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Assessment of a Farmer Base Network in Promoting an Integrated Farming System at the Mekong Delta in Vietnam

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ABSTRACT

This study analyzed forces driving the emergence of farmer networks in Vietnam and quantified the benefits of an integrated farming system (IFS) and the role of a farmer network in promoting IFS in the Mekong Delta. This case study applied a combination of literature review, participatory community assessment, and household survey approaches. The case study was undertaken in the My An commune, Cho Moi districtW of An Giang province. Findings from the study show that both networking and non-networking household groups recognize the important advantages of farmer networks, and that practicing IFS gives farming households economic, environmental, and social benefits and food security. Networking and practicing IFS are synergistic. By networking, farmers can gain better access to agricultural extension and credit services as well as improve their social networking, and hence adopt and practice IFS efficiently and contribute to rural poverty reduction. These benefits of networking and IFS practices should be considered at the community and regional levels rather than only at the level of individual households. Positive linkages and synergism should go beyond network or farm boundary (i.e., between specific networks or farms). Further development of farmer networks and IFS needs more effective policies and support from the government.

Keywords: farmer networks, integrated farming system, benefits
JEL classification: L13, F21, C72

INTRODUCTION

Agriculture in the Mekong Delta of Vietnam has shifted from subsistence to commercial production and from rice monoculture to more diverse farming systems. The shift has been promoted by the government and the development of local and international markets. Before 2000, rice farming had been considered as the region's major means of meeting domestic consumption and creating an export-based sector. Intensive rice farming, however, has been viewed as unsustainable because its high dependence on external agro-chemical inputs and global rice markets results in economic risks and negative environmental impact. Since 2000, the government has recognized that agriculture and the rural economy need to be transformed towards increasing resource use efficiency, farming income, and job creation, especially for the rural poor. Consequently, farmers have transformed their rice monoculture to rice-based farming systems, which entail the cultivation of rice, upland crops, livestock, and aquaculture on the same farm, allowing better use of farm resources and improving farm income while safeguarding the environment (Bosma et al. 2005; Phong et al. 2008).

Farmer networks may promote the adoption of integrated farming systems (IFS), but problems prevent farmers from switching to IFS and exploiting resource integration. Integrated farming systems require high start-up costs (Tipraqsa et al. 2007). In addition, the farming practice is labor-intensive and requires technical farming and management knowledge (Pein 2002). However, previous studies show better access to farming input and output services as one benefit of farmer networks (De 2006; Duong et al. 2000; Nghiem 2006). Therefore, if farmers can organize themselves into farmer networks, they might have more opportunities to adopt IFS and use their farmer resources more efficiently. Several studies have demonstrated the benefits of IFS to small farmers and sustainable rural development in developing countries (Nhan, Be, and Trung 2007; Pein 2002; Tipraqsa et al. 2007), but knowledge on the role of farmer networks in the adoption of IFS by farmers is still limited. The present study analyzes forces driving the emergence of farmer networks in Vietnam and quantifies the benefits of IFS and the role of a farmer network in promoting IFS in the Mekong Delta.

LITERATURE REVIEW

Network Establishment and Evolution in Vietnam

Types of Farming Networks

In Vietnam, farmer networks are diverse, depending upon local needs and resource capability. In general, farmer networks can either be formal or informal. The former is the so-called agricultural cooperative, which is structurally organized and fully commercially oriented. In contrast, the latter is a non-structured organization, the so-called farmer network or group that are formed for subsistence or semi-commercial purposes. Farmer networks can be service-oriented, farming production-oriented, or community-based organization (CBO)-related. The service-oriented network mainly deals with agricultural inputs and output services, including credit supply, farming materials, irrigation services, and product marketing. The production-oriented network is associated with technical and management support through group/individual discussions, training courses organized by local agricultural extension agencies, and agricultural credit supply. CBO-related networks consist of the so-called farmer's union, women's union, youth union, and veteran association at the hamlet. This

type of network combines political functions with farming technology demonstrations and transfer.

Farmer networks were categorized by Cho (2001) as multi-purpose or specialized. The former has diversified enterprises, which include both production technologies and farming input and output services, thereby generating employment opportunities for local people. The latter yields a specific enterprise for a special market niche, promoting the development of rural agricultural markets.

Driving Forces of Network Evolution

Major driving forces of farmer network evolution are governmental policies and support, service supply, rural market development, limited resource base, and farmers' needs.

State Government Policy

In northern Vietnam, the old-style agricultural cooperative was commonly established during the 1960s–1980s from a collectivized agricultural systems perspective. Members commonly shared land, livestock, farm equipment, and agricultural products. In southern Vietnam, this cooperative form existed between 1975 and 1986. Since 1986, the Vietnamese government has reformed its policies, shifting from a centrally-collective economy to a market-oriented economy. The cooperative was deemed to be an inappropriate structure and thus disappeared. In the 1990s, the government promoted new agricultural cooperatives which address the particular needs of farmers who join the group voluntarily. Majority of farmers saw the new cooperatives as more suitable, stimulating agricultural development and increasing the farming income of households. In 1993, the government promulgated Decree No.13/CP to regulate agricultural extension activity and establish agricultural extension systems at the national, provincial, and district levels. Agricultural extension establishments significantly contributed to promoting organization within farmer networks. In addition, the Cooperative Law, which was based on the basic principles of the International Cooperative Alliance, was promulgated in 1997.

Local Government Support

The local government has contextualized its implementation of the state's incentive policies to promote farmer networks. Support may take the form of credit supply, technical farming and management support or consultancy, marketing organization, or tax exemptions (in the first 3 years), etc. With the support of local government, farmer networks can participate in rural development projects. In addition, the government organizes training programs on network management for network members and also upgrades land-transportation infrastructure, irrigation systems, electricity, and rural markets. At the provincial level, the Bureau of Cooperatives and Rural Development, which is under the Department of Agriculture and Rural Development, was established. This agency gives direct support to farmer networks.

Credit Supply

One necessary support from the government is the favorable provision of credit (Duong et al. 2000). Farmers who are network members can take a loan without security or with low interest rates, provided that they have a guarantee from their network head. In joining a network, farmers can also benefit from having the government cover 50 percent of their expenses for training programs organized by local agricultural extension agencies (Nghiem 2006).

Rural Market Development

Rural market development is a crucial factor in encouraging farmers to organize networks. The development of rural markets stimulate cooperation among small-scale farmers to meet

consumer demand, with the right quality and at the right time. Recently, governmental policies on rural market development promote farmers getting together in groups to share experiences and information and to deal with market problems that could not be solved individually (De 2006). Market information is always important for most farmers.

Limited Resource Base

Farmer networks are important in densely populated places with limited natural resources. There is a need to transform farming enterprises into intensified farming units and incorporate them into the market-oriented economy. For many farm households, agricultural production is shifted from subsistence to commercial needs. Currently, rice prices effectively result in low farmer incomes. Farmers therefore attempt to shift to intensified or diversified production systems to generate higher income. Land use exchange related to the decrease and increase of farming areas for some crops have influenced farmer network needs, especially irrigation management and input and output services. More than 80 percent of agricultural cooperative groups in northern Vietnam and 20 percent of those in the south are formed due to the limited land size of individual households (MARD [Ministry of Agriculture and Rural Development] and UNDP [United Nations Development Programme] 2003). In addition, farmer networks are organized to manage or supply irrigation. In the Mekong Delta, there are conflicts regarding water use between farm households and agriculture zones (Hashimoto 2001; Nhan, Be, and Trung 2007). The conflicts would be minimized through appropriate solutions at the community level or the establishment of a farmer network to better manage common resources.

Farmers' Needs

Small farmers participate in production groups to share technical knowledge and farming experiences, and obtain better access to input and output services. For example, not all farmers in the Mekong Delta can access governmental extension services due to limited human and financial resources even if governmental extension services are established at the grassroots level. In this region, only 85 percent of districts have agricultural extension stations and 30 percent of communes have extension workers (De 2006). Individual farmers who participate in groups can easily access these services. Moreover, a network gives farmers better access to markets (Cho 2001; Gianatti and Carmody 2007) and hence, leads to increased effectiveness of agricultural extension activities. Further, an irrigation management group is an example of the farmer network where small-scale farmers can use existing irrigation systems more efficiently (Stacey 1999; Nhan et al. 2003). These are economic and social benefits that a small individual farmer can hardly obtain alone (DANIDA [Danish International Development Agency] 2007). Farmer networks also create rural employment opportunities by stimulating industrial development and growth in the services sector, thereby contributing to rural poverty reduction and reduced migration of people from rural to urban areas.

Farmer Networks and Integrated Farming Systems

Integrated farming is considered a sustainable farming model for subsistence farmers (Edvards 1998). The practice results in the diversification of agriculture towards nutrient linkages among components within a farm (Little and Muir 1987). Edvards (1998) explains that integrated farming generally means concurrent or sequential linkages between two or more human activity systems, either directly

on-site or indirectly through off-site needs and opportunities, or both. Nutrient linkages contribute to farming intensification, efficient use of natural resources, income generation, and environmental protection (Devendra and Thomas 2002; Lightfoot et al. 2003).

In the Mekong Delta, small farmers tend to adopt integrated farming while larger farmers usually practice commercial monoculture systems (Duong et al. 2000; Yamazaki 2004). On-farm integration and diversification require labor, management, and knowledge. Farming networks are necessary for households adopting integrated farming systems. Through a network, farmers have opportunities to share labor, knowledge, experiences, and to develop off-farm or between-farm integration towards commercialization and specialization of agriculture, stimulating strategies for integrated natural resources management in local communities (Can et al. 2007). For example, integrated crop-livestock-aquaculture farming systems include not only on-farm but also off-farm or between-farm integrations. Additional off-farm inputs allow further production intensification. Networking and off-farm resource integration might create more services for the rural poor household while reducing environmental pollution (Nhan et al. 2003).

Institution and Governance of Farmer Networks

Network size

The size of farmer networks highly depends on network type and production scale. The size of networks in the north is larger than in the south (MARD 1999). In the north, cooperative groups with 100 members account for 81 percent of the total number of groups while in the south, the figure is about 50 percent. In general, network size ranges between 10 and 310 household members (DANIDA 2007; Yamazaki 2004). Production and CBO-related networks have more members than service networks. In An Giang province, an irrigation management group has more than 300 members.

Organizational structure and governance

A farmer network is usually managed by a board comprised of a head, a vice-head and a secretary. Management board members are elected from among the network's members, whose participation in the network is voluntary. Network operations observe the cooperative law, which the Vietnamese government implements through four decrees: (1) policies to support cooperative development, (2) guidance in the establishment of cooperatives, (3) guidance in registration of cooperatives, and (4) guidance in detailed articles of the law. Aside from the cooperative law, farmer networks also follow other laws like those concerning land and income taxes. The local government plays an important role by giving support and guidance (Nghiem 2006).

METHODOLOGY

Study Site

The fieldwork was conducted in the My An commune, Cho Moi district of An Giang province. The Cho Moi district is located in the flood zone of An Giang province (Figure 1).

About 80 percent of the district area has been fully flood-protected with regional embankments and sluice-gate structures since 2000. Therefore, agricultural production activities are well irrigated and unaffected by annual monsoon floods. Soils are alluvial. Agricultural irrigation is available year-round, relying on water from the Mekong River. Most of agricultural land is devoted to rice farming but is used to cultivate an average of three crops per year (Table 1). Other secondary farming components include upland crops and fruit trees. Aquaculture is a minor economic sector. Since flood-control structures have been in place,

Figure 1. Mekong delta map showing the location of Cho Moi district, An Giang province, Vietnam

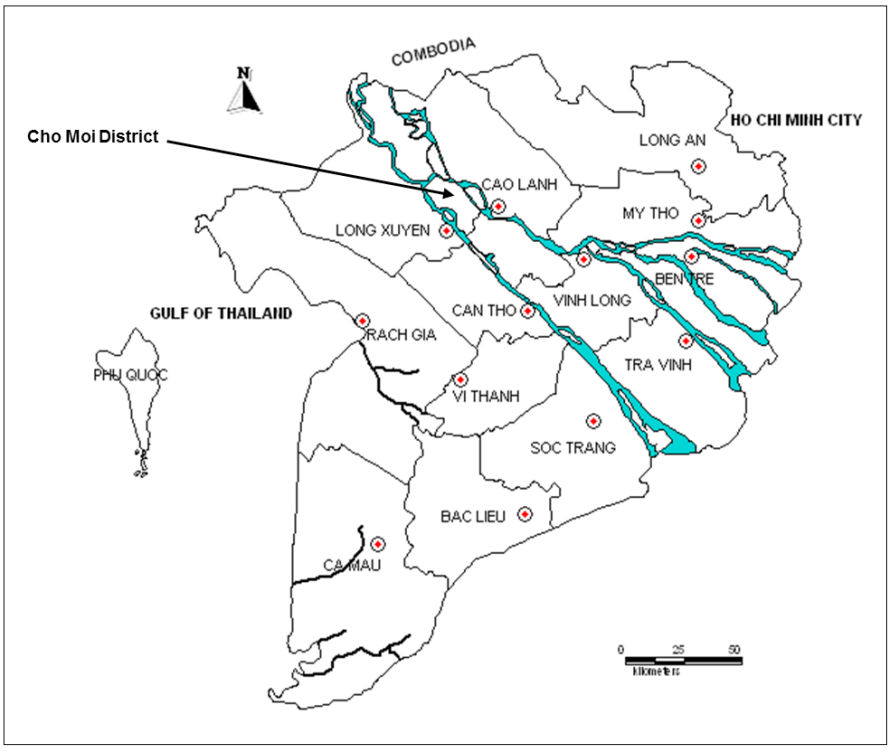


Table 1. Major characteristics of the study area, 2010

Parameters	Cho Moi district	My An commune
Land uses		
Natural land (ha)	36,962	1,287
Agricultural land (ha)	27,368	973
Rice (%)	77.8	28.0
Upland crops (%)	11.9	50.8
Orchards (%)	10.3	20.6
Ponds (%)	1.2	0.3
Socio-economic data		
Households (HH)	78,517	2,921
Poverty rates (%)	8.66	4.1
Population density (persons/km^2)	1,005	1,081
Per capita income (USD/year)	687.2	580

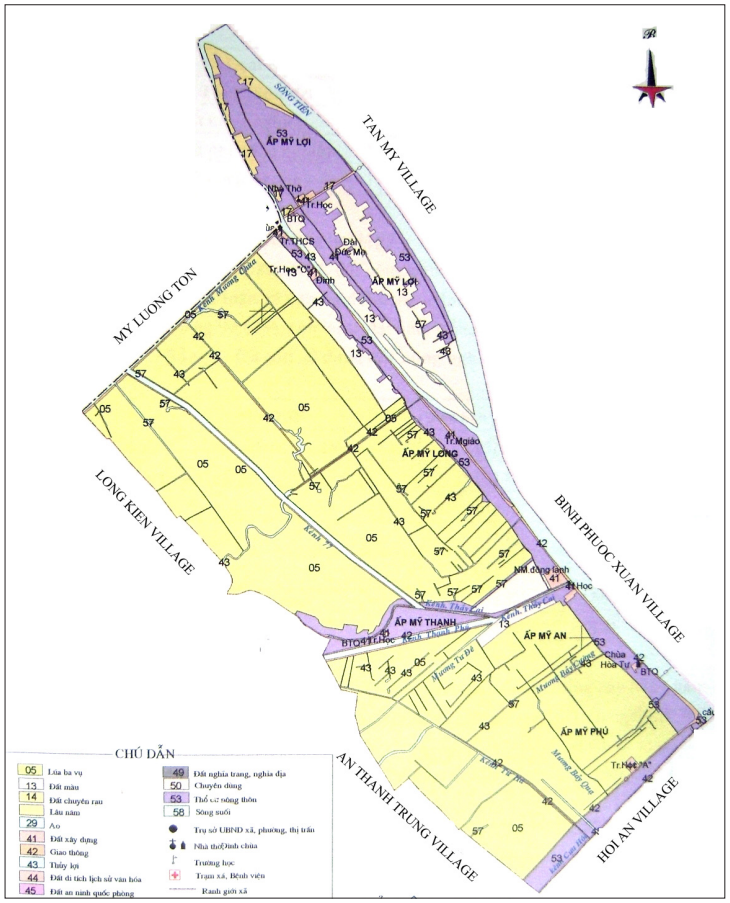
Source: District and commune statistics in 2010

agricultural production has been intensified and commercialized. Farmers have shifted from double-rice to triple-rice cropping. They have also switched from rice to cash crops, mainly baby corn and vegetable production, and integrated this with cattle production. Between 2000 and 2010, the land area for rice production increased by 1.5 times while areas devoted to cash crops and cattle herbs increased by 15 and seven times, respectively.

Cho Moi is highly populated with about 1,000 persons per square kilometer, much higher than the provincial average of 625 persons per square kilometer as well as the Mekong Delta figure of 429 persons per square kilometer. Poverty rate is estimated at nine percent, lower than the provincial average rate of 13 percent.

My An commune is considered indicative of the Cho Moi district (Figure 2). It is characterized as a fully flood-controlled and highly populated area with commercially-oriented agriculture at some levels of intensification. Commercial cash crop production is dominant. Cash crops include baby corn, beans and vegetables, grown at three to six crops per year. Of the total upland crops, corn cropping accounts for 45 percent. Rice and fruit crops are secondary. The integrated crop-livestock farming system is commonly practiced. In this farming system, residues of baby corn and rice are used as cattle feed and cattle manure is then applied as fertilizer for crops. In 2010, of 2,921 households in the commune, about 11 percent or 330 farm households were practicing this form of

Figure 2. A map showing the location of the My An study site



farming system with about 2,348 cattle heads. My An commune was selected for case study because it is representative not only of the Cho Moi district, but also of highly populated areas in the Vietnamese Mekong Delta which feature agricultural intensification, IFS, and farmer networks, as these have been found to be more common in My An than in other districts with high poverty rates.

An Giang province is one of the first provinces in Vietnam to have promulgated and applied innovative policies on agricultural and rural development since 1986. These policies include provisions on the "land use right" of farmers (Direction No. 22/CT-UB 1987), land exploitation and use (Decision No. 176/QĐ-UB 1988), short-term loan for small-scale agricultural development (Directive No. 202-CT 1991), and exploitation and use of water resources for agriculture (Decision No. 244/QĐ-UB 1991). In 1991, the provincial government issued Directive No. 25/CT-UB to encourage farmers to organize into agricultural production groups. In addition, governmental agricultural extension agencies were established at the provincial and district levels in 1992. Since then, models of "new-styled cooperatives" or "farmer networks" have been commonly established, including agricultural production groups, farmers' clubs, irrigation management groups, and women's credit groups. This type of cooperative group or farmer network has been found to be more common in Cho Moi than in other districts within An Giang province because of flood management and agricultural intensification and commercialization. In 2010, the district had 21 agricultural cooperatives and about 129 farmer networks. However, households joining the networks account for only 5 percent of the total 78,500 households in the district.

Research Approach and Methods

The study was carried out in three steps: (1) literature reviews, (2) focus group discussion and (3) household interviews. Details of these steps are as follows.

Literature Reviews

A comprehensive assessment of the literature on farmer networks in Vietnam with special reference to the Mekong Delta was undertaken. Drivers of the establishment and evolution of networks in Vietnam from a historical perspective were identified. The activity also documented the existence of networks in the delta region of Vietnam. Information on networks was also supplemented by group discussions, which are described in the next section.

Focus Group Discussions

Focus group discussions were carried out with key informants, including government staff at both district and commune levels as well as with local communities. The discussions with the key informants led to a general understanding of the context of the study site and the identification of target communities. Subsequently, discussions with selected target groups were organized to obtain general information about IFS practices, farmer networking, and households' livelihoods within the commune. Four target groups were recognized: (1) households without networking and are non-IFS, (2) households without networking but practicing IFS, (3) households with networking but are non-IFS, and (4) households with networking and practicing IFS. In each group, about 10 participants (including three to four females) were randomly selected from the wealth ranking results. The key issues discussed included (1) the elements of a life considered to be of good quality and people's capacity to manage their lives successfully; (2) advantages and disadvantages

of farmer networks, their influence on people's livelihoods, and their cause-effect relationships; (3) problem trends and potential solutions; and (4) important and influential persons, groups, or organizations in addressing the problems or carrying out programs for farmer network improvements. In each group, participants classified the elements according to importance (1=very important, 2=important, 3=less important) and obtainability (1=easily obtainable, 2=obtainable, 3=less obtainable). Likewise, the importance and influence of actors addressing the problems of group participants were classified according to importance (1=very important, 2=important, 3=less important) and degree of influence (1=more influential, 2=influential, 3=less influential). For each problem, the importance was ranked using score weight, which was calculated as the percentage of the total score of all the problems. Findings from discussions were useful in formulating the questionnaire for the household surveys.

Household Interviews

Household surveys applied structured interviews using a questionnaire prepared in 2010. One hundred and forty households, which are located in three different hamlets within the commune, were involved in the interviews. The criteria of networking and IFS adoption were used to select households to be interviewed. Their possible combinations yielded four groups of households: without networking and are non-IFS (n=25), without networking but practicing IFS (n=41), with networking but are non-IFS (n=13), and with networking and practicing IFS (n=61). In this study, farmer networks considered were those which farmers join to benefit from favorable loans, technical and management training, and other social connections to improve farming activities. A monoculture-household was characterized with mono-rice culture as the major farming activity, without cattle production and weak nutrient linkages among farm enterprises. In contrast, an IFS household was considered to have an upland crop and cattle production enterprise as an economically important livelihood activity, where strong nutrient linkages existed, regardless of the existence of rice or other farm enterprises. The concept of multifunctionality of agriculture was applied to determine important information to be collected (Tipraqsa et al. 2007). Both qualitative and quantitative data were collected. To quantify the farmers' adoption of a farmer network and the impacts of IFS, participants were requested to list down reasons for adopting a farmer network and the impacts of IFS, and to score them from "0" (not important at all) to "10" (most important).

Data Analysis

Data from household surveys were analyzed using a 2-way factorial ANOVA to evaluate the effects of networking and IFS. The first factor, networking, consists of two levels: with networking and without networking. The second factor IFS consists of two levels: practicing IFS and practicing mono-rice farming. Interactions between networking and IFS adoption were evaluated using HST post-hoc multi-comparisons of means, at 5% significance level. In addition, multivariate factor analysis was applied to evaluate cross-relationships between characteristics of households and reasons for adopting networking and IFS by households as well as the major factors underlying those relationships.

Verification

Validation of the fieldwork results was undertaken by presenting and discussing with representatives of the different target groups, the chief of the study and adjacent hamlets, and officials of the commune and the district at a stakeholder meeting held in the commune.

RESULTS AND DISCUSSION

Farmer Networking and Integrated Farming Systems in the Study Commune

Present Status of Farmer Networks

The structure of a network depends on its activities and production scale. In general, a network is composed of network members and a management board which includes a head, a vice-head, and an accountant. The network head makes work plans and holds monthly meetings with the management board and network members to implement the work plans, share farming experiences, and organize training courses.

The development of a farmer network is strongly influenced by the capability and sense of responsibility of the management board, the participation of network members, technical training and credit supply, regulation and transparency, and strong support and cooperation from local government, agricultural extension agencies and CBOs.

In My An, farmer networks have been established since 2003 (Table 2) At present, there are eight "formal" farmer networks with about 410 members, accounting for about 14 percent of the total 2,920 households in the commune. Most of the networks focus on agricultural production and business through the provision of farming techniques, credit, and other input and output services.

At present, farmer networks have the following major problems: (1) small-scale production of individual members, (2) the increase in local market prices of production inputs and outputs, (3) limited loan supply and lack of capital, (4) poor linkages between networks' farm products and markets, (5) weak off-farm bio-resource linkages among network's members or between networks, and (6) profit sharing.

Influence of Key Actors

Study participants identified several key actors that influence the development of farmer networks. First, members of farmer networks suggested the hamlet farmer association and

Table 2. Existing farmer networks in the My An commune

Network Names	Year Established	Activities
Credit groups (10 groups)	2003–2010	Getting loans from the Bank of Social and Policy Affairs
Integrated crop-cattle raising	2004	Supply of farming technique, credit and market information, and organization of marketing farm products
Livestock feed supply	2005	Livestock feed business
High-quality rice production	2006	Source of information on farming technique, credit and market information, and organization of rice marketing
Rice seed production	2006	Rice seed production and business
Input and output services of corn production	2007	Supply of input and output services of baby corn production
Safe vegetable production	2008	Supply of farming technique, credit and market information, and organization of vegetable marketing
Development of agricultural cooperatives and large-scale rice field model	2009–2010	Provision of the highest benefits from production services, ranging from seeds, soil-work, care and water management to harvesting, preservation, processing, and storage

people committee and the Bank for Policy and Social Affairs as key actors, as they considered the Bank for Agriculture and Rural Development to be less important and influential. Second, group participants who are not part of any farmer network identified 10 key actors that influence their activities. Local vocational schools, the commune's farmers association, the agricultural extension station, agricultural cooperatives, and the hamlet's people's committee were considered important and influential. Unlike network members, the non-network group did not appreciate the importance and influence of the Bank for Policy and Social Affairs and the important credit providers available to network members, although they recognized the role of the agricultural extension station.

Development of Farming Systems in the My An Commune

Integrated farming is only a recent practice in My An commune (Figure 3). Rice culture is the traditional farming enterprise. Before 1986, rice cropping was dominant with only one crop per year. Since then, rice cropping has intensified to meet the demands of food security and export markets. Since 1998, agricultural production has been more diversified, switching from rice monoculture to rice- and crop-based farming systems. Since flood-control structures were built in 2000, integrated crop-livestock farming systems have been commonly practiced and agricultural production has been more commercially oriented. Integrated crop-livestock farming systems have been further diversified and intensified in recent years, as more agricultural cooperatives and farmer networks have been developed. Compared to other freshwater regions in the Mekong Delta, integrated farming, particularly integrated crop-livestock production, has only been recently developed in My An (Phong et al. 2008).

Results from the multivariate factor analysis reveal inter-relationships among variables related to major characteristics of households and resource uses, and identified eight major factors which help explain the relationships between the characteristics (Table 3). The first and most important factor accounts for 29 percent of total variance and reflects the dominance of rice area in households' farm land and the economic importance of rice production to the household income. In this factor, variables such as farm size, rice field, crop farming income, total farming income, and household and per capita income are positively inter-related. The second factor, accounting for 12 percent of total variance, shows relationships among upland crop and livestock production and farm bio-resource flows in the integrated crop-livestock farming system. Corn and cattle are the major enterprises of the IFS in the Cho Moi district. Development of corn farming stimulates cattle production, resulting in increased nutrient linkages between these enterprises and hence better uses of on-farm nutrient resources (See Figure 4). The third factor shows the effect of credit supply from government banks on improved off-farm income of households. Households which took larger credits had higher off-farm income, including off- and non-farming income, and hence increased their total household income. The fourth factor describes the positive relationship between household size and non-farming jobs. The fifth factor shows relationships among educational level of household heads, household size, and on-farm jobs. In households whose heads have higher educational attainment, household sizes are smaller and on-farm labor is less. The sixth factor explains the role of cattle production, which was recognized as an important farm enterprise contributing to increased resource uses among households. Cattle production significantly contributes to increasing per-hectare farming income, especially for resource-poor farmers. The seventh factor, accounting for 5 percent of

Figure 3. The evolution of agricultural production in the My An commune

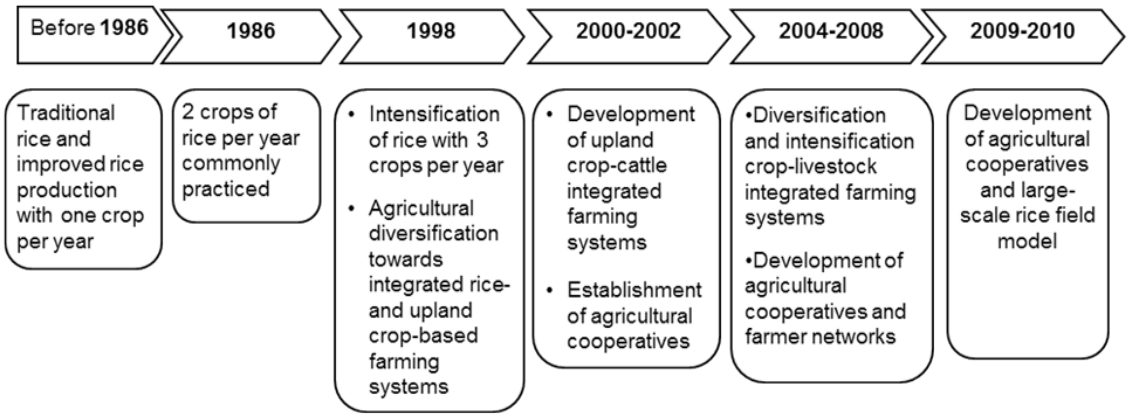


Figure 4. Diagrams of farm bio-resource flows: an IFS (a) and a rice mono-culture household (b)

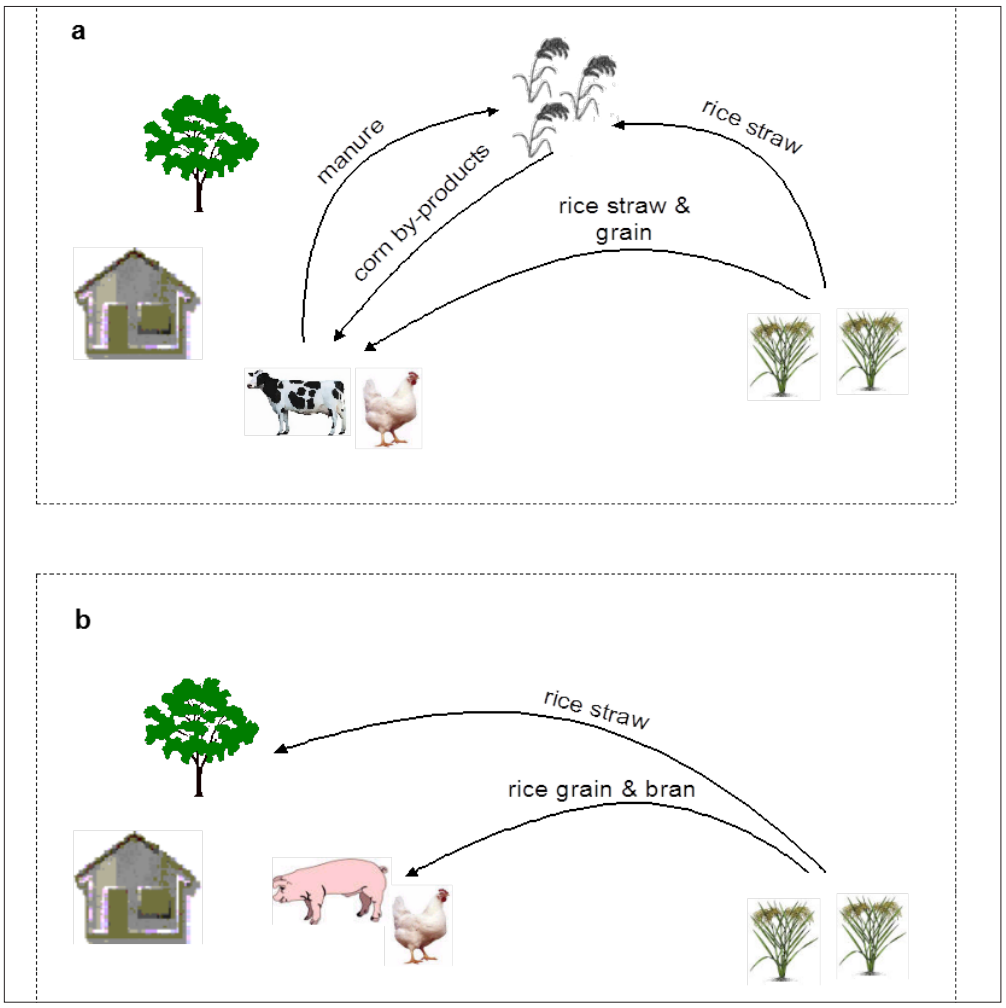


Table 3. Major factors correlating the important characteristics of interviewed households

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
HH head's educational attainment	0.07	0.22	0.16	0.16	**−0.55**	−0.09	**0.52**	0.18
HH size	0.07	0.06	−0.04	**0.49**	**0.78**	−0.08	0.12	0.05
On-farm labor	0.01	0.27	0.01	−0.33	**0.73**	0.04	0.19	0.06
Off-farm labor	−0.05	−0.02	0.02	0.04	−0.02	−0.02	0.00	**−0.98**
Non-farming labor	−0.01	−0.07	0.10	**0.90**	−0.04	−0.05	−0.05	−0.05
Farm size	**0.94**	0.09	−0.06	0.00	0.00	−0.09	0.11	0.03
Rice field	**0.72**	0.06	0.12	−0.15	0.19	−0.15	0.03	0.08
Orchard	0.05	0.00	−0.07	−0.09	0.18	0.01	**0.89**	−0.04
Upland crop field	0.36	**0.67**	−0.16	0.34	0.03	0.02	0.02	0.08
Crop farming income	**0.96**	−0.01	0.01	0.06	−0.02	−0.03	0.00	0.01
Livestock farming income	0.20	**0.48**	0.16	−0.05	0.17	**0.67**	0.01	0.05
Total farming income	**0.93**	0.16	0.07	0.04	0.05	0.24	0.00	0.01
Per-hectare farming income	−0.02	−0.10	−0.07	−0.03	−0.08	**0.88**	−0.01	−0.01
Off-farm income	0.14	0.05	**0.88**	0.31	−0.12	0.00	0.00	0.00
Total household income	**0.83**	0.16	**0.48**	0.16	−0.01	0.19	0.00	0.01
Per capita income	**0.82**	0.01	0.38	−0.01	−0.25	0.19	−0.04	−0.01
Loan	0.22	−0.01	**0.89**	−0.16	0.05	0.00	−0.03	0.01
Monetary value of farm bio-resource flows	0.06	**0.81**	0.02	0.01	0.09	0.00	−0.02	0.00
Number of farm bio-resource flows	0.01	**0.78**	0.10	−0.26	0.01	0.05	0.08	−0.02
Variance explained (%)	29.1	12.2	9.1	8.3	7.1	6.7	5.3	5.1
Factor interpretation	Role of crop production in increased HH income	Upland crop and livestock production and bio-resource flows	Effect of credit on improving off-farm income	Relationship between HH size, and non-farm labor	Relationship between HH head's education, HH size, and off-farm labor	Role of livestock production in increased resource use	Relationship between HH head's education and orchard area	Off-farm labor

Note: Values in bold (³ 0.5) were considered in the interpretation of the respective factor. The same applies to the following tables.

total variance, explains the fruit orchard area of households. Households in which heads have higher educational attainment possess larger orchard areas. Finally, the eighth factor explains off-farm jobs among households. Households with better-educated heads have less off-farm labor.

Human and Land Resources of Households

Off-farm labor, upland crop land, and farm size are important indicators that differentiate between households with and without network or with and without IFS (Table 4). First, households practicing IFS, especially those which are also part of a network, have more on-farm labor than those not adopting IFS due to its high labor input requirements (Nhan et al. 2007). Second, households practicing IFS have a larger upland area than those not practicing IFS. This result confirms the results from the aforementioned factor analysis, with upland crop and cattle production being the main enterprises of the integrated farming system in Cho Moi district. Third, households with networks hold larger farm sizes than those without networks, particularly households practicing mono-rice farming, as they are usually better off and can take advantage of the credit with low interest of farmer networks. Households practicing mono-rice farming without networking have smaller land. These households are perhaps poorer and lack on-farm labor.

Resource Uses and Economic Parameters of Households

Farmer networks and IFS enable households to improve their farm resource uses and the economy and thus, aid in poverty reduction (Table 5). As previously mentioned, the development of livestock farming stimulates farm resource integration. Households with networking or with IFS have a greater number of bio-resource flows and hence, higher monetary value of the flows than those without networking or IFS. Networking and IFS adoption allow households to earn a higher income from livestock production and hence, obtain higher per-hectare and total household income than those with neither networking nor IFS. The combined effect of networking and practicing IFS helps households improve their income significantly. The opposite occurs with those without networking and IFS adoption. Consequently, households with networking or IFS adoption saved more money while household expenditure did not significantly differ among groups. The development of agriculture or adoption of IFS requires capital inputs (Tipraqsa et al. 2007). Average amounts of loan per year were USD 594 and USD 706 for households with and without networking, respectively, and were USD 500 and USD 711 for IFS-practicing and non-IFS households.

Farmers perceived five major impacts of practicing IFS on their households. The five impacts (factors) account for 72 percent of the dataset's total variance. First, through IFS practice, farmers could further intensify and commercialize their farming, resulting in higher farm productivity and improved food supply for the family. Second, frequent marketing of diverse farm products, which include three to five baby corn crops, cattle, and farm by-products allows farmers to increase their capital and savings. In addition, IFS adoption is an opportunity to generate employment and income for family members. The third impact is that with IFS, farmers can reduce off-farm nutrient inputs through better use of farm nutrient resources, resulting in higher household income and higher educational attainment of their children. Lastly, with networking and IFS adoption, households improve their social networking within their community. The results of the present study confirm that IFS practice can be considered multifunctional agriculture (Tipraqsa et al. 2007).

Table 4. Human and land resources of households by farmer network and integrated farming system

Effects	On-Farm Labor	Off-Farm Labor	Non-Farm Labor	Household Size	Rice Field	Orchard	Upland Crop Field	Farm Size
2-way ANOVA significance								
Network (N)	ns	ns	ns	ns	ns	ns	ns	*
Farming system (FS)	**	ns	ns	ns	ns	ns	*	ns
Network × Farming system	*	ns	ns	ns	ns	ns	ns	*
Comparison of mean by network								
Without network (n = 65)	2.2 ± 0.2	0.0 ± 0.0	0.7 ± 0.1	5.3 ± 0.2	0.5 ± 0.1	0.1 ± 0.0	0.2 ± 0.0	0.8 ± 0.1
With network (n=72)	2.5 ± 0.2	0.0 ± 0.0	0.7 ± 0.1	5.3 ± 0.2	0.6 ± 0.1	0.1 ± 0.0	0.2 ± 0.0	1.1 ± 0.1
Comparison of mean by farming system								
Mono-rice farming (n=37)	1.6 ± 0.1	0.0 ± 0.0	0.9 ± 0.2	5.1 ± 0.3	0.7 ± 0.1	0.0 ± 0.0	0.1 ± 0.0	1.1 ± 0.3
Integrated farming (n=100)	2.6 ± 0.1	0.0 ± 0.0	0.6 ± 0.1	5.4 ± 0.2	0.5 ± 0.1	0.1 ± 0.0	0.2 ± 0.0	0.9 ± 0.1
Comparison of mean by interaction N × FS								
Without network & mono-rice (n=25)	1.8 ± 0.2[a]							0.6 ± 0.1[a]
Without network & integrated farming (n=41)	2.5 ± 0.2[ab]							0.9 ± 0.1[ab]
With network & mono-rice (n=13)	1.5 ± 0.1[a]							1.3 ± 0.2[b]
With network & integrated farming (n=61)	2.7 ± 0.2[b]							0.9 ± 0.1[ab]

Note: n = sample size; ANOVA notes: ns = not significant, * = $p<.05$, ** = $p<.01$; in each column per effect, means followed by the same letter (a or b) are not significantly different at $p<.05$; Units: household human resources (members), land (ha)

Table 5. Farm bio-resource flows and household economics (US dollar per household) by farmer network and integrated farming system

Effects	Number of Bio-Resource Flows	Value of Bio-Resource Flows	Crop Income	Livestock Income	Per ha Farm Income	Off-Farm Income	Total Household Income	Saving
2-way ANOVA significance								
Network (N)	*	ns	ns	*	ns	ns	*	*
Farming system (FS)	**	**	ns	**	**	ns	*	ns
Network × Farming system	ns	ns	ns	ns	ns	ns	*	ns
Comparison of mean by network								
Without network (n = 65)	1.3 ± 0.2	56 ± 11	1,022 ± 228	506 ± 122	1,900 ± 267	628 ± 111	2,133 ± 294	789 ± 289
With network (n=72)	2.0 ± 0.1	106 ± 22	1,128 ± 233	1,083 ± 156	2,561 ± 278	1,011 ± 161	3,206 ± 328	1,894 ± 439
Comparison of mean by farming system								
Mono-rice farming (n=37)	0.5 ± 0.1	17 ± 6	1,244 ± 350	6 ± 6	1,283 ± 206	800 ± 156	2,011 ± 333	1,256 ± 739
Integrated farming (n=100)	2.0 ± 0.1	17 ± 17	1,006 ± 183	1,100 ± 128	2,606 ± 244	844 ± 133	2,950 ± 278	1,411 ± 256
Comparison of mean by N × FS interaction								
Without network & mono-rice (n=25)							1,617 ± 356[a]	
Without network & integrated farming (n=41)							2,450 ± 361[ab]	
With network & mono-rice (n=13)							2,828 ± 567[ab]	
With network & integrated farming (n=61)							3,283 ± 317[b]	

Note: n = sample size; ANOVA notes: ns = not significant, * = $p<.05$, ** = $p<.01$; for N × FS interaction, means followed by the same letter (a or b) are not significantly different at 0.05 significance level.

Determinants of Networking by Farmers

Multivariate factor analysis indicates three major reasons why households join networks. The first and important reason, accounting for 30 percent of total variance, is better access to training and credit support from the local government. Farmers adopting a network have better opportunities to participate in technical training courses organized by government agricultural extension agencies or private agro-chemical companies. In addition, network members can take loans from government banks without security or with low interest rates. The second reason, accounting for 24 percent of total variance, shows that households joining networks want to improve their farming techniques and management and hence, further increase farm productivity. The third reason, accounting for 21 percent of total variance, is social networking. Previous studies showed that social networking is one important element contributing to the quality of household life (Nhan, Son, and Be 2008).

On the other hand, households do not form networks for four reasons. The first and most significant reason (factor), accounting for 22 percent of total variance, is that farmers are not aware of farmer networks. Second is the perception that farmers lack labor and that networking might give farmers less benefit. Third, the limited capital for agricultural production and poor social connections also constrain farmers from participating in a network. The final reason, accounting for 14 percent of total variance, indicates that farmers lack free time and prefer individual farming. They believe that networking might take up a lot of their time.

Farmers see the advantages of networking although they have yet to adopt it. Multivariate factor analysis identifies three of these perceived major advantages. The first and most important advantage is the opportunity to improve their farm productivity through better access to technical training. The second advantage is better access to governmental credit supply, while the third one is social networking. These advantages are the same as those suggested by networking farmers.

Determinants of IFS Adoption by Farmers

Seven important reasons determine the adoption of IFS among households. The first reason accounts for 17 percent of total variance and reflects the local government's promotion of and farmers' experiences on IFS. The second reason, accounting for 14 percent of total variance, is that practicing IFS allows farmers to increase reuse of farm by-products and therefore reduce external input costs. The third reason, accounting for 11 percent of total variance, shows that if the soil is suitable for IFS, adopting IFS gives farmers higher farming income than mono-rice farming. The fourth reason, accounting for 10 percent of total variance, is that IFS farmers want to be network members and practice IFS to spread the economic risks of farming while maintaining soil fertility from nutrient recycling. The fifth reason, accounting for 9 percent of total variance, is less use of agro-chemicals in agriculture. In integrated corn-cattle farming systems, the use of pesticides on corn is low because corn stalks and leaves are used as cattle feed and then cattle manure is used as corn fertilizer. In addition, farmers believe that the sufficiency economy approach is one reason to adopt IFS. Finally, farmers practice IFS because they are following recommendations from local extension workers.

Results of multivariate factor analysis show five major reasons why households in Cho Moi do not adopt IFS. The five reasons account for 72 percent of the total variance. The first reason is that the soil is not very suitable for IFS and that farmers lacking in farming technologies

for corn and cattle production prioritize food security from rice production instead. The second reason is that farmers believe that given the present soil status, rice production may yield a higher income than IFS. That farmers lack farming labor also limits them from practicing IFS. In this case, farmers suggested that rice production would be less economically risky than IFS. In addition, good prices of rice at local markets in the past years also result in farmers preferring rice production over others. Finally, farmers also lack the capital for cattle feed.

CONCLUSION

This study showed that farmer networking is organized by farmers themselves on a voluntary basis and based on their real needs. Farmer networks are diverse, and major types include service agricultural production, mixed service and production, and CBO-based networks. The state and local government issued several policies to promote farmer networks, which are recognized as a way to further develop agriculture and improve rural livelihood. Government policies, rural market development, and farmers' needs are the major forces driving the evolution of networking. Not only networking households but also non-networking ones have recognized the important advantages of a farmer network. However, there is only a small proportion of farming households forming networks, as many institutional limitations constrained farmers from organizing into networks. The effective application of government policies to real contexts at the community level is also still limited.

Networking and practicing IFS give farming households economic, environmental, and social advantages, and food security. Networking and practicing IFS are complementary and help farmers improve farm resource integration and use efficiency and hence, earn more income and increase capital savings. Practicing IFS is labor-intensive and require start-up costs, and technical and farm management knowledge. By networking, farmers get better access to agricultural extension and credit services as well as improve their social networking and are thus able to adopt and practice IFS efficiently and contribute to rural poverty reduction. However, there are some disadvantages to networking that keep some farmers from joining networks. Particularly, large-scale farmers who already have farm facilities, enough capital, and better access to the market have a disinclination to form into groups. In addition, credit policies given to farmer networks have not really attracted members. It shows that policy support to poor households should be more efficiently developed throughout the farmer network.

These research findings can be applied to densely populated places with limited natural resources. It is useful for farmers to be familiar with networking in order to transform farming enterprises into intensified farming units and incorporate them into a market-orientated economy. It conforms with the development of agricultural cooperative programs and the large-scale rice field model in the Mekong Delta nowadays. However, the promotion of farmer networks and IFS practices requires more effective policies, support, and a new perspective from the government. Further government support for farming inputs and outputs, particularly credit and seed supply and marketing, are necessary. The multiple benefits of networking and IFS practices need to be considered at the community and regional levels rather than at the level of individual households. To enhance these networking and IFS benefits, positive linkages and synergism should go beyond network or farm boundary, (i.e., between specific networks or farms). In such a context, more households—not only better-off and IFS households but also worse-

off and mono-culture ones—can participate in and benefit from a network or IFS, which in turn would create more opportunities for rural employment and market development.

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REFERENCES

Bosma, R.H., H.M.J. Udo, J.A.J., Verreth, L.E. Visser, and C.Q. Nam. 2005. "Agriculture Diversification in the Mekong Delta: Farmers' Motives and Contributions to Livelihoods." *Asian Journal of Agriculture and Development* 2 (1&2): 49–66.

Can, N.D., L.T. Duong, N.V. Sanh, and F. Miller, 2007. "Livelihoods and Resource Use Strategies of Farmers in the Mekong Delta." In *Literature Analysis: Challenges to Sustainable Development in the Mekong Delta: Regional and National Policy Issues and Research Needs*, edited by T.T. Be, B.T. Sinh, and F. Miller, 69–98. Bangkok: The Sustainable Mekong Research Network.

Cho, K. 2001. "New Agricultural Cooperatives in Vietnam—Discussions based on the Japanese Experience." In *Vietnamese Agriculture under Market-oriented Economy*, edited by K. Cho and H. Yagi, 281–318. Hanoi: The Agricultural Publishing House.

DANIDA (Danish Ministry of Foreign Affairs). 2007. "Capacity Building Support to Vietnam Farmer Union (VNFU) Component: Impact, Lessons Learned and Recommendations." *Agriculture Sector Programme Support (ASPS) Vietnam. Ref. No. 104.* Vietnam: SEAC.

De, N.N. 2006. *Farmers, Agriculture and Rural Development in the Mekong Delta of Vietnam*. Hanoi: Education Publishing House.

Devendra, C., and D. Thomas. 2002. "Crop-animal Interactions in Mixed Farming Systems in Asia." *Agricultural Systems* 71 (1): 27–40.

Duong, P.B., T. Sato, S. Shindo, and Y. Izumida. 2000. "Microanalysis on the Vietnamese Agricultural Structure—Result of the Field Survey in Ninh Binh and An Giang Provinces." *Working Paper Series, No. 00-F-005*. Tokyo: DARE, The University of Tokyo, Japan.

Edvards, P., 1998. "A System Approach for the Promotion of Integrated Aquaculture." *Aquaculture Economics and Management* 2 (1): 1–12.

Gianatti, T.M., and P. Carmody. 2007. "The Use of Networks to Improve Information Flows between Grower Groups and Researchers." *Field Crops Research* 104 (1): 165–173.

Hashimoto, T.R. 2001. "Environmental Issues and Recent Infrastructure Development in the Mekong Delta: Review, Analysis and Recommendations with Particular Reference to Largescale Water Control Projects and the Development of Coastal Areas." *Working Paper No. 4.* Sydney, Australia: Australian Mekong Resource Centre, University of Sydney.

Latin, J.M., J.D. Carroll, and P.E. Green. 2003. *Analyzing Multivariate Data*. New York: Thomson Learning Inc.

Lightfoot, C., M.B. Bimbao, J.P.T. Dalsgaard, and R.S.V. Pullin. 2003. "Aquaculture and Sustainability through Integrated Resources Management." *Outlook on Agriculture* 22: 143–150.

Little, D.C., and J. Muir. 1987. *A Guide to Integrated Warm Water Aquaculture*. Stirtling: Institute of Aquaculture, University of Stirtling, UK.

MARD (Ministry of Agriculture and Rural Development) and UNDP (United Nations Development Programme). 2003. *Farmer Needs Study: Project VIE/98/004/B/01/99*. Hanoi: Statistical Publishing House.

MARD. 1999. *Report on Review of Two Years Implementing the Law on Cooperatives in Agriculture in Provinces of North and the Central Coast Region*. MARD.

Nghiem, N.V. 2006. "Agricultural Cooperatives in Vietnam." Paper presented at the International Seminar on Agricultural Cooperatives in Asia: Innovations and Opportunities in the 21st Century, Seoul, September 11–15.

Nhan, D.K, N.N. Son, and T.T. Be. 2008. *Raising Basin Level Agricultural Water Productivity for Poverty Reduction: Mekong Delta Case Study.* Mekong Basin Focal Project Report.

Nhan, D.K, D.N. Thanh, V. Marc, and L.T. Duong. 2003. "Towards Agriculture Diversification and Rural Poverty Alleviation Development of Agri-aquaculture farming in the Mekong Delta, Vietnam." Paper presented at Deutcher Tropentag 2003: Technological and Institutional Innovations for Sustainable Rural Development, Goettingen, Germany, October 8–10.

Nhan, D.K., N.V. Be, and N.H. Trung. 2007. "Water Use and Competition in the Mekong Delta, Vietnam." In *Literature Analysis: Challenges to Sustainable Development in the Mekong Delta: Regional and National Policy Issues and Research Needs*, edited by T.T. Be, B.T. Sinh, and F. Miller, 143–188. Bangkok, Thailand: The Sustainable Mekong Research Network.

Nhan, D.K., L.T. Phong, M.J.C. Verdegem, L.T. Duong, R.H. Bosma, and D.C. Little. 2007. "Integrated Freshwater Aquaculture, Crop and Animal Production in the Mekong Delta, Vietnam: Determinants and the Role of the Pond." *Agricultural Systems* 94 (2): 445–458.

Pein, M. 2002. "Integration of Aquaculture into Crop-animal Systems in Asia." *Agricultural System* 71 (1): 127–146.

Phong, L.T., L.Q. Tri, H.M.J. Udo, D.K. Nhan, M.E.F. van Mensvoort, A.J. van der Zijpp, and R.H. Bosma. 2008. "Integrated Agriculture-aquaculture Systems in the Mekong Delta, Vietnam: An Analysis of Recent Trends." *Asian Journal of Agriculture and Development* 4 (2): 51–66.

Stacey, David. 1999. "Water User's Organizations." *Agricultural Water Management* 40 (1): 83–87.

Statistical Office of Cho Moi District. 2006. *Statistical Yearbook 2006*. Statistical Office of Cho Moi District.

Tipraqsa, P., E.T. Craswell, A.D. Noble, and D. Schmidt-Vogt. 2007. "Resource Integration for Multiple Benefits: Multifunctionality of Integrated Farming Systems in Northeast Thailand." *Agricultural Systems* 94 (2): 694–703.

Yamazaki, R., 2004. *Agriculture in the Mekong Delta of Vietnam*. Aniane: Louma Productions.