harrison, E. 1997. "Fish, Feminists and the FAO: Translating 'Gender' through Different Institutions in the Development Process," In Goetz, A.M. (ed.). *Getting Institutions Right for Women in Development*. London: Zed Books.

Hoshino, E. 2007. "Examples of Fisheries/Aquaculture Projects with Gender Impacts."World Bank. Agriculture and Rural Development, Washington, DC.

Josupeit, H. 2004. "Women in the Fisheries Sector of Argentina, Uruguay and Southern Brazil," FAO Fisheries Circular No. 992, FIIU/C992 (En). FAO, Rome.

Kabeer, N. 1994. *Reversed Realities: Gender Hierarchies in Development Thought*. London: Verso.

Kabeer, N., and T. T. V. Anh. 2002. "Leaving the Rice Fields, but Not the Countryside: Gender, Livelihoods Diversification, and Pro-Poor Growth in Rural Vietnam'. In Razavi, S. (ed.). 2002. *Shifting Burdens: Gender and Agrarian Change under Neoliberalism*. Bloomfield: Kumarian Press.

Kumaran, M., N. Kalaimani, K. Ponnusamy, V. S. Chandrasekaran, and D. Deboral Vimala. 2003. "A Case of Informal Shrimp Farmers Association and Its Role in Sustainable Shrimp Farming in Tamil Nadu, India."*Aquaculture Asia* 8(2):10–12.

Kusakabe, K., and G. Kelkar (eds.). 2001. "Gender Concerns in Aquaculture in Southeast Asia." Gender Studies Monograph 12, Gender and Development Studies, School of Environment Resources and Development, Asian Institute of Technology, Bangkok, Thailand.

Locke, C., Nguyen Thi Ngan Hoa, and Nguyen Thi Thanh Tam. 2008. "Linking Migration, Reproduction and Wellbeing: Exploring the Strategies of Low-Income Rural-Urban Migrants in Vietnam." Research Report No. 1 for the Research Project The Institutional Context Influencing Rural-Urban Migration Choices and Strategies for Young Married Women and Men in Vietnam.

Markussen, M. 2002. "Women in the Informal Fish Processing and Marketing Sectors of Lake Victoria." NIBR Working Paper No. 115.

Meagher, K. 2000. "Veiled Conflicts: Peasant Differentiation, Gender and Structural Adjustment in Nigerian Hausaland." Disappearing Peasantries: Rural Labour in Africa, Asia and Latin America. Intermediate Technology Development Group (ITDG). 81–98.

Nandeesha, M. C. 2007. "Asian Experience on Farmer's Innovation in Freshwater Fish Seed Production and Nursing and the Role of Women," InFAO, "Assessment of Freshwater Fish Seed Resources for Sustainable Aquaculture," FAO Fisheries Technical Paper No. 501. Rome, FAO.

Nathan, D., and N. Ahmed Apu. 1998. "Women's Independent Access to Productive Resources: Fish Ponds in the Oxbow Lakes Project, Bangladesh." *Gender Technology and Development* 2(3):397–413.

Nathan, D., and N. Ahmed Apu. 2004. "Case Study of the Oxbow Lakes Small-Scale Fishermen's Project (OLSSFP) IFAD Innovation Mainstreaming Initiative, Bangladesh—1990–1997." IFAD, Rome.

Prahdan, D., and M. Flaherty. 2008. "National Initiatives, Local Efforts: Trade Liberalisation, Shrimp Aquaculture, and Coastal Communities in Orissa, India." *Society and Natural Resources* 21:63–76.

Sinh, L. X. 2004. "Policy Environment for Aquaculture Development." Report prepared for the World Bank, Hanoi, Vietnam.

Voeten, J., and B.-J. Ottens. 1997. "Gender Training in Aquaculture in Northern Vietnam: A Report." Gender Technology and Development 1(1997): 413–432.

World Bank. 2004. "Nigeria: Strategic Country Gender Assessment." Africa Regional Office, World Bank.

World Bank. 2006. "Final Aide Memoire on COREMAP II: Second Supervision Mission." World Bank, Washington, DC.

World Bank. 2006. Aquaculture Review: Changing the Face of the Waters. Meeting the Promise and Challenge of Sustainable Aquaculture. Washington, DC: World Bank.

World Bank, FAO, and IFAD. 2008. "Gender in Fisheries and Aquaculture," Module 13 of the Gender in Agriculture Sourcebook. Washington, DC: World Bank.

Endnotes

[1] The term mobility, as used in this report, means the ability of persons to relocate/travel over short or long distances and/or periods of time in order to pursue a particular educational, business, or other endeavor without greatly disrupting the functioning of their families and/or the interactions within their social network.

[2] In the case of large-scale commercial operations and even cooperative ventures (of which one is detailed in the Vietnam section of this report), income is not pooled. These are expensive ventures requiring considerable capital, which, as far as can be seen, is usually obtained from banks or private individuals.

[3] This reported lack of networks relates to credit and is not discussed in relation to marketing and processing where women may depend on similar networks. However, Kabeer and Anh (2002) note that men need more capital than women for their activities—land, ponds and equipment—whereas women's nonfarm investments (trade and marketing) are less financially demanding.

[4] This is not to deny the success of the CARE Bangladesh project that, through a carefully constructed program designed to change norms and values, was able to revert to using male agents in meetings with women in socially conservative locations.

[5] The communities that invested in more lucrative markets—shrimp, for example—may lose out in the face of changes in technology or a failure to comply with international food safety standards (as in Bangladesh, where large-scale unemployment followed the closing of a number of the factories exporting to EU countries because they failed to meet safety regulations [Gammage et al. 2006]). Smallholders in general may be forced out if, as is likely, they are unable to compete with more powerful players in the chain.

[6] Technical shifts in aquaculture (toward inland cage culture from subsistence pond aquaculture, for example) are reported to be reinforcing the more-limited control over production and incomes from aquaculture by women compared with men in many locations, with negative consequences for households.

[7] See "Leaving the Rice Fields but not the Countryside," by Kabeer and Ahn (2002).

[8] Pre-1986 movements were strictly controlled using a household registration system. The economic changes introduced as part of the *doi moi* economic renovation have included a progressive relaxation of these institutional controls, although the controls have not yet completely disappeared. As a result, migration remains stratified in terms of qualifications for residency and related social entitlements (Locke et al. 2008).

[9] At current exchange rates, VND40 million and VND50 million are equivalent to US$2,500 and US$3,125, respectively.

[10] Section based on Sinh 2004.

[11] The study area involves northeastern Vietnam, mainly around Quang Ninh Province. See following section titled Study Area for more details.

[12] *Shrimp* and *prawn* are the terms used interchangeably in commercial aquaculture industries. *Prawn* is the term used almost exclusively in Europe, whereas *shrimp* is used in United States. Many times *prawn* is used to describe larger *shrimp.* This paper will use the term *shrimp*, even though prawn can be distinguished from shrimp by the gill structure, which is branching in prawns but is lamellar in shrimp.

[13] Quang Ninh Trade Department, www.quangninhtrade.gov.vn.

[14] Authors' interviews.

[15] Authors' interviews.

[16] Southern Vietnam produces the bulk of the country's shrimp, and it is not allowed to grow the nonnative whiteleg shrimp due to fear of this type spreading pathogens to the native monodon.

[17] The names of interviewees presented in the report have been changed.

[18] Salaries are indexed on both seniority and on-the-job experience.

[19] Brood stock is commonly purchased in couples in Vietnam.

[20] The hatchery reports that it is not engaged in nauplii production for sales in the marketplace, a claim that could not be verified independently.

[21] RIA1 data from official statistics.

[22] Decision number 251/1998/QD-TTg.

[23] Surface (per hectare) aquaculture metrics, as used by Vietnamese producers and statistical agencies, is used throughout this report except for marine cage aquaculture where volume (per m^3) metrics are commonly used.

[24] The share of each stage in the total cost is expressed to the nearest tenth (one decimal point) throughout the report, and a software-generated rounding error of 0.1% may appear in some value chains.

[25] The bulk of study area shrimp production remains *monodon* shrimp as most smallholders, who produce the greater part of shrimp in the area, farm the *monodon* species.

[26] Please note that a comprehensive survey is needed to establish average intensive farm profits in the study area.

[27] According to the official Vietnamese Living Standards Survey of 2004, a rural household of six spent an average of US$732.8 annually on foodstuffs, tobacco, and alcohol (or US$0.33/person/day), whereas annual nonfood spending on education, health care, and so on was US$560.50, or US$0.26/person/day.

[28] Prices of VND40/PL and VND45/PL are equivalent to US$0.0025/PL and US$0.0028/PL respectively.

[29] In 2007, Mr. Nguyen had two cows to cushion him from falling into debt. By 2008, he did not have any cows left, yet was determined to try another shrimp crop. In the event of another shrimp crop failure, he thus risked significant indebtedness.

[30] The term mobility, as used in this report, means the ability of a person to relocate/travel over short or long distances and/or periods of time in order to pursue a particular educational, business, or other endeavor without greatly disrupting the functioning of his or her family and/or the interactions within his or her social network.

[31] In the past, large-scale irrigation projects in the past were handed over to state-owned irrigation companies to manage, such as the concrete canal support projects in which cooperatives heavily invested in the construction of the canal system and in which investments were recuperated through irrigation fees paid by members.

[32] Note that the polyculture comparison between smallholder and largeholder fish farmers illustrated in this report may not be a like-with-like comparison: In contrast to largeholders, smallholders do not keep precise records of how much and which polyculture fish is stocked and harvested.

[33] At an average farm gate sales price for the nine polyculture fish species of VND35,661 in 2008 (a reported 53.1 percent increase from 2007 fish sales prices).

[34] Chyen My commune, where this farm is located, for example, has an estimated 2,150 households and a total of 9,300 inhabitants, of which 5,700 are of working age. Interviews in the field suggest that an estimated 3,200 people work mainly in the handicrafts sector, whereas most of the remaining 2,500 working age inhabitants migrate to urban areas around Hanoi and other big cities to look for seasonal jobs.

[35] Data from workshop materials from Vietnam Ministry of Fisheries on April 13, 2006, in Hanoi.

[36] Grouper has a 7–10 month crop cycle, whereas mollusks have a 16-month crop cycle.

[37] Collector's vulnerability and capacity assessment (VCA) is based on the aggregate mix of shrimp purchases reported to be mostly grade two and grade three giant tiger (Monodon) shrimp (50–60 pieces per kilogram).

[38] ODINAFRICA III: First Review Meeting April 2006; http://www.nodc-nigeria.org

[39] From nursery ponds, only about 10,500 fingerlings, now called juvenile fish, survive to be transferred to the catfish farming pond.

[40] The situation in Kaduna State is better with regard to grid power supply. However, the petrol generators are expensive. Diesel/petrol-based power generation makes up about 5 to 10 percent of the energy cost.

[41] According to the Nigerian Institute for Oceanography and Marine Research, fry survival rates range from 76 to 94 percent. Hatchling survival rate is 50–80 percent. According to a 2006 study by Akinwole and Faturotia of the Department of Wildlife and Fisheries Management of Ibadan, titled "Biological performance of African Catfish (Clarias gariepinus) cultured in recirculating system in Ibadan," survival rates vary from 75 to 80 percent for fingerlings, 75 to 93 percent for juveniles, and 77 to 88 percent for adult fish.

[42] A table-size catfish typically weighs 1 kg per piece.

[43] Even though NIOMR has come up with quantitative requirements for balanced rations for indigenous fish species, which, however, were not made available for this study.

[44] A 1.5 horsepower pump can pump 6 cubic meters of water per hour. A generator with a 2.5 kW capacity requires 1 liter of petrol or diesel to run a 1.5 horsepower pump. One liter of petrol runs the generator for an hour, which in effect pumps 6 cubic meters of water.

[45] Microfinance institutions have a reasonably wide coverage but require borrowers to fulfill the following criteria: They must be practicing farmers; well-known in the community; must belong to a registered group; and must have opened accounts with the bank in operation for a minimum of three months before applying for a loan, group guarantee, apex guarantee, Central Bank of Nigeria guarantee, or Agricultural Credit Guarantee Scheme. Collateral commensurate with the amount of loan is also required.

[46] Almost all women sellers have two mobile phones to avoid phone line disruptions from preventing them from doing their work. Average cost of telephone usage is 0.70 Naira per second. There is a special service for businesses that uses a sliding fee scale based on the volume of usage. There are around 38 telecommunication companies in Nigeria. Around 95 percent of women sellers use a network operated by Celtel and MTN Nigeria. Interviews suggest that it takes approximately 5 minutes of telephone airtime to complete a transaction. This translates into about Naira 270 per ton, or Naira 0.21 per fish.

Agriculture & Rural Development Department
World Bank
1818 H Street, NW
Washington, DC 20433
http://www.worldbank.org/rural