

# Agriculture Diversification in the Mekong Delta: Farmers' Motives and Contributions to Livelihoods

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## ABSTRACT

*Although specialization is the global trend in agriculture, integrated farming systems have emerged in Vietnam. An important motive was the desire to improve the livelihoods and the diet of the nuclear families; this was evident in the analysis using the household life cycle of five phases. Off-farm diversification was especially important for a new household. At the onset of expansion, the new mothers replaced off-farm with homebound activities. During expansion the farmers increased virtual farm size by keeping more livestock; during accumulation they invested in land or education, and during consolidation old couples adjusted farm activities to their labor capacity. Livestock, including fish, was essential for livelihood. The distribution of goats instead of cattle by credit or by "passing-on-the-gift" was far more effective for poverty alleviation.*

*Technological innovations on the cultivation of rice and fruits, and the breeding of fish were essential for change. The improved food security and reduced cash income from rice after the 1986 reforms pushed farmers to take risks. The farm area and number of component farm activities providing cash determined the level of cash income from agriculture. Farms with at least four flows of biomass between components earned more, demonstrating that real integration improved profits. A minimum area of land in, or close to, the homestead, and know-how are required for an effective integration of components.*

## INTRODUCTION

In the more industrialized countries, a trend towards specialization in agriculture was observed during the second half of the last century. Specialization is often considered equal

to intensification and to a higher efficiency of labor and land, but usually requires more capital. However, there is concern for the ecological, economic, and social sustainability of specialized farming. For the increasing global population, it is essential to improve the efficiency of nutrient use for

securing sustainable food production. Mixed crop-livestock and livestock-fish-crop systems may have the potential to maintain an ecosystem's healthy functioning and enable it to absorb not only the shocks to the natural resource base (Holling 1995; Prein et al. 1998) but also those brought about by sudden changes in the economic environment (Luu 1999). Inversing the trend is not an easy task, given that specialized systems generally generate higher labor efficiency, but might be feasible if integration proves to be more profitable.

Contrary to the global trend of specialization, farming systems integrating aquaculture and agriculture have emerged in Asian countries like Vietnam (Luu 1992; Prein 2002). Within the past three decades, the Vietnamese family farms in the Mekong Basin have been transformed from self-sufficient systems producing mainly rice for marketing to integrated agriculture-aquaculture farming systems (IAAS), producing and marketing a large variety of products (Nhan et al. 2003). The existing literature describes the systems but does not answer the question as to what motivated the Vietnamese farmers to integrate various components in their system. Most authors stopped short of determining whether this diversification was a mere accumulation of components without synergy, or if these components were really integrated through an exchange of wastes, thus enabling an increase of income. The identification of the factors that have driven farmers' decision-making in the Mekong Delta (MD) since the war ended in 1976 could be a first step toward formulating strategies for diversification in other regions. In this paper we analyze, using the livelihood capital asset framework, the driving forces and motives that led to the integration of farm components, and assess the contribution of the various farm components to their livelihood.

## METHODOLOGY

The sampling procedures we followed respected the triangulating principles of Participatory Rural Appraisal (PRA), meaning that findings are cross-checked and compared by using at least three sets of contexts (Chambers 1994). This approach assumes that by considering opinions from three distinguishable groups in three different contexts, a good overview of the variability and possibilities

is obtained.

As a farmers' decision to adopt an innovation can only be evaluated if the exogenous pre-conditions allow the technology, we chose for our sample two agro-ecological zones appropriate for livestock-fish-crop systems in the MD, namely, the fresh water alluvial zone (delta), and the hill and upland zone (hills). Moreover the sample had to contain users, as well as non-users, that either respond or not to the criteria of the potential user group (Reece and Sumberg 2003). We retained three hamlets of an existing sample representing the agro-ecological variation in the delta; these were selected for having a land-use policy allowing the development of integrated systems (Phong et al. 2004). In the hill zone, mainly located in the districts Tri Ton and Tinh Bien along the border with Cambodia, we retained three hamlets where rainfed agriculture predominates irrigated cropping. Hamlets are the smallest administrative unit in Vietnam and government offices are at the village level.

We interviewed 144 farmers in 6 hamlets. In each hamlet, 24 were selected through stratified random sampling based on the following wealth rankings: poor, intermediate and well-off (Table 1). This stratification links well to the existing practice wherein each Vietnamese village has a classification of its resident families in at least three categories of well-being in accordance with the pro-poor policy (Bosma et al. 2003). For the delta hamlets, we used an existing list in which we discarded a class of very rich residents who were mostly traders. In the hills, the lists of the village security department were submitted to three knowledgeable resource persons who, as a first step, discarded non-farmers from the list. A household was assigned to the category in which at least two out of the three persons classified them. The few cases classified in three different categories were ranked as medium. When the original selection fell short of the required number due to absences or errors in classification, we completed the list by conducting another round of random sampling or by filling up the lots with a qualified neighbor in the same category.

Besides the interviews, we surveyed the literature to gather needed data. During on-farm interviews with the head of the household or his wife, we drew a resource flow diagram, collected

**Table 1. List of hamlets in the sample and their population stratified according to class**

	Location				Numbers according to classes			Household size **
	province	district	village	hamlet	poor	medium	well-off	
Fresh water alluvial	Can Tho	O Mon	Thoi Long	Thoi My	127 (7)	195 (12)	70 (5)	5,8
		Tam Binh	Song Phu	Phu Dien	70 (6)	170 (14)	42 (4)	4,1
		Cai Be	Thien Tri	My Hung	77 (5)	191 (13)	99 (6)	4,9
Upland with hills	An Giang	Tri Ton	Le Tri	An Thanh*	25 (3)	91 (11)	90 (10)	4,4
		Tinh Bien	An Phu	Phu Hiep *	27 (8)	56 (13)	9 (3)	6,3
		"	"	Phu Hoa *	8 (2)	65 (18)	14 (4)	5,8

Note: The numbers in parentheses correspond to the number of persons interviewed.

\* We included only the households engaged in agriculture.

\*\* This refers only to the interviewed households.

some standard farm characteristics, and gathered information on changes since the establishment of their farm. The household was defined as the number of persons living and eating at the farm. We distinguished the non-working members from the active young, adult, and old members. Open-ended questions, which addressed the farmers' motivations for changes in the composition of his production system or for the integration of components in the system, focused on the process rather than the outcome (ODG 2001; Long 2001).

The duration of the initial interview per household, which was conducted between February and May 2004, was restricted to two hours and concentrated on a limited number of changes. The other changes, if any, were documented in a second series of interviews that we held in August 2004, when we also asked farmers to rank their knowledge of the most frequent farm activities and to rank the importance they gave to a rice-field for food security, both on a scale of 1 to 5.

A series of interviews in a hamlet ended with a meeting to collect supplementary information from individual farmers and to focus on specific topics. Farmers were asked to rank activities according to the required labor, capital or knowledge. We also asked them for information to help us trace the historical development of prices or margins for various components. Pairs of farmers established "if-then" rules which consisted of the conditions they believed should be met before undertaking a specific activity such as planting a specific crop or raising livestock. These conditions centered on various components such as the land area and quality, water, savings, family labor, and market.

These were rated using the following linguistic terms: very bad/low (*không ảnh hưởng*); bad/low (*ảnh hưởng rất ít*); acceptable (*trung bình*); good (*khá nhiều*); and very good (*tốt rất nhiều*). The linguistic values were converted into numerical values, averaged, and transposed back into linguistic values (Table 2).

Farm characteristics, descriptive information, and the reasons for the change and integration of components were entered in a database using the program MS-Excel. The extent of the integration of various components was quantified by assigning the value 1 to each flow between two components: e.g., when rice bran was fed to pigs, a value 1 was attributed to the flow *field-livestock*; when manure was returned to the field, the total value became 2. The cumulated values represented an Indicator for the Integration of Components (IIC).

Financial information was collected based only on the net cash income from the farm components, either in local currency (VND<sup>1</sup>) or in the local gold standard (Cay<sup>2</sup>). We did not ask the farmers to quantify the contribution to home-consumption, as we considered the recall method over a long period less reliable, and also because a large variety of products were available on most farms.

The net cash income was distinguished as coming from: on-farm activities (CAF), livestock

<sup>1</sup> VND=Vietnamese dong; first trimester 2004: 1 Euro = 18,500VND, fluctuates more than: 1 US\$ = 15,500VND. 1,000 VND is expressed as kVND and 1,000,000 VND as mVND.

<sup>2</sup> 1 Cay = 10 Chi = 1.4 Ounce; Value development: 1 Cay = 2.5 mVND (1976), 3 (1983), 4 (1991), 4.5 (2001), 5.5 (2002), 7.5 (2004).

**Table 2. The “if-then” rules developed by farmers to guide their choice of a specific activity (limited list)**

If land area,	and land quality,	and water availability,	and savings,	and family labor,	and market,	then I:
Good	good	good	good	acceptable	*	Plant rice lowland
Acceptable	good	very good	acceptable	acceptable	*	Plant rice upland
Acceptable	good	low	acceptable	acceptable	acceptable	Plant cassava
Acceptable	good	acceptable	acceptable	acceptable	acceptable	Plant corn
Good	good	good	acceptable	good	acceptable	Plant vegetables
Acceptable	acceptable	bad	acceptable	acceptable	good	Plant cashew
Good	good	acceptable	good	acceptable	very good	Plant citrus
Acceptable	acceptable	good	acceptable	low	good	Breed fish
Small	low	acceptable	acceptable	low	good	Raise chicken
Acceptable	low	good	acceptable	acceptable	good	Raise ducks
Small	low	good	good	low	good	Raise pigs
Acceptable	low	acceptable	good	acceptable	good	Raise goats
Acceptable	low	acceptable	good	acceptable	very good	Raise cattle

Note: This list was the result of the average responses given by 20 pairs of farmers.

\* The average of the pairs was good. But during the validation meeting, the farmers contradicted this, reasoning out that the irrigated fields need to be cultivated anyway to prevent crowding by weeds.

(CIL), and off- and non-farm activities (CON). For analytical purposes we also derived the number of Components contributing to Cash Income (CCI). Statistical analysis [comprising means and standard error of mean; frequency distributions; the non-parametric Spearman’s rank correlation coefficient ( $\rho$ ); and univariate analysis of variance] was done using SPSS (version 12.0). To analyze the qualitative data we used the livelihood capital assets framework (Allison and Ellis 2001) which considers five capitals, namely: natural, social, human, physical and financial (Table 3).

## DISCUSSION OF RESULTS

### *Natural Capital*

In the delta of the MD the natural resources are derived from land, forests, and water. The land use is mainly determined by the flooding period, the possibility to manage the water level, the attribution of land user rights, and the farm size.

The MD is located within a tropical monsoon climate zone with one rainy season. Seasonally, all its lowlands are flooded for two to six months with

**Table 3. The capital assets for analysis of livelihoods**

Capitals	Description
Natural	The natural stock from which resource flows are derived (e.g. land, water, wildlife).
Social	The social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods.
Human	The skills, knowledge, ability to labor and good health needed.
Physical	The basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable people to pursue their livelihoods.
Financial	The financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) and which provide them with different livelihood options.

Source: Adapted from Diana Carrey (1998) and Ian Scoones (1998).

water levels between 0.3 to 3 meters, depending on the year and location (various authors in Xuan and Matsui 1998). The effects of the diurnal tides of the South China Sea are felt in the river and waterways, up to the Cambodian border. Upon the construction of a network of waterways in the lower reaches of the Mekong after 1840, people settled along or on the raised borders of the waterways, mostly building a wooden house with raised floor. The waterways, its tides, and the yearly flood imposed on their livelihood practices. For the choice of their homestead, the rural people in the delta of the MD still give a higher priority to access to a waterway than to a road. To construct dry land for a homestead in the seasonally flooded fresh water alluvial zone, in the swamps, or in the rice-field, people excavate soil, thereby creating a pond. These ponds are suitable for undertaking aquaculture because it naturally attracts fish after the retreat of the floodwater.

To restrict the effects of flooding and tides and to allow the management of water for irrigation and multiple-cropping seasons, dams were built after 1976. The nature of the IAAS that developed depended on the physical conditions, that is, intensive fruit and low-input fish culture on fertile soils with low flood levels, semi-intensive fruit /medium-input fish systems on less fertile soils with medium flood levels, and extensive fruit/high-input fish systems on less fertilized soils with high monsoon flood levels (Nhan et al. 2006). If the infrastructure for water management did not allow sufficient immersing and draining, the soils acidified and fertility went down dramatically (Tri 1996).

In the hills, the land quality varied considerably between farms and hamlets. Only 57% of the farmers also had access to lowland fields. About 25% of the upland farms had homesteads on loamy soil and easy access to underground water welling after removal of the upper loamy layer, while most had only shallow sandy soils, and thus needed concrete water reservoirs. The former planted three or four crops a year, while latter could plant only cashew trees on the sandy soils, plus one other crop if the slope had more favorable conditions. The sandy or shallow soil could be a reason for not having a fishpond. In the hills some ponds were used mainly to store water for livestock and orchards (Bosma et al. 2006).

Since 1992 the government has attributed land to the farmers cropping it. Against payment of a fee for registration and measurement, they could obtain either a red (owner) or a green (user) certificate. Green certificates were given for land with some communal interest, e.g. forest. Holding a green certificate for forest plots required farmers to bring land use in line with regulations; e.g. in the MD, land more than 30 meters above sea-level had to be planted with perennial crops like timber and fruit trees to prevent massive deforestation and subsequent erosion.

Gradually a liberalized land market developed; the access to land became dependent on capital availability, and the prices of land increased (Figure 1). The sudden increases in land prices were due to policy changes (mango/fruit export after 1990), improved water management (construction of a dam after 1999 in Cai Be and Tam Binh), or new technologies (e.g., artificial stimulation of mango flowering after 2000 in An Phu but not in An Thanh). The value of orchards in the hills became higher than the irrigated ricefields in the vicinity of the hamlets. Due to demographic pressure of the Kinh and multiple-cropping options in the hills, the prices for upland fields became higher than those of the irrigated ricefields that stay flooded for several months.

Notwithstanding the relatively recent occupation of the MD, the average farm size was small: 1.0–1.8 ha in the delta and 2.1–2.3 ha in the hills (Table 4). Due to demographic growth in the delta, the area of the homesteads had shrunk significantly such that neighboring households agreed not to raise pigs because of the stench it caused. The average area of the homesteads in the hill zone was about twice the size of those in the delta, except for An Thanh where most families lived on roadside plots that were allocated to them after the war with Cambodia in 1978.

In the hills, the Khmer, who were the original inhabitants, mainly owned the lowlands while the Kinh or ethnic Vietnamese occupied the uplands. After the war, the Khmer population thinned due to emigration, and the resettlement of the Kinh along the hillside roads boosted the cultivation of the uplands. Our sample contained only two Khmer households, as we selected hamlets where rainfed agriculture predominated irrigated cropping.

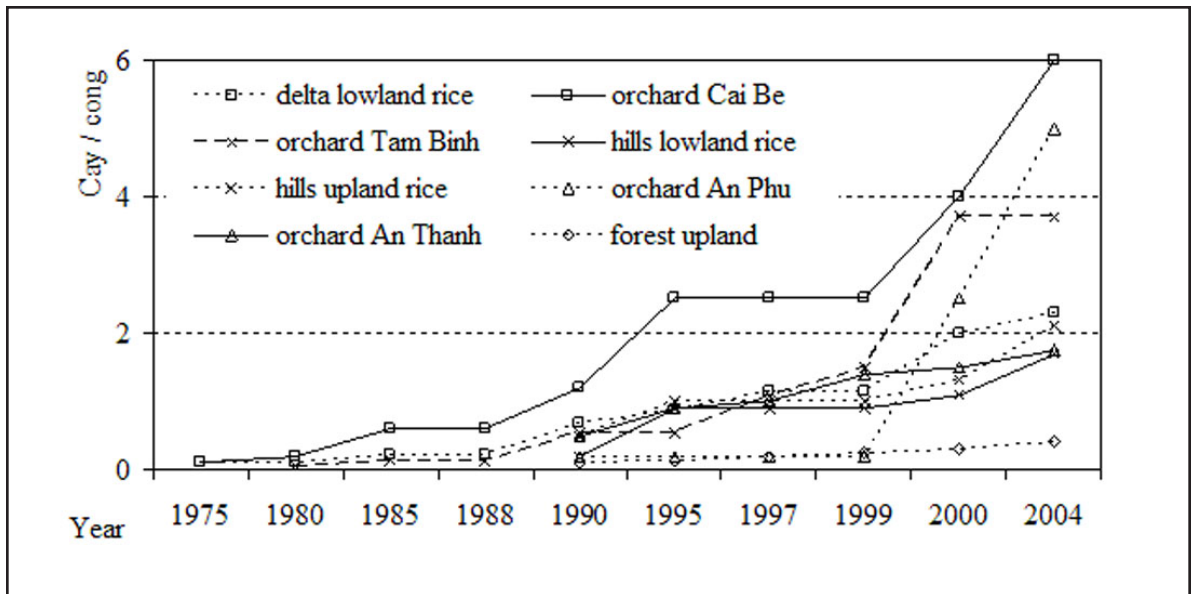


Fig. 1. Price development of various types of land in the delta and upland villages of the Mekong Delta

Table 4. Farmers' ranking of knowledge and experience needed for different farm activities

Village	Know-how needed						
	→ little	→	→	→	→	→	much →
<b>Lowland</b>							
Thoi My *	rice	cattle	pigs	chickens	fish	orchard	ducks**/goats
Phu Dien	rice	pigs	chickens	fish/orchard	goats	cattle	ducks**
My Hung	rice	orchard	pigs	fish	chickens	ducks**	(cattle/goats)
<b>Upland</b>							
An Thanh	cattle	rice	orchard	pigs	fish	ducks**	
Phu Hiep	cattle/rice	orchard	chickens	pigs	goats	ducks**	fish
Phu Hoa	cattle/rice	orchard	chickens	pigs/goats	ducks**	fish	

Note: The data cover three upland villages and three lowland villages, and the rating ranges from little to much.

\* The one person with a lot of experience in fruit thought it easy compared to pigs, chickens, and fish and insisted on its ranking like My Hung; most farmers raised cattle or buffalo in the past.

\*\* Ducks for egg production; ducks for meat were mostly ranked equal to chickens extensively raised.

Very often the poorest rural households did not have enough land and made most of their income from non- and off-farm activities; some did not consider themselves as farmers, though the resource persons classified them as such. The total land area was positively correlated with the total cash income ( $\rho=0.35$ ;  $p<0.01$ ) and with various household characteristics: in the delta with the households' labor availability, as well as its life cycle ( $\rho=0.3$ ;  $p<0.05$ ), and in the hills with the household size ( $\rho=0.3$ ;  $p<0.05$ ). The findings on the delta support the data of Phong et al, (2004) which explained the

variation in per capita income by the total cultivated area of the household.

### Social Capital

This refers to the major networks, groups, relationships of trust, and wider institutions of society upon which people draw in pursuit of livelihoods. These include the family, the neighbors, the network of traders, and the political structures. The national land-use policy affected the temporal and spatial spread of innovations, and middlemen

emerged as important after the 1986 'Doi Moi' reform of the central economy.

The farmers traced about half of the changes in their farming systems to an information source. The most important sources for information were relatives and neighbors: 16% and 19%, respectively, while the media and extension services accounted for 7.5%, and friends, for 5%. People relied mostly on local social networks for price information; they considered the prices given by the media as not applicable to their locality.

Local government support and intervention structures for agriculture depended upon the national land use policy plan. The land-use policy supported the creation of IAAS with the mix of aquaculture, orchards, livestock and rice in the delta, and the combination of cattle, crop and orchard systems in the upland hamlets. Until recently, the extension services in the hills did not include agents specialized in aquaculture. Notwithstanding the land-use policy, farmers in the hills introduced aquaculture, and subsequently the extension and credit services became more attuned to the farmers' needs.

After 1994, the Poverty Alleviation Program supported households classified as poor. Poor households did not have to pay school fees and were given access to credit with low interest rates. We could not confirm the commonly held observation that this had led to larger family sizes among the poor: the correlations between number of children and the wealth index or income were not significant. In the hills, goats were included in the pro-poor land-use package through the initiatives of an NGO. Such induced chronological differences caused technologies to have different impacts in the districts and their hamlets (Phong et al. 2004).

Between 1979 and 1990, the incentives given to farm households were directed towards achieving self-sufficiency within cooperative units numbering 10 to 12 family farms. Moreover, the marketing for most products was either restricted to the local markets (e.g. vegetables) or state-regulated (e.g. pigs, rice and clothing). This policy of enforced cooperativism bred a general distrust of cooperative marketing.

Before 1976 the farmers used middlemen only for trading pigs. Between 1976 and 1986, for access to legal markets outside the village, farmers depended on the middlemen to undertake the

administrative procedures needed for the transport of products. Gradually middlemen imposed themselves in most commercial chains and, at present, most produce from farms in the MD reach the market through middlemen who determine a price and collect produce from the farm. According to farmers, "Middlemen know the papers and the ways through bureaucracy." In addition, farmers also reasoned that fulfilling all administrative procedures for their small quantity of products was too costly and time-consuming, or even impossible if the products were to be exported. This system favored the integration of a large numbers of small producers in the global market.

### *Human capital*

Three sets of factors affected the valuation of human capital: the household life cycle, education and knowledge, and the importance given to the rice-field for food security. The mean size of the nuclear families varied somewhat between hamlets, but the averages of the delta and the hills were equal (Table 1). The household size was positively correlated to the off-farm and non-farm income ( $\rho=0.3$ ;  $p<0.05$ ). In the hills, off-farm labor was available for three months only and the demand was high for 21 days during rice harvest; the opportunities for earning from non-farm activities were limited.

**Household life cycle.** Farmers repeatedly mentioned the following drives for innovation: improving income and diversifying the diet, both mainly for the well-being of children. These can be analyzed in the context of the five phases of the household life cycle, namely: preparation, creation, expansion, accumulation, and consolidation, which in our sample accounted for 3%, 1%, 49%, 28% and 19%, respectively.

In the local language, the step from preparation to creation is referred to as separation. At separation most couples already have children, explaining the low frequency of households in the creation phase.

During the preparation phase, a new couple stays in the household of the husband's parents until the next son marries; then the first married couple separates from the family and creates its own household. During the period of cohabitation, the young couple prepares their future by developing

off-farm or non-farm activities, to accumulate savings. If the parents or the parents-in-law had accumulated enough fields, they could give land to the young couple at the creation of their household.

After the young couple leaves the husband's parental household, most young families exploit the available resources through the optimal diversification of activities: non-farm, off-farm, and on-farm, whether requiring land or not. For landless couples who are creating a new household, the alternative would be to pursue non-farm and off-farm livelihood opportunities, like raising ducks (Text block 1).

Normally, young couples raise both chickens and ducks and, if sufficient capital is available, also pigs to produce food for home-consumption, to employ family labor, and to earn cash. The timing of the cash income would depend on the type of livestock raised. Ducks are cheaper than chickens and could be sold after three months, providing cash income in the short term. Chickens could be sold after six months providing medium-term cash. Raising a pig would be like saving money: each day one puts in a small investment and once the pig is sold, one would have accumulated a large sum, mostly with interest.

The livestock is kept in small numbers: as long as their number is small they could feed themselves by scavenging and with the available residues or resources the farmer could collect himself without supplementary investment. Keeping small numbers of different animals which shared the same type of feeds would still generate enough profits because those small numbers need only a small investment. Focusing on one type of livestock would require more animals in order to earn the same amount of cash income, and greater capital investments in, for example, housing and feeding to make an intensive system possible.

As soon as the couple starts having children, the activities of the wife become homestead-bound and she could start, or expand, the raising of chickens, pigs or fish. When their children grow older and stay at home, the available family labor to be employed is high, often too high for the land-related activities. As livestock claims less land and of lower quality compared to fruits or vegetables, for example (Table 2), farmers expand farm turnover by developing activities like raising

**Text block 1:**

**Raising ducks, a risky livelihood strategy for the landless in the VMD**

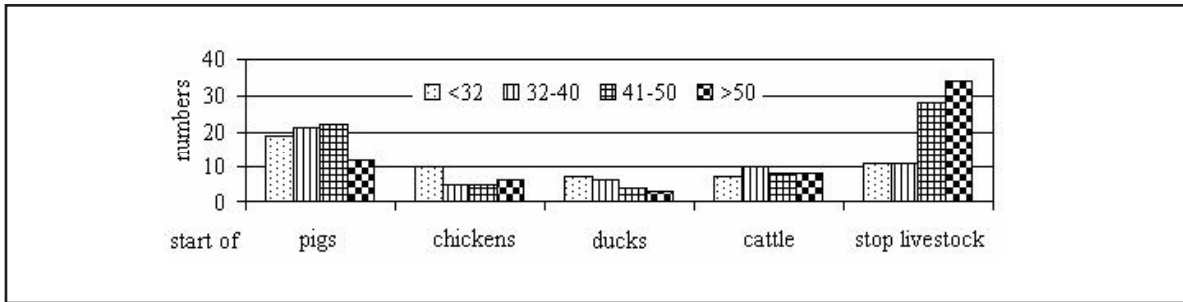
Raising ducks for eggs was one of the livelihood strategies of landless households. An enclosure of nets on a public dike kept the ducks together at night and a bedding of straw prevented the eggs from breaking; unlike hens, ducks may lay eggs in an unprotected place. The flock-size for intensive production varied from about 500 to 5000 ducks. Landless households could start small and once the flock grew bigger, they could hire a youngster to help them raise these ducks, while developing other activities themselves.

Farmers knew raising ducks was risky; diseases may kill all ducks of a flock within a few days. Three farmers in our sample sold land to reimburse credits for raising ducks. However, even 3 months after the avian influenza and the "stamping out", farmers with insufficient alternatives to earn an above-average income but with experience in raising ducks took out huge loans to restart.

ducks or chickens, fattening fish or pigs, or keeping buffaloes or cattle (Figure 2).

In the hills, the breeding of cattle for fattening and reproduction gradually replaces the use of bullocks for transport to value available labor. Unmarried children stay at home until schooling or a job keeps them away from home. Most youngsters still in secondary school stay at home and are thus partly available for farm activities; however, the family often stops an activity like raising a large flock of ducks for example, if all children go to secondary school. Thus, the desire to give the children a higher education level limits the possibilities for the accumulation of farm assets.

Until recently, farmers intended to accumulate enough land for each of their children to be able to create a family farm. If farming represented the major opportunity for youngsters after primary school, the expanded farm turnover generated capital that was used to invest in rice-fields thus increasing real farm size. After 'Doi Moi', the possibilities for education and for non-farm employments increased and some parents invested in the education of their children instead of land; farmers also invested in houses in major villages and cities. Both investments at first contributed to family livelihood and later served as wedding



**Fig. 2.** Frequency distribution of the age of household head at starting or stopping a livestock activity

*Note:* The age categories were adjusted to contain approximately an equal number of total on-farm changes each.

dowry, i.e. starting capital for the newly created families of the children.

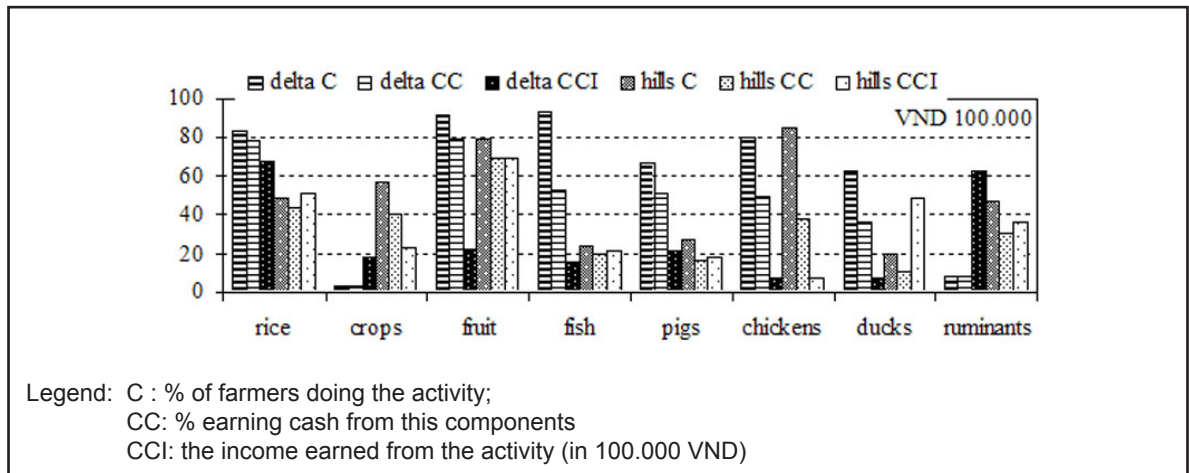
In principle, the youngest son stays at the parental homestead and has to take care of the parents. If the youngest married son lives with his parents, it is hard to classify the family farm in one of the five phases. The parents adjust the farming system to their labor and capital capacity if: 1) the land size of the family is insufficient for both the parents and the household of the youngest son, and 2) the son finds permanent employment in a non-farm activity at a far distance from the parental homestead. In such cases the parents stop raising livestock (Figure 2) and replace their rice-field or other annual crops with an orchard or a fishpond which requires a smaller area and less labor input (Table 2). According to the farmers' ranking, the labor demand for fruit is lower than for vegetables and rice but higher compared to most livestock and fish. The number of independent older couples seemed to increase because most parents wanted their children to leave agriculture and thus invested in their education.

**Formal education and know-how.** Know-how on a farm activity was a decisive factor in opting to start or not to start a component. "I practiced it on our parents farm" was a frequent answer to the question of why one chose to start a farm activity. This was also reflected in the farmers' ranking (Table 4). The formal education level of the farmer population has been changing: the older the household head, the lower his formal education level ( $\rho = -0.21$ ,  $p < 0.05$ ). The formal education level of the household head was positively correlated to the IIC ( $\rho = 0.25$ ,  $p < 0.01$ ) and the CAF ( $\rho = 0.3$ ,  $p < 0.01$ ).

Due to the frequent introduction of new species, the farmers in the delta ranked fruit farming more difficult, but the farmers in the hills considered aquaculture and raising ducks more difficult: in the delta, almost every farmer bred fish or ducks (Figure 3). This was confirmed by the higher frequency of insufficient know-how of aquaculture as a reason not to breed fish in the hills (Bosma et al. 2004). Breeding fish in latrine ponds for home-consumption was ranked even less difficult. Most farmers just stocked the fish; if the fish got sick they let them die and replaced them with new fingerlings, as their knowledge on fish diseases was limited. Not all hill-zone farmers were aware of the possibility of fattening fish in the rainy season (Text block 2), as is the common practice in the uplands in the north of Vietnam (Bosma et al. 2003). However, farmers ranked information as low as 5th on a list of seven factors driving farmers to adopt aquaculture in the delta (Nhan et al., 2006).

The level of know-how needed for raising chickens, ducks, and pigs was ranked high, not because more experience was required, but because it was risky compared, for example, to raising cattle (Table 4). Cattle raising was recently introduced in the delta. According to the farmers, cattle are more frequently attacked by diseases than the buffaloes they raised in the past, explaining the higher ranking in Phu Binh. Relatively more farmers in the hills raised very large flocks of ducks in the nearby irrigated areas; this could explain why the farmers in the hills rated the need for family labor for raising ducks significantly higher than those in the delta – good (3.6) and low (2.7), respectively ( $p = 0.05$ ).

The state provided information and innovations to the farmers through the media and their research



**Fig. 3. The percentage distribution of farmers and incomes earned from the activities undertaken in the delta and hills of the Mekong Delta**

#### Text block 2:

##### **Solving the water constraint to improve livelihood.**

The lack of water did not prevent an elderly couple in Phu Hoa with a small homestead and orchard from breeding fish. When complementing their income with off-farm labor in rice fields became too heavy, they gradually switched to trading fish. The baskets of fish bought from the fishermen also contained small fish, which they did not sell. The old man dug a 6 -square meter hole in his sandy soil to which he added a layer of clay to reduce leaching. Years later, he used a plastic sheet to reduce leaching. They raised the small fish and other fingerlings to marketable size and earned nearly VND 20,000/day. The man acquired the know-how from radio, television, and from other farmers.

and extension services. Training topics were related to the land-use policy. The poor farmers had limited access to the media but some picked up ideas during their travels (sometimes because of military or community services), and visits to friends to acquire specific knowledge for new farm components.

**Rice field and food-security.** For people living in the Vietnamese Mekong Delta, rice was and still is the main staple crop. Until recently, having a rice-field was the first step in the creation of a new household because it guaranteed food security. Surplus production was sold to pay inputs and to obtain cash. Until 1986 Vietnam had imported rice, but the construction of dikes for water-management

and the new rice technologies have allowed the cultivation of three rice crops a year. Between 1989 and 1995, the price competitiveness index for rice decreased by an annual rate of 5.5% (IFPRI 1995) and in 1994 the government purchased huge quantities of rice to support the farm-gate price (Linh 2001). Since 1996, exports have been allowed and an acceptable farm-gate price for rice has been set in accord with the global rice market. At present the farm-gate price for rice is above the level of 1995 (VND1,500 to VND2,000 per kilogram), but it dropped to as low as VND800/kg in 1998 and 1999, thus forcing several farmers to sell land to reimburse short-term loans they incurred to finance inputs for rice cultivation.

The continuous availability of rice in the market at relatively stable prices since 1989 (compared to pigs, for example) (Figure 4) and the level of their production reduced the farmers' preoccupation to produce rice on-farm as a means to provide for their family's food security. This change was demonstrated in the negative correlation between the importance given to rice and the cash income derived from fruits ( $\rho = -0.28$ ,  $p < 0.05$ ).

In the hills the importance of a rice field was lower than in the delta because farmers relied more on other staple crops for food security (Figure 5). In the delta, for more than half of the farmers, the link between rice and food security was still a very important factor in their decision-making. Others maintained the minimum area of rice-field to secure food provision and took more risks with

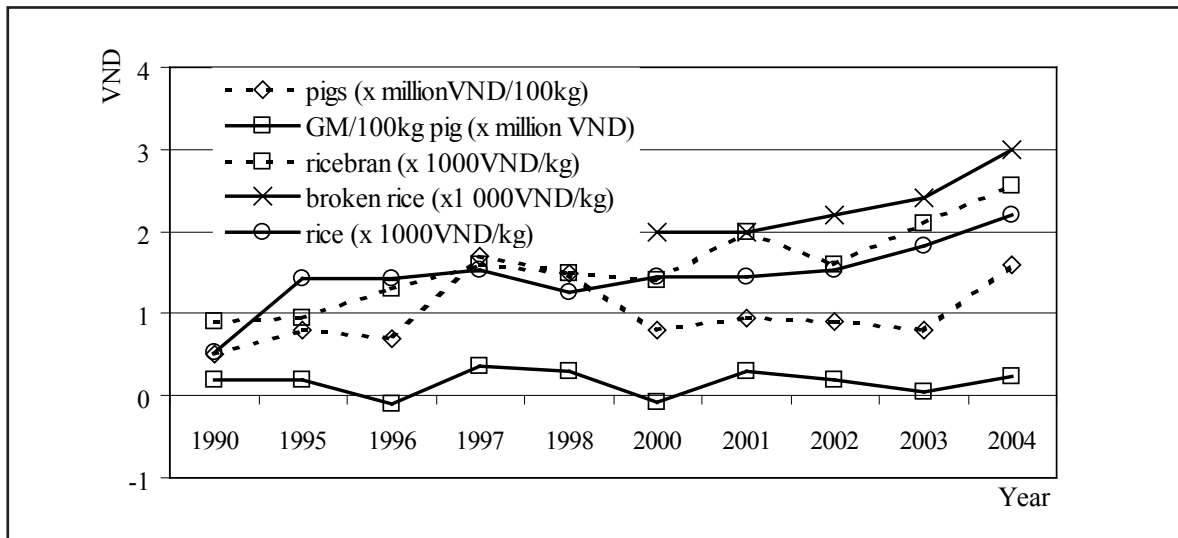


Fig. 4. Trend of prices for rice, broken rice, rice-bran and pig, and the gross margin for pig

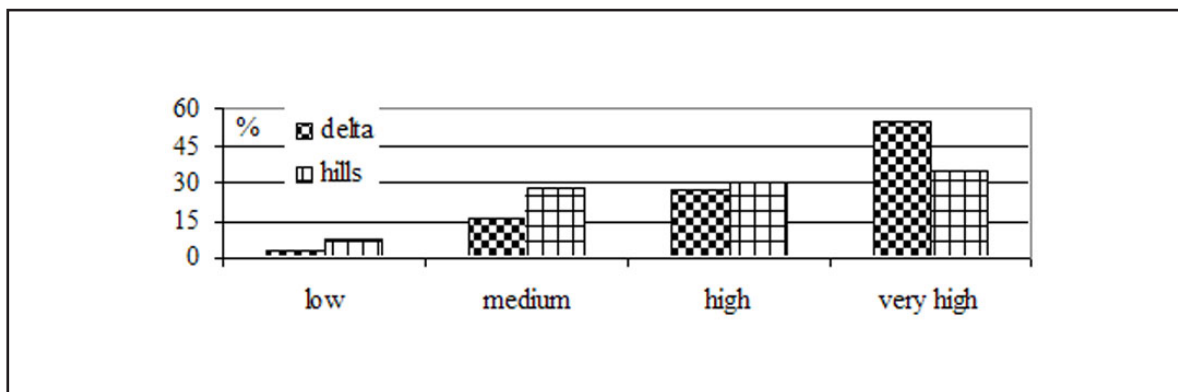


Fig. 5. Farmers' comparative ratings on the importance of a ricefield for food security

other activities, thereby transforming most of their rice-fields into ponds or dike-ditch systems. Having one's own rice-field was not important for 5% only and this comprised the specialized breeders and producers.

### Physical Capital

The availability of waterways and roads to markets, of dams for the management of water, and of neighbors' activities affected the valuation of physical capital in the pursuit of livelihood. We did not consider the individual distribution of production equipment in our analysis.

The importance of the distance between the field and the road or waterway was reflected, for instance, in the prices for orchards in O Mon:

the orchards on the border of a waterway or at the roadside have a higher market value than the orchards within the field. Though middlemen collected the products mostly in bulk, to get the best price farmers could transport their produce to the main road or a nearby market. In the delta most transport went by boat; thus distance to the road was not as important. In the hills the distance to the road affected the number of farm components positively ( $\rho = 0.25, p < 0.05$ ), indicating a higher tendency toward self-sufficiency.

According to our sample, neither the distance between the fields and the homestead or the road, nor the distance to the market affected the income. But for the delta area, differences in the management of IAAS farms in the three districts were significantly related to the distance of farms

to main markets (Phong et al. 2004). In the delta, farmers ranked the presence of outlet markets second, while the presence of traders and fish processing companies was ranked as having the lowest impact among seven factors driving farmers to adopt aquaculture (Nhan et al. 2006).

The possibility of cultivating three crops a year in the delta was a relatively more recent development in Tam Binh (1997) compared to O Mon (1983) and Cai Be (1986). Consequently, rice still occupied 70% of the cropland in Tam Binh while it was about 50% in Cai Be and O Mon (Phong, forthcoming). Rice production had become less attractive for at least three reasons: the double- and triple-rice technologies improved family food security, the gross margins of triple rice were lower than double rice due to the high costs of inputs (Nhan et al. 2003), and they failed to realize profits when market prices dropped due to oversupply.

As the irrigated fields needed to be cropped to maintain their value<sup>5</sup>, farmers looked for alternatives; at first they replaced the third rice crop with vegetables, but finally they replaced all three rice crops. The farmers who resorted to the latter transformed part of their rice-fields into ponds, orchards or ditch-dike systems to produce fruit and fish species which fetched good prices in the market.

Farmers produced marketable fruits on raised beds or embankments that gradually developed into ditch-dike systems; the ditches provided water for irrigation and contained fish, either naturally retained or stocked (Linh 2001; Prein 2002; Sanh et al. 1998). Also in the hill zone, close to canals and to roads in irrigated areas, farmers constructed ditch-dike systems.

The changes made by farmers could also be induced by their neighbors if the latter's innovations changed the physical conditions. For example, in An Thanh, a widow replaced the annual cassava with the perennial bamboo some years after her neighbor had planted *Melaleuca* trees and her narrow plot was shaded all day; the first bamboo became marketable in three years' time. Another

example is a farmer in O Mon who had to transform the rice-field near his homestead into a ditch-dike system as the water management was adjusted to the fruit production of his neighbors, making irrigation for three rice-crops no longer possible.

### ***Financial Capital***

The type of crop, the market opportunities, and the availability of credit affected the financial resources that provided livelihood options. Less than 5% of the households profited from regular remittances, pensions, or irregular remittances; the last were often used to invest in new farm components.

In the emerging market economy, the cropping of rice alone was disadvantageous compared to the IAAS wherein fruits and vegetables were grown, and livestock raised, aside from planting rice. With rice alone, one could earn cash only one to three times a year, thus failing to meet one's need for cash on a regular basis; also the rice-field could be too small or the yield too low to earn the cash needed. Orchards planted with several species provided a more regular cash income and mostly with higher gross margins. This was reflected in the price development of land in the uplands, especially since the chemical stimulation of the flowering of mango was introduced after 1998. Since 2001 the price of land for orchards had become higher than for lowland irrigated rice-fields (Figure 1).

A good market was a condition for the development of new activities like fish or fruit farming (Table 5), but not a major condition for cultivating rice on the irrigated fields, for keeping ducks or chickens in small numbers, or raising fish in latrine ponds. One farmer replaced all his fruit trees within three years after planting, than concentrated on one type of fruit; unfortunately, the market prices of the particular species he chose dropped dramatically.

The ready availability of capital was essential for most farm components (Table 2). Lending among relatives and friends was frequent, mostly without interest, and with no collateral required. Loans from banks for agriculture have only become available since 1992 when the introduction of land certificates gave land a collateral value. In 2003 the collateral value of the red certificate was VND10 million (US\$645) and the green certificate was

<sup>5</sup> If they did not use the irrigated field, it would be too difficult to get rid of the weeds for a next crop; also, they planted rice since they needed food anyway.

**Table 5. Average sizes of farmlands, and fishponds, and the distance from homestead to fields, main roads, and main market for the products**

	Size (ha)			Pond (m <sup>2</sup> )	Distance (km) between homestead and				
	home- stead	lowland	upland		total	lowland	upland	market	field and road
Thoi My	0.21	0.71		0.92	234 (22)	1.0		9.1	2.3
Phu Dien	0.18	0.83		0.94	570 (23)	0.3		10.9	2.5
My Hung	0.20	0.40		0.60	274 (23)	0.7		3.6	1.6
An Thanh	0.27	1.43 (14)	0.60 (17)	1.68	597 (3)	1.3 (14)	3.9 (17)	2.0	0.4
Phu Hiep	0.56	0.63 (12)	1.76 (16)	2.01	242 (9)	0.2 (12)	1.2 (15)	1.6	0.3
Phu Hoa	0.57	1.67 (15)	1.21 (17)	2.62	427 (4)	3.2 (15)	1.7 (17)	2.4	0.6
Average	0.33	0.87	0.80	1.62	360	1.5	1.3	4.9	1.3

Note: The numbers in parentheses refer to the number of farms. If no number is indicated, then the total is 24.

valued half of the red. Most institutional credit for farmers was available for activities related to the land-use policy or to the poverty alleviation program. Short-term loans for crop inputs were available from banks, input providers, and traders. For some years, specialized services provided inputs like fertilizer or animal feed and collected the produce, both for a contractual price that often included an interest rate close to the one asked by private money lenders. Private money lenders did brisk business and were charging at least triple the interest rate of the banks. To solve the capital constraint for aquaculture, several farmers had provided soil for the construction of a road or a homestead.

**Contribution of Farm Components to Livelihood**

The wealth ranking was corroborated by a positive correlation of the three classes of well-being with the total net cash income ( $\rho=0.4$ ;  $p<0.01$ ). The rank of well-being was also related to the family farms’ total land area ( $\rho=0.43$ ;  $p<0.01$ ) and to the CAF ( $\rho=0.4$ ;  $p<0.01$ ).

Mean household cash income was slightly higher than VND18 million/year (i.e. 0.64 US\$/day/person). In the delta, 58% of the families earned from both CAF and CON, compared to 36% in the hills; average CAF and CON were close to 12 and 6 mVND/year, respectively (0.32 US\$/day/person and 0.16 US\$/day/person). The most important

contribution to cash income for close to 70% of farmers in the hills came from fruits, while for almost 80% in the delta it came from rice (Figure 3). More than half of the farmers also earned cash income from raising chickens, for example, but for most, the profit was negligible. Almost half of the interviewed farmers raised pigs but for only 8% was it a substantial contribution to cash income ( $>15$  kVND/day,  $>0.95$  US\$/day/person). In the delta the contribution of fruits to cash income was about the same as that of pigs, fish, or crops other than rice. The level of cash income derived from ruminants and ducks demonstrated an effect of specialization: the few farmers keeping cattle in the delta or ducks near the hills had high cash returns from this component.

Livestock allowed farmers to expand the farm turnover without increasing farm size, and was essential for poverty alleviation. On average, the income from livestock, including fish, formed close to 1/3 of the total net cash income; it contributed 64% and 32% to CAF, respectively in the delta and the hills. For the average five-person household, this amounted to US\$1–2/day. According to farmers, the availability of family labor was important in the decision to start or to stop raising livestock, but the income from livestock was not correlated to household size or the number of adults. Negative or low margins were the most general reason for stopping a farm activity or changing the type of crop (Text block 3). The farmers raising pigs to obtain manure for fish were reluctant to stop when

**Text block 3:  
The pig cycle**

In the past four years, 23% of the interviewed farmers stopped raising pigs due to low margins. The gross margins from pig fattening have fluctuated dramatically (Figure 4). The last dip was related to a decline in the market price for live pig from VND14,000 to VND 8,000 per kg when the export market to China did not expand at the same rate as the number of large commercial producers in Vietnam. Prices remained fair after 2000 but the margins hardly recovered as the cost for the piglets of improved breeds remained high. The prices recovered after the avian influenza towards the end of 2003, but the gross margin stayed low as the prices for rice-bran and commercial feeds increased to about 30%.

the profit margins from pig fattening dropped since the income from fish compensated for the losses. These farmers bought concentrates for the pigs only; the manure fertilized the pond and they had no need for other feed input.

Farmers could build up a livestock component through own capital investment, credit, sharing, or 'passing on the gift.' For the shareholder, sharing was a way to start raising cattle, goats or pigs without capital investment. For the share-owner it was a way to earn interest without investing in labor. For the share-owner, sharing was lucrative: one share-owner in the hills made an interest of approximately 50 % per year after his investment in goat raising. For the shareholder, sharing beef cattle to fatten could be profitable if the fattening period was short, but sharing cattle for reproduction could be recommended only for those having other regular cash-generating activities and supplementary labor, like the adolescent members of the household. For the poorest, building up a cattle herd by sharing or credit proved to be a losing proposition; their meager finances usually forced them to sell the cow even before it begot a calf. Out of eight (10%) farmers in the hills starting to raise cattle through sharing or credit, five stopped—two needed to reimburse the credit and three needed additional capital. Worse, one still had a loan to pay, yet did not have cattle in his possession. Those who raised chicken, pigs or goats did not experience these difficulties to the same extent.

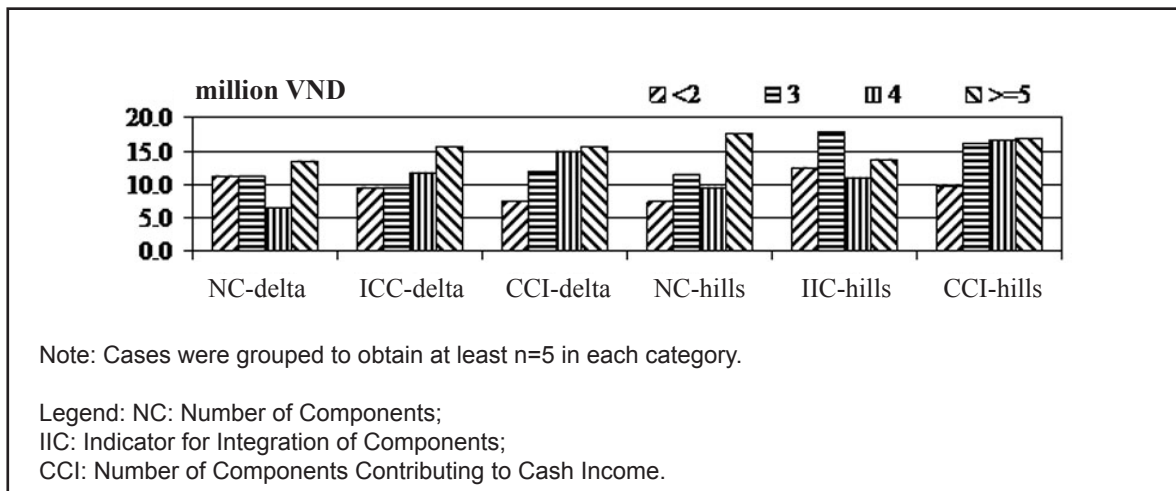
***Farm Diversification: Cumulate or Integrate***

The average number of farm components (NC), the IIC and the CCI were all significantly higher in the delta than in the hills: 5.5 versus 3.8; 4.5 versus 2.5; and 3.7 versus 2.7 ( $p < 0.001$ ) respectively. The CCI was positively correlated to the rank of wealth ( $\rho = 0.4$ ;  $p < 0.01$ ) in both delta and hills, and to the NC and the IIC in the delta only ( $\rho = 0.3$ ,  $p < 0.01$ ). In the delta both IIC and CCI correlated significantly to the CAF ( $\rho = 0.3$ ;  $p < 0.01$ ), but in the hills the CAF was correlated significantly only to the CCI ( $\rho = 0.3$ ;  $p < 0.05$ ).

In the delta the distance to the lowland fields affected the IIC negatively ( $\rho = -0.2$ ,  $p < 0.05$ ). Similarly, in the hills the distance to the upland fields affected the CCI and the IIC negatively ( $\rho = -0.3$ ,  $p < 0.05$ ). Only in the delta were the correlations between the farm area, on the one hand, and the IIC and CCI on the other, significantly positive ( $\rho = 0.3$ ,  $p < 0.01$ ), meaning that the very small farmers turned to specialized tasks. The positive correlation ( $\rho = 0.3$ ,  $p < 0.01$ ) between the size of the homestead and the IIC in the hills confirmed that integration needed a minimum area of land in, or close to, the homestead. Indirectly this shows that the availability of labor and transport equipment limited an effective integration through the exchange of wastes.

The total farm area and the CCI explained the variation in CAF significantly. The NC and CCI determined two distinct clusters of CAF—15.2-1.6 and 10.0-1.2 x10<sup>6</sup> VND/year (981 US\$/year and 645 US\$/year, respectively). In general farms having at least three CCI performed better (Figure 6). Especially in the delta, farms with an IIC of 4 and higher earned more cash. In the delta some farmers who specialized generated a high income; however these farmers need more cash for their livelihood.

The farmers in the delta exploited all possible means to cumulate farm components; e.g. the houses of ducks and chickens were constructed above the fishpond where the manure was recycled; furthermore vegetables were grown in or above the pond. However, raising ducks did not mix well with ditch-dike systems: when the ducks tried to catch the fish in the ditches they destroyed the narrow dikes; they needed a special pond for their exclusive use.



**Fig. 6. Average yearly cash income from agriculture as a function of the number of components, the indicator for integration of components, and the number of components contributing to cash income**

Housing the poultry increased the risk of theft. This risk was very low if the adult chickens stayed in the homestead trees, and the ducks on the water, overnight. Farmers said that they increased the number of components for an optimal use of the small area of land available. They recycled farm residues as much as possible. Rice straw could be used not only to feed ruminants but also to cultivate mushrooms.

The most frequent integration in the delta was the recycling of human waste; to prevent spreading through flood and tides, the use of latrine ponds to breed catfish was widely practiced notwithstanding the legal restrictions of using human waste to fertilize ponds. Manure-fertilized ponds were also more popular in the delta. The proposed use of excreta to feed animals was not accepted by the Hieu Nghia Buddhists who formed part of the population in the uplands. Research is needed to quantify the risk for disease transmission to secure this source of income and sustainable waste management (Bunting 2004).

## DISCUSSION AND CONCLUSIONS

We did not include in the foregoing analysis the contribution to home-consumption of the various farm components, nor did we ask the farmers how much cash they needed for family nutrition. A baseline study of 80 farm households in the three

delta villages showed that home-consumption plus other non-cash contribution to income was on average 16% only (Phong, forthcoming). As a family farm having less components would need more cash for family nutrition, our conclusion on the positive relationship between the number of components and the net cash income from agriculture would even be reinforced.

Some farmers claimed that IAAS used resources more efficiently than monocultures, but very often the additional components were not integrated effectively through the exchange of wastes but were a mere cumulation of components. In the delta, a high index for integration was positively correlated to the level of well-being and the income from agriculture, but was limited by the size of the homestead and the distance to the fields in the hills. The total number of components and the components providing cash determined two clusters of gross income from agriculture in which income from livestock, including fish, composed close to 2/3 and 1/3 in the delta and hills, respectively.

The infrastructures for water management and the services related to land use policy, affected the chronology of the innovations according to the districts. The improved rice food security changed the farmers' reference frame and pushed farmers to take risks and to engage in activities in which they had less know-how. In the delta area farmers intensified the fish production in the available

ponds and transformed rice-fields in ditch-dike systems for fish and fruit. The technological innovations of rice, fruit, and fish were essential for the development of integrated systems in the MD, partly contradicting Netting (1993) who stated that scientific and technological innovations were not the crucial causal factors in the development of intensive agriculture.

Data showed that the distribution of cattle by credit or sharing arrangements was not an effective instrument for the resource-poor to build a sustainable livestock component. The short reproduction cycle, the large litter size, and the low individual value makes sharing or “passing on the gift” of pigs or goats a more appropriate strategy for poverty alleviation.

Stirrat (2004) criticized the reductionistic use of social capital within the livelihood approach, but we used this factor to analyze the social resources affecting change and diversification. In a comparable framework of analysis such as the agri-family system (Benneth 1980), these fall within the categories of ‘broker agents’, ‘instrumental network’, and ‘access to sources of support’. The livelihood framework helped us to identify the importance of the household life cycle in the decision-making. Clearly, decision-making was not a one-time event but a process (Benneth 1980) and mostly embedded in a pathway (Bruijn and Dijk 2004) that was obstructed by political structures, natural disasters and diseases, especially for the resource-poor, but at the same time also offered oases of opportunities.

After ‘Doi Moi’, the large variety in farm compositions resulted from the valuation of the available resources/capitals through the agency of the individual actors (Long and Ploeg 1994). Though the political context in the Mekong Delta was particular, the fact that the Khmer in the hills zone did not grasp the same opportunities as the Kinh in that area shows also that the social context affects the actors’ motives for diversification.

As concluded by Ellis (1998), diversification is a heterogeneous social and economic process, following a wide range of pressures and possibilities. The most mentioned motive for the on-farm innovations was the desire to improve family well-being. As borne by the findings, the household life cycle determined the labor and subsequently the capital availability to engage in more market-

oriented activities. Farmers’ choice of a new component to add to their livelihood activities was motivated by know-how and market opportunities; educated farmers were more innovative, as found by Chi and Yamada (2002). After the reforms starting in 1986, on-farm diversification was triggered by the low market price of rice, the improved possibilities of product marketing and off-farm labor (Phong, 2006), and the freedom of farmers to develop activities of their own choice. The marketing system of middlemen enabled the integration of small farmers to participate in the global market of fruits and fishes.

In nuclear families, the phases of creation, expansion, accumulation, and consolidation confer to the household life cycle (Chayanov, as cited by Perz 2001) as well as to the livelihood strategies (Zoomers 1999). The phenomenon of young couples living with the husbands’ family may be explained differently by anthropologists; in our study we distinguish this as a phase of preparation towards establishing an independent household since the cohabitation only starts after marriage to allow the young couple to save money. Off-farm diversification was important for all households from preparation until expansion, but for the resource-poor, it was a necessity at all times. In the expansion phase the farmers increased the farm turnover by keeping more livestock, and in a later phase they accumulated their savings either in land, houses or the education of their children. The MD farmers diversified on-farm activities to increase food production and maximize the cash income from their limited area. This on-farm diversification and the effective integration of components affected income positively, but needed know-how, and a minimum area of land in, or close to, the homestead.

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