Participatory evaluation of sustainability of farming systems in the Philippines

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We shall never achieve harmony with land any more than we shall achieve justice or liberty for people. In these higher aspirations the important thing is not to achieve, but to strive.

Aldo Leopold

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List of abbreviations

ACIAR	Australian Centre for International Agricultural Research
Bdf	board foot
CBFM	Community Based Forest Management
DENR	Department of Environment and National Resources
DFID	Department for International Development
DSR	Driving-Force/State/Response (Framework)
FA	Farmer association
FESLM	framework for evaluation of sustainable land management
FAO	Food and Agriculture Organisation of the United Nations
FGD	Focus group discussion
GTZ	German Agency for Technical Cooperation
ICRAF	World Agroforestry Center
ISFP	Integrated Social Forestry Program
ITE	Institute of Tropical Ecology
MAO	Municipal Agricultural Office
NGO	Non-Governmental Organisation
NPV	Net Present Value
NSO	National Statistics Office
PCA	Philippine Coconut Authority
PHP	Philippine Peso (100 PhP equal approximately 1.78 € on June 12, 2010)
RF	Rainforestation Farming
SI	Sustainability Indicators
SRL	Sustainable Rural Livelihoods (framework)
ViSCA	Visayas State College of Agriculture
VSU	Visayas State University
WCED	World Commission on Environment and Development

Included publications

Chapter 2: Vilei S. Local perceptions of sustainability of farming systems on Leyte, Philippines - divergences and congruencies between different stakeholders. Submitted to *International Journal of Sustainable Development and World Ecology*.

Chapter 3: Vilei S. Involving stakeholders in developing sustainability indicators for farming systems: a Philippine case study. Published in *International Journal of Sustainable development* (Volume 13, Issue 4, 2010, copyright Inderscience Publishers).

Chapter 4: Vilei S. Adoptability and rentability of a complex agro-forestry system for small-scale tree farmers, Leyte, Philippines. Submitted to *Agroforestry systems*.

1. Introduction

1.1 Background

1.1.1 Introduction to the problem

The location of the study is the island of Leyte in the Philippines. Typical for the Philippines, a country of numerous densely populated islands, Leyte has relatively flat lands around the coastline and mountainous terrain towards the central part. In the Philippines, slopes of more than 18% are officially excluded from any agricultural or other use and classified as forest land. Only 51% of the area in Leyte has a slope of less than 18%, meaning that a large part of the land area can officially not be used for agriculture. But in reality the majority of this land is cultivated, at least temporarily.

Forest cover has been greatly reduced during the last decades. The Forest Management Bureau (cf. Chokkalingam et al. 2006) reports that in 2003 forest cover was 24% of the country's land area or 7.2 million ha. While this figure is higher than the 1988 forest cover of 6.5 million ha, rehabilitation of remaining forests as well as reforestation need to be continued. Some also argue that natural old-growth and secondary forests continue to decline because of logging and expanding frontier agriculture and that the forest cover increase is primarily due to regrowth vegetation and plantations through reforestation (Chokkalingam et al. 2006). As a reaction to continuing deforestation, the government imposed a total logging ban, in place since 1990. Due to increasing land pressure, farmers cultivate upland areas, not well suited to agricultural activities. Most farmers in the Philippines have to survive on an average of 2 ha (NSO 2002), facing insecure land tenure, and many families have no legal access to land. The removal of the upland forest areas can lead to erosion and subsequent flooding or landslides with dramatic consequences. In the southern part of Leyte a landslide occurred in 2006, burying a whole village (BBC News 2006).

Agricultural practices have a direct impact on the environment, but are in turn also impacted directly by changes in the environment. Since agriculture is one of the main sources of rural peoples' livelihoods in many developing and transition countries, including the Philippines, social and economic impacts of environmental changes are of significant importance (Rao and Rogers 2006). None of the land-use systems that replace(d) the natural forest can match it in terms of biodiversity richness and carbon storage capacity. However, these systems do vary greatly in the degree to which they combine at least some environmental benefits with their contributions to economic growth and poor peoples' livelihoods (ASB 2003). It is, therefore, always worth asking what will replace forest compared to possible alternatives (Tomich et al. 1998).

1.1.2 Sustainability concepts, indicators and frameworks

While sustainability is today the goal of every development program, there is no consensus on a precise definition. ‘Sustainability’ means different things over different timeframes and to different stakeholders (see i.e. Bell and Morse 1999). Most definitions would agree, though, that sustainable agriculture must be environmentally sound, economically viable and socially responsible (Ikerd et al. 1996; Rigby and Caceres 2001; Wirén-Lehr 2001). Since sustainability is not an ultimately measurable entity, a more precise definition is not meaningful and not sought after in this study. To see if the goals of more sustainable agricultural practices have been reached, an evaluation is necessary. Evaluations are mostly carried out by the use of sustainability indicators (SIs), which can be seen by the numerous publications concerning the topic of indicators. Even less agreement can be reached on the right way of selecting the appropriate indicators for evaluating sustainability and several different frameworks and methods have been created, tested and presented for this reason, so many that King et al. (2000:631) refer to it as “an industry of its own”. Some criticise the use of SIs (i.e. Morse et al. 2001; Morse et al. 2004), but Rigby et al. (2000:5) argue that the development of SIs is useful in the respect that “it pulls the discussion of sustainability away from abstract formulations and encourages explicit discussion of the operational meaning of the term”. McCool and Stankey (2004:295) identify three important roles of indicators in sustainability assessments:

> “First, they help depict the existing condition of systems that are often complex, multi-faceted, and interdependent. Second, […] indicators facilitate evaluating the performance of various management actions and policies implemented to achieve sustainability. Third, they alert users to impending changes in social, cultural, economic, and environmental systems.”

The search for SIs has its origins in the sustainable development paradigm (Rigby et al. 2000). In the well known Brundtland Report (WCED 1987), sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Following this definition, one of the key aspects of sustainability is the concern over the impacts on future generations of actions taken today, the ‘intergenerational justice’ (Rigby et al. 2000). Another important aspect is the issue of ‘intragenerational justice’. Brundtland (1990:137) concluded that: “it is both futile and an insult to the poor to tell them that they must remain in poverty to protect the environment” and that “problems of poverty and underdevelopment cannot be solved unless we have a new era of growth in which developing countries play a large role and reap large benefits.”

A number of frameworks have been developed to identify indicators. Emphasis has mostly been on assessment of sustainability in biophysical terms. Pearson (2003:5) identifies one of the reasons in the

> "rapid adoption of government policy on sustainability [...] leading to needs to discover how it should be measured. The need for measurement led to a plethora of definitions of sustainability so that the 'thing' might be more amenable to quantification. Many of these indices shifted the emphasis from a 'triple bottom line' towards the biophysical".

Indicators have most commonly been identified by experts with little or no participation from concerned stakeholders. In the last decade, several authors have debated about the need to involve local stakeholders in the search for suitable sustainability indicators (i.e. Rigby et al. 2000; Morse et al. 2001; Reed et al. 2005). Bell and Morse (2001, cf. Reed et al. 2005) differentiate two methodological paradigms: reductionist (expert-led or top-down) and participatory (bottom-up). Many researchers though have applied a combination of qualitative (participatory) and quantitative methods, valuing both indigenous or farmer knowledge and scientific knowledge.

Several international organisations, such as the FAO, the World Bank and the Department For International Development DFID, focused on the agricultural sector for improving rural livelihoods and developed frameworks for assessment of sustainable rural livelihoods (Carney 1999), which emphasised more the social and economic dimensions of sustainable development, in contrast to the focus on ecological aspects previously (Rao and Rogers 2006). Among these was the Framework for Evaluation of Sustainable Land Management (FESLM), introduced by Smyth and Dumanski (1993). Sustainable land management is defined by five 'pillars' (productivity enhancement, security or risk reduction, protection of the natural resource base, economic viability, and social acceptability) and is based on the conviction that the analysis of sustainability on the single basis of biophysical characteristics is insufficient (FAO 1999). It has been criticised though that under the FESLM many biophysical indicators have been developed (generally referred to as land quality indicators), but that appropriate economic and social indicators are still lacking (Neef et al. 2003).

A framework focusing on social and economic aspects is the Sustainable Rural Livelihoods (SRL) Framework (Figure 1), proposed by the DFID. This framework has been proposed as the basis for qualitative analysis that covers the full diversity and richness of livelihoods, and the dynamic effects of these on the environment (Carney 1999). It is assumed that, for sustainable livelihood strategies of individuals and households, access, use and development of five 'capital assets' is necessary: financial (savings, disposable assets), natural (land, water, biodiversity), human (labour, skills), physical (infrastructure, machinery) and social capital (rights, support systems).

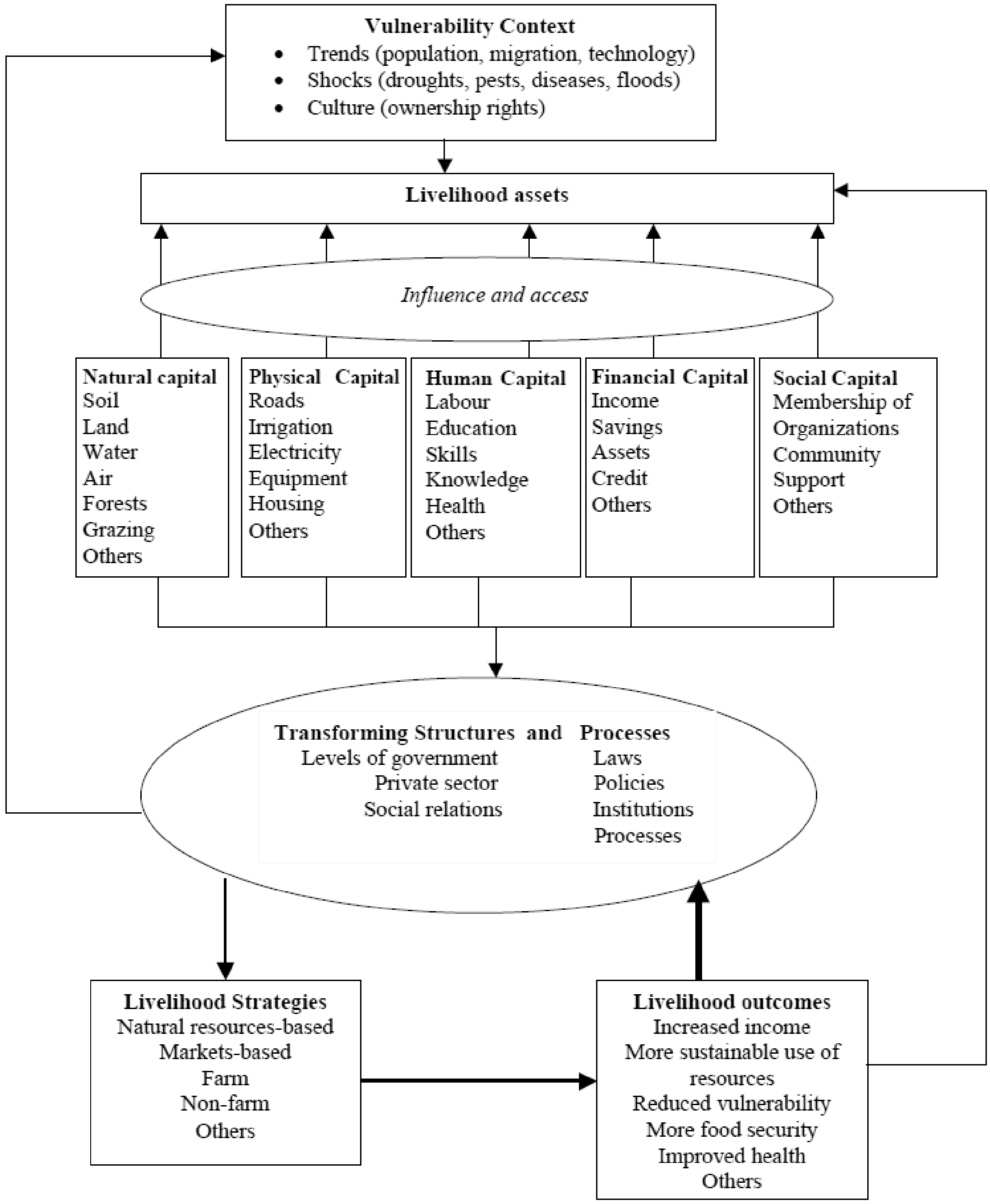


Figure 1. Sustainable rural livelihoods framework (Rao and Rogers 2006)

The framework identifies furthermore two categories which govern livelihood strategies: (i) the vulnerability context in which the assets exist (trends, shocks and local cultural practices that affect livelihoods) and (ii) structures (government and private organisations) and processes (policies, laws and incentives) which define livelihood options. Access, control and use of assets are influenced by structures and processes. The assets, and existing structures and processes, guide development of livelihood strategies which lead to outcomes and which in turn impact the assets.

Three types of strategies can be distinguished (Serrat 2008): agricultural intensification or extensification, livelihood diversification, and migration. The strategies are both natural resources-based and non-natural resources-based (Scoones 1998). Potential livelihood outcomes can include more income, improved food security and more sustainable use of the natural resource base (Serrat 2008).

In Figure 2 the close link of the capital assets to each other are presented, pointing out the dynamic nature of natural resource management (Campbell et al. 2001). One capital asset can be transferred to another capital asset, i.e. financial capital can be invested to improve human capital (such as skills or knowledge). Indicators should cover the full spectrum of capital assets in order to be relevant.

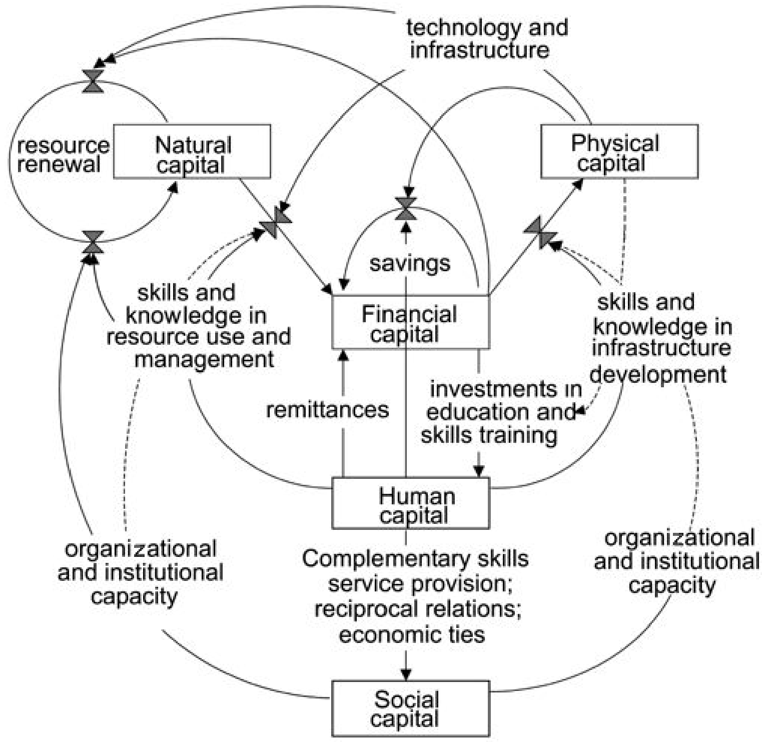


Figure 2. The dynamic nature of capital assets (Campbell et al. 2001)

The SRL Framework was not originally proposed as a framework for sustainability indicators, but has been proposed or used by Woodhouse et al. (2000), Campbell et al. (2001) and Fernandes and Woodhouse (2008) in the specific context of SI selection. To evaluate the theoretical base and usability of the SRL framework for this purpose, both Fernandes and Woodhouse (2008) as well as Rao and Rogers (2006) compared the 'Drivingforce-State-Response (DSR) Framework' (Pieri et al. 1995; OECD 1999) and the SRL Framework (Figure 3). The DSR framework has evolved from the 'Pressure-State-Response Framework', widely applied as framework for organising information on environmental impacts (McCool and Stankey 2004). In the DSR framework,

> "the chain of causal links begins with driving forces and through to pressures states, impacts and responses. Driving forces are human activities which underpin environmental change (industry, agriculture) and impacts are results of pressures (on ecosystems, human health) which induce responses" (Rao and Rogers 2006:440).

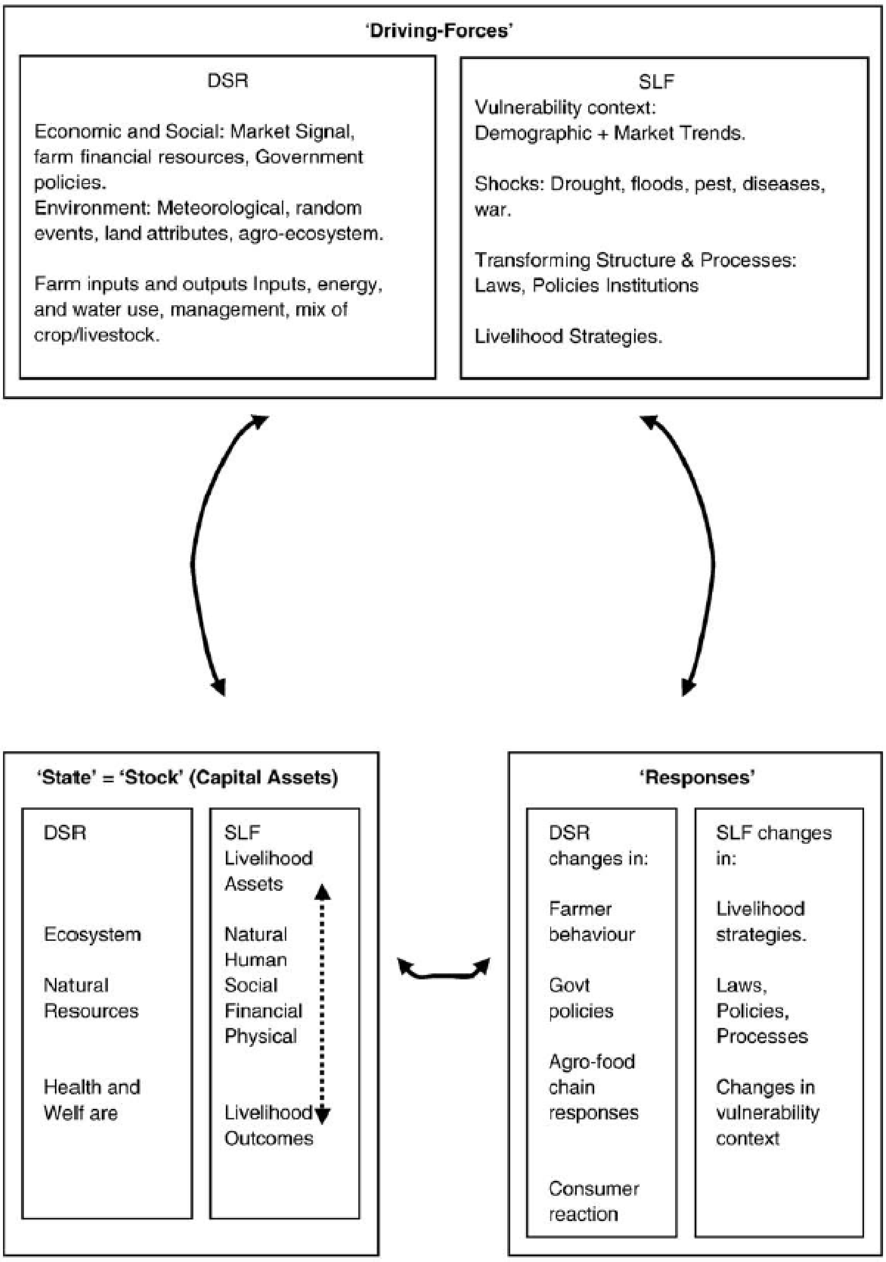


Figure 3. The Sustainable Livelihood and Driving Force-State-Response Frameworks combined (Fernandes and Woodhouse 2008)

When comparing the SRL and the DSR framework, driving forces correspond to the vulnerability context, pressures to livelihood strategies, state to biophysical outcomes, impact to socio-economic outcomes and response to structures and processes (Rao and Rogers 2006). The 'state' category of the DSR frameworks corresponds to the category of 'capital assets' in the SRL Framework. Both frameworks see 'driving-forces' in terms of social, economic and political (legal, institutional, policy) forces, as well as 'natural' ones. Similarly, both frameworks see 'response' at both local level, i.e. 'farm behaviour' or 'livelihood strategies' in terms of farmers/resource user decisions, and also at national government scale, i.e. changes in legislation and policy (Fernandes and Woodhouse 2008).

An advantage of the SRL framework is that it achieves a holistic spread across ecological, human and economic factors whereas the DSR framework, in the OECD formulation, is restricted to ecological and human health dimensions. Capital assets "are indicators of outcomes of past and present livelihood strategies but can also be interpreted in terms of potential for (sustainable) future livelihoods" (Fernandes and Woodhouse 2008:246). The framework recognises the complex interactions in rural livelihoods. This point of view was seen as being appropriate for the study region in Leyte. Most small-scale farmers have to rely on other income sources to secure their livelihoods besides their agricultural activities, i.e. off-farm labour opportunities, small enterprises or remittances. The current status and further development of their farming practices will be judged by them in the wider context of their entire livelihood system (Cedamon and Harrison 2004; Emtage 2004).

1.2 Study site

In the beginning of 2010, the Philippines have an estimated population of 94 million inhabitants, an estimated population density of 315 persons/km^2 and an annual population growth rate of 2.04% for the years 2000-2007 (according to the official census of population under URL: www.census.gov.ph/).

The island of Leyte (Figure 4) forms part of the Eastern Visayas (encompassing the three islands of Leyte, Samar and Biliran) and is the 8th largest of the Philippine islands. The island has relatively flat lands around the coastline and mountainous terrain towards the central part, rising up to 1150 m, the top of Mt. Pangasugan. Leyte province is home to 1.7 million people and 391,000 people live in Southern Leyte province. Fifty-five percent of the households on Leyte depend on agriculture and fishing to make their living. The average annual family income of the Eastern Visayas Region (2006) stands at 125,731 Philippine Peso (NSCB 2008) - approximately 2,241 Euro as in June 2010.

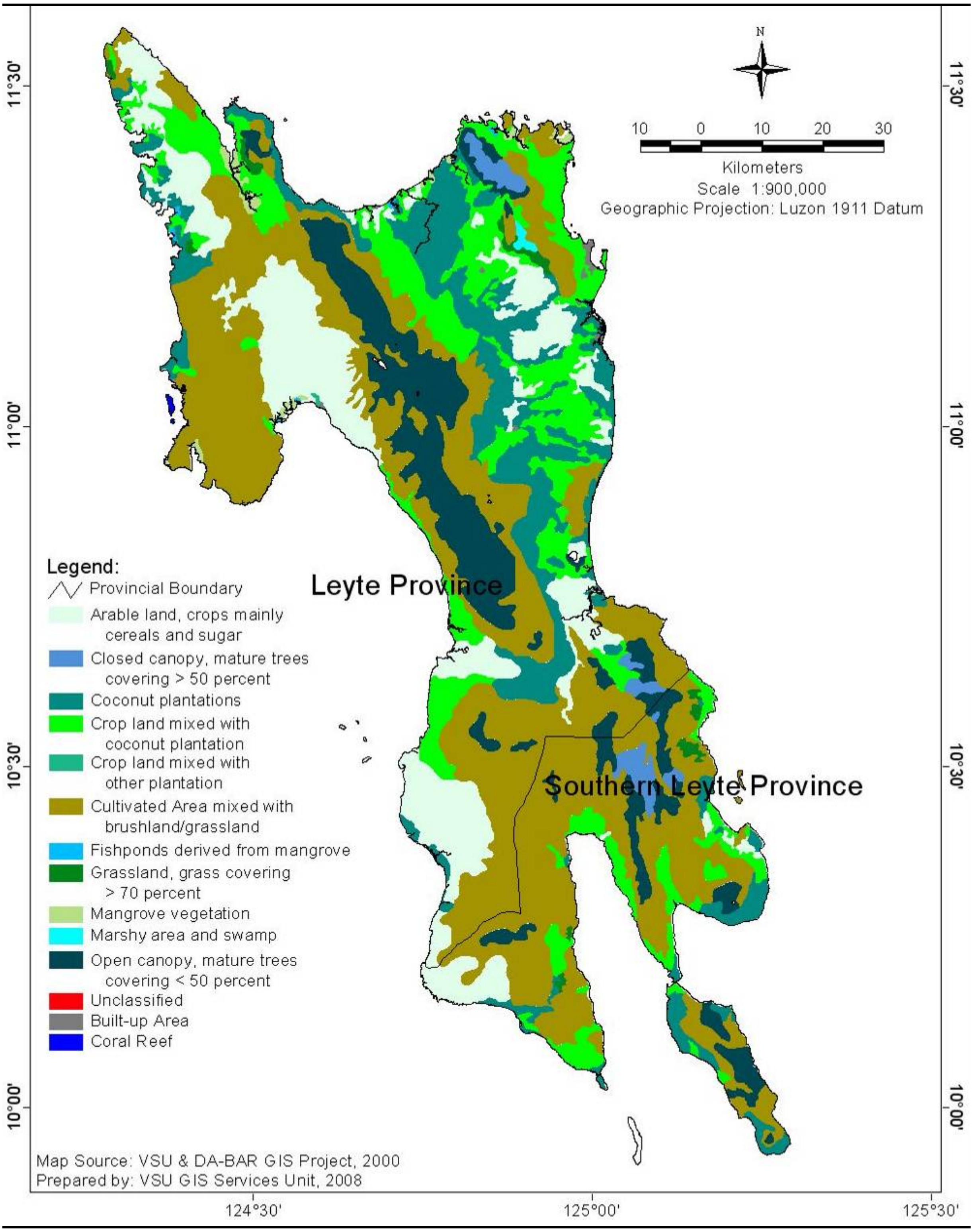


Figure 4. Land cover map of Leyte (FARMI, Visayas State University 2008)

Figures regarding forest cover in Leyte vary from a 10% estimate in 1996 (Asio et al. 1998) to estimated 31.5% in 2009 (REIS 2009). As of 1990, just 39% of the island forest lands actually had forest cover (ERD-MO 1991, cf. Dargantes 1996). A national logging ban in 1990 led to a gradual withdrawal of the big logging companies and its enforcement in Leyte Island became more prevalent after the Ormoc disaster in 1991 (Göltenboth and Hutter 2004). Today, main causes for the ongoing forest conversion can basically be attributed to the rampant practice of shifting cultivation, extending settlement, and to a certain extent illegal logging activities (Groetschel et al. 2001).

In Figure 5, a typical outline of the topography and the agricultural use of the different areas on Leyte is displayed. During the past 20 years there has been a transition of the traditional farming systems from shifting cultivation to more permanent upland farming in Leyte. Dargantes (1996) found that newly-cleared forests got transformed into grain farms (mainly planted to corn), rootcrop farms (usually with sweet potato, cassava and taro), non-forest plantations (abaca and/or coconut), vegetable farms and wetland rice paddies. Even parcels which went through the grains and rootcrops cultivation stages eventually got converted into abaca and/or coconut plantations. From the various land use transformations, only about 7% reverted to forest fallow vegetation.

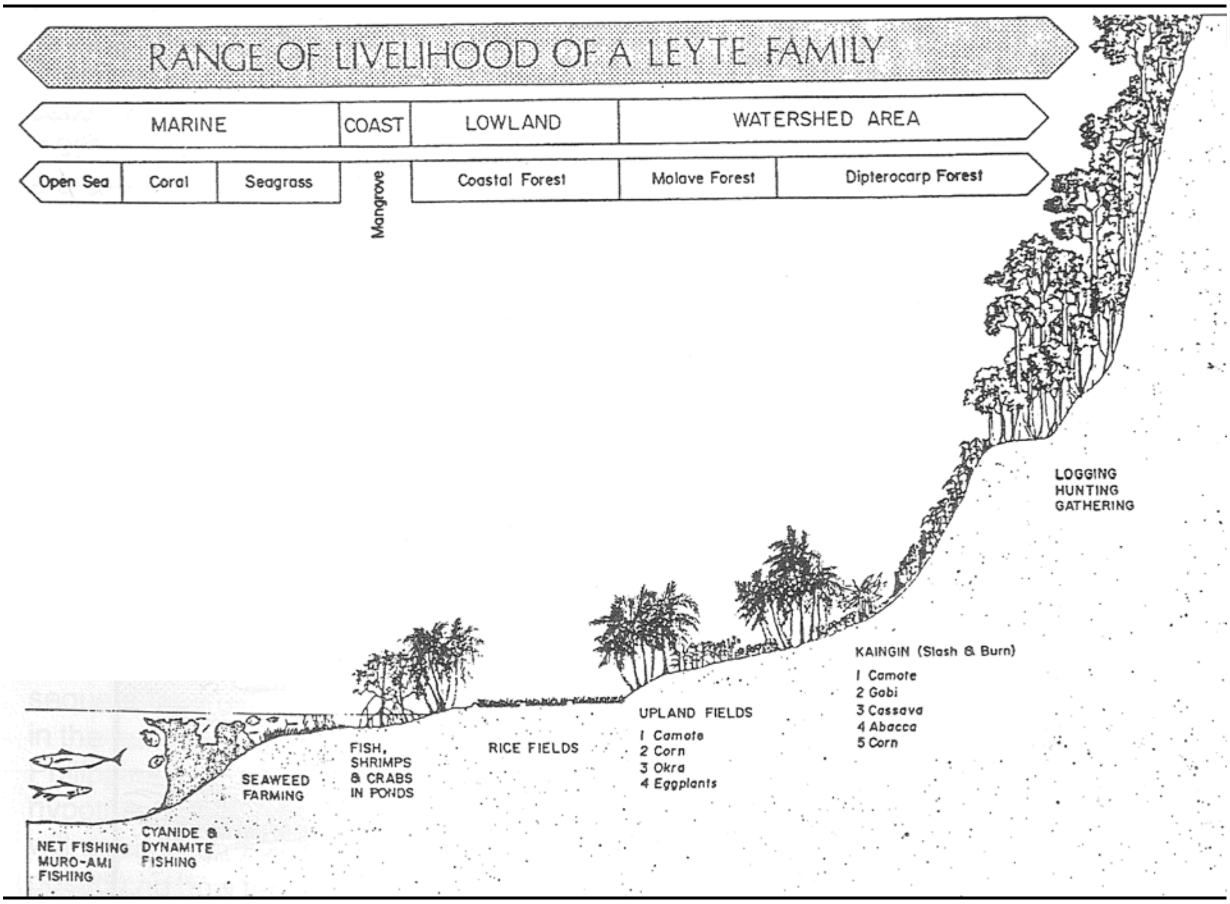


Figure 5. Range of Livelihood of a Leyte Family (ViSCA-GTZ Ecology Program 1990-1993:7)

1.3 Objective of the study

The general objective of this study was to evaluate sustainability of farming systems on the island of Leyte, using a set of indicators which has previously been identified with the participation of local stakeholders.

The specific objectives of the study were:

- An analysis of the methodology used for including local stakeholders in the process of finding suitable criteria for a comparison of sustainability of farming systems;
- An evaluation of the (possibly) diverse perceptions of different stakeholders regarding sustainability;
- Identification of a possible set of indicators which can be used for a comparison of different farming systems, including agroforestry systems and comparison of farming systems using this set of indicators;
- Evaluation of sustainability, financial feasibility and adoptability of the concept of Rainforestation Farming, as a promising sustainable farming system.

Strategies to advance sustainability must include local approaches to take local definitions of sustainability and cultural values into account. Hence, the need for participatory approaches is essential (Campbell et al. 2001) and is acknowledged by many studies, drawing on 'external' (scientists) and 'internal' (local stakeholders) views on sustainability and corresponding indicators. It can be argued that for society as a whole and for the use of future generations it is important that renewable natural resources are used sustainably. For the local farmer it is essential that the farming system practised is both successful and sustainable.

In the context of this study it is seen as useful to include both views: the ones of 'external experts', the project researchers and the 'internal' ones, identified by local stakeholders. It is necessary to discuss the issue of sustainability of farming systems in the area and to judge if new farming approaches can keep their promise of being more sustainable than conventional practices. And it is especially important to include the local farmers when discussing sustainability, since they will be the ones applying or not applying these new approaches. As the proponents of the framework of sustainable rural livelihoods put it, "if we genuinely believe in the livelihoods approach, then we should be prepared to negotiate the indicators of our success with those whom we are trying to support" (Carney 1998:9).

1.4 Outline of the thesis

In Chapter 1, the general problematic was introduced as well as the background of the study, covering the issue of sustainability evaluation using indicators and corresponding frameworks as well as the participatory approach.

Chapter 2 focuses on the method of identifying local criteria for evaluating sustainability of farming systems and participation of different stakeholder groups. A consolidated list of sustainability criteria has been developed, including local criteria suggested by farmers during group discussions and other stakeholders, active in extension advice, in individual interviews. This consolidated list has been ranked individually by farmers and other stakeholders. It is investigated if differences regarding ranking of criteria exist between different groups of stakeholders as well as between different locations on Leyte.

In Chapter 3, the highest ranked criteria are analysed and evaluated for their use as indicators for comparing sustainability of three different groups of farmers, practicing different farming systems in the area of Baybay. One of these farming systems is Rainforestation Farming, an agroforestry system based on indigenous trees, which has been developed on Leyte. A shorter set of 15 indicators was then chosen for such a comparison and the methodology is discussed as well as the performance of the different groups of farmers, in relation to the 15 indicators.

Chapter 4 is concerned with a financial evaluation of the Rainforestation Farming system, in comparison to other agroforestry systems. Based on financial data of the first adopters, it is calculated if the Net Present Value, which can be expected, has changed compared to ex-ante evaluations. The adoptability of this system is discussed, considering the situation of resource-poor small scale farmers.

In Chapter 5, a summary of the results of the different parts of the thesis is discussed. Based on the findings of the different parts of the study, general conclusions as well as suggestions for future research are presented.

2. Local perceptions of sustainability of farming systems on Leyte, Philippines - divergences and congruencies between different stakeholders

Abstract Resource-poor farmers in the Philippines have limited options for sustaining their livelihood, therefore it is important for them to practise and/or develop sustainable farming systems. But often in sustainability evaluations the perceptions of local stakeholders are not considered, although they are the ones who will apply sustainable technologies – or not apply them!

This paper reports about a study in Leyte, Philippines, were farmers, as well as stakeholders active in extension advice, were asked on five study sites to identify and rank criteria which could be used for comparison of different farming systems. Criteria were organised under the Sustainable Rural Livelihoods Framework with its five capital assets: financial, physical, natural, human and social.

When stakeholders ranked the identified list of criteria later individually, statistical differences between farmers and other stakeholders as well as between regions were found with regard to single criteria, but not regarding the importance of the five different capital assets. Furthermore, farmers' individual ranking differed from the ranking carried out by the group during focus group discussions. These findings indicate that the perceptions of farmers and other stakeholders regarding sustainability of farming systems are similar when looking at the whole picture, but differences regarding single issues can be wider. This underlines the importance of including several local stakeholders to identify suitable criteria. The concept of sustainable rural livelihoods seemed to correspond with stakeholders', especially farmers', perception of sustainability and worked well for identifying criteria covering all aspects of sustainability, including social and human aspects.

Keywords

local indicators; sustainability criteria; small-scale farmers; sustainability indicators; sustainable rural livelihoods

2.1 Introduction

> "Agriculture is complex. It provides food and fibre for the world's population. It provides profits, employment, a way of life and, for the two-billion subsistence farmers around the globe […], a means of survival. It draws upon dwindling resources of natural and social capital and creates a wide range of social and environmental impacts" (Stevenson and Lee 2001:58).

Contrary to agricultural systems in developed countries, where farms are usually large and devoted to few main crops, farmers in developing countries are often small and have a wide array of production, reaching from several different crop and animal species to agroforestry-type systems (Goma et al. 2001). This situation is also found in the Philippines, where this study takes place, with an average farm size of 2 ha (NSO 2002). Due to population pressure, to limited availability of areas favourable for agriculture in the lowlands and to the dominance of slope land areas on most Philippine islands, the agricultural utilisation of slope land areas is increasing in the Philippines. Hilly lands in the Philippines are estimated to cover 9.4 million ha or about 31% of the total land area (Maglinao 2000). The farming systems are generally characterised by low input use (fertilisers and pesticides) and poor living conditions of their producers, and often situated in fragile environments, where natural resources are under high pressure. These complex, multi-faceted farming systems deserve therefore high attention, and evaluation of their sustainability has to acknowledge this complexity and involve local stakeholders.

The basic motivation for evaluating sustainability of farming systems is the fact that many land-use systems degrade the natural resources and cannot be sustained over a longer period (Dalsgaard and Oficial 1997). A problem with the concept of sustainability is the fact that there is no consensus on a definition. But most definitions would agree that sustainable agriculture must be environmentally sound, economically viable and socially responsible (Ikerd et al. 1996). A more precise definition is on the one hand problematic, due to the high number of stakeholders involved (Rigby and Càceres 2001) and their different world views (Cromwell et al. 2001; Wallis 2006). And on the other hand, it would not be useful, since

> "the concept of sustainability is a dynamic concept in the sense that what is sustainable in one area may not be in another, and what was considered sustainable at one time may no longer be sustainable today or in the future because conditions or attitudes have changed. In addition, […] what one group considers sustainable may not be sustainable for another group" (Lefroy et al. 2000:138).

A commonly applied method for 'measuring' sustainability is the use of sustainability indicators (SIs). Even the shortest literature research for SIs produces numerous articles and publications concerning SIs, the right ones, the right way of identifying them, etc. The use of indicators has been widely criticised (Morse et al. 2001; Morse et al. 2004), but in this context it is "important to recognise that indicators do not break up sustainability, they break up agricultural development into measurable components" (Stevenson and Lee 2001:64). A more important challenge is to develop sets of suitable indicators at the local level in developing countries. Studies on development of indicators in developing countries are sparse. One reason is the complex nature of farming systems practiced, with high crop diversity and the interaction of other influences on farmers' livelihoods. Another reason is that data and information required for sustainability assessment are often unavailable or sometimes inaccessible, sparse and/or incomplete (Shrestha 2004).

One of the basic underlying questions when using SIs is: which indicators do we use? Underlying this question is the question: who decides which indicators are the right ones? Only recently has the scientific community started to ask local perceptions of sustainability in connection to farming systems and/or forest management (Mendoza and Prabhu 2000; Purnomo et al. 2005; Berninger et al. 2009) in diverse regions of the world. But to make efforts for measuring and reaching sustainability successful, participation of different groups of stakeholders is essential and is recognised widely (i.e. Chambers 1992; Campbell et al. 2001; Reed et al. 2005).

Even when sustainability is viewed globally – considering issues such as biodiversity conservation and carbon sequestration – agronomic sustainability and environmental services at the local scale have to be considered. The objectives of (small-scale) farmers have to be integrated, since they make the decisions on the ground level and decide about the adoption of land use alternatives. According to the theory of 'livelihood strategies', as described in Kragten et al. (2001:2-3)

> "small-scale farmers […] base their decisions – including the decision about how to use the land – on the extent to which their potential alternatives fulfil their private household objectives. […] In the absence of alternatives more suitable to their objectives, small-scale farmers will continue to seek forest to clear to plant crops in order to secure their livelihood".

While small-scale farmers probably share everyone's (diffuse) interest in the global environment, their over-riding interest will concern the profitability of their agricultural production system and sustainability of their livelihood strategies.

Several frameworks have been used for selecting and grouping indicators, whereby the first frameworks were developed by experts with little or no participation by local stakeholders, i.e. the Framework for Evaluation of Sustainable Land Management (FESLM) of the FAO (Smyth and Dumanski 1993). More recently, several authors put the importance of stakeholder participation into focus (Morse et al. 2001, 2004; Bell and Morse 2004; Reed et al. 2005). For this study, indicator search focused on criteria for a comparison of farming systems, and these have to be regarded in the wider context of farmers' livelihoods. Wattenbach and Friedrich (1997) define a farming system as

> "[…] a natural resource management unit operated by a farm household, [including] […] the entire range of economic activities of the family members (on-farm, off-farm, agricultural as well as off-farm non-agricultural activities) to ensure their physical survival as well as their social and economic well-being […]."

Following this definition a farming system cannot be seen isolated, but the world outside the farm has to be considered as well, including off-farm employment opportunities, migration and education of the children. Any advice given to farmers regarding management of their farms will be put by them into the wider context of considerations about the development of their livelihood systems.

A framework, which has not specifically been developed for indicator identification, but for analysis of livelihoods, is the Sustainable Rural Livelihoods (SRL) Framework. It argues that, for a sustainable livelihood, five ‘capital assets’ are necessary: financial, natural, human, physical and social capital. (The SRL Framework is presented in Figure 1 and details of the five capital assets are given in Table 1, for a more detailed discussion see i.e. Carney 1998; Scoones 1998 and Ellis 2000).

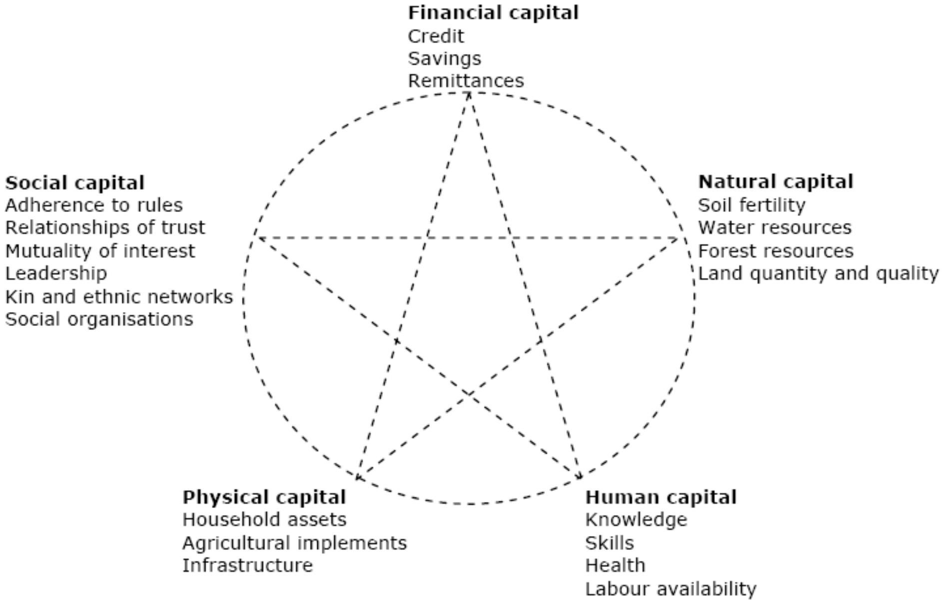


Figure 1. The five capital assets of the Sustainable Rural Livelihoods Framework (Campbell et al. 2001)

The SRL Framework has been proposed or used by Woodhouse et al. (2000), Campbell et al. (2001) and Fernandes and Woodhouse (2008) in the specific context of SI selection. Other than, for example, the FESLM, the SRL framework focuses on all dimensions that comprise a livelihood and not solely on agriculture and natural resource management problems. It therefore represents a more holistic and dynamic concept which recognises the complex interactions in rural livelihoods. This point of view was seen as being appropriate for the study region. Farmers on Leyte mostly have an array of income sources and will not see their farm as isolated system, but regard their whole livelihood as such (Cedamon and Harrison 2004; Emtage 2004).

Table 1. Categories of livelihood capital assets in the Sustainable Livelihoods Framework (modified from Ellis 2000:32-37)

Capital asset	
Natural	Land, water and biological resources that are utilised by people to generate means of survival
Financial	Stocks of money to which the household has access
Physical	Capital (e.g. infrastructure, housing) created by economic production processes
Human	Labour available to the household, education, skills, and health
Social	Community and other social claims on which individuals and households can draw by virtue of their belonging to social groups of various degrees of inclusiveness in society

The inclusion of human and social capital indicators is seen as an important aspect, since without social and human capital (i.e. knowledge, access to training, membership in farmers associations), farmers will have more difficulties reacting to changes in their environment and adapting their farming methods, when necessary.

It is investigated in this paper if stakeholders' views, regarding sustainability of local farming systems, differ so much as has been reported elsewhere (see i.e. Lefroy et al. 2000; Parkins et al. 2001; Purnomo et al. 2005). This paper reports on the first research phase of a wider study, whereby indicators, identified with the help of local stakeholders, were used for comparison of farming systems, existing on the western side on the island of Leyte, Philippines. "The human element is not one-third of sustainability; it is central to its implementation" (Pearson 2003:6).

2.2 Methods

2.2.1 Study site

The study sites for the focus group discussions were selected along the western side of Leyte (Figure 2). Western Leyte has no pronounced rainy season, but the lowest rainfall is experienced throughout the months of March, April and May. Average temperature at sea level is around 27°C. Day and night temperatures differ by about 5°C, whereas the coldest and warmest months differ only in the range of 2°C. Typhoons, characterised by strong winds and heavy rainfall, are common on Leyte. They cannot only damage the vegetation, but enhance erosion, landslides and floods (Jahn and Asio 1999).

Farmers involved in focus groups were chosen to represent different farming systems, which were also compared in a later research phase regarding sustainability. The main source of income for the majority of the population comes from the production of crops, livestock and marine products. Main cash crops are copra (dried coconut meat) and abaca (a fibre producing plant).

The location furthest north, Tabango, is characterised by relatively infertile soils and a high percentage of the population living of agriculture. Due to a lack of irrigation, rice yields are low and cultivation of corn is common. (Big) livestock is more predominant than in the other areas. Farmers mostly had a wider range of subsistence crops, including corn, bananas, vegetables, upland rice and fruits, but only copra as cash crop. Half of the farmers were engaged in tree faming, mostly as hedgerows, planting Mahogany (*Swietenia macrophylla*) mainly.

The area around Lake Danao (Ormoc) has an altitude of 700m, farmers produce mainly vegetables for the Ormoc market, and abaca, shifting cultivation is still frequent. Land is mostly public land (cannot be owned by individuals) and is administered by the Philippine National Oil Company. The area is prone to typhoons and subsequent flooding.

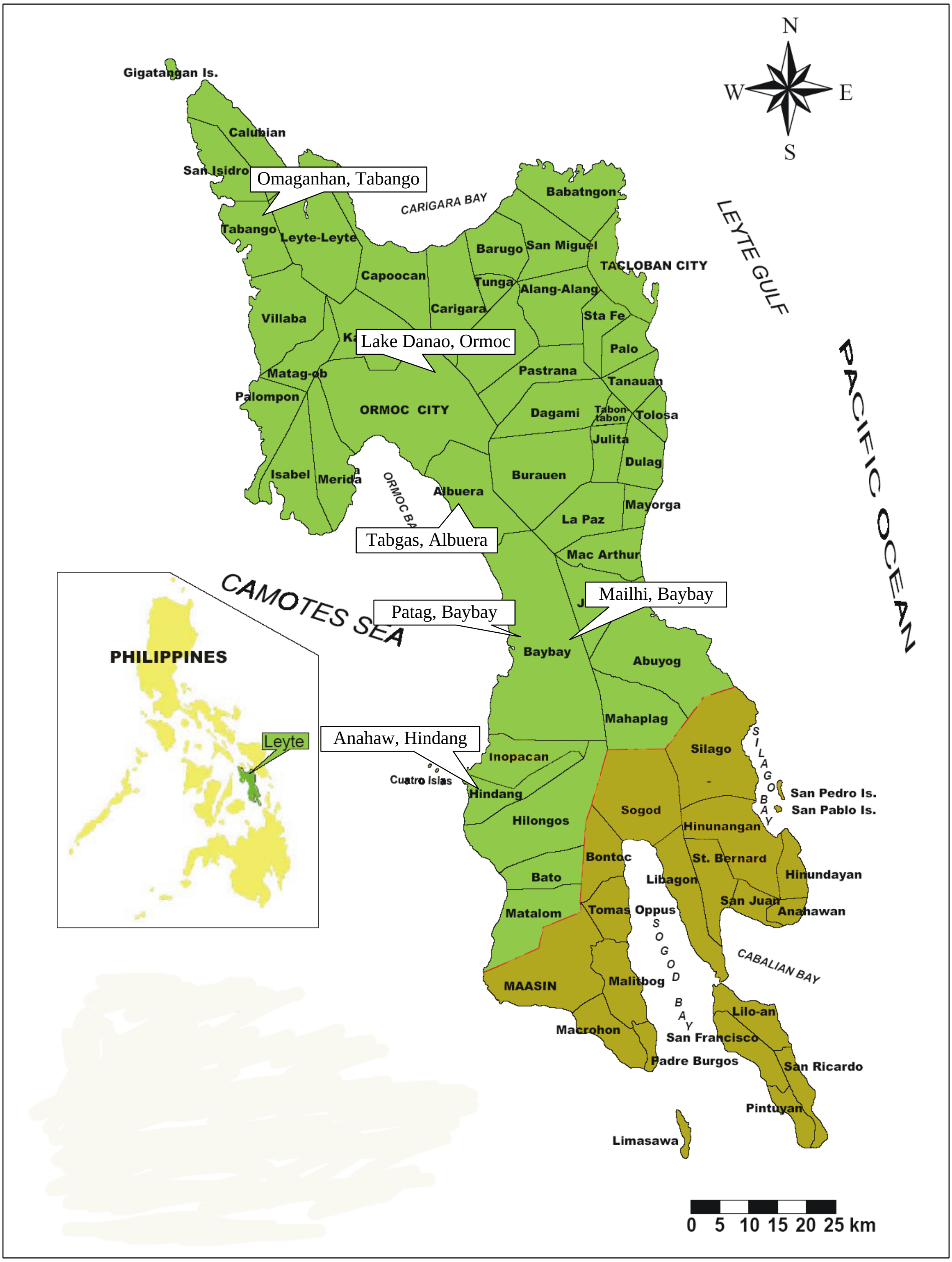


Figure 2. Map of study area (GIS DENR Region 8, Tacloban 2001)

The location in Albuera is quite remote and can only be reached walking 20 minutes upstream. Main crops are coconut and abaca. Farmers were practicing RF in a co-operative, and had an extensive tree nursery set up.

In Baybay, one barangay is located along the coast and farmers plant rice and coconut and are involved in RF on common land, organised under a farmers association. The other barangay is located in the upland and has an altitude of 400m asl, farmers plant coconut and abaca and have lumber trees, mainly exotic ones, such as *Gmelina* and *Acacia mangium*.

In Hindang, the location furthest south, the climate is similar to Baybay and also prone to typhoons, but the area is a little bit drier. Farmers mostly have rice fields as well as some upland areas, where they plant coconut, abaca, and some lumber and fruit trees.

2.2.1 Framework for Indicator Identification and Stakeholder Involvement

What is needed is a methodology how to identify suitable criteria for comparison of farming systems and to integrate different stakeholders. The divergent nature of sustainability makes it unlikely, if not useless, to identify a small, universally applicable set of baseline indicators for different farming systems in different regions. The challenge is to choose those indicators which best represent sustainability issues in the evaluated local situation. It is argued here that this can best be achieved by involving several groups of stakeholders in identifying a potential set of indicators. For identification and grouping of indicators the Sustainable Rural Livelihoods Framework was used (Figure 1). Indicators were organised under the five capital assets described in Table 1 (natural, financial, physical, human and social capital).

Focus of this paper lies on the investigation of local perspectives about sustainability of farming systems and differences between different groups of stakeholders. Stakeholders included were mainly small-scale farmers and other stakeholders, active in extension advice. This shall provide further insights into the ways local stakeholders define sustainability and how they judge or weigh the importance of the different dimensions or aspects of sustainability, here separated into five capital assets (natural, financial, physical, human and social). Group discussions and individual interviews were applied in the first phase of identification of suitable criteria, while a consolidated criteria list was ranked individually by stakeholders in a second phase. This study was undertaken with a small sample size and does therefore not aim to provide many quantitative results. The idea is to gain a deeper qualitative insight into sustainability perceptions of local stakeholders.

Stakeholders' views were elicited on what criteria they consider to be most important for sustainable farming systems and this was used as proxy for their perspectives on sustainability. The field work for this study took place at the end of 2006, with another visit at the end of 2007. Farmers were gathered in focus group discussions (FGDs), while other stakeholders were interviewed individually. Eight FGDs were carried out with farmers, distributed over five municipalities and six barangays (Figure 2). A barangay is the smallest administrative district in the Philippines that often corresponds to a village or town district. Six groups consisted of farmers participating in a development project (and therefore they were organised in Farmers Associations (FAs) or a co-operative) while two groups were not connected to any project (more details are presented in Table 2). The original idea was to include more farmers outside any organisation, to gain a wider range of opinions of farmers regarding sustainability. But it was also more difficult to organise farmers, which were not active in any organisation, and they were less willing to participate.

Table 2. Overview over participants in focus group discussions and interviews 2006/07, Leyte, Philippines

FGD or interview	Location	Participants
2 FGDs	Omaganhan, Tabango	One group with small-scale tree farmers in a FA associated with ICRAF, one group of farmers not associated with ICRAF (planting corn, upland rice, coconut, livestock)
3 Interviews		MAO, ICRAF, co-operative
1 FGD	Lake Danao, Ormoc	Sustainable vegetable production initiated by local NGO
1 Interview		Local NGO
1 FGD	Tabgas, Albuera	Abaca and RF in co-operative
1 FGD	Patag, Baybay	RF in FA
1 FGD	Mailhi, Baybay	Small-scale tree farmers in FA, mostly exotic trees
5 Interviews	Baybay	University representatives, local NGO, MAO, PCA
2 FGDs	Anahaw, Hindang	One group with small-scale tree farmers in a FA associated with ICRAF, one group of farmers not associated with ICRAF (planting rice, coconut)

FA=Farmers Association, FGD=Focus Group Discussion, ICRAF=World Agroforestry Center, MAO=Municipal Agricultural Office, NGO=Non-Governmental Organisation, PCA=Philippine Coconut Authority, RF=Rainforestation Farming

Farmers are of course the primary stakeholders when discussing farming systems. FGDs were chosen as the appropriate method for farmers for several reasons: (i) farmers might be intimidated in the direct interview and might fear that they have only little knowledge compared with scientists; (ii) the group will generate more ideas than each individual; (iii) and it is a quicker and easier way to organise farmers in a meeting than to contact each one individually, especially in an area where people cannot be easily contacted by phone before. The disadvantage of this approach is the strong influence of the barangay leaders or other individuals in similar high and/or influential positions. The FGDs were either organised by the NGOs involved or by the barangay captain or other individuals in similar high and/or influential positions. We preferred that no NGO staff member was attending to avoid bias, but it was not always possible. Two translators and research assistants were employed for the FGDs.

Other stakeholders were interviewed individually and were all active in extension advice, either by the University, by international and local NGOs and by the agricultural offices of the municipalities, as well as by the DENR – the Department of Environment and Natural Resources, since the farming systems included (agro-)forestry systems and the DENR is responsible for registration of timber trees. The appropriate stakeholders were identified by asking key persons in the municipalities. The nine interviews were mostly conducted in English; if necessary a translator was present.

The set-up of the FGDs was as follows: Farmers were asked in an opening round for their idea of a successful and of a sustainable farming system. To facilitate ranking of criteria afterwards, answers were written down on cards. After this opening round, more probing questions were asked related to the different capitals, such as: *How can farmers be successful despite natural misfortunes? How would you recognise a successful farm (a failing farm) from its appearance? What social advantages and/or responsibilities does a successful farmer have in the community?* At the end of the FGDs the cards were again used for ranking of the identified criteria, whereby the group usually agreed on few criteria (ranging from 5 to 11). Other stakeholders were also asked to bring their list into an order or to rank the most important ones.

After all FGDs and interviews had been carried out, a complete list was compiled out of the locally identified criteria and external ones, identified from literature research. The list consisted of 49 criteria: 14 natural -, 11 financial -, 9 physical -, 8 human - and 7 social capital criteria. (The ranking list for the stakeholders had only the criteria listed without any reference to type of capital). This list was given to some of the FGD participants and of the interviewed stakeholders as well as to additional farmers and stakeholders. They were asked to rank the criteria individually, whereby ranking was done for each criterion from 1=not important at all to 5=very important. Overall, 30 farmers were involved in the individual ranking and 18 other stakeholders (Table 3).

Table 3. Overview over respondents for individual ranking 2007/08, Leyte, Philippines

Farmers	No. of respond.	Organisation	Local farming conditions	Main crops
Baybay, Mailhi	5	Farmers agro-forestry association	Upland farming, close to main road, 18 km to city	Coconuts, (exotic) trees, some abaca
Baybay, Patag	4	RF farmers associations	Lowland and upland, close to main road and to city (7 km)	Rice, coconuts
Albuera	7	RF co-operative	Upland farming, typhoon prone, no concrete road close to fields	Coconut, rice, abaca
Ormoc	4	Organic farming association	Upland, climatic cooler	Vegetables
Tabango	10	Farmers association (ICRAF)	Upland, distance and bad roads to town, seasonal drought	Upland rice, coconuts, trees, livestock
Other stakeholders				
Baybay	8	MOA/University	NA	NA
Ormoc	6	MOA/Traders/NGO	NA	NA
Tabango	4	MOA/Traders/NGO	NA	NA

ICRAF=World Agroforestry Centre, MOA=Municipal Office of Agriculture, RF=Rainforestation Farming

Stakeholders were asked for individual ranking for two reasons: the first one was the strong influence of the group leaders on the group opinion. The idea was to see if the ranking would yield different results when respondents were asked individually. Secondly, respondents might have forgotten to mention a criterion but would nonetheless regard it as important, an assumption which seems to be supported by the findings (see Results section).

Comparisons were carried out as follows and are described in section 2.3:

- between the ranking of the nine interviewed other stakeholders and farmers' group ranking during the eight FGDs,
- between farmers' group ranking during the eight FGDs and the individual ranking of 30 farmers,
- between the ranking of the nine interviewed other stakeholders and the individual ranking of 18 other stakeholders,
- between the individual ranking of the 30 farmers and the 18 other stakeholders.

2.3 Results

2.3.1 General

Most criteria identified during group discussions and by other stakeholders during interviews belonged to the natural capital group; especially farmers identified many natural capital criteria. Overall, 49 different criteria were identified during group discussions and interviews; farmers identified 46 and other stakeholders 34 criteria (criteria were overlapping). In Tables 4 and 5 an overview is presented over the highest ranked criteria by farmers and other stakeholders in comparison to the ranking during the eight group discussions (as a group) and during initial interviews with the nine other stakeholders.

2.3.2 Analysis of results according to the different capital assets

In the following section, results will be discussed according to the different capitals.

2.3.2.1 Natural capital

Natural capital is a term used for the natural resource stocks, i.e. land, coastal resources, clean air, resources such as trees, pastures and wildlife upon which people rely. It is clearly important to those who derive all or part of their livelihoods from resource-based activities, in this case farming.

The natural capital criteria ranked highest by FGD participants was the influence of the *weather* (*climate*) on second place. Typhoons and floods caused problems especially around Lake Danao, Ormoc with its vegetable based farming, while farmers in Tabango suffer lack of irrigation during the dry season. But the influence depends strongly on the main crops. Coconut farmers and those having a lot of trees were mostly not so hard hit and therefore less concerned. Interestingly, in the individual ranking, famers did not consider *climate/weather* such an important factor for a sustainable farming system, it was not even ranked under the first 25 criteria. Other natural capital criteria were considered more important (Table 4), such as *crop productivity* (rank 4), *quality of product*, *crop diversity* and *farm size* (rank 8, 9 and 10).

Table 4. Comparison of farmers' individual ranking of identified criteria with individual ranking of other stakeholders and ranking of farmers' group discussions, Leyte, Philippines, 2007

Mean farmers	Type of capital	Name of criterion	Individual ranking farmers (n=30)	Ranking other stakeholders (n=18)	Ranking farmers group discussions (n=8)
4.67	Human	Food security	1	8	13
4.60	Human	Health	2	2	15
4.57	Physical	Water quality household***	3	**18**	-
4.53	Natural	Crop productivity	4	5	15
4.53	Human	Knowledge	4	4	12
4.30	Social	Security of tenure	5	14	**1**
4.23	Physical	Use of improved seeds	6	9	15
4.23	Human	Education children	6	9	9
4.17	Physical	Housing quality***	7	**31**	9
4.17	Physical	Condition of road to market	7	11	12
4.13	Natural	Quality of product	8	14	-
4.10	Natural	Crop diversity	9	12	11
4.07	Natural	Farm size	10	11	4
4.03	Financial	Income diversification	11	14	7
3.97	Physical	Water availability farm**	12	**3**	10
3.90	Social	Membership in organisation**	13	**28**	-
3.83	Natural	Soil quality***	14	**1**	3
3.83	Human	(Small) family size	14	21	10
3.80	Physical	Farm implements	15	23	10
3.77	Natural	No pests/diseases	16	13	2
3.77	Natural	Soil conservation measures	16	8	5
3.73	Social	Training	17	16	6
3.73	Physical	Distance field to house*	17	**25**	15
3.70	Social	Accountability representatives*	18	**27**	15
3.70	Physical	Market access	18	6	6
3.40	Natural	Climate/weather	24	15	2
2.43	Financial	Access to credit*	35	**23**	1

Mean for the individual ranking: ranking from 1=not important at all to 5=very important. Ranking for group discussions was done by the whole group. Some criteria had the same mean and share therefore the same rank.
Significance according to T-Test: ***:p<0.001, **:p<0.05, *:p<0.1, significance was analysed for famers and other stakeholders individual ranking, not for group discussions

During group discussions, many natural capital criteria were suggested and also ranked highly. In the individual ranking, when farmers had all criteria identified on a list, the distribution between the different capital assets was far more evenly. One natural capital criterion which was ranked higher during FGDs and individually was *farm size*. Farm size ranged from 0.25 ha to 22 ha, while the average ranged between 2 ha in Tabango and 2.5 ha in Baybay (figures are based on the later carried out survey).

Table 5. Comparison of other stakeholders' individual ranking of identified criteria with farmers' individual ranking and ranking of the nine interviewed stakeholders, Leyte, Philippines, 2007

Mean other stakeholders	Type of capital	Name of criterion	Individual ranking other stakeholders (n=18)	Individual ranking farmers (n=30)	Ranking interviewed stakeholders (n=9)
4.78	Natural	Soil quality***	1	**14**	3
4.72	Human	Health	2	2	6
4.67	Natural	Water availability farm**	3	**12**	-
4.61	Human	Knowledge	4	4	4
4.50	Natural	Crop productivity	5	4	-
4.33	Physical	Market access	6	18	10
4.28	Financial	Income**	7	**22**	1
4.22	Natural	Soil conservation measures	8	16	5
4.22	Human	Food security	8	1	15
4.17	Physical	Use of improved seeds	9	6	7
4.17	Human	Education children	9	6	-
4.11	Natural	Biodiversity	10	24	10
4.11	Financial	Farm prices (high and stable)	10	19	9
4.06	Natural	Farm size	11	10	-
4.06	Physical	Condition of road to market	11	7	-
4.00	Natural	Absence of soil erosion	12	26	7
4.00	Natural	Crop diversity	12	9	8
3.94	Natural	No pests/diseases	13	16	13
3.83	Natural	Quality product	14	8	15
3.83	Financial	Income diversification	14	11	3
3.83	Social	Security of tenure	14	5	11
3.78	Natural	Climate /weather	15	24	11
3.67	Natural	Biological crop protection	16	23	12
3.67	Social	Training	16	17	2
3.67	Physical	Labour requirements	16	34	13

Mean for the individual ranking: ranking from 1=not important at all to 5=very important. Ranking for group discussions was done by the whole group. Some criteria had the same mean and share therefore the same rank.
Significance according to T-Test: ***:p<0.001, **:p<0.05

While *farm size* was not even mentioned by other stakeholders during the initial interviews, it reached rank 11 in the individual ranking (Table 5). A highly significant difference was found for *soil quality*, which was the most important criterion for other stakeholders on average, and reached only rank 14 in farmers' individual ranking, but rank 3 during farmers' group discussions.

2.3.2.2 Physical capital

Physical capital comprises the basic infrastructure and physical goods that support the farming system or agricultural based livelihoods. It includes infrastructure such as roads, irrigation works, farm equipment and tools, electricity supply, good communication and access to information. During the initial phase of identification of criteria, it was not ranked so high by farmers and other stakeholders alike (the exception being the FGD in Tabgas, Albuera). But physical capital criteria were considered as being quite important during the individual ranking. *Use of improved seeds* was ranked quite high by farmers and other stakeholders alike (rank 6 and 9, respectively, Tables 4 and 5), while the differences in ranking were significant for *water quality household* (rank 3 and 18), *housing quality* (rank 7 and 31, respectively), *water availability on farm* (rank 3 with other stakeholders, rank 12 with farmers) and *distance field to house* (rank 17 with farmers, 25 with other stakeholders). *Access to market* is considered more important by other stakeholders (rank 6) than by farmers (rank 18) as well as *labour requirements* (rank 16 with others, 34 with farmers). *Farm implements* were more important for farmers (rank 15) than for other stakeholders (rank 23). During the phase of criteria identification, agents from the municipal agricultural offices (MOA) named *use of improved seeds* and *use of pesticides and fertiliser*. In contrast to University and NGO staff questioned, the MOAs focus a lot on the use of mineral fertilisers and pesticides.

2.3.2.3 Financial capital

Within the DFID Sustainable Livelihood context, financial capital is defined as the financial resources that people use to achieve their livelihood objectives (Carney 1998). It is a stock of money or other savings in liquid form e.g. financial assets such as pension rights, easily disposed assets like livestock, jewellery etc. During the identification phase this type of capital reached the highest score with the nine interviewed stakeholders, with (*high and stable*) *income* being the highest ranked indicator. Also ranked high was *income diversification*, named by farmers' groups (rank 7) and other stakeholders (rank 3). Farmers' groups ranked *access to credit* (to buy inputs) on first place (with *security of tenure*), other stakeholders ranked it on ninth place only.

In the individual ranking, natural and physical capital criteria were ranked higher than most financial capital criteria (compare Tables 4 and 5). But the difference for *income* was still significant (rank 7 with other stakeholders, rank 22 with farmers). Farmers ranked *income diversity* as highest financial capital criteria on rank 11 (14 for other stakeholders). The only other criterion ranked under the first 25 in the individual ranking was (*high and stable*) *farm prices*. Interestingly, farmers often mentioned *access to credit* during FGDs and ranked it on first place, while in the individual ranking it reached only place 35 (rank 23 for other stakeholders, a significant difference).

In contrast to the observations of our research team, farmers never mentioned the practice of cash advance during FGDs when asked for constraints they face, unless being asked for directly (exception being Omaganhan, Tabango). Most farmers get inputs or cash before the harvest from traders or farm-supply shop owners and are therefore forced to sell their harvest to before agreed conditions to the creditor (Table 6).

Table 6. Issues raised by the participants of the focus group discussion, in relation to capital assets, Leyte, Philippines, 2006

Form of capital	Local farmers' perceptions	Comments/contradictions
Natural	Organic agricultural practices should be applied (i.e. manure only, no pesticides)	Sounds like an answer they are expected to give, since they prefer to have access to fertilizer and pesticides
Financial	Farmers only mentioned the practice of cash advance as a problem when being directly asked for	Being stuck in debts seems a problem when trying to alter farming techniques or harvest new products, or influence time of sale
Human/ Social	Expect that training would help them (or their children) to farm more sustainably	It seemed often that they were more looking for support in money or in assets, than that they were interested to be told what they can do better
General	Decisions only depend on themselves	No mention of traders (abaca), although prices depend on them

2.3.2.4 Human capital

Human capital is constituted by the quantity and quality of labour available. It represents the skills, knowledge, capacity to work and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. At household level, human capital is determined by household size, education, skills, and health of household members. Several criteria were identified by farmers, and only few by other stakeholders. Although this capital asset scored last during FGDs, it scored first in the individual ranking, with *food security* and *health* on first and second rank (rank 8 and 2 for other stakeholders), *knowledge* on place 4 for all stakeholders and *education of children* on place 6 (place 9 for other stakeholders, Tables 4 and 5). None of these criteria were ranked very high during FGDs (ranging from rank 9 for *education of children* to rank 15 for *health*), but *health* and *knowledge* were considered more important by other stakeholders during initial interviews (6^{th} and 4^{th} place, respectively). What seemed surprising during the group discussions is the fact that farmers having rice fields, and therefore mostly applying pesticides by walking barefoot through the field and spraying, were not concerned about their health.

2.3.2.5 Social capital

Social capital comprises social resources upon which people draw in pursuit of their livelihood objectives. These social resources are developed through interactions that increase people's ability to work together, membership of more formal groups in which relationships are governed by accepted rules and norms, and relationships of trust that facilitate cooperation and reduce transaction costs. During FGDs *security of tenure* played a very important role, for tenants and landowners alike, and was ranked highest, and still reached rank 5 in the individual ranking. Lack of secure tenure was often named by tenants as reason for not investing in soil conservation measures or (agro-)forestry. Other stakeholders did not credit such great importance to *security of tenure* and ranked it on 11th place, during initial interviews.

The only other criterion which reached a rank under the first 25 in the individual ranking later, was *training* on place 16 (place 17 for farmers). Farmers individually ranked *membership in organisation* on 13 (other stakeholders on 28 only) and *accountability of representatives* on 18 (other stakeholders on 27), both differences were statistically significant (Tables 4 and 5). Overall, social capital was not perceived as so important by both stakeholders alike.

2.3.3 Differences between farmers' group ranking, farmers' individual ranking and other stakeholders' ranking

As already outlined, differences could be seen in the ranking carried out during the group discussions with farmers by the whole group and in the individual ranking, carried out later individually. For most of the 31 criteria, which were ranked during FGDs, the ranks turned out differently after the individual ranking: during FGDs, farmers ranked *security of tenure* highest, while in the individual ranking *food security* was perceived of upmost importance and *security of tenure* was ranked on fifth place. *Access to credit* was ranked first alongside *security of tenure* during FGDs but was not considered very important in famers' individual ranking (rank 35). Also for the other criteria, which reached higher ranks during FGDs, results of the individual ranking of farmers differ: *climate/weather* and *no pests/diseases* (both rank 2 during FGDs, rank 24 and 16 for the individual ranking), *soil quality* (rank 3 in FGDs, rank 14 individually), *farm size* (rank 4 in FGDs, rank 10 individually) and *soil conservation measures* (rank 5 in FGDs, rank 16 individually).

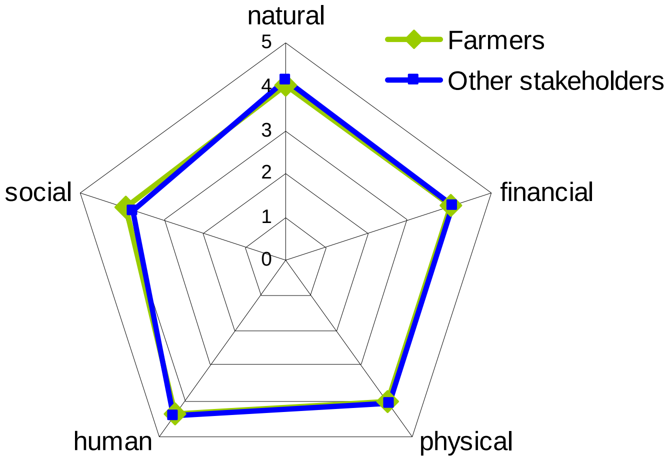
For some criteria the difference between farmers and other stakeholders was significant (Tables 4 and 5). A highly significant difference ($p<0.001$) was found for *water quality of household* (with a mean of 4.57 for farmers and 3.56 for other stakeholders), *housing quality* (mean of 4.17 for farmers, 2.67 for other stakeholders) and *soil quality* (3.83 for farmers, 4.78 for other stakeholders). A weaker significant difference ($p<0.05$) could be detected for *water availability farm* (3.97 for farmers, 4.67 for other stakeholders), *membership in organisation* (3.90 for farmers, 2.89 for other stakeholders) and *income* (3.53 for farmers, 4.28 for other stakeholders). A weak significant difference was found for *distance field to house* (3.73 for farmers, 3.11 for other stakeholders), *accountability of representatives* (3.70 for farmers, 2.94 for other stakeholders) and *access to credit* (2.43 for farmers and 3.22 for other stakeholders).

Most criteria were included in both criteria sets, those ranked highly by the 30 farmers individually and those ranked highly by the 18 other stakeholders individually. Those seven criteria which were only ranked under the first 25 by farmers and not by other stakeholders (Tables 4 and 5) were *water quality household, housing quality*, *membership in organisation*, (*small*) *family size*, *farm implements*, *distance field to house* and *accountability representatives*. Four criteria belong to the physical -, two to the social – and one to the human capital group. Also seven criteria were ranked highly by other stakeholders but not by farmers: *income*, *biodiversity*, (*absence of*) *soil erosion*, *climate*, *biological crop protection*, *labour requirements* and *investment costs*. Four of these criteria were from the natural -, two of the financial – and one from the physical capital group.

Farmers ranked five criteria from the human capital group under the first 25 criteria. This group reached the highest mean with 4.37 (Figure 3a). The next highest mean reached the eight physical capital criteria with 4.04, followed by the seven natural capital criteria with 4.03 and the four social capital criteria with 3.91. The only financial capital criterion had a value of 4.03. Other stakeholders had a high prevalence for natural capital criteria, with 12 out of the 25 highest ranked criteria from this group. But the average value was also highest for the four human capital criteria, 4.43, followed by natural capital criteria with a mean of 4.13. Other values were 4.06 for the four physical capital criteria, 4.07 for the three financial capital criteria and 3.75 for the two social capital criteria.

When comparing ranking of farmers and other stakeholders regarding the prevalence of a capital asset group, based on all 49 identified criteria, the differences were greater than for the 25 highest ranked criteria, but still small and statistically insignificant (Figure 3b).

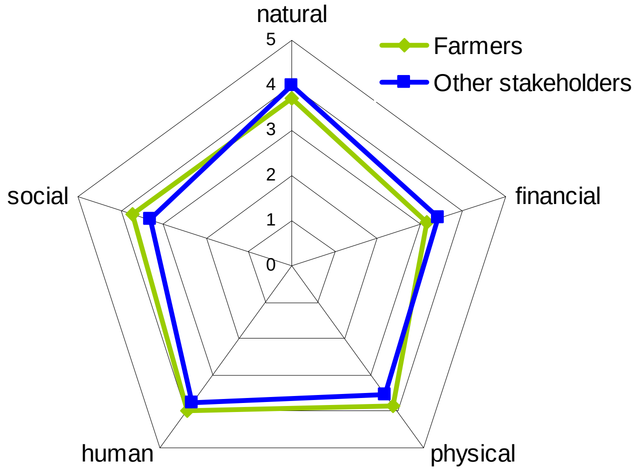
In Figure 3c, the results of the ranking from focus group discussions and from the nine interviewed stakeholders in the initial phase of identification of suitable criteria are presented. During FGDs, farmers showed a high prevalence for natural capital indicators, while other stakeholders focus was strongly on financial indicators. This result is quite contrary to the result from the individual ranking. While this result cannot be compared with quantitative means, since the ranking situation during group discussions and later was done differently, and the sample size is only small, it does have qualitative value. It shows that it is important to include several different stakeholders in the identification phase to obtain a balanced picture.



Capital asset	Farmers	Other stakeholders
Natural	4.03	4.13
Financial	4.03	3.96
Physical	4.04	4.06
Human	4.37	4.43
Social	3.91	3.75

No significance test was possible

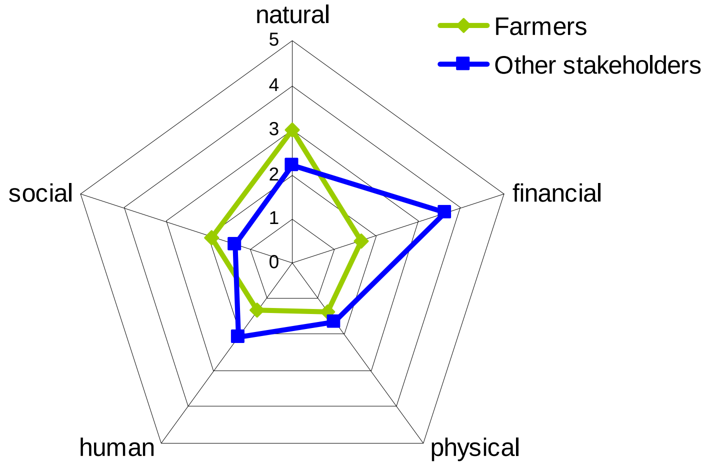
Figure 3a. Ranking (from 1=not so important to 5=very important) of the different capital asset groups, based on the list of the 25 highest ranked criteria by 30 individual farmers and the 25 highest ranked criteria by 18 other stakeholders, Leyte, Philippines 2007



Capital asset	Farmers	Other stakeholders
Natural	3.71	4.01
Financial	3.16	3.44
Physical	3.86	3.52
Human	3.96	3.76
Social	3.71	3.33

No significant differences were found

Figure 3b. Ranking (from 1=not so important to 5=very important) of the different capital asset groups, based on the complete list of 49 criteria, by 30 individual farmers and 18 other stakeholders, Leyte, Philippines 2007



Capital asset	Farmers	Other stakeholders
Natural	3.00	2.18
Financial	1.63	3.64
Physical	1.37	1.64
Human	1.32	2.09
Social	1.89	1.36

No significance test was possible

Figure 3c. Ranking (from 1=not so important to 5=very important) of the different capital asset groups, based on personally identified criteria by 8 farmers groups and 9 individual stakeholders, Leyte, Philippines 2006

2.3.4 Differences between ranking in the different study regions

The data were also analysed for differences between the four different regions of Baybay, Albuera, Ormoc and Tabango, where the individual ranking was carried out (in Hindang, only group discussions took place, but no individual ranking). Farming conditions differ between these regions: most farmers in Baybay had both upland as well as lowland plots, rain is abundant, and farmers mostly had coconuts, rice, and lumber as well as fruit trees. In Albuera, farmers mostly had their plots located far upland, only reachable on foot, which makes transport of crops (abaca and copra mainly) more difficult and more expensive. In Ormoc farmers plant mostly vegetables, due to favourable climatic conditions, higher elevation and cooler temperatures. Tabango is the driest region, with times of water shortages. Farmers there plant a variety of crops, such as upland rice, vegetables, corn, some fruit and lumber trees and have more livestock. When comparing the ranking with regard to capital asset groups (Figure 4), again, no significant differences were found.

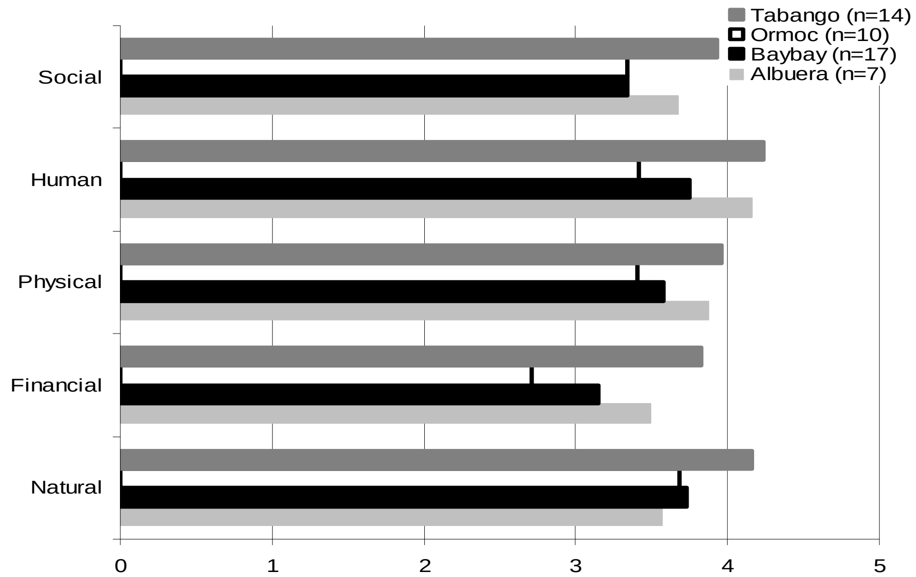


Figure 4. Ranking (from 1=not so important to 5=very important) of 30 individual farmers and 18 other stakeholders grouped into regions, Leyte, Philippines 2007

When having a look at the ranking of the single criteria, significant differences were found for nine criteria out of the 49 ones (Table 7). These were two natural capital criteria (*absence of soil erosion* and *use of soil conservation measures*), four financial capital criteria (*high and stable farm prices*, *insurance*, *record-keeping* and *investment costs*), one physical capital criteria (*household assets*), two social capital criteria (*membership organisation*, *no theft*) and no human capital indicator.

It seems that the human capital group was the one with the highest agreement among the different stakeholders (farmers and others) and between the different regions. The sample size was too small to go into further detail and separate the stakeholders in the four study regions into farmers and other stakeholders.

Table 7. Overview over mean of significantly different criteria, ranked by all stakeholders (n=48) in four different regions, Leyte, Philippines, 2007

Capital	Indicator	Mean Baybay (n=17)	Albuera (n=7)	Ormoc (n=10)	Tabango (n=14)
Natural	(Absence of) soil erosion	3.65^{A}	2.00^{B}	3.70^{A}	4.14^{A}
Natural	Soil conservation measures	4.00^{A}	2.43^{B}	3.80^{AB}	4.70^{A}
Financial	Farm prices (high and stable)	4.24^{A}	4.00^{AB}	2.90^{B}	3.93^{AB}
Financial	Insurance	1.82^{a}	4.29^{b}	2.10^{a}	3.86^{b}
Financial	Record-keeping	2.53^{a}	2.57^{ab}	2.90^{ab}	4.14^{b}
Financial	Investment costs	3.59^{ab}	4.57^{a}	2.70^{b}	3.79^{ab}
Physical	Household assets	2.59^{AB}	2.43^{AB}	2.10^{AB}	3.50^{B}
Social	Membership organisation	3.18^{A}	3.43^{AB}	2.90^{A}	4.43^{B}
Social	No theft	2.71^{A}	4.29^{B}	2.70^{AB}	3.21^{AB}

Mean for the individual ranking: ranking from 1=not important at all to 5=very important. Means with the same letter within rows are not significantly different ($p<0.05$ for small letters or $p<0.1$ for capital letters) according to Tukey's Honest Significance Difference Test.

2.4 Discussion and Conclusion

2.4.1 Differences between ranking results of farmers groups, famers individually and other stakeholders

A discrepancy in ranking results could be seen comparing farmers' group ranking and farmers' individual ranking. One possible reason for the discrepancy in ranking of farmers as a group and farmers individually is certainly the influence of group leaders, such as the barangay captains or chairmen of the different associations, on the outcome of the ranking during group discussions. Ranking was done by the group in agreement. But the fact that the individual ranking gives a different picture, leads to the conclusion that the ranking was far more influenced by a few people, and that the opinions are quite diverse among farmers. This might have particular impact on the identification of criteria covering social and human capital, since the more successful farmers will likely be the leaders of the discussion. It was often mentioned during group discussions that a successful farmer is willing to work hard, suggesting that non-successful farmers are lazy. It is therefore important, when setting up such discussion groups, to try to minimise the influence of powerful leaders as well as to minimise the bias factor by extension agents setting up the discussions, as has been stated by Bahiigwa et al. (2000) as well. Moreover, it underlines the importance of giving stakeholders, in this case farmers, the opportunity to raise their voice individually and not only in group decisions. While working with focus group discussions yields quick and more numerous results than interviewing all stakeholders individually, this is a drawback which has to be considered. Another reason for the different ranking is likely the much larger list of identified criteria, compared to the ones identified during group discussions. The involvement of a wider range of stakeholders (and external experts) provides a more holistic picture.

Although the sample size was small, some significant differences between farmers and other stakeholders as well as between the different regions could be observed, regarding individual ranking of all 49 criteria. When ranking results of farmers and other stakeholders are compared for the different capital asset groups, differences in the individual ranking were only marginal. Taking a closer look, significant differences between single criteria were there. Farmers ranked more personal criteria higher, such as *water quality in the household* and *housing quality*. Other stakeholders put higher value on *soil quality*, *water availability on farm* and *income*. Cromwell et al. (2001) report in their study that farmers chose sustainability indicators which were relating closely to farmers' goals of meeting immediate livelihood needs, but not referring to longer-term goals or wider ecosystem functions. This was also the case here, but farmers involved in this study did show a high awareness for the need of long-term sustainability during FGDs.

There were no significant differences for criteria from the human capital group, neither between farmers and other stakeholders, nor between the four study regions. The biggest differences were between financial capital criteria, especially when comparing the different regions. Findings suggest that although there is general agreement on the importance of a certain capital asset group; on a finer scale different stakeholders may hold significantly different views. But from the fact that there were also differences with regard to single criteria between the different regions, it can be concluded that the different perceptions of sustainability are greater between individuals than between different group of stakeholders. Generally, in other studies, differences between stakeholders' perception were detected (i.e. Purnomo et al. 2005; Berninger et al. 2009). Mostly, these studies were relying on a bigger sample size. From the small group which was involved here, it is difficult to gain many statistically significant results. But the divergence of opinions regarding single criteria highlights the need for better communication among and between groups of stakeholders.

2.4.2 Methodological considerations

It was found that the use of the Sustainable Rural Livelihoods Framework as such worked well with the farmers during group discussions, being close to their own perception of their livelihoods and sustainability of it. It helped identifying the different areas of their livelihoods and facilitated the discussion of sustainability with regard to the farming systems practiced.

It has proven to be useful to have several groups of stakeholders (as well as external experts) involved in the process of identification of suitable criteria, since the ranking during group discussions (where only the self-identified criteria could be ranked) and the individual ranking of the consolidated list differed. The importance of including external experts as well as local stakeholders has also been stressed by Rigby et al. (2000).

A basic question that arises when using such a qualitative approach is how valid the results are. A crucial point is the communication. First, translators have to be used, which is the first step on the way where the meaning can be lost. Second is the different world view of the respondents, especially with regard to definitions such as ‘sustainability’, a point which was emphasised by Neef et al. (2003) as well. While the cultural differences between the different farmers in the regions included in this study are small, there is no word for sustainability in the local dialect and the English term is commonly used. Nonetheless, the meaning of this word might be a different one.

Farmers are aware of their own local knowledge and do value it. But they often told us that they would not confront the extension agents when disagreeing with them, but simply listen and act as they want in the end. This might partly be due to the Philippine culture where it is avoided to contradict a person of a perceived higher status. But it also hinders a better cooperation between farmers and the officers of the municipal agricultural offices. Without feedback from farmers it is difficult for them to adapt to farmers needs.

It seems that farmers were perceiving power relations and constraints in their lives differently then extension agents: they seldom mentioned the practice of cash advance as a problem and were not concerned about their health although many used pesticides frequently and without any appropriate protection. The fact that reality is perceived differently by farmers and our research team as well as by extension agents, is an indicator that the involvement of different group of stakeholders as well as external experts is necessary for a discussion about sustainability of farming systems.

Concluding, this study shows that the involvement of several stakeholders in discussing sustainability of farming systems is necessary to identify a meaningful set of criteria, and later indicators, to evaluate this sustainability.

2.5 Acknowledgements

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3. Involving stakeholders in developing sustainability indicators for farming systems: a Philippine case study

Abstract Small-scale farmers in the Philippines have an average landholding of 2 ha and often no secure land tenure. Many cultivate unsuitable upland areas, leading to erosion and sometimes dramatic landslides. To evaluate sustainability of different farming systems with the involvement of local stakeholders, sustainability indicators were used in this study to compare three different farming systems on Leyte, Philippines. First, local criteria were identified with farmers and other stakeholders (from University, local government and NGOs) in group discussions and interviews, arranged within the Sustainable Livelihoods Framework. Secondly, criteria were ranked by farmers and other stakeholders and analysed statistically to test for relevance regarding comparison of farming systems. Fifteen indicators were chosen for comparison. The results show that farmers practicing tree farming were better off with regard to the chosen indicators, but it is difficult to assess why tree farmers are better off, based on these indicators only.

Keywords

agroforestry; capital assets; local indicators; small-scale farmers; sustainable development; sustainability evaluation; sustainability indicators; sustainable livelihoods; tree farming

3.1 Introduction

The Philippines consist of several densely populated islands. Additionally, the topography of many islands comprises very steep mountain ranges, often with volcanic activity, and only a small part of the remaining land area is suitable for agriculture. Due to increasing land pressure, farmers cultivate marginal land in upland areas with steeper slopes. These marginal soils degrade easily, and farmers do not have enough time to let them recover until they are cultivated again (Magcale-Macandog and Ocampo 2005). Hilly or mountainous areas with slope above 18% are by definition excluded from agricultural use and are classified as forest lands (Pulhin et al. 2006). But on many islands, the majority of forest lands are in fact used for agriculture (Groetschel et al. 2001; Pulhin et al. 2006).

Most farmers in the Philippines have to survive on 2 ha on average (NSO 2002), facing insecure land tenure, and many families have no legal access to land. The removal of the upland forest areas can lead to erosion and subsequent flooding or landslides with dramatic consequences. On the island of Leyte, where this study takes place, a landslide occurred in 2006 in Guinsaugon, South Leyte, where a whole village was buried under mud (BBC News 2006). Under these preconditions, it is necessary to discuss the issue of sustainability of farming systems in the area and to judge if new farming approaches can keep their promise of being more sustainable than conventional practices. And it is especially important to include the local farmers when discussing sustainability, since they will be the ones applying or not applying these new approaches.

The literature covering the area of ‘sustainability’ and ‘sustainability indicators’ is vast (Hezri and Dovers 2006; Rigby et al. 2000); King et al. (2000:631) even refer to it as “an industry of its own”. Yet no general agreement is reached, neither on a definition of ‘sustainability’, nor on the right method to identify suitable indicators to measure it, and not even on the right way to present the indicators (Rigby and Caceres 2001). As Pearson (2003:7) has pointed out, when attempting to measure sustainability of agricultural systems, it has to be clear that these systems

> “are human activity systems or constructs, so that ‘what is sustainable’ will be value-laden and subject to change. Conversely, activities we previously regarded as being sustainable may become regarded as unsustainable, either because of better biophysical information, changing social values or increased uncertainty either in perception […] or fact […]”.

This does not mean that sustainability is a meaningless concept, but that the focus should not be on a definition which is valid now and forever, but on a methodology which enables a discussion about local and global perceptions of sustainability (Sydorovych and Wossink 2008).

In the beginning, the search for suitable indicators focused on frameworks developed by experts with little or no participation by local stakeholders, such as the Framework for Evaluation of Sustainable Land Management (FESLM) developed by the FAO (Smyth and Dumanski 1993). More recently, several authors put the importance of stakeholder participation into focus (Bell and Morse 2004; Morse et al. 2001, 2004; Reed et al. 2005). Reed et al. 2005:2) differentiate two

> “methodological paradigms: reductionist and participatory. Reductionist frameworks such as that of Bossel (2001) tend toward the expert-led development of universally applicable indicators. They acknowledge the need for indicators to quantify the complexities of system dynamics, but do not necessarily emphasize the complex variety of resource-user perspectives.”

The second paradigm, according to Reed et al. (2005:2) is “based on a bottom-up, participatory philosophy. Scholars in this tradition focus on the importance of understanding the local context and contest the way in which experts set goals and establish priorities.” But a totally bottom-up approach can be criticised as well. Following King et al. (2000:632)

> “a bottom-up approach (i) assumes that traditional scientific knowledge is less valid than indigenous or farmer knowledge and (ii) denies the input of other stakeholders in the development process with regard to the ecological sustainability endeavour at a system level, wider than that of a farm or catchment”.

Still, the involvement of local stakeholders in the process seems crucial, since those are the ones who should apply the indicators in the end. It seems likely that their involvement in identifying indicators (and in developing them further), will lead to more local stakeholders actually applying them.

Regarding presentation of indicators, several indices have been developed for a quick comparison, such as the Environmental Sustainability Index, developed by the Yale University (Environmental Sustainability Index 2005) on the national level and several indices on the local level (i.e. Gomez et al. 1996; Rigby et al. 2001). While the advantage of an index is to present a quick overview over several systems, critiques of the approach argue that too much information is lost in aggregating and that in turn the index does not help but hinder effective decision-making (Morse et al. 2001). Another problem is the weighting (nor non-weighting) of the different components of the index.

The purpose of this study was to analyse if and which local and external indicators can be used to compare sustainability of different farming systems on Leyte, Philippines. Farmers and other stakeholders were engaged in group discussions and individual interviews and were later asked to rank the identified indicators individually. Statistical analysis was applied to evaluate, which indicators, local and external ones, are suitable. The results have relevance beyond a methodological discussion of sustainability indicators, allowing also an exploration of the agricultural 'sustainability' of the compared farming systems.

3.2 Methods

3.2.1 The framework for indicator identification

Several sets of methodological frameworks or guidelines have been identified for the measurement of sustainability indicators (SIs) at the farm or community to district level. The frameworks within which these methodologies and indicators are being proposed differ, but their frequent use is a recognition that a conceptual framework is required to organise indicators (Rigby et al. 2000; Smyth and Dumanski 1993).

The framework for evaluation of sustainable land management (FESLM, Smyth and Dumanski 1993) was the first approach that explicitly included social and economic aspects in the assessment of sustainability. Sustainable land management was based on five pillars (productivity enhancement, security or risk reduction, protection of the natural resource base, economic viability, and social acceptability) and was influenced by the conviction that sustainability can not be based on biophysical characteristics alone (FAO 1999).

> "One major problem of this framework remains that trade-offs between the different objectives are inadequately taken into account. It also does not consider factors beyond land management, such as the wider institutional framework or the non-farm sector which can exercise

indirect but nevertheless strong influences on the sustainability of land management practices" (cf. Neef et al. 2003:497).

While many biophysical indicators have been developed under the FESLM, appropriate economic and social indicators are still lacking. The focus of this study was on comparison of farming systems. Wattenbach and Friedrich (1997) define a farming system as

> "[…] a natural resource management unit operated by a farm household, [including] […] the entire range of economic activities of the family members (on-farm, off-farm, agricultural as well as off-farm non-agricultural activities) to ensure their physical survival as well as their social and economic well-being […]."

Following this definition a farming system cannot be seen isolated, but the world outside the farm has to be considered as well, including off-farm employment opportunities, migration and education of the children. Any advice given to farmers regarding management of their farms will be put by them into the wider context of considerations about the development of their livelihood systems. Therefore farmers tend to give less weight to field-level, biophysical and ecological considerations than to sustainability of the whole farming system. When applying this definition, the Sustainable Rural Livelihoods (SRL) Framework (Figure 1) seems well suited for the analysis of local indicators for evaluating sustainability of farming systems.

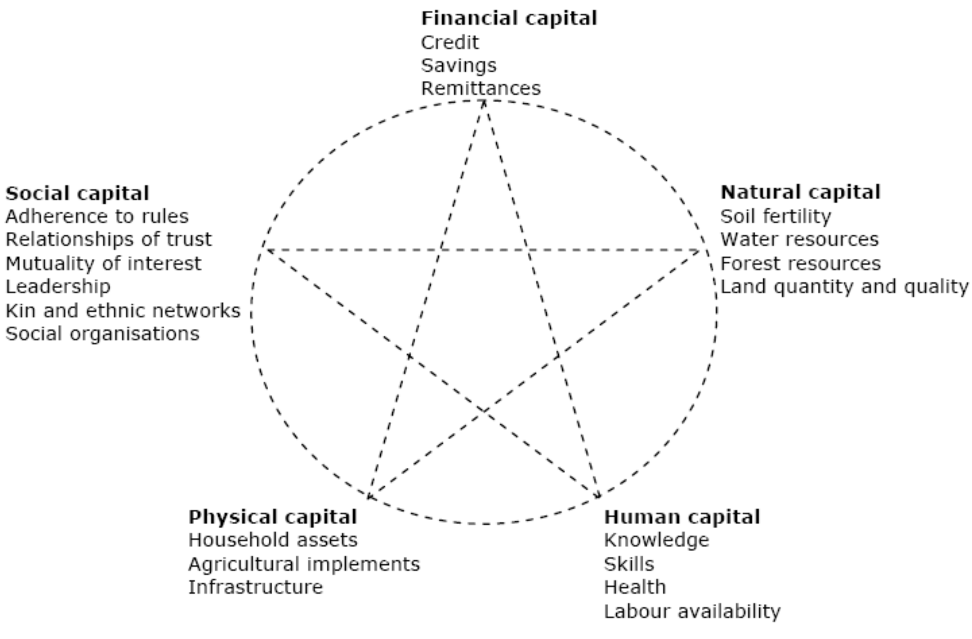

Figure 1. The five capital assets of the Sustainable Rural Livelihoods Framework (Campbell et al. 2001)

The SRL Framework is the development of an approach to the analysis of links between livelihoods and natural resource use which has been widely discussed in recent years (Scoones 1998; Carney 1998; Ellis 2000), and has been proposed or used by Campbell et al. (2001), Woodhouse et al. (2000) and Fernandes and Woodhouse (2008) in the specific context of SI selection. It assumes that rural people depend on five different 'capital assets' (natural, human, physical, social and financial capital) to sustain their livelihoods (Table 1). According to this concept, rural livelihoods are regarded as sustainable when they can "cope with and recover from stresses and shocks and maintain or enhance [their] capabilities and assets both now and in the future, while not undermining the natural resource base" (Carney 1998:4). Livelihood or capital assets are indicators of outcomes of past and present livelihood strategies but can also be interpreted in terms of potential for (sustainable) future livelihoods.

Table 1. Categories of livelihood capital assets in the Sustainable Livelihoods Framework (modified from Ellis 2000:32-37)

Capital asset	
Natural	Land, water and biological resources that are utilised by people to generate means of survival
Financial	Stocks of money to which the household has access
Physical	Capital (e.g. infrastructure, housing) created by economic production processes
Human	Labour available to the household, education, skills, and health
Social	Community and other social claims on which individuals and households can draw by virtue of their belonging to social groups of various degrees of inclusiveness in society

Other than, for example, the FESLM, the SRL framework focuses on all dimensions that comprise a livelihood and not solely on agriculture and natural resource management problems. It therefore represents a more holistic and dynamic concept which recognises the complex interactions in rural livelihoods. This point of view was seen as being appropriate for the study region. Farmers on Leyte mostly have an array of income sources, and will not see their farm as isolated system, but regard their whole livelihood as such (Cedamon and Harrison 2004; Emtage 2004). The inclusion of human and social capital indicators is seen as an important aspect, since without social and human capital (i.e. knowledge, access to training, membership in farmers associations), farmers will have more difficulties reacting to changes in their environment and adapting their farming methods, when necessary (Pearson 2003; Pretty and Ward 2001).

3.2.2 Description of study site and farming systems

The study was conducted in the area of Baybay municipality on the Western side of the island of Leyte. Lists of farmers were provided by the barangay captains (a barangay is the smallest administrative district in the Philippines that often corresponds to a village or town district). Most farmers included in the study live in short distance to the coast while some live further inland and therefore also further in the mountainous upland (Figure 2).

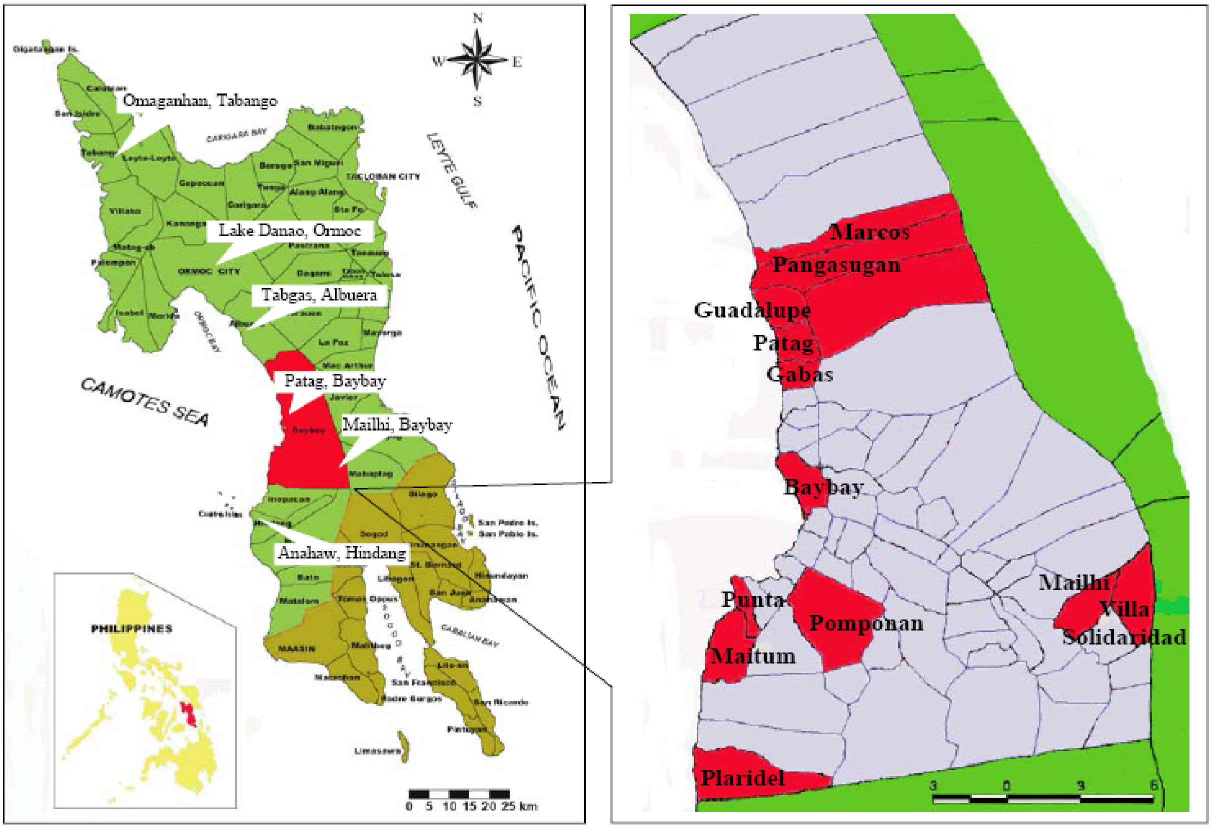

Figure 2. Map of study area indicating locations of focus group discussions and interviews in 2006/07 (left) and barangays included in household survey 2007 in the municipality of Baybay, Leyte, Philippines (right) (Department of Natural Resources and the Environment Region 8, GIS Service Unit, Tacloban, Leyte, Philippines 2001, and Visayan State University, GIS Services Unit, Baybay, Leyte, Philippines 2007)

Rainfall in Baybay is evenly distributed throughout the year with an annual average precipitation of 2600 mm. Although Western Leyte has no pronounced dry season, lowest rainfall is experienced throughout the months of March, April and May. Average temperature at sea level is around 27°C. Day and night temperatures differ by about 5°C, whereas the coldest and warmest months differ only in the range of 2°C. Typhoons, characterised by strong winds and heavy rainfall, are common on Leyte. They cannot only damage the vegetation, but enhance erosion, landslides and floods (Jahn and Asio 1999).

The main source of income for the majority of the population comes from the production of crops, livestock and marine products. Main cash crops are copra (dried coconut meat) and abaca (*Musa textilis Nee*), a fibre producing banana plant (Groetschel et al. 2001; NSO 2002).

Around Baybay, the so called ‘Rainforestation Farming’ (RF) has been developed in a German-Philippine cooperation by the Visayan State College of Agriculture ViSCA (now Visayas State University VSU) and the German Society for Technical Cooperation GTZ. The project started in the early 1990s, while the 22 individual farmers who first adopted the RF system started their plantations between 1994 and 1996. RF was defined as a “Closed Canopy and High

Diversity Forest Farming System" (Milan and Margraf 1994; Göltenboth and Hutter 2004). For this study, the definition was based on the planting of several indigenous timber trees species in a considerable amount on one plot, i.e. Bagalunga (*Melia dubia*), Antipolo (*Artocarpus blancoi*) or Narra (*Pterocarpus indicus*). The project developers laid their focus on the species of *Dipterocarpaceae*, dominant in the native forest of the Philippines, i.e. Dalingdingan (*Hopea foxworthyi*), White Lauan (*Shorea contorta*) or Yakal (*Shorea astylosa*) (Schulte 2002).

For this study, 25 RF farmers, having adopted the technology on their individual plots, were identified and interviewed: 16 from the original 22 farmers (the others had stopped) and 9 farmers from the two farmers associations (FAs), which adopted the RF concept in 1996. Mostly, RF farmers had planted their indigenous trees under old coconut stands, while some started on degraded pasture areas. Costs for seedlings for the first adopters were covered by the project. The later adopters either collected seeds and/or seedlings themselves or bought them from their association. For comparison two other farmers groups around Baybay were included in the survey. These farmers were chosen randomly from the barangays in which the RF farmers were located (Figure 2). One group of 32 farmers had not planted any timber trees, the other group of 14 farmers had planted exotic timber trees, such as *Gmelina arborea*, the predominant species, *Acacia mangium* or Mahogany (*Swietenia macrophylla*).

For the final comparison three groups were distinguished:

- Group A: Rainforestation farmers, having planted indigenous, mostly high-value timber trees. Other crops include coconut, abaca, fruit trees and sometimes rice.
- Group B: Farmers without any timber trees, planting mainly rice and/or coconuts and sometimes abaca.
- Group C: Farmers which had planted exotic timber trees, mostly low-value *Gmelina* or *Acacia* and sometimes Mahogany. Other crops include coconut and abaca.

3.2.3 Identification of local indicators

For identification of local indicators eight focus group discussions (FGD) were carried out with farmers, while nine other stakeholders (all active in extension advice, either at the University in Baybay, in NGOs or governmental agencies) were interviewed individually, at the end of 2006. The original idea was to include more farmers outside any organisation, to gain a wider range of opinions of farmers regarding sustainability. But it was more difficult to organise farmers, which were not active in any organisation, and they were less willing to participate. The FGDs and interviews were distributed over five municipalities and six barangays. Six FGD groups consisted of farmers participating in a development project (and therefore they were organised in Farmers Associations (FAs) or a co-operative), while two groups were not connected to any project (Table 2). This approach is based on the idea of recognising, and reconciling where possible, 'external' and local viewpoints on what constitutes sustainability in farming systems (Rigby et al. 2000; Reed et al. 2006).

Table 2. Overview over participants in focus group discussions and interviews on Leyte, Philippines, 2007

Number of FGDs or interviews	Barangay, Municipality	Participants	Number rankings[1]
2 FGDs	Omaganhan, Tabango	One group with small-scale tree farmers in a FA associated with ICRAF, one group of farmers not associated with ICRAF (planting corn, upland rice, coconut, livestock)	10 -
3 Interviews		MAO, ICRAF, farmers co-operative	4
1 FGD	Lake Danao, Ormoc	Sustainable vegetable production initiated by local NGO	4
1 Interview		Local NGO	6
1 FGD	Tabgas, Albuera	Abaca and RF farmers in co-operative	7
1 FGD	Patag, Baybay	RF farmers in FA	4
1 FGD	Mailhi, Baybay	Small-scale tree farmers in FA, mostly exotic trees	5
5 Interviews	Baybay	University staff, local NGO, MAO, PCA	8
2 FGDs	Anahaw, Hindang	One group with small-scale tree farmers in a FA associated with ICRAF, one group of farmers not associated with ICRAF (planting rice, coconut)	-

FA=Farmers Association; FGD=Focus Group Discussion; ICRAF=World Agroforestry Center, MAO=Municipal Agricultural Office, NGO=Non-Governmental Organisation; PCA=Philippine Coconut Authority; RF=Rainforestation Farming
1: Number of stakeholders in each barangay, who ranked the complete list individually in a later phase of the study

Indicator search was based on the SRL Framework and its five capital assets (natural, physical, financial, human, and social, Table 1). Farmers were asked in an opening round for their idea of a successful and of a sustainable farming system. To facilitate ranking of criteria afterwards, answers were written down on cards. After this opening round, more probing questions were asked related to the different capitals, such as: *How can farmers be successful despite natural misfortunes? How would you recognize a successful farm (a failing farm) from its appearance? What social advantages and/or responsibilities does a successful farmer have in the community?* A list of 49 criteria was given once more to the stakeholders for individual ranking, whereby ranking was done from 1=not important at all 5=very important.

As first criterion for choosing indicators, the results of the stakeholders' rankings were used: of both group of stakeholders (farmers and others) the 25 indicators which were ranked highest were used. Since both groups of stakeholders mostly ranked the same indicators high, this procedure resulted in 30 indicators overall: 11 natural -, 4 financial -, 6 physical -, 5 human -, and 4 social capital. These 30 indicators were analysed statistically for the three farmers groups to identify variables that could be transformed into meaningful indicators of livelihood assets. Comparison between means of two different samples was made using Tukey's HSD (honestly significant difference) test. Furthermore, the general guidelines for indicator selection, which are i.e. summarised by the OECD (1999) or by Hart (1999), were applied. In short summary these include (i) (policy) relevance, (ii) reliability/validity of data, (iii) accessibility (understandability) of data to non-scientists and (iv) availability of data. Based on the results of the statistical analysis, three indicators out of each capital asset group were then chosen for comparison of farming systems.

For graphic presentation of the indicators, a radar diagram was used for this study. This approach has been used by Gomez et al. (1996), Bockstaller et al. (1997) and Rigby et al. (2000), showing indicators of different sustainability dimensions on separate axes without having to aggregate their values. For this graphical presentation, indicator values have to be transformed in a way that all indicators can be plotted on a positive scale ('more is better'). This required the change of some indicators from 'negative' to 'positive' ones, i.e. the non-use of pesticides was used as indicator instead of the use of pesticides. If necessary, indicator values were standardised by using the mean of the whole sample as the middle of each scale. For some indicators the original measurement had taken place on a scale from 1 to 4, which correlates with the scale of the axis used for comparison. In these cases, no standardisation was necessary.

Primary data for the indicators was gathered in a survey in 2007, including 71 farmers from the Baybay area: 25 RF farmers (group A), 32 farmers without timber trees (group B) and 14 farmers with exotic timber trees (group C). Some basic demographic data of survey respondents are presented in Table 3.

Table 3. Demographic data of survey respondents in Baybay, Leyte, Philippines, 2007

	n	Min	Max	Mean
Age female	*67*	22	75	54.04
Age male	*66*	25	82	56.24
Household size	*71*	1	9	4.52
Income household per year (in PhP)[1]	*71*	3,185	539,420	82,231
Income per capita per year (in PhP)[1]	*71*	1,062	82,250	20,714
Total farm land available (ha)	*71*	0.25	21.25	2.45

1: PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

3.3 Results

3.3.1 Summary of locally identified indicators

Overall, 49 different indicators were identified; farmers identified 46 and other stakeholders 34 indicators. Table 4 gives an overview over the 30 indicators which were ranked highest by both stakeholder groups (farmers and others) and were analysed statistically.

Table 4. Overview over identified indicators, used for further analysis, by farmers (n=30) and other stakeholders (n=18) on Leyte, Philippines, 2007

Capital[1]	Stakeholder indicator	Rank farmers	Rank others	Indicator tested (problems with measurement/comments)
N	Crop productivity	4	5	Yield (data not reliable); net farm income/ha (not suitable for comparisons of agroforestry and annual crop systems)
	Water availability farm	15	3	Occurrence of draught (no problem in area)
	Soil quality	17	1	Soil quality; trend of soil quality based on farmers perception
	Land available	13	14	Total land available; per capita
	Crop diversity	12	17	Number of crops and trees/ha
	Quality of product	11	19	(Not measurable, no difference made at farm gate, same price paid regardless of quality)
	Incidence of pests/diseases	20	18	% crops lost and trend of pests/ diseases (recordings of farmers too unreliable)
	Soil conservation and agronomic measures	36	8	Number of soil conservation and agronomic measures used
	(Absence) of soil erosion	35	16	Based on farmers recordings (no differences between systems)
	Biodiversity	39	12	(No data available at farm level)
	Climate/weather	34	22	Damage by typhoon (no differences between systems)
F	Income diversification	14	20	% off-farm income
	Income (high and stable)	28	7	Annual income of household and per capita; value assets of household and per capita
	Prices cash crops	27	13	Ratio farm gate/market price
	Investment costs	30	25	Based on calculations
P	Use of improved seeds	7	10	Use of improved seeds
	Road/access to market	10/24	15/6	Quality of road to market; distance to market (km)
	Water quality	2	29	Based on farmers perception
	Farm implements	19	38	Value/number of farm assets (not comparable for different systems)
	Housing conditions	9	49	Quality of house and appliances
	Distance house-field	22	40	Distance in km
H	Health	3	2	% of respondents without pesticide use; yearly medical costs; distance to health service (km)
	Knowledge	5	4	Education level reached
	Food security	1	9	No household reported food insecurity
	Education children	8	11	% of children at college
	Family size	18	34	Number of household members
S	Security of tenure	6	21	% land owned (of land available)
	Government support programs	18	26	(No data available at household level, very little support available)
	Training	21	23	Number of contacts with extension service/year
	Membership organisation	16	42	% membership; degree of benefit

1: N=natural -, F=financial -, P=physical -, H=human -, S=social capital

3.3.2 Natural capital indicators

This group was the largest indicator group. Stakeholders identified mostly natural capital indicators, especially farmers, and rankings showed greater agreement for this group (Vilei 2007). Group A had significantly more *land available per household* (4.48 ha) as well as *per capita* (1.53 ha) than groups C (1.64 ha per household and 0.51 ha per capita) or B (1.22 ha per household and 0.40 ha per capita, Table 5).

While the majority of farmers of groups A and C were content with the amount of land they had available, nearly half of the farmers of group B wished to have more land available. According to the census of the National Statistics Office in 2002 (NSO 2002), the average landholding of a farmer in Region 8 (encompassing several islands and including the island of Leyte) is 2.19 ha while it is 2 ha for the whole Philippines. Group A also perceived significantly better *soil quality* of their plots (2.34 on a scale from 1=low to 4=very high) and applied more *soil conservation measures* (2.44) as group B (1.92 for *soil quality* and 1.03 for *soil conservation measures*), but not as group C (2.0 for *soil quality* and 1.79 for *soil conservation measures*).

A significant difference was also found for *trend of pests and diseases,* but this time group C judged the trend significantly different (1.38) from the two other groups (1.89 for group A, 1.70 for group B, from 1=rising to 4=declining). While the general trend is more towards the negative value, it might be that farmers of group C faced more problems with their non-indigenous trees. It was mentioned by several farmers of group A during the interviews that they had shifted from exotic trees, like *Gmelina* or *Acacia mangium,* to indigenous species, since the trees were not growing well and were more prone to insect attacks. Farmers were asked for more detailed data about pests and diseases and crop losses caused by it, but recordings were very unreliable, therefore it was decided not to include *trend of pests and diseases* as indicator for final comparison.

Table 5. Overview over analysed natural capital indicators, used for comparison of three farming systems (groups A, B, C) on Leyte, Philippines, 2007

Local indicator	Measured indicator	Group A[1] (n=25)	Group B[1] (n=32)	Group C[1] (n=14)
Land available:	Total land available (ha)	4.48[a]	1.22[b]	1.64[b]
	Land available per capita (ha)	1.53[a]	0.40[b]	0.51[b]
Soil quality:	Soil quality[2] (farmers perception)	2.34[a]	1.92[b]	2.00[ab]
	Trend of soil quality[3]	1.98	1.75	1.92
Crop productivity: Trend of crop yield[3]		2.25	1.87	2.39
Number of soil conservation measures[4]		2.44[a]	1.03[b]	1.79[ab]
Incidence of pest/disease: Trend[5]		1.89[a]	1.70[a]	1.38[b]
Crop diversity: number of crops and trees/ha		9.54	5.69	7.35
No soil erosion reported (% of respondents)		64.0	65.6	71.4
Water availability: no draught (% of respondents)		96.0	93.8	100
Climate: no typhoon damage (% of respondents)		56.0	56.3	78.6

Means with the same letter within rows are not significantly different ($p<0.05$) according to Tukey's HSD Test (if no letters are used, there are no significant differences)
1: Group A: Rainforestation farmers, group B: farmers with timber tree, group C: farmers with exotic timber trees
2: from 1=low to 4=very high
3: from 1=declining to 4=rising
4: incl. mulching, composting, fallowing, crop rotation, intercropping, contour farming, terracing and tree planting
5: from 1=rising, to 4=declining

Soil erosion and *typhoons* are a problem in the area, but no significant differences between the different farming groups were detected. And it is likely that the occurrence of typhoons and erosion would not only be due to the farming system practised but to the specific location and characteristics of the plot. Respondents who experienced erosion on their plots had significantly more slope on their land (a mean of 3.1 compared to 3.5 where a value of 4 represents flat land). Looking at *erosion*, it seems that the indicator is useful when comparing farmers with identical plots. But since the farmers in the area have normally several, very diverse plots, it makes the use and interpretation of erosion occurrence quite difficult.

Some indicators were not easily measurable, i.e. *crop productivity*. Farmers' recordings were too unreliable to calculate crop yield per hectare precisely, especially due to the high number of intercrops. *Quality of the product* could also not be measured on farm basis. Different quality grades exist for abaca and copra, but the price paid depends more on the area than on the quality of the product. Farmers can achieve a better price if they sell directly to a bigger trader in town, but even the bigger traders mostly do not measure the quality but pay a standard price.

Biodiversity can, by means of a survey, only be measured regarding crop diversity and no reliable secondary data exists on the farm and/or plot level. While *crop diversity* (number of crops and trees/ha) was higher for groups A (9.54) and C (7.35) than for group B (5.69), the differences were insignificant and it is not a good indicator for comparison of agroforestry and annual crop systems.

Natural capital indicators were *land available per capita*, *soil quality* and *number of soil conservation and agronomic measures*. The differences in *available land area* were highly significant and it has also been shown in other studies that it is an important factor for small-scale farmers for investments in tree farming (i.e. Herbohn et al. 2004). This indicator could also serve as physical indicator, but since it forms the natural basis of any farmers' activity, it was decided to group it under natural capital indicators. Differences for *soil quality* were also significant and it is a crucial element for the success and the long-term sustainability of farming systems. Regarding the *use of soil conservation measures* it has also elements of human and social capital indicators, since it deals with knowledge and (access to) training and/or extension advice.

3.3.3 Financial capital indicators

For the few financial indicators which were ranked high by stakeholders only one (weak) significant difference could be found regarding *income per year and capita* (Table 6). This time not group A (23,236 PhP) but group C (28,168 PhP) was significantly better off than group B (15,483 PhP). The difference between group A and B was not significant. Regarding *income diversity*, almost half of the total income of group A came from sources outside farming, including labour, business and, sometimes quite substantially, remittances. For the other two groups it was less, but the distribution was too uneven to be statistically significant.

Table 6. Overview over analysed financial capital indicators, used for comparison of three farming systems (groups A, B, C) on Leyte, Philippines, 2007

Measured indicator	Group A[1] (n=25)	Group B[1] (n=32)	Group C[1] (n=14)
Income per household/year in PhP[2]	91,702	71,160	90,624
Income per capita/year in PhP	23,236^{AB}	15,483^{B}	28,168^{A}
Value of household assets in PhP	41,052	25,181	13,264
Value of household assets per capita in PhP	9,808	4,845	3,756
Income diversity: % off-farm income	48.22	39.32	29.50
Ratio farm gate/market price main product[3]	0.81	0.71	0.75

Means with the same letter within rows are not significantly different ($p<0.1$) according to Tukey's HSD Test (if no letters are used, there are no significant differences)
1: Group A: Rainforestation farmers, group B: farmers with timber tree, group C: farmers with exotic timber trees
2: PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
3: Group A: coconut, abaca, indigenous timber; group B: rice, coconut, abaca, group C: coconut, abaca and timber

Comparing the *value of household assets* the picture was a little different; group C had less valuable assets than group B (while group A had the most valuable assets). But the information from the households regarding value of their assets was less reliable. Income data was calculated from income through labour or self-employment, income by farm products (including animal products) and remittances. These data were in most cases quite reliable and based on several sources and cross-cutting questions. Regarding assets the values were spread substantially from one family to another, reflecting more an incorrect or incomplete recording of household assets than the actual asset status. Therefore it was decided to use *income per capita and year* as indicator.

In Table 7 several agro-forestry systems are compared regarding *investments costs*, years to positive cash flow and Net Present Value (NPV). RF (group A) has the highest *investment costs* (ranging from 87,595 PhP to 111,230 PhP) but can reach the highest NPV as well (from 141,245 PhP to 444,331 PhP). An *Acacia mangium* plantation (group C) has 35,366 PhP investment costs and a NPV of 67,417 PhP.

Table 7. Investment costs, years to positive cash flow and Net Present Value (NPV) of different agroforestry systems on Leyte, Philippines, 2007, in Philippine Peso (PhP)[1]

Land use systems	Investment costs/ha	NPV (discount rate)		Years to positive cash flow
		9%	15%	
RF based on kaingin[2] farm (0.5ha kaingin, 0.5ha RF)	87,595	993,658	444,331	5
Coconut based Rainforestation Farming, survey data	111,230	349,793	141,245	5
Tree farming with *Acacia mangium*	35,366	165,022	67,417	6
Coconut farming (old plantation)[3]	-	319,793	217,580	-
Coconut farming (new plantation)[3]	54,825	84,882	18,232	11

Calculations are based on Dirksmeyer (2000), Ahrens et al. (2004) and own data and based on a cycle of 25 years
Investment costs are considered until the first year where a positive accumulated cash flow has been reached
1: 100 PhP equal approximately 1.78 € on June 12, 2010
2: shifting cultivation
3: based on a copra price of 20 PhP/kg

Least attractive is a new coconut plantation with 54,825 PhP investment costs and only 18,232 PhP NPV. But generally, coconut farmers have mature trees already and might plant additional new ones, but will seldom start a new plantation. Since *investment costs* are less concerned with the sustainability of farming systems but the adoptability of them it was not included as indicator.

Apart from *income per capita*, financial capital indicators included for final comparison were *percentage of off-farm income* and the *ratio of farm gate prices in relation to market prices* of main cash crops. Relying on a wider range of income sources reduces the pressure on the household as well as on the land by allowing the farmer to choose a long-term strategy instead of having to earn a living by all means from his available land. And if farmers produce cash crops where they can achieve a high market price, they might be more interested in management strategies.

3.3.4 Physical capital indicators

Regarding physical capital indicators, significant differences were only found for *quality of roads to market* and in the *distance to market* in kilometres (Table 8). Group B had significantly better *roads to* the next *market* (3.17 from 1=poor to 4=very good) than group A (2.72); the value of group C was 3.14. And group B had a significantly shorter *distance to the market* (3.2 km) than groups A (7.6 km) and C (11.0 km).

Table 8. Overview over analysed physical capital indicators, used for comparison of three farming systems (groups A, B, C) on Leyte, Philippines, 2007

Local indicator	Measured indicator	Group A[1] (n=25)	Group B[1] (n=32)	Group C[1] (n=14)
Access to market	Quality of roads to market[2]	2.72^{A}	3.17^{B}	3.14^{AB}
	Distance to market (in km)	7.6^{a}	3.2^{b}	11.0^{a}
Distance of house to field (in km)		1.2	2.0	1.9
Use of improved seeds (% of respondents)		16.0	3.1	7.1
Housing conditions[2]		2.49	2.43	2.27
Water quality household[3]		2.36	2.50	2.43
Value of farm assets (in PhP)[4]		2,949	4,294	1,820

Means with the same letter within rows are not significantly different ($p<0.05$ for small letters or $p<0.1$ for capital letters) according to Tukey's HSD Test (if no letters are used, there are no significant differences)
1: Group A: Rainforestation farmers, group B: farmers with timber tree, group C: farmers with exotic timber trees
2: from 1=poor to 4=very good
3: 1=medium, 2=good, 3=very good
4: PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

Not useful was *value of farm assets*: not all farming systems require substantial equipment, i.e. copra production does not require any machinery. The highest need for equipment have rice farmers (such as hand tractors or threshing machines), but mostly they rent the machinery instead of owning it themselves. Another problem of this criterion is that the respondents who held a job beside their farm hired labourers for most of the work and they will often bring their own tools.

Physical capital indicators included in final analysis were *quality of roads to market*, *use of improved seeds* and *housing conditions*. More important than the distance to the market is the quality of the road which leads to the market. Transportation of products in the Philippines is usually done by motorcycle, tricycle (an adapted motorcycle with side car) or by multicab (mini-van). If the road is very bad the products might have to be carried down or transported by motorcycle instead of a multicab, which makes the transport more complicated and more expensive. *Quality of housing* was chosen since it is an indicator which can easily be observed over time and shows the economic status of a household quite well. The *use of improved seeds* is a difficult indicator. It was ranked highly by both groups of stakeholders, but is mostly applicable to rice farmers, and also to abaca, and not so much to tree or coconut farmers. It was still chosen since it can also act as social capital indicator (access to extension advice) and the use of quality germplasm plays a role for tree farmers as well.

3.3.5 Human capital indicators

One of the indicators identified and ranked highly was *knowledge*. Unfortunately, this one is not easy to measure. Education is only one way of measuring it and does not take into account knowledge and other skills which were not acquired in school. Measuring *education of adults* and *education of children*, significant differences were found between group A and group B (Table 9).

Table 9. Overview over analysed human capital indicators, used for comparison of three farming systems (groups A, B, C) on Leyte, Philippines, 2007

Local indicator	Measured indicator	Group A[1] (n=25)	Group B[1] (n=32)	Group C[1] (n=14)
Know-ledge/ Skills:	Education male[2]	2.65[a]	2.19[b]	2.50[ab]
	Education female[2]	2.60	2.37	2.50
	Education adults (male+female)[2]	2.64[A]	2.25[B]	2.46[AB]
Education children[3]		2.45[a]	1.75[b]	1.75[ab]
Health:	General medical expenses hh/year (PhP)[4]	4,654	7,922	3,186
	Health expenditure due to illness last year (PHP)[4]	5,977[A]	633[B]	136[B]
	Distance to next health service (km)	2.9[a]	1.7[a]	10.1[b]
	No use of pesticides (% respondents)	44.0[ab]	37.5[a]	71.4[b]
Family size: Number of household members		4.32[ab]	5.13[a]	3.50[b]
Food security		Only 4 households reported temporary food insecurity		

Means with the same letter within rows are not significantly different (p<0.05 for small letters or p<0.1 for capital letters) according to Tukey's HSD Test or to Chi-square (if no letters are used, there are no significant differences)
1: Group A: Rainforestation farmers, group B: farmers with timber tree, group C: farmers with exotic timber trees
2: from 1=illiterate to 4=college
3: from 1=no grown-up child at college to 3=all grown-up children at college
4: PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

Group A had significantly higher education levels for both adults (2.64 from 1=illiterate to 4=college) and children (2.45 from 1=no grown up child at college to 3=all grown up children at college) than group B (2.25 for adults and 1.75 for children). Group C was in between regarding *education of adults* with a value of 2.46, but had the same value for *education of children* (1.75) than group B. But the distribution of the values in the group was too uneven for a significant difference and group C was the smallest one.

With regard to *health* it is difficult to find a meaningful indicator. When asked for *general medical expenses* per year, groups A (4,654 PhP) and C (3,186 PhP) had spent less than group B (7,922 PhP). But when asked for *health expenditure due to illness* of the previous year, group A had spent significantly more (5,977 PhP) than groups B (633 PhP) and C (136 PhP). Additionally, the fact that a household spends more on health does not necessarily mean that the health of the household members is worse than from the other groups, but could mean also that the household can afford medication. As an alternative the *distance to the next health service* usually visited by the family was compared. Group C had the greatest distance to the next health unit (10.1 km), since many farmers of this small group lived in a barangay which was located farther from the next town. But in this case the next health unit was the hospital in Baybay city although there is a health centre with free basic medication in every barangay. This is most likely an indicator that these farmers can afford to go to a doctor in Baybay and pay for the treatment.

In the end the *non-use of pesticides* was chosen as an indicator for health, counting the use of toxic pesticides only. A significant difference was only found between groups C (71.4% did not use pesticides) and B (37.5% did not use pesticides, as well as 44% of group A). The difference between groups A and C is probably due to the fact that more farmers from group A had rice fields as well, the crop with the highest input of pesticides. Health hazard of pesticide use in the Philippines is great since farmers do not use any protective clothing, not even footwear. Therefore the reduced use of pesticides in certain farming systems can influence the health of farmers (and their families) positively and has additionally positive influences on the environment. A more detailed calculation of pesticide use (i.e. quantity used or toxicity levels of pesticides used) would have been preferred, but the recordings of the farmers were not detailed enough to allow a more complex analysis.

Group C had the smallest *family size*, but this might be caused by their slightly higher age where the children have left the parents home already. *Food security* was ranked high by farmers, but only 4 families experienced of temporary food insecurity. It is not unlikely that the real figure is higher, but reliable secondary data does not exist.

Apart from *non-use of pesticides, education of adults* and *education of children* were chosen from human capital indicators.

3.3.6 Social capital indicators

The most important criterion for farmers during group discussions was the *security of tenure* (Vilei 2007). The differences between groups A and B, concerning *percentage of landowners* and *percentage of available land owned*, were highly significant (Table 10). Only one group A farmer did not own land, while the remaining 24 (92%) owned at least part of it, compared to 50% of group C and 34% of group B. Group A farmers owned on average 83% of their cultivated land area, while group B farmers owned 48% and group C farmers 31% on average. This result seems to support the theory that farmers need a high degree of tenure security to invest in planting trees and agro-forestry-type farming systems, a finding which was also reported in other studies conducted in Leyte (Emtage and Suh 2004).

Groups A (72%) and C (71%) were significantly more active than group B (41%) with regard to *membership in organisations*. Group B had significantly fewer *contacts with extension advice* (1.47) than group A (2.12, ranging from 1=none to 4=monthly, value for group C was 1.79). Between groups C and B, a significant difference was found for *degree of benefit from membership* (2.89 for group C and 2.31 for group B, ranging from 1=marginal to 3=very important, value for group A was 2.57). With regard to *government support programs* there is no secondary data available, but there are also very limited ways of support. Officers from the Municipal Agricultural Office will go to their 'field offices' once a week and can be contacted there and they promote certified seeds and hybrid rice, selling them to farmers at subsidised prices. Tree farming is sometimes encouraged as well, with the provision of free seedlings, usually exotics such as *Gmelina*, and one-day training courses on tree cultivation.

Again, three indicators were chosen concerning social capital: *percentage of available land owned*, *membership in organisations* (percentage of respondents which are members of an association, co-operative or similar organisation) and the *number of contacts with extension advice per year*.

Table 10. Overview over analysed social capital indicators, used for comparison of three farming systems (groups A, B, C) on Leyte, Philippines, 2007

Local indicator	Measured indicator	Group A[1] (n=25)	Group B[1] (n=32)	Group C[1] (n=14)
Tenure:	Percentage of landowners	92.0[a]	34.4[b]	50.0[b]
	Percentage of available land owned	83.0[a]	31.0[b]	47.6[b]
Training/ membership organisation:	Member in organisation (% respondents)	72.0[A]	40.6[B]	71.4[A]
	Number contacts extension advice/year[2]	2.12[a]	1.47[b]	1.79[ab]
	Degree of benefit from membership[3]	2.57[ab]	2.31[b]	2.89[a]
Government support programs		No data available		

Means with the same letter within rows are not significantly different (p<0.05) according to Tukey's HSD Test or Chi-square (if no letters are used, there are no significant differences)
1: Group A: Rainforestation farmers, group B: farmers with timber tree, group C: farmers with exotic timber trees
2: 1=none, 2=yearly, 3=quarterly, 4=monthly
3: 1=marginal, 2=important, 3=very important

3.3.7 Comparison of farming systems with selected indicators

The results for the comparison of the three different farming systems or farmers groups, according to the selected indicators, are summarised graphically in Figure 3, details are presented in Table 11.

In two cases group A had significant advantages over groups B and C: they had significantly more *land available per capita* (1.53 ha, compared to 0.51 ha for group C and 0.40 ha for group B) and on average they owned 83% of the land they cultivate, compared to 48% for group C and 31% for group B (*percentage of available land owned*). These two indicators do not necessarily say anything about the sustainability of a particular land-use, but are more prerequisites for a sustainable livelihood. Therefore, to assess a farming system, these indicators only make sense when regarded together with the other indicators, covering all capital assets.

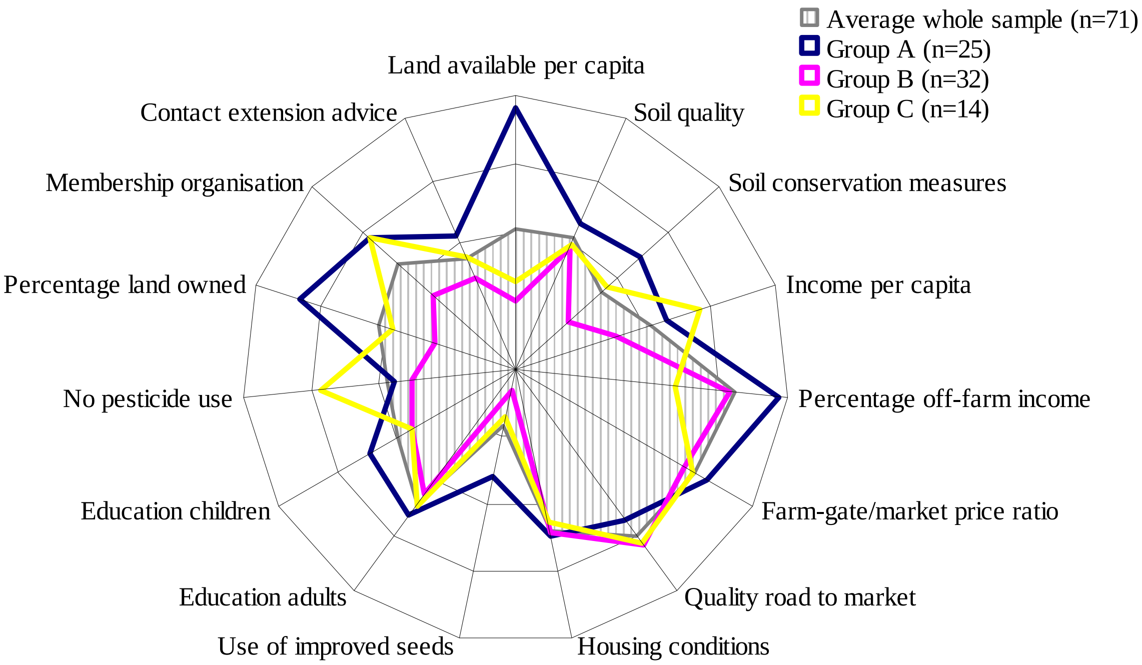

Figure 3. Radar diagram, comparing three different farming systems (groups A, B, C) using selected indicators, on Leyte, Philippines in 2007, (if necessary values were adapted to fit a scale of 4 (see section 3.2.3), see Table 11 for detailed data with significant differences)

For six more indicators, group A had significantly higher values than group B, but not than group C. Two of these indicators are concerned with natural capital: *soil quality* (as perceived by farmers from 1=poor to 4=very good, reaching 2.34 for group A, 2.0 for group C and 1.92 for group B); and number of *soil conservation measures* applied (2.44 for group A, 1.79 for group C and 1.03 for group B). The application of soil conservation measures is an indicator which should lead to more sustainability while improved soil quality is a desired outcome of a more sustainable agricultural system.

With regard to human capital, group A reached an average value of 2.64 for *education of adults* (from 1=illiterate to 4=college) and 2.45 for *education of children* (from 1=no grown-up child at college to 3=all grown-up children at college). The significantly different values of group B were 2.25 and 1.75, respectively; the not significantly different values of group C were 2.46 and 1.75, respectively. Although groups C and B had the same value for education of children, the difference between groups C and A was not significant, due to the high variation in the group size and the small size of group C. When these indicators are measured repeatedly over time, they can give a picture of the situation of the households' livelihood situation, especially if the education of the children is improving. Regarding the educational status of the parents, this is less a sign for a successful/sustainable farming system and consequently sustainable livelihood, but an asset which farmers acquired previously and is likely helpful in reaching a better position (regarding income and farming) for their family.

Table 11. Comparison of three different farming systems (groups A, B, C) using selected indicators, on Leyte, Philippines in 2007

Indicator	Capital[1]	Group A[2] (n=25)	Group B[2] (n=32)	Group C[2] (n=14)
Land available per capita (ha)	N	1.53[a]	0.40[b]	0.51[b]
Soil quality[3]	N	2.34[a]	1.92[b]	2.00[ab]
Number of soil conservation measures	N	2.44[a]	1.03[b]	1.79[ab]
Income per capita/year (in PhP)[4]	F	23,236[AB]	15,483[B]	28,168[A]
Income diversification: % off-farm income	F	48.22	39.32	29.50
Ratio farm-gate/market price	F	0.81	0.71	0.75
Quality of road to market[3]	P	2.72[A]	3.17[B]	3.14[AB]
Housing conditions[3]	P	2.49	2.43	2.27
Use of improved seeds (% of respondents)	P	16.0	3.1	7.1
Education adults[5]	H	2.64[A]	2.25[B]	2.46[AB]
Education children[6]	H	2.45[a]	1.75[b]	1.75[ab]
Health: no use of pesticides (% of respondents)	H	44.0[ab]	37.5[a]	71.4[b]
Percentage of available land owned	S	83.0[a]	31.0[b]	47.6[b]
Member in organisation (% of respondents)	S	72.0[A]	40.6[B]	71.4[A]
Number contacts extension advice/year[7]	S	2.12[a]	1.47[b]	1.79[ab]

Means with the same letter within rows are not significantly different ($p<0.05$ for small letters or $p<0.1$ for capital letters) according to Tukey's HSD Test or to Chi-square (if no letters are used, there are no significant differences)
If necessary, values were adapted to fit a scale of 4 (see Methods)
1: N=natural -, F=financial -, P=physical -, H=human -, S= social capital
2: Group A: Rainforestation farmers, group B: farmers with timber tree, group C: farmers with exotic timber trees
3: from 1=poor to 4=very good
4: PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
5: from 1=illiterate to 4=college
6: from 1=no grown-up child at college to 3=all grown-up children at college
7: 1=none, 2=yearly, 3=quarterly, 4=monthly

From the social capital indicators, *membership in organisation* and frequency of *contact with extension advice* were chosen for comparison. Farmers from groups A (72%) and C (71%) were mostly members of a farming association or similar group, a significantly higher rate than for farmers from group B (41%). Group A farmers had also more *contact with extension advice* on average per year (2.12, ranging from 1=none to 4=monthly) than group C (1.79) and significantly more contact than group B (1.47).

Regarding financial capital indicators, group C scored significantly better for two chosen indicators than group B (but not than group A): they had a significantly higher *income per capita* (28,168 PhP compared to 15,483 PhP for group B and 23,236 PhP for group A). And most farmers from group C did *not use pesticides* (71%), compared to 44% of group A and 38% of group B. This difference is certainly a consequence of the different farming systems. Farmers of group B cultivated rice mainly, where pesticides are commonly used in the area. Many farmers from group A had rice fields, while many farmers from group C had mostly upland areas and no rice.

For only one (physical capital) indicator, *quality of road to market*, group B scored higher, having significantly better roads (3.17 from 1=poor to 4=very good) than group A (2.72), an advantage which can be used for easier marketing of agricultural products. This might also be a reason for group A farmers to invest in tree farming on those plots which are located upland and in more remote areas.

In summary, it can be said that group A reached higher, and therefore more desirable, values for many indicators. Except for two cases, where group A had significantly higher values (*land available per capita* and *percentage of land owned*), group C farmers reached similar high (and sometimes higher) values for many indicators. But to be able to judge if the specific farming system leads to a more sustainable livelihood, time series indicators would be necessary. From this simple, one-time comparison, it is possible to say that tree farmers (groups A and C) have higher resources – such as land, available income, and education levels. Most likely they will have had these resources before starting their farming systems and they possibly put them into a good starting position for investments in tree farming. But these groups are also more active with regard to membership in organisations and seeking advice, therefore enhancing their social (and human) capital, and improving their position further. Group A had substantially more land available than the two other groups, which is certainly a big advantage. Group C had on average a very limited land area available but was still more active and had more income than group B, indicating a possible difference due to the different farming systems practised.

3.4 Discussion and Conclusion

3.4.1 Methodological considerations

Several of the indicators used for this study can be classified as ‚effort’ indicators (i.e. *number of soil conservation measures, use of improved seeds, (non-) pesticide use*) and only few as ‘effect’ indicators, likely to be a result of the farming system practices (i.e. (perceived) *soil quality* and *farm gate to market price ratio,* Fernandes and Woodhouse 2008). While the focus in most indicator sets is on effect indicators, and/or indicators directly related to biophysical ‘health’, an alternative approach has been proposed (King et al. 2000:632) “that some measure of behaviour (e.g. implement sales) or land condition description (e.g. soil cover) may be more stable and measurable than environmental conditions such as erosion rates, water quality or soil organic matter”. Data for ‘effort’ indicators is certainly more accessible and is an important reason for their inclusion in the indicator set used for comparison in this case study.

It was found that the use of the sustainable rural livelihoods framework corresponded well with farmer’s perception of sustainability of farming systems and livelihoods during group discussions (similar approaches have been used by Cromwell et al. 2001 or Fernandes and Woodhouse 2008). This makes it useful as starting point for discussing scientist’s and local stakeholder’s perceptions and interpretations of sustainability. But it is less clear if farmer’s idea of ‘sustainability’ corresponds with the scientific view of it. There is no word for sustainability in the local dialect on Leyte, therefore the English term is commonly used and known to farmers. Nonetheless, the views of the different stakeholders regarding importance of indicators were not so far apart (Vilei 2007).

While the use of the capital approach is considered as helpful for identification of indicators, it seems less important for later analysis and comparison of farming systems. They could as well be regrouped into three commonly used dimensions of sustainability, such as ecology, economy and society, as has i.e. been done by Fernandes and Woodhouse (2008) and Berninger et al. (2009). But, considering the objective that a farming system should not be reduced to its agricultural aspects only but includes the whole livelihood of the household, the use of the SRL Framework helps ensuring that all aspects are considered in terms of corresponding indicators.

To provide practical outcomes, indicator values should be evaluated in comparisons over time. For this purpose, goals with regard to farming systems could be agreed upon by several stakeholders and policy makers and progress towards these goals could be monitored. The sustainability of the farming systems can only be assessed by repeated measurements to see if a change in indicator values can be observed and if these can really be connected to an analysis of sustainability. In this term it is important to analyse first, as has been done here, which indicators fit the local context and therefore reduce further effort but improve efficiency. The use of a relatively simple method of indicator identification, such as the one used here, and simple methods of collecting primary data generation, such as the use of questionnaire surveys of farms, make repeated measurements more likely.

An area for further research would be to obtain a feedback from the farmers regarding the outcome of the comparison approach and further refinement of the indicators. This has not been done in the course of this timely and financially limited study.

3.4.2 Comparison of farming systems

Due to the heavy loss of most of their (primary) forest (down from originally 90% in 1521 to 24% in 2003 (Pulhin et al. 2006), the Philippine government has introduced regulations regarding logging which affect small scale tree farmers substantially: In 1999 a complete logging ban was introduced. If farmers want to harvest the timber trees which they have planted, those have to be registered and farmers have to access a cutting permission at the Department for Environment and Natural Resources (DENR). This procedure can be quite complicated for the farmer and it was often reported that tree farmers have to pay the travel costs of the DENR officer, since the officers lack funds for this activity (Herbohn et al. 2004:210). The current regulations have been repeatedly reported to be a major impediment for small-scale tree farmers (Bertomeu 2005; Harrison et al. 2007).

Although the participation of stakeholders has become more common recently with regard to sustainability indicators (Reed et al. 2006) the involvement of local stakeholders in developing policies has not become reality in many countries, and the Philippines make no exception. This becomes clear from the official policies regarding logging and harvesting of trees. Most farmers which were surveyed for this study were not fully aware of all the regulations, even farmers from group A which were in closer contact with the University in Baybay.

Using the identified set of indicators it can be seen that group A scored highest on most indicators, followed by group C, therefore both tree farmers groups. Since this study concentrated only on one municipality, Baybay, the climatic and agronomic conditions of the compared groups of farmers are similar. It is therefore likely that both statements hold true: (i) tree farmers (groups A and C) scored higher on the chosen set of indicators because they were originally in a better position, be it that they were entitled with more land and secure tenure or a wider range of other income sources; (ii) the better score on some indicators are a result of the farming system practiced, such as (perceived) *soil quality* and (non-) *use of pesticides*. Several studies on Leyte, including this one, indicate that small-scale farmers who plant timber trees have more resources than others, especially regarding the land available and are more often landowners instead of tenants (i.e. Emtage and Suh 2004; Herbohn et al. 2004). When farmers of group B were asked why they do not plant trees, they mostly answered that they have no land available (48%) or that it is not their own land (45%). This might be substituted by social capital, i.e. membership in an organisation or knowledge. One farmers association close to Baybay was quite successful in spreading the concept of RF to its members and several have started it on their individual plots after becoming familiar with the system in the association.

Regarding sustainability it is important to consider the long-term view. Further empirical research is needed on long-term or short-term orientation in farmers' decision-making. It is often argued by economists that resource-poor farmers are forced to focus on short-term survival, thus valuing future benefits much lower than immediate increases in productivity. This would then lead to fast depletion of resources and soil degradation. Chambers (1997:176, cf. Neef et al. 2003:503), on the other hand, argues that “it is less the poor and weak and more the rich and powerful who take the short-term view.” During interviews, many wealthier RF farmers told us that they planted the trees not for their own benefits but for their children later benefit. This seems to confirm the theory that resource-poorer farmers are short-term oriented, since they do not have the means to invest in time-, labour-, and resource-consuming farming practices.

The scientific facts with regard to RF (group A) are not yet fully understood. It is not clear which indigenous trees can best be planted together and how this system really influences soil quality and other ecological factors. This kind of knowledge cannot be provided by a simple set of indicators, which was intended to measure the longer-term success and therefore sustainability of the farmers’ approach as a whole.

3.5 Acknowledgements

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4. Adoptability and rentability of a complex agro-forestry system for small-scale tree farmers, Leyte, Philippines

Abstract 'Rainforestation Farming' was developed on the island of Leyte, Philippines in a Philippine-German co-operation in the 1990s. It is based on the use of indigenous trees in contrast to the predominant use of exotic timber trees in commercial tree planting. For this study a survey was conducted with twenty-five farmers, having adopted Rainforestation Farming on individual plots. Detailed data about costs and benefits of the Rainforestation Farming plots of the early adopters were used to calculate the Net Present Value and compare it with earlier calculations.

Results showed that the early calculations were rather optimistic, assuming higher prices (and yields) for the lumber as well as more intercropping in the first years. Rainforestation Farming still showed to be profitable, but the potential outcome is associated with a high risk and a long investment period.

Regarding adoptability, the socio-economic situation of Rainforestation Farming adopters was compared with other farmers Rainforestation Farming farmers were typically endowed with greater than average resources, either larger landholdings or a more attractive off-farm employment.

The Rainforestation Farming concept has the potential to offer ecological benefits as well as financial ones. But to represent a viable alternative for resource-poor small-scale farmers, and to achieve a more widespread adoption, considerable extension advice over the course of several decades has to be offered and external (financial) assistance is required. Additionally, current policy regulations make harvesting and marketing of indigenous timber trees a complicated procedure, especially for small-scale tree farmers.

Keywords

farmers associations; farming systems; financial analysis; Net Present Value; Rainforestation Farming; small-scale farmers; tree farming

4.1 Introduction

Between 1995 and 1996, 22 individual farmers and two farmers associations commenced planting indigenous trees in their farms, situated in the municipality of Baybay, situated on the western part of Leyte Island, Philippines. They followed the advice from an agroforestry project called Rainforestation Farming (RF), which was developed in a Philippine-German co-operation project. This farming system involves planting indigenous tree species, aiming to create a farming system resembling as close as possible the natural ecosystem (Göltenboth and Hutter 2004). Thus, RF aims to replace the kaingin (shifting cultivation) system and release pressure from primary and still close-to-natural secondary forests (Marohn 2007). The need of small-scale farmers to benefit financially from this system was acknowledged in the development by adding the interplanting of annual crops. A manual has been prepared for farmers, guiding them in the implementation of a Rainforestation Farm in old coconut stands or on degraded areas and advising them which annual crops can be intercropped during the first five to six years to provide income (Margraf and Milan 2006). In year six the first fruit trees will start bearing fruit, i.e. Rambutan (*Nephelium lappacaeum*) or Santol (*Sandoricum koetjape*), and shade tolerant intercrops, i.e. the fibre producing banana species abaca (*Musa textilis Nee*), can still be intercropped, until the canopy finally closes around year 10, depending on planting density and plot management.

Implementation and monitoring of the project was carried out by the GTZ (German agency for technical co-operation) and the Visayas State University (VSU, formerly Visayas State College of Agriculture - ViSCA) during the first 10 years. Currently, farmers can still ask for advice at the VSU, but monitoring has ended. The Institute of Tropical Ecology (ITE) at the VSU carries out training with interested farmers associations and co-operatives in other areas of the Philippines. On Leyte itself the ITE is consulting already practicing RF farmers if they seek advice, but does not pursue any further outreach activities anymore.

Several studies have been undertaken with regard to the RF project, mostly Bachelor or Master theses, and some PhD projects. Out of these, few studies were concerned with the economics, adoptability and management of the project (these include Dirksmeyer 2000; Ahrens et al. 2004 and Neuberger 2005). One reason for the few studies is the fact that little data have been collected over the years regarding management and development of trees, as well as the still young age of the trees. Usually a cycle of 25 years is used for financial and economic calculations, a time span which will not be reached before 2020 for the first adopters. The 25 years cycle was chosen for the calculations since a stewardship agreement could be signed which was valid for 25 years (see section 4.2.1) and since this is the minimum harvestable age for some high value indigenous species.

This study aims to investigate and compare the socio-economic profile of the RF adopters as well as the management of their plots. The investigation focuses on whether the mostly hypothetical financial calculations are likely to come true for the first individual adopters. The reasons for the low adoption rates are also examined. For this purpose, a survey and a literature review were carried out. The objective was to analyse if Rainforestation Farming is financially feasible and profitable for individual small-scale farmers, since this was the intention of the project development.

4.2 Methods

4.2.1 Study site

The study was carried out in the municipality of Baybay, Leyte (see Figure 1). Most farmers included in this study live a short distance from the coast, while some live in the mountainous upland. Rainfall in Baybay is evenly distributed throughout the year with an annual average precipitation of 2600 mm. Although Western Leyte has no pronounced dry season, lowest rainfall is experienced throughout the months of March, April and May. Average temperature at sea level is 27°C. Day and night temperatures differ by about 5°C, whereas the coldest and warmest months differ only in the range of 2°C. Typhoons, characterised by strong winds and heavy rainfall, are common on Leyte. These can damage vegetation, enhance erosion, and cause landslides and floods (Jahn and Asio 1999).

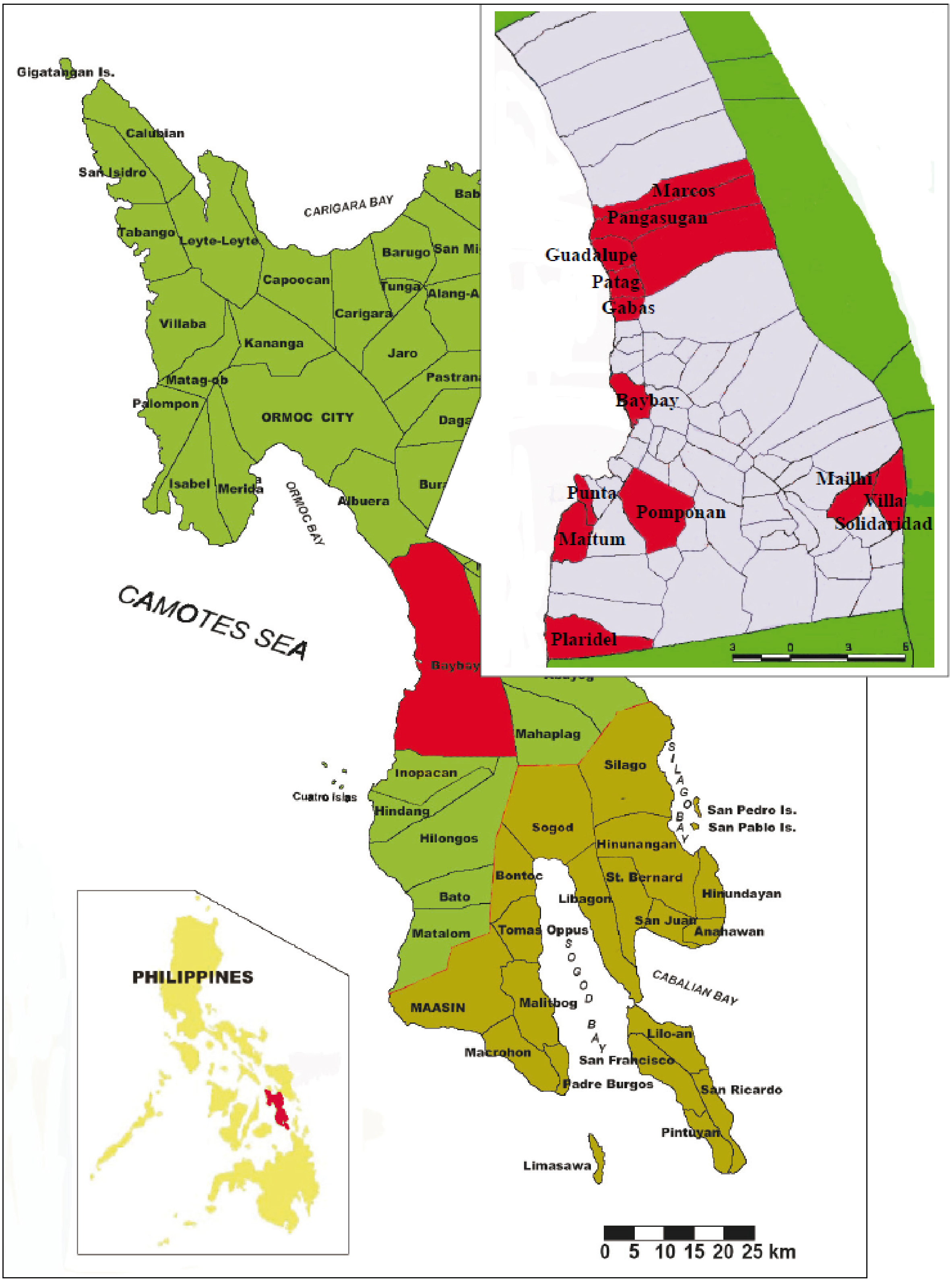

Figure 1. Map of study area, indicating locations included in household survey 2007/8 in the municipality of Baybay, Leyte, Philippines (Department of Natural Resources and the Environment Region 8, GIS Service Unit, Tacloban, Leyte, Philippines 2001 and Visayan State University, GIS Services Unit, Baybay, Leyte, Philippines 2007)

The main source of income for the majority of the population comes from the production of crops, livestock and marine products. Main cash crops are copra (dried coconut meat) and fibres from abaca (*Musa textilis Nee*), a fibre producing banana species (Groetschel et al. 2001; NSO 2002). Security of land tenure can also play a role in adoption of agroforestry systems. In the Philippines, the land is classified into A&D land (alienable and disposable land) and timber land. A&D land can be titled by the Department of Environment and Natural Resources. Most A&D land, titled or not, is 'declared', meaning that it is declared to the municipality for the calculation and collection of taxes. Land with a slope of 18% or more is classified as timber land and cannot be privately owned. Timber land will also be called timber land if no trees are left. In such a case timber land can also be declared A&D land when the land has been used agriculturally for more than 20 years. Traditionally, land was perceived as being in the control of the established occupant rather than being available through legal rights bestowed by a superior authority. It is still accepted within the communities that somebody who has cleared a piece of land and planted something is considered the owner of that area.

Stewardships for utilisation of timber land areas are given within certain programs, such as Community Based Forest Management (CBFM) or the older Integrated Social Forestry Program (ISFP). Under the ISFP, certificates of stewardship contracts were issued for 25 years, renewable for another 25 years, to individuals and families for plots up to five hectares and farmers were obliged by contract to plant at least 20% of the area with trees (Groetschel *et al*. 2001). In 1995, the CBFM initiative was labelled the national strategy for sustainable development of forest resources. Participating communities are granted access to forest land resources under a tenurial agreement for 25 years, renewable for another 25 years.

4.2.2 Rainforestation Farming

No strict definition of Rainforestation Farming has been set by the project developers. The objective was the creation of a farming system resembling as close as possible the natural ecosystem. But each farmer adopted the system according to his own needs; consequently there are as many different systems as there are adopters. Initially (in 1992), fast-growing exotic species, such as *Gmelina arborea*, and *Acacia mangium* and other exotic species were part of the Rainforestation pattern. But since the exotic trees turned out to be less resistant to extreme climatic events (Kolb 2003) and more susceptible to numerous pests and diseases (Chokkalingam et al. 2006), focus shifted more and more towards native species, especially the high-value *Dipterocarpaceae*, dominant in the native forests of the Philippines (Margraf and Milan 2006; Schulte 2002). The concept was laid out as a multi-story agroforestry system, where annual crops could be intercropped during the first years. Once the canopy closes only shade-tolerant crops can be planted, including some fruit trees, i.e. Mangosteen (*Garcinia mangostana*) and Durian (*Durio zibethinus*) and abaca. For this study, the definition was based on the planting of several species of indigenous lumber trees in a considerable amount on one plot. Indigenous species include for example Bagalunga (*Melia dubia*), Antipolo (*Artocarpus blancoi*) or Narra (*Pterocarpus indicus*). Examples for *Dipterocarpaceae* are Dalingdingan (*Hopea foxworthyi*), White Lauan (*Shorea contorta*) or Yakal (*Shorea astylosa*).

When starting the project, the project developers were aware that the typical small-scale farmer of the area has to acquire sufficient income from the plot before the trees are mature enough to be harvested, which can take 25 years or more. In the manual for farmers wishing to start a RF farm, farmers are instructed which plants they can use for intercropping during the years until lumber harvest (Margraf and Milan 2006). In the establishment phase, sun-loving root crops – such as sweet potato or pineapple – can be intercropped. Once trees have grown only shade-tolerant crops can be planted, such as rattan, abaca (to some extent) and Ube (purple yam, *Dioscorea alata*, climbing up the trees). But the productivity of crops and fruit trees will be reduced due to the shade of the trees. If farmers start a RF farm in an old coconut stand, there is no need for intercropping and coconuts can continuously be harvested. After several years the planted trees will start to shade out the coconuts, thereby decreasing the yield of copra. Costs for seedlings were covered by the project. Farmers were supposed to provide seedlings for other farmers in later years as kind of repayment. For some farmers, the planting was carried out by students from the University in Baybay free of charge.

4.2.3 Survey participants and data gathering

The first task for this study was to identify RF farmers on Leyte, having adopted the technology on their individual plots. From the original 22 farmers only 16 could be included in the survey: the others either had stopped RF or were not available at the time of the study. In addition to the 16 farmers from the original list, nine farmers from the two farmers associations, which adopted the RF concept in 1996, have trees planted on their individual plots. Therefore, 25 farmers practicing RF individually were interviewed from January to March 2007 and 22 of these were included in a follow-up survey in February 2008. All RF farmers included in the survey are from the municipality of Baybay, where the VSU is also located. Outside of Baybay there are only three other individual co-operators in Leyte. However, these individuals were not included in this study since the owners did not represent the typical small-scale farmer, but had larger landholdings instead.

For comparison two other farmers groups around Baybay were included in the survey. These farmers were chosen randomly from the barangays (smallest administrative district in the Philippines that often corresponds to a village or town district) in which the RF farmers were located. The list of farmers in these barangays was provided by the barangay captains. One group of 32 farmers had not planted any timber trees (half of them had planted fruit trees). The other group of 14 farmers had planted exotic timber trees, such as *Gmelina arborea*, the dominant species, *Acacia mangium*, or Mahogany (*Swietenia macrophylla*).

For the further analysis three groups were compared:

- Rainforestation farmers, having planted indigenous, mostly high-value timber trees, as well as coconut, abaca, fruit trees and sometimes rice;
- farmers without timber trees having rice mainly and/or coconuts and sometimes abaca;
- farmers having planted exotic timber trees as well as coconut and abaca and sometimes rice.

RF farmers and farmers with exotic timber trees were both considered tree farmers. The RF manual indicates that the first revenue from the RF farm will start in year five with firewood, while round timber, which might be used for products such as small tables, telephone stands or baby cribs, could be harvested starting in year ten. Financial calculations were based on the recommended management as well. After the first survey in 2007 it became apparent that most RF farmers did not follow such management instructions; therefore the RF farmers were interviewed once more in 2008 with a focus on management and the use of their RF plot. RF farmers were monitored in the course of the Leyte Island Program under the supervision of the Institute of Tropical Ecology (ITE) at the Visayas State University (VSU) and the German Agency for Technical Co-operation GTZ. In the course of this monitoring, income-costs sheets were set up for fifteen individual RF adopters and the two farmers associations (ITE and GTZ 2006).

4.2.4 Financial analysis

For financial evaluation of Rainforestation Farming and other agroforestry systems in the study area, the Net Present Value was calculated. Given the scarcity of land in the area, both private and social objectives are to maximise returns per unit of land (Rasul and Thapa 2006, cf. Alam et al. 2010). Return to land is expressed by net present value (NPV), which determines the present value of net benefits by discounting the streams of benefits and costs back to the base year. It was calculated using the following formula:

$$\mathrm{NPV} = \sum_{t=0}^{n} \frac{(B_t - C_t)}{(1 + r)^t},$$

where B_t is the benefits accrued over the years, C_t is the cost incurred over the years, t is the time period, and r is the interest rate.

When comparing different agroforestry systems, calculations by Ahrens et al. (2004, based on Dirksmeyer 2000) were used, whereby the harvesting pattern with concern to RF was calculated as follows: In year 5, 50% of the fast growing pioneer species are harvested, another 50% (= the remaining ones) in year 12. In year 8, the first 5% of the fast growing Dipterocarps are harvested. In the course of 20 years, 5% annually of the slow-growing Dipterocarps can be harvested, 50% are harvested in year 18. Thereafter 10% of trees are harvested annually. In year 25, it was assumed that all remaining trees are harvested, including fruit trees. This was based on the 25-year agreement which can be reached under a stewardship agreement. Normally, farmers would continue to harvest some trees and the fruits annually, assuming they have further ownership.

The NPVs of three RF farms, which were interviewed for the survey of this study, were calculated using the farm recordings until 2008 and estimating costs and income until 2020.

4.3 Results and Discussion

4.3.1 Management and Economics of Rainforestation Farms

Table 1 reports on how the existing individual co-operators manage their plot and whether they obtain income from it in year 13 (corresponding to the year 2007). To date, the great majority of the RF farmers had not received substantial income from the plot. While some trees, such as *Gmelina* or Mahogany, can be harvested after 10-12 years, the Dipterocarps and other indigenous high-value trees will take 25 years or more to reach harvestable size. Farmers were fully aware of this fact and many stated during the survey that they planted the trees more for the benefit of their children than for their own profit.

Table 1. Management and income of Rainforestation farmers in Leyte, Philippines in 2007/08

Income from…	Answers of the 25 farmers
Firewood	**14** adopters either sold firewood or used it for home consumption; **8** adopters did not use firewood from their RF plots, usually because their plot was located very far from their home.
Lumber	**3** respondents sold lumber, **7** used it for housing, trees at **1** farm were cut for an electricity line, **16** did not harvest lumber yet.
Fruits	**7** farmers harvested fruit from their RF plots; some had no fruit trees planted. **2** sold fruit for 5,000 PhP and 16,000 PhP (net) in 2007[1].
Has your income increased since starting RF?	To date, **13** respondents received no income from the plot. **5** reported earning more from the plot than before they started RF, because of sale of: fruit (**1**), tree seedlings (**1**), lumber (**1**), abaca intercropping (**2**). **3** respondents reported earning less than before the start of RF, because large trees shaded out the coconuts and decreased copra yields.

Sources: Own survey results (2007, 2008) and secondary data from ITE and GTZ (2006)

1: PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

2: Fritsche (2004) conducted a survey among 23 RF farmers in 2003 where 17 reported receiving higher income, averaging 4,600 PhP. It is assumed that he focused on income from the plot in general, which would have been gotten without RF as well.

In Table 2, details of the 12 individual adopters regarding costs and benefits, which have occurred during the first 11-12 years since they have adopted the system, are presented.

Table 2. Costs and benefit (1995/6 to 2007) of individual RF farms in Leyte, Philippines, based on farmers' records until 2003 in ITE and GTZ (2006), and own survey results 2007

Plot use before	Size (ha)	Costs 1 ha (PhP)	Benefit 1 ha (PhP)	Compounded costs 1 ha (PhP)	Compounded benefit 1 ha (PhP)	Ys. pos. cash flow
Coconut	0.33	55,121	271,621	95,868	472,410	5
Cogon grass	0.33	89,612	170,239	155,855	296,084	9
Coconut	0.33	127,561	143,518	221,857	249,610	2
Coconut	0.25	39,996	131,628	69,562	228,931	2
Coconut	0.50	69,554	77,236	120,970	134,331	3
Fruit trees	1.00	34,700	62,710	60,351	109,067	3
Coconut	0.60	58,950	48,467	102,543	84,295	4
Coconut	3.20	42,782	42,938	74,408	74,679	10
Coconut	0.33	48,212	19,597	83,851	34,084	4
Cogon grass	0.90	47,056	- 24,129	81,841	- 41,966	13
Coconut	0.25	93,100	- 25,300	161,922	- 44,002	13

PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
An interest rate of 4.72% was used for calculation of compounded costs and benefits

The situation is quite diverse for the different farmers. Some have not even regained their investment costs because they started the system on degraded, vacant plots, and did not yet receive any income from the plot. It is important to remember, however, that all respondents received the seedlings for free and many also received in-kind support as labour during setting up of the plantations.

According to the calculations of Ahrens et al. (2004), Rainforestation Farming has the potential to be very profitable, reaching the highest NPV among the compared land-use systems, when still practicing the kaingin (shifting cultivation) on half a hectare (Table 3). Ahrens et al. (2004) based their calculations on the management and harvesting pattern advised by the project developers (see financial analysis in section 2.4). When comparing the NPVs of the calculations of Ahrens et al. and the surveyed RF farmers, the labour costs have to be regarded in more detail. Unpaid family labour was not included in the calculations of Ahrens et al. but estimated to sum up to 45,000 PhP/year, if family members would be paid for the labour. It was not included by Dirksmeyer (2000) in the original calculations since he assumed no foregone opportunity costs: it is unlikely that the family members would find another occupation during this time. The RF farmers of the surveyed farms did mostly hire workers for the labour on their farms, since they have other occupations. The value of unpaid family labour for maintenance each year averages around 4,000 PhP. From farmers' recordings it was not possible to separate family and hired labour for the start up of the RF system. If family labour is included in the calculations of Ahrens et al. the difference in NPVs and annuity of the calculations and the surveyed farmers becomes much smaller. The NPV (using a discount rate of 15%) reaches 108,445 PhP when labour costs are included compared to 444,331 PhP without unpaid family labour (results are given in Table 3 and in Appendix 1 and Appendices 5-7).

Table 3. Financial values of agroforestry systems (1 ha), in Leyte, Philippines, after a 25 year cycle, based on Ahrens et al. 2004

Land-use system		Investment costs[2] (PhP)	NPV in PhP (discount rate)		Annuity in PhP		Years to pos. cash flow
			9%	15%	9%	15%	
RF based on kaingin[1] farm (0.5ha kaingin, 0.5ha RF)		87,595	993,658	444,331	101,161	68,738	5
Including family labour			506,642	108,445	51,579	16,776	13
Coconut plantation old	20PhP/kg copra	-	319,793	217,580	32,557	33,659	-
	15PhP/kg copra		224,066	151,558	22,811	23,446	-
Tree farming with *Gmelina*		35,366	223,788	97,546	22,783	15,090	6
Coconut plantation new	20PhP/kg copra	54,825	84,882	18,232	8,642	2,821	11
	15PhP/kg copra		45,507	- 328	4,633	-51	12

NPV=Net Present Value, PhP=Philippine Peso; RF =Rainforestation Farming
1: shifting cultivation
2: Investment costs were calculated up to the first year where positive cash flow was reached. Cash-flow tables are given in appendices 1-7
100 PhP equal approximately 1.78 € on June 12, 2010

Two different interest rates were used for the calculations in Table 3. Since this study is concerned with resource-poor small-scale farmers, it is likely to assume the higher interest rate of 15%. The NPV for RF based on a kaingin farm is 444,331 PhP. Even an already existing, productive coconut plantation, assuming a copra price of 20 PhP/kg, reaches only a NPV of 217,580 PhP. The price of 20 PhP/kg copra is quite high, but more problematic is the high fluctuation of the price for this world commodity. The big advantage for farmers is the low risk involved: farmers are familiar with the production, harvesting and marketing of copra, and mostly they are continuously replanted, so that it is not necessary to start an entirely new coconut plantation. Regarding RF, prices which can be achieved for the indigenous lumber are not certain, investment costs are high in the beginning and marketing is more difficult. These factors might explain the enduring high popularity of coconut plantations.

Calculations carried out by Ahrens et al. (2004) were based on the management as proposed by the project developers. For this study, farmers' records regarding their RF farm were available and were used for calculating the NPV of three differing RF farms (Table 4 and Appendices 2-4). While the records do not cover the full 25 years of the assumed harvesting cycle, results differ due to different management practices of the farmers up to year 13. Future prices and harvests are still based on assumptions, of course.

Table 4. Financial values of agroforestry systems (1 ha), in Leyte, Philippines, after a 25 year cycle, based on own calculations from survey results 2007

Financial values		RF farm A (based on coconut farm)	RF farm B (many fruit trees)	RF farm C (based on vacant area)
NPV	9% discount rate	349,793	188,695	77,405
(PhP)	15% discount rate	141,245	40,606	-10,660
Annuity	9% discount rate	35,611	19,210	7,880
(PhP)	15% discount rate	21,851	6,282	-1,649
Investment costs (PhP)		111,230	107,159	90,400
Years to positive cash flow		5	10	13
Cumulated gross benefit after 25 years from…				
Coconuts		384,900	25,433	-
Fruits		230,260	645,218	-
Other		-	66,195	-
Lumber		1,225,460	495,640	381,487

NPV=Net Present Value, PhP=Philippine Peso; RF =Rainforestation Farming
100 PhP equal approximately 1.78 € on June 12, 2010

The resulting NPVs from the three RF farmers are much lower than the one Ahrens et al. had calculated and are lower than for an already existing, productive coconut farm. The highest NPV can be reached by RF farm A, based on a coconut plantation, with 141,245 PhP (using 15% interest rate). RF farm B reaches only a NPV of 40,606 PhP and RF farm C even has a negative NPV of -10,660 PhP.

There are several reasons for this difference: mostly farmers had fewer intercrops, except farm B which had many fruit trees planted. But in this case, the high amount of fruit trees leads to fewer high valued timber species and to a lower NPV. Another reason were the lower lumber prices used for the calculation. Farm-gate prices which can be received for commonly traded high-value lumber, such as i.e. Narra (*Pterocarpus indicus*), White Lauan (*Shorea contorta*) or Yakal (*Shorea astylosa*) average around 40 PhP per board foot (bdft). Farm-gate prices paid for *Gmelina* ranged from 11 to 15 PhP/bdft with a market sale price averaging around 25 PhP.[1] Ahrens et al. (2004) used higher prices which ranged from 12 to 25 PhP for low value species and up to 55 PhP/bdft for high value species. For this study only about 75% of the revenues for lumber were achieved when using the actual, lower prices.

The reason for the low NPV of farm C is the fact that the farmer had no intercrops and planted many low value timber species. The farmer who started his RF farm under old coconut trees (farm A) achieved the highest NPV, whereby the biggest part comes from the lumber. But the continuing harvesting of coconuts helps to gain the investment costs back in five years time, compared to 10 and 13 years for the other two farms. While RF farm A can compete with an already set up coconut farm, depending on the copra price, it remains a risky business.

[1] Prices are based on ITE and GTZ (2006), on survey data (2008) and 2006 data received from the Australian Centre for International Agricultural Research (ACIAR), located at the Department for Forestry at the Visayas State University, in February 2008.

A further concern for small-scale farmers wishing to invest in a system such as RF is access to credit. There are very limited opportunities for small-scale farmers to gain a large sum of credit. Credit is mostly given by shop owners for agricultural products (i.e. seeds, fertilisers) or traders (i.e. for abaca or rice) in terms of cash-advance, which will be repaid after the harvest. Credit is also offered by co-operatives for their members, but the lending sum will not exceed a few thousand Philippine Pesos, which would not suffice for such a large project. Therefore, the likelihood of small-scale farmers investing in this kind of (agro)-forestry project is only given, when they (i) are either supported by a development project (as has been the case for the pioneering farmers), or (ii) have own means in terms of paid employment or other, or (iii) have access to seedlings by a co-operative or farmers association (as is the case for the farmers association in Cienda, Baybay).

The annual income (discounted and averaged over 25 years) which can be achieved by a RF farm varies from 101,161 PhP (Table 3, annuity RF kaingin, 9% discount rate) to 35,611 PhP or even a negative value (Table 4, RF farm A and C, discount rate 9%). An unskilled farm labourer could expect a payment of 150 PhP/day in the year 2008. Assuming that he would find work five days a week and 50 weeks a year, this could sum up to 37,500 PhP/year. (Generally, day workers with such a low income would not pay any tax on their income.) But it is unlikely that he would find work for every day. A lecturer at the Visayas State University in Baybay has a net income of 144,000 PhP a year (Table 5). The average income of the surveyed population in 2007 was 20,714 PhP per capita or 82,231 PhP per household. The income which local RF farmers can achieve with plots of one hectare in size is in the average range of a per capita income and would therefore require another income source in order to suffice for the household in total.

Table 5. Average yearly net income in PhP of different households in Leyte, Philippines, 2007

	Likely income (PhP/year)
Rainfo kaingin	45,236
Rainfo coconut	54,186
RF farmers Baybay area	20,900
University lecturer	144,000
Skilled worker	80,000
Unskilled agricultural worker	30,000

PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
Figures are based on the results of own survey, 2007

Apart from the high investment costs there are other problems related to the financial success of RF. These are: lack of markets for high-value lumber and the complicated and bureaucratic procedure, which farmers have to undertake to harvest their trees. RF is based on the use of high-value, indigenous trees. To prevent illegal logging a logging ban was introduced in 1999 for indigenous species in the Philippines (Göltenboth and Hutter 2004). Farmers are required to register their trees with the Department of Environment and Natural Resources to be allowed to harvest them and sell the lumber. While the logging ban was meant to protect the little that remains of the primary forest, it also seems to inhibit the planting of trees, especially of the high-value indigenous trees, by small-scale farmers (Harrison et al. 2007). The supply of this lumber is limited but the demand by customers still exists, leading to an illegal market. In 2003, a survey by the VSU found that of the nineteen furniture makers around Baybay nine bought their lumber from illegally-operating chainsaw owners, while the remaining ten did not indicate where they bought the lumber, presumably because the sources were also illegal (ITE and GTZ 2006). Results from this study in February 2008 were similar. The five respondents (furniture makers and lumber dealers) from the area of Baybay said they still receive lumber from illegal sources since it is difficult to get high-value lumber otherwise.

4.3.2 Adoptability of Rainforestation Farming

When discussing financial and ecological benefits of an agroforestry system such as Rainforestation Farming, it has to be evaluated if farmers are actually adopting the system outside of the project. Some household characteristics proxies are often used for adoptability studies (Pattanayak et al. 2003) and are presented in Table 6. RF farmers and exotic tree farmers had a higher percentage of upland fields cultivated and both groups had significantly higher slope of land than farmers without timber trees. Flat land is usually used for rice farming, while agroforestry might be carried out on land which cannot so easily be used for annual crops. Farmers adopting RF, and their children, are on average significantly better educated than farmers without timber trees.

Table 6. Comparison of household characteristics of Rainforestation farmers and other Baybay farmers in Leyte, Philippines, 2007

Household characteristics	Rainforestation farmers (n=25)	Farmers without timber trees (n=32)	Exotic tree farmers (n=14)
Age male	58.30	55.61	53.92
Education adults[1]	2.64^{A}	2.25^{B}	2.46^{AB}
Education children[2]	2.45^{a}	1.75^{b}	1.75^{ab}
Land tenure (% of respondents who own majority of their farm land)	92.0^{A}	34.4^{B}	$50,0^{B}$
Farm land owned (%)	83.02^{a}	31.0^{b}	47.62^{b}
Farm size per capita (ha)	1.53^{a}	0.40^{b}	0.51^{b}
Percentage upland cultivated	63.36^{ab}	41.77^{a}	75.71^{b}
Slope of land cultivated[3]	3.25^{a}	3.50^{b}	3.17^{a}
Membership in organization (%)	72.0^{A}	40.6^{B}	71.4^{A}

Means with the same letter within rows are not significantly different (p<0.05 for small letters or p<0.1 for capital letters) according to Tukey's HSD Test or Chi-square (if no letters are used, there are no significant differences)
1: from 1=illiterate to 4=college
2: from 1=no grown-up child at college to 4=all grown-up children at college
3: 1=very steep, 2=steep, 3=gently sloping, 4=flat

The great majority (92%) of RF adopters are land owners, but only 50% of exotic tree farmers and 34% of farmers without timber trees own the land they cultivate. RF farmers had significantly larger landholdings (averaging 4.48 ha) than exotic tree farmers (1.64 ha) and farmers without timber trees (1.22 ha). The average landholding of farmers in Region 8 (Eastern Visayas, encompassing 3 islands and including Leyte), is 2.19 ha, according to the census of the National Statistics Office in 2002 while it is 2 ha for the whole of the Philippines.

A closer look at the type of land ownership in Table 7 reveals that most RF farmers had land titles, while farmers without timber trees often had no formal document to prove their ownership.

Table 7. Type of land ownership in percentage of Rainforestation farmers and other Baybay farmers in Leyte, Philippines, 2007

Type of ownership	Rainforestation farmers (n=25)	Farmers without timber trees (n=32)	Exotic tree farmers (n=14)
None	4.0	59.4	36.6
Titled	64.0	18.8	35.2
Tax declared	28.0	15.6	22.5
No formal document	-	6.3	4.2
Stewardship certificate	4.0	-	1.4

No significant differences were found

Overall, the results seem to support the argument that farmers need a high degree of security, which is offered by the ownership of the land and larger landholdings, to invest in agroforestry (Mercer 2004). Reasons for not planting trees, stated during the survey, were either a) not enough land area available (n=11) or b) not my own land (n=10). Baynes (2007) reports about a forestry extension program with 22 farmers in Southern Leyte, the Philippines, where the participants had relatively large landholdings and other income sources available and/or owned land which was unproductive, and therefore showed interest in planting trees. Similar results were reported by Emtage and Suh (2004) from a survey of 203 households in Leyte, Philippines, indicating that households planning to plant trees had higher resources.

To estimate if the RF system is likely to be more widely adopted, it was investigated if the system has spread to farmers outside the RF farming associations, inquiring with RF adopters and the two RF farmers associations for this purpose. Outside of Baybay there are only three cooperators in the municipality of Ormoc and two in Biliran province, who started a few years ago. Another study determined that the RF technology, applied by individual farmers, had not transferred to neighbours or friends (Velarde 2007). The two farmers associations transferred the technology to their members; nine could be identified and were included in the survey. Some members pointed out others to us, but these had only planted one lumber tree species at the side of their fields or only planted some fruit trees or exotic timber trees, such as *Gmelina arborea* or *Acacia mangium*; these farmers were consequently not included as RF farmers.

While the concept has not been widely adopted by small-scale farmers, it is spread by Haribon, a Philippine environmental organisation, through their reforestation projects. Several private companies, i.e. Del Monte, have also reforested large areas on other islands of the Philippines following the RF concept. The Department of Environment and Natural Resources had an official decree in 2004, stating that they will use the RF concept for their reforestation activities.

4.4 Conclusions and Policy Implications

The financial calculations show that Rainforestation Farming can be profitable for farmers, but only if the plot is well managed. On contrary it even reaches a negative Net Present Value if no intercrops are planted and low value timber species are chosen. Even for the well-managed plots, farmers need to have other resources to rely on for the investment costs, and while they wait 20 years or longer for their profit. Comparisons of RF farmers and other Baybay farmers indicated that the RF adopters did not represent the typical small-scale farmer, having significantly larger landholdings and being mostly owners of their farm land. Most of the farmers had generated very little or no income from their Rainforestation Farming plot. It has to be taken into account that the early RF adopters obtained their seedlings for free from the project; some even got their trees planted and were themselves responsible only for the following maintenance. One of the later adopters, belonging to a RF farmers association, reported that he paid for his seedlings, and the other later adopters collected the seeds themselves, having acquired the necessary knowledge.

Several of the surveyed smallholders were growing timber trees, but of exotic species, predominantly *Gmelina*. Despite regarding *Gmelina* timber as having a low value and believing that the tree is prone to typhoon damage, *Gmelina* continues being one of the farmers' favourites, even among many RF farmers. Several reasons for this can be suggested: *Gmelina* seedlings are readily available, the tree can be harvested in as few as 10-12 years, it has a certain, though low, market value, and the legal procedure to harvest the trees is less strict. The indigenous timber is highly valued, but has a longer rotation, is more demanding in its cultivation, and marketing, under the current legal frame, is difficult.

Only few economic studies were carried out regarding the RF project so far (Dirksmeyer 2000; Ahrens et al. 2004 and Neuberger 2005). While these studies showed that the system can be highly profitable, the investment costs and risks are very high compared to coconut farming or shifting cultivation. It seems that RF has only been taken up by few farmers after the start of the project and is better known outside of Leyte than among small-scale farmers on Leyte. A possible reason for the low adoption rate is the low short-term rentability.

Rainforestation Farming as a concept aimed at small-scale farmers remains a pilot project. It seems unlikely that farmers, having little other income sources, will adopt this system in great numbers. Since the system was only spread through the farmers associations and not by individuals, the Institute of Tropical Ecology at the VSU consequently promotes RF through training of farmers associations. Bertomeu (2005:8-9) recommends in his financial analysis that farmers could profit most if they gradually plant tree hedgerows, or rotational timber fallows; it

> "is more acceptable to farmers (i.e. more profitable and feasible [and] less risky [...]) because it provides higher returns to land and reduces the risk of agroforestry adoption by spreading over the years labour and capital investment costs and the economic benefits accruing to farmers from trees".

If responsible policy makers are seriously interested in encouraging small-scale farmers to become tree farmers, harvesting regulations should be accustomed to the needs of this group (suggestions have been made by Harrison et al. (2007) how this could be achieved). Continuing the advising activities to the farmers seems crucial for the success of the Rainforestation Farming systems. In order to be able to carry out this task, financial assistance to the farmers as well as to the responsible agencies or institutions will be necessary. Without further assistance (as has been granted to the first adopters in kind of seeds and sometimes also labour) resource-poor small-scale farmers will stay reluctant to convert their farm if they have little or no other means for securing their livelihood.

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Appendix 1: Cash flow table of Rainforestation Farming based on kaingin[1] farm (0.5 ha kaingin, 0.5 ha RF), based on Ahrens et al. 2004

Year	Activities	Costs (PhP)	Revenues (PhP)	Cash flow (PhP)
0-15	Seedlings	10,118	-	-10,118
0	Land preparation[2]	20,298	-	-20,298
1	Weeding/ maintenance	95,215	47,033	-48,182
2	Weeding/maintenance	93,793	60,779	-33,014
3	Weeding/maintenance	74,959	63,466	-11,493
Ø4-12	Maintenance	41,207	78,032	36,823
13	Harvesting, maintenance	274,728	1,998,104	1,723,376
Ø14-24	Maintenance (Harvesting)	53,319	181,101	127,782
25	Final harvest	132,122	672,979	540,857
SUM of 25 years		1,609,532	5,536,749	3,927,226
Ø0-25	Unpaid family labour	45,000	-	-
SUM of 25 years incl. family labour		2,734,523	5,536,749	2,802,226

Discount rate	6.5%	9%	15%
Net Present Value excl. family labour	1,419,511	993,658	444,331
Net Present Value incl. family labour	825,606	506,642	108,445

1: shifting cultivation
2: includes brushing, lay-outing, staking, hauling, digging and planting
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

Appendix 2: Cash flow table of Rainforestation Farm A (1 ha), former coconut farm, based on farmers' records in ITE and GTZ (2006) and own survey data

Year	Activities	Costs (PhP)	Benefits (PhP)	Cash flow (PhP)
0	Seedlings, land preparation[1]	132,905	21,675	-111,230
1	Maintenance, harvesting	3,000	20,898	17,898
Ø 2-12	Maintenance, harvesting	5,156	36,353	31,197
13	Harvesting	12,120	222,080	209,060
14	Harvesting	12,120	220,271	208,151
Ø 15-24	Maintenance	6,060	45,474	39,414
25	Final harvest	12,120	484,413	472,293
SUM of 25 years		289,576	1,823,965	1,534 389

Discount rate	6.5%	9%	15%
Net Present Value	513,824	349,793	141,245

1: includes brushing, lay-outing, staking, hauling, digging and planting
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
Family labour is included in the calculations, since it was not possible to calculate it from farmers' recordings; annual family labour for maintenance is estimated to average 4,000 PhP per year

Appendix 3: Cash flow table of Rainforestation Farm B (1 ha), many fruit trees planted, based on farmers' records in ITE and GTZ (2006) and own survey data

Year	Activities	Costs (PhP)	Benefits (PhP)	Cash flow (PhP)
0	Seedlings, land preparation[1]	52,881	-	-52,881
1	Seedlings, maintenance	27,301	-	-27,301
Ø 2-12	Maintenance, harvesting	6,174	21,574	15,400
13	Harvesting	8,320	246,799	238,479
Ø 14-24	Maintenance	3,840	50,487	46,647
25	Final harvest	21,143	209,693	188,550
SUM of 25 years		219,845	1,249,141	1,029,296

Discount rate	6.5%	9%	15%
Net Present Value	306,787	188,695	40,606

1: includes brushing, lay-outing, staking, hauling, digging and planting
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
Family labour is included in the calculations, since it was not possible to calculate it from farmers' recordings; annual family labour for maintenance is estimated to average 4,000 PhP per year

Appendix 4: Cash flow table of Rainforestation Farm C (1 ha), vacant area, based on farmers' records in ITE and GTZ (2006) and own survey data

Year	Activities	Costs (PhP)	Benefits (PhP)	Cash flow (PhP)
0	Seedlings, land preparation[1]	51,440	-	-51,440
1	Maintenance, harvesting	12,500	-	-63,940
Ø 2-12	Maintenance, harvesting	3,009	-	-3,009
13	Harvesting	5,800	157,926	152,126
14	Harvesting	5,800	159,512	153,712
Ø 15-24	Maintenance	2,900	10,648	7,748
25	Final harvest	11,600	381,847	370,247
SUM of 25 years		149,239	805,765	605,126

Discount rate	6.5%	9%	15%
Net Present Value	154,642	77,405	-10,660

1: includes brushing, lay-outing, staking, hauling, digging and planting
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010
Family labour is included in the calculations, since it was not possible to calculate it from farmers' recordings; annual family labour for maintenance is estimated to average 4,000 PhP per year

Appendix 5: Cash flow table of existing coconut plantation (1 ha) based on Ahrens et al. 2004

Year	Activities	Costs (PhP)	Benefits (PhP)	Cash flow (PhP)
Ø 0-25	Harvesting, maintenance	21,638	50,544	28,906
25	Lumber harvest	-	-	60,000
SUM of 25 years		562,593	1,314,144	811,551

Discount rate	6.5%	9%	15%
Net Present Value	393,923	319,793	217,580

Copra price used was 20 PhP/kg
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

Appendix 6: Cash flow table of *Gmelina* plantation (1 ha) based on Ahrens et al. 2004

Year	Activities	Costs (PhP)	Benefits (PhP)	Cash flow (PhP)
0	Seedlings, land preparation[1], fertilization	23,517	-	-23,517
1	Pest control, fertilization, weeding	7,908	-	-7,908
Ø 2-5	Maintenance	985	-	-985
6	Harvesting	66,157	158,711	92,554
Ø 7-11	Maintenance	689	-	-689
12	Harvesting	218,916	631,968	413,052
13	Seedlings, land preparation, fertilization	18,186	-	-18,816
14	Pest control, fertilization, weeding	7,908	-	-7,908
Ø15-18	Maintenance	985	-	-985
19	Harvesting	66,157	137,668	71,511
Ø20-24	Maintenance	689	-	-689
25	Final harvest	218,916	675,960	457,044
SUM of 25 years		642,434	1,604,307	961,873

Discount rate	6.5%	9%	15%
Net Present Value	242,251	165,022	67,417

1: including burning, digging, planting
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

Appendix 7: Cash flow table of new coconut plantation (1 ha) based on Ahrens et al. 2004

Year	Activities	Costs (PhP)	Benefits (PhP)	Cash flow (PhP)
0	Land preparation, seedlings, fertilizer, weeding[1]	15,975	-	-15,975
Ø1-6	Weeding, fertilizer	6,475	-	-6,475
7	Harvesting, maintenance	10,266	12,636	2,370
8	Harvesting, maintenance	14,057	25,272	11,215
9	Harvesting, maintenance	16,584	33,696	17,112
10	Harvesting, maintenance	19,111	42,120	23,009
Ø 11-25	Harvesting, maintenance	21,638	50,544	28,906
25	Lumber harvest			60,000
SUM of 25 years		439,415	871,884	432,469

Discount rate	6.5%	9%	15%
Net Present Value	140,166	84,882	18,232

1: includes clearing the area, lay outing and digging, hauling and planting
Copra price used was 20 PhP/kg
PhP=Philippine Peso, 100 PhP equal approximately 1.78 € on June 12, 2010

5. Discussion and Conclusion

5.1 Methodological considerations

The use of indicators for assessing sustainability of agricultural systems is widely used and also widely accepted, as illustrated by numerous projects and resulting publications dealing with identifying sustainability indicators (SIs) and creating and/or improving frameworks. However, it remains a heavily criticised and debated topic, just as the definition of sustainability itself (be it for development purposes or focused on agricultural systems). Notwithstanding, it is argued here that the assessment of sustainability of farming systems can be a useful undertaking with a useful outcome. It will be discussed further, what factors are important when discussing sustainability and specifically the evaluation of sustainability of agriculture and farming systems by the means of using indicators.

Sustainability in agriculture (and in general) depends on anticipating uncertainty or managing risk: we do not deal with simply predictable, deterministic systems (Pearson 2003). The challenge is therefore not to identify a universally applicable set of indicators, or even a composite index, but to identify methodological tools for facilitating a discussion of sustainability and to start a process between researchers, farmers and other stakeholders, so that development and implementation of indicators can take place in a participatory manner.

Not all authors agree with the idea of sustainability as an insecure, dynamic concept. Many expert-led and quite reductionist frameworks for indicator identification have been developed (i.e. Bossel 2001) and authors have favoured (and do favour) a common set for comparison of farming systems instead of locally identified site-specific sets (i.e. Gomez et al. 1996). More recently, though, a participatory identification process and simultaneously a move towards site-specific indicators sets, has been advocated by several authors (Fraser et al. 2006; King et al. 2000; Freebairn and King 2003). "It is [now] generally perceived that [...] [relying on managers coming from outside] led to a number of failures as these managers rarely had the benefit of detailed local knowledge and failed to generate community support for policy changes" (Fraser et al. 2006:126).

In order to identify and group indicators for evaluating sustainability of farming systems, this study applied a framework developed for a qualitative analysis of livelihoods at the village or catchment level, the Sustainable Rural Livelihoods (SRL) Framework. In this study, it has been used to guide the discussion and the grouping of indicators during focus group discussions with farmers as well as in interviews with other stakeholders, active in extension advice. The notions of the five capital assets of the SRL Framework are now widely used; especially the terms of natural capital and social capital (i.e Cramb 2005; Pretty and Ward 2001) have gained importance. In the context of identification of SIs, the framework has been applied or suggested i.e. by

Campbell et al. (2001), Cromwell et al. (2001), Fernandes and Woodhouse (2008) and Rao and Rogers (2006). The framework has proven to have several advantages, including that (i) indicators derived from capital assets can be selected on the basis of being consistent with desirable (sustainable) outcomes (Fernandes and Woodhouse 2008); (ii) identifying indicators grouped under the five capital assets assures an equally distributed set of indicators without bias towards the ecological or economical side (Rao and Rogers 2006); (iii) the concept is well suited for application in group discussions, since the idea of capitals is close to farmers perceptions of their livelihoods and the success/sustainability of their farming systems. Serrat (2008) points out that it acknowledges the need to move beyond narrow sectoral perspectives and emphasises seeing the linkages between sectors; this might be especially helpful when scientists from different disciplines as well as diverse stakeholders are coming together. The framework has been criticised for missing analytical strength for selection of SIs, though, since the search for a fitting indicator set remains rather open without structuring it closer (Freebairn and King 2003). Serrat (2008) criticises that the SRL framework underplays the fact that enhancing the livelihoods of one group can undermine those of another. This notion is of particular importance when sustainability is defined locally: the objectives of neighbouring communities have to be regarded as well, since sustainability cannot be reached at the expense of others.

While the SRL Framework is useful in the local context, it is not well applicable on a wider (above the regional) scale. For this purpose Rao and Rogers (2006:447) propose a combination of the Driving force-State-Response (DSR) Framework to identify causal chains, and the use of the SRL framework to “identify multidimensional attributes of agricultural sustainability indicators at the farm and higher levels. Further, for aggregating the indicators into an agricultural sustainability index, the general approach followed by the widely accepted Environmental Sustainability Index is adopted”. They suggest that the indicators at the lower levels of spatial hierarchies can be scaled to higher levels using GIS tools.

Summarising it can be stated that the SRL Framework is a useful tool for discussing the topic with stakeholders from diverse backgrounds and for defining a locally relevant set of indicators. But it remains difficult to guarantee a selection of the ‘right’ set of indicators giving a balanced picture of the sustainability of farming systems.

5.2 Evaluation of sustainability of farming systems

In this case study, a set of 15 indicators was identified, by the rankings of stakeholders and further statistical analysis, and used to compare three groups of farmers, with two groups of farmers being ‚tree farmers’, practicing agroforestry on part of their available land area.

Tree farmers scored higher on several of these indicators (*education level, available land area, soil quality*). The differences between those farmers having indigenous trees (the Rainforestation farmers) and farmers without trees were mostly significant. But it is not possible to conclude if this is an effect of the farming systems practiced or a pre-requisite for investments in tree farming. Other studies concerning agroforestry often come to the conclusion that farmers are in need of (at least) tenure security to invest in agroforestry (i.e. Emtage and Suh 2004; Herbohn et al. 2004; Pattanayak et al. 2003). The better result of the tree farmers in this study is likely to be an effect of both, the farming systems practiced and the original higher endowment with resources: Rainforestation farmers stated that soil quality improved some years after having taken up the system. But the higher education level of most tree farmers has most likely led to their engagement in more complex farming systems. A difficulty when defining a local (or any) indicator set is the comparison of different farming systems. Some indicators will apply to certain farming systems and not to others, i.e. the use of pesticides is common in rice farming, but has no meaning for copra production. The (absence of) soil erosion is of importance on slope land, but not on even rice fields.

While the Rainforestation Farming system might have ecological and even financial advantages, the comparison of this system with other (agro-)forestry systems showed that the risk is very high. Consequently the early adopters do not represent the typical resource-poor small-scale farmer, but are already (relatively) better off. They had either unused land areas or substantial off-farm income available, and most could afford to wait up to 13 years to reach a positive cash flow and gain back their initial investment, without having earned anything. While they are likely to profit in the long run, they either need higher resources or external (financial) assistance. This finding supports the notion that farmers are only oriented towards long-term sustainability, when they have enough resources to rely on for their daily livelihood (Neef et al. 2003). Cromwell et al. (2001) and Morse et al. (2001) report from their case studies in Africa that farmers sustainability strategies often did (or better could) not support the ‘western’ understanding of long-term sustainability: the focus was on improving their current livelihood, even when this would lead to soil degradation in the long run.

The political framework plays a major role for the adoption of more sustainable farming systems by smallholders. In many developing countries, policies are not in favour of this group (Reed et al. 2006); in the Philippines current policy regulations regarding harvesting and marketing of indigenous timber are more hindering than encouraging smallholders to plant trees (Harrison et al. 2007). Pretty and Ward (2001:221) report that “in the Philippines, many tenant farmers’ groups who have improved their local natural capital through sustainable agriculture have found that this has simply encouraged landlords to take back the formerly degraded farm without paying compensation for the improvements."

5.3 The use of (locally identified) indicators

Indicators must be relevant to local people, and in order to reach this goal it is absolutely necessary to involve local people in the process. The focus groups and interviews employed for this study helped to create a long and complex list of sustainability criteria, providing a comprehensive assessment of local social, environmental and economic issues. A strength of relying on local stakeholders is this complexity since "environmental policy and management is too often driven by simple and incomplete sets of indicators" (Fraser et al. 2006:124). While stakeholders in this study (namely farmers) suggested several very specific criteria (i.e. *distance to the next field*), these were generally not ranked high, not even by farmers. Therefore the ranking process already led to a much smaller, common list of indicators. Others had to be ruled out for measurability reasons (i.e. *biodiversity* or even *incidence of pests*), so that it was possible to identify 15 indicators for the comparison in the end.

With regard to the ranking of identified sustainability criteria by farmers and other stakeholders, the differences found in this study were quite small. Greater differences were observed between ranking of farmers groups during the discussions and individual farmers. This indicates the importance of having several stakeholders from diverse backgrounds to make sure that all important criteria are really identified. From a methodological point it shows the importance of minimising (if possible) the influence of powerful group leaders during focus groups.

Generally, in other studies, greater differences between stakeholders' perceptions were detected (i.e. Purnomo et al. 2005; Berninger et al. 2009). Mostly, these studies were relying on a bigger sample size. From the small group which was involved here (30 farmers and 18 other stakeholders), it is difficult to gain many statistically significant results. Wallis (2006) reports that key stakeholder organisations in Australia held similar values and largely agreed on what they consider to be important indicators for assessing regional sustainability. Summarising, the most important point is to discuss the issue of sustainability with several stakeholders to gain an insight into their perceptions. If controversies arise, these can be discussed further and an agreement will be reached more likely, than when implementing an externally identified indicator system from the outside.

Another point of discussion is the use of quantitative versus qualitative sustainability indicators. Most authors are in favour of quantitative indicators, since they provide measurable, and therefore seemingly more scientific, results. For this study, indicators were to a great part selected for their measurability and ease to use, since it was the aim to develop a set of indicators which can easily be measured repeatedly. Several are ‘effort’ indicators, (i.e. *number of soil conservation measures used*) and fewer are ‘effect’ indicators (i.e. *soil quality*). Freebairn and King (2003) argue that ‘soft’ indicators, measuring behavioural change can often be more effective in measuring sustainability, if sustainability is understood as a dynamic process. Indicators measuring changes in natural resource attributes (i.e. soil or water quality) might take years to measure any significant change. Therefore, indicators reflecting changes in behaviour or attitude might be more relevant and changes might be quicker and easier to identify, therefore allowing a re-evaluation and possible change of current practices. King et al. (2000:638) found that often indicators used by farmers were similar to those suggested by the scientific community, but expressed in different terms or using simpler methodological tools. Other studies comparing expert- and community-selected indicators found also a great deal of overlap between these (Stocking and Murnaghan 2001 cf. Reed et al. 2005). In this study, Rainforestation farmers reported that soil quality improved some years after having taken up the system, a fact which could not be proven satisfactorily yet by several studies, due to the many factors influencing soil quality (i.e. Marohn 2007). But small-scale farmers will most likely be more convinced by the statement of other farmers than by scientifically proven figures and numbers.

5.4 Conclusions

Sustainability is as much a process as an endpoint. Maybe more important than the debate about which indicator set and, corresponding, which framework, is the right one to use, is that an evaluation is taking place and a discussion among stakeholders (including scientists and policy makers) is started. For example: although it cannot be determined if tree farmers are better off because they practice their agroforestry system or because they were better off originally, it is useful to carry out the evaluation and detect the difference. The underlying reasons can then be analysed and discussed further. “The key issue is that we move towards systems that we perceive are more sustainable, and that this is a journey without a finite destination” (Freebairn and King 2003:234). The importance lies therefore on a methodology to enable discussion and an identification of locally relevant indicators rather than concentrating on the weighting of indicators and in finding ‘optimal’ solutions (López-Ridaura et al. 2002).

In order to ensure sustainability it does not suffice to develop methods for sustainability evaluation and involve stakeholders in this process. Stakeholders, farmers in particular, have to be given a voice in the process of political decision-making, in order to pursue their options regarding sustainability of farming systems.

A necessity are repeated measurements to see if a change in indicator values can be observed and if these can really be connected to an analysis of sustainability. When using a simple method of indicator identification, such as the one used here, and simple methods of collecting primary data generation, such as the use of questionnaire surveys of farms, repeated measurements are more likely to take place. A shortcoming of this study, though, is that no second consultation round has been carried out, discussing the results of the evaluation with the farmers.

To some extent the methodology achieves a compromise between technical judgements and social preferences. Doing so, it acknowledges complexity and uncertainty and thus is more in line with a co-evolutionary perspective, corresponding to the dynamic nature of sustainability.

6. Summary

The Philippines are a country of over 7,000 islands, and Leyte, where this study takes place, is the 8th largest. Forest cover of the country has been greatly reduced in the past and slightly recovered since, and is estimated at around 24% of land surface currently. Small-scale farmers have to survive on small landholdings (2 ha on average and mostly under 5 ha), face insecure land tenure, and the high population density leaves little scope for gaining new agricultural land. Their farming systems continue to form an important part of their livelihoods, but often their strategies are unsustainable in the long run. While the need for evaluating common farming systems and compare them with new alternatives exists, it is important to involve local stakeholders in the search for suitable sustainability indicators. In this study, the search was based on the Sustainable Rural Livelihoods Framework and therefore organised under its five types of capital assets: natural, financial, physical, human and social capital.

Farmers from five study sites along the Western side of Leyte were gathered in eight focus group discussions to discuss the issues of success and sustainability of their farming systems and identify and rank possible criteria for an evaluation of sustainability. Nine other stakeholders from the same sites were interviewed individually. In a second research phase, all 49 identified criteria were given to 30 farmers and 18 other stakeholders for ranking. Using the results of the ranking, identified criteria were analysed further for their usefulness as indicators.

The main source for the necessary data came from a survey among 71 farmers from the municipality of Baybay, practicing different farming systems. One group of farmers cultivate mainly rice and coconuts. A second group of farmers have (additionally) planted exotic timber trees (usually *Gmelina* and *Acacia mangium*). The third group of farmers have (additionally) planted indigenous timber trees in a system named ‘Rainforestation Farming’. Survey data were analysed statistically and the indicators identified were tested regarding their usefulness for comparing the three groups of farmers. Rainforestation Farming, as promising alternative farming system, was analysed further regarding financial aspects and its adoptability with regard to small-scale farmers, comparing it with other (agro-)forestry systems.

The Sustainable Rural Livelihoods Framework worked well with the farmers and helped in identifying suitable evaluation criteria. The importance of the five capital assets groups was perceived similarly by farmers and other stakeholders in the ranking, but ranking results for single criteria, such as *soil quality, housing quality* and *membership in organisation*, differed. The same holds true when comparing ranking results for the four study regions, where the individual ranking was carried out: significant differences existed for single, mostly financial, criteria (i.e. *record-keeping, insurance, investment costs*) but not for importance of the five capital asset groups. The ranking results differed quite substantially, though, between focus groups and indi-

vidual farmers. This indicates on the one hand the influence of group leaders on the ranking results of the groups. But on the other hand, it is certainly due to the fact that farmers were provided with a complete list of criteria for the individual ranking, including several criteria which they had not thought of previously, but which they still regard as important.

Fifteen criteria (three out of each capital asset group) were chosen as indicators for comparing the three farmers groups. Based on this set of indicators, Rainforestation farmers were the group scoring significantly higher on most indicators (*education level adults* and *children*, *land available per capita* and *percentage of land owned*, (perceived) *soil quality*, *number of soil conservation measures used*, *membership in organisation* and *number of contacts with extension advice*) than farmers without timber trees. Farmers having planted exotic timber trees scored closer to Rainforestation farmers. But to be able to judge if the specific farming system leads to a more sustainable livelihood, time series data would have been necessary. The data of this study allowed concluding that tree farmers planting (indigenous or exotic) timber trees are endowed with higher resources – such as more land, higher income, and higher education levels. Most likely they had these resources before starting their farming systems and they possibly put them into a good starting position for investments in tree farming. In addition, these farmers were also more actively engaged in organisations and had more contact to extension agents, therefore enhancing their social (and human) capital, improving their position further. The higher score regarding (perceived) *soil quality* and (non-) *use of pesticides* these farmers groups reached, compared to the farmers group without timber trees, are likely to be an outcome of the farming system practiced.

Taking a closer look at financial feasibility and adoptability of Rainforestation Farming shows, that the system has the potential to be profitable, but this comes with a high risk: investment costs are very high and it takes a long time to regain them, up to 13 years. Consequently, the first adopters either had unused land areas or substantial off-farm income, and the subsequent adoption rate is low. When discussing sustainability of farming systems, aspects of risk (i.e. amount of investment costs and time span to regain it) and adoptability (i.e. skills and knowledge) have to be considered as well.

Sustainability has to be understood as a dynamic and not a static concept and the concept of sustainable land management must consequently evolve as well. This study tried to add further findings regarding the use of suitable methods for this cause, but as already mentioned above, time series data would be necessary to assess the progress of farming systems towards ‘sustainability’.

7. Zusammenfassung

Der philippinische Staat besteht aus über 7,000 Inseln. Die vorgestellte Studie wurde auf Leyte, der achtgrößten Insel durchgeführt. Deren Waldfläche wurde stark reduziert, hat aber in den letzten Jahren wieder leicht zugenommen, Schätzungen kommen auf 24% bewaldeter Fläche. Die philippinischen Kleinbauern bewirtschaften Parzellen von durchschnittlich 2 ha und meist kleiner als 5 ha. Dabei sind die Landrechte sehr unsicher, und die hohe Bevölkerungsdichte macht die weitere Erschließung von Agrarflächen schwierig bis unmöglich. Für die Kleinbauern ist die Landwirtschaft ein wichtiger Teil ihrer Lebensgrundlage, aber oft sind die praktizierten Anbausysteme auf lange Sicht nicht nachhaltig. Es ist notwendig bestehende Anbausysteme mit neuen Alternativen des Anbaus auf ihre Nachhaltigkeit hin zu untersuchen. Dabei ist es wichtig lokale Stakeholder in die Suche nach geeigneten Nachhaltigkeitskriterien und Indikatoren mit einzubeziehen.

Für die Suche nach geeigneten Nachhaltigkeitskriterien wurde der ‚Sustainable Rural Livelihoods Framework' angewandt, welcher die fünf verschiedenen Kapitalformen unterscheidet: natürliches, finanzielles, physisches, menschliches und soziales Kapital. Es wurden acht Gruppendiskussionen mit Kleinbauern an fünf Studienorten der Westküste von Leyte durchgeführt. Dabei wurden Kriterien zusammengestellt und bewertet, die die Kleinbauern für den Erfolg und die Nachhaltigkeit ihrer Anbausysteme verwenden (würden). Neun weitere Stakeholder an den jeweiligen Orten wurden individuell interviewt. In einer zweiten Feldphase wurden die identifizierten 49 Kriterien von 30 Kleinbauern und 18 anderen Stakeholdern individuell bewertet. Aufbauend auf den Ergebnissen der Bewertung wurden die identifizierten Kriterien weiter auf ihre potenzielle Verwendung als Indikatoren untersucht.

Die hierfür erforderlichen Daten stammen hauptsächlich aus einer Umfrage mit 71 Kleinbauern aus dem Bezirk Baybay, die verschiedene Anbaumethoden praktizieren. Die erste Gruppe Kleinbauern baute hauptsächlich Reis und Kokosnüsse an. Die zweite Gruppe Kleinbauern hatte (zusätzlich) nicht indigene Baumarten gepflanzt (hauptsächlich *Gmelina* und *Acacia mangium*). Die dritte Gruppe Kleinbauern hatte (zusätzlich) einheimische Baumarten nach dem sogenannten ‚Rainforestation Farming' System gepflanzt. Die Umfrageergebnisse wurden statistisch ausgewertet und die identifizierten Indikatoren auf ihre Eignung hinsichtlich eines Vergleiches der drei Gruppen untersucht. Das Rainforestation Farming System wurde hinsichtlich ökonomischer Kennzahlen und der Akzeptanz unter Kleinbauern mit den anderen (Agro)forstsystemen verglichen.

Der Sustainable Rural Livelihoods Framework erwies sich als geeignet für Gruppendiskussionen mit Kleinbauern und als nützlich um geeignete Evaluationskriterien zu identifizieren. Die Bedeutung der fünf Kapitalformen wurde von Kleinbauern und anderen Stakeholdern gleichermaßen bewertet. Die Bewertungsergebnisse der einzelnen Kriterien wiesen einige signifikante Unterschiede auf, z. B. für *Bodenqualität*, *Wohnqualität* und *Mitglied in einer Organisation*. Dasselbe gilt auch für den Vergleich der Bewertungsergebnisse der vier Standorte, an denen das individuelle Ranking durchgeführt wurde: signifikante Unterschiede existieren für einzelne Kriterien, z. B. *Buchführung*, *Versicherung* und *Investitionskosten*, aber nicht für die fünf Kapitalformen. Deutliche Unterschiede gab es dagegen zwischen den Bewertungsergebnissen der Gruppendiskussionen und der individuellen Bewertung der Kleinbauern. Dies zeigt zum einen den Einfluss von Führungspersönlichkeiten auf die Gruppendiskussionen. Aber zum anderen ist es sicher darauf zurückzuführen, dass die Kleinbauern für die individuelle Bewertung die gesammelte Kriterienliste hatten, inklusive Kriterien an die sie selbst nicht gedacht hatten, die sie aber dennoch als wichtig erachteten.

Fünfzehn Kriterien wurden als Indikatoren für den Vergleich der drei Gruppen von Kleinbauern ausgewählt, je drei Indikatoren jeder Kapitalform. Basierend auf den ausgewählten Indikatoren erzielte die Gruppe der Rainforestation Kleinbauern für die meisten Indikatoren (*Ausbildungsstand Erwachsene und Kinder*, *verfügbares Land pro Kopf* und *Prozentanteil eigenes Land*, (geschätzte) *Bodenqualität*, *Anzahl von angewandten Bodenkonservierungsmaßnahmen*, *Mitgliedschaft in einer Organisation* und *Anzahl Kontakte mit Beratungsagenturen*) höhere Ergebnisse als Kleinbauern ohne Holz liefernde Baumarten. Die Gruppe Kleinbauern, die nicht indigene Holz liefernde Baumarten angepflanzt hatte, erzielten ähnliche Ergebnisse wie die Rainforestation Kleinbauern. Aber um beurteilen zu können ob das jeweilige Anbausystem zu einer nachhaltigeren Lebensgrundlage führt, wäre es notwendig diese Erhebung in zeitlichen Abständen zu wiederholen. Aus der Datengrundlage dieser Studie kann geschlossen werden, dass forstwirtschaftlich orientierte Kleinbauern mit indigenen oder nicht indigenen Baumarten über höhere Ressourcen verfügen – z.B. mehr landwirtschaftliche Fläche, höheres Einkommen und bessere Ausbildung. Es ist anzunehmen, dass diese Ressourcen vor der Aufnahme der jeweiligen forstwirtschaftlichen Anbausysteme vorhanden waren und die Kleinbauern sich somit in einer günstigen Ausgangsposition befanden für eine solche Investition. Die Kleinbauern die (indigene oder exotische) Bäume angepflanzt hatten, waren auch aktiver in Organisationen vertreten und hatten mehr Kontakt zu Beratungsstellen, wodurch sie ihr soziales (und humanes) Kapital erhöhen und so ihre Position weiter verbessern können. Das bessere Ergebnis im Hinblick auf (geschätzte) *Bodenqualität* und (nicht)-*Gebrauch von Pestiziden* sind wahrscheinlich ein Ergebnis des praktizierten Anbausystems.

Ein genauerer Blick auf finanzielle Aspekte und die Akzeptanz des Rainforestation Farming durch die beteiligten Kleinbauern zeigt, das das System sehr profitabel sein kann, gleichzeitig aber mit einem hohen Risiko verbunden ist: Die Investitionskosten sind sehr hoch und eine lange

Zeitspanne (bis zu 13 Jahren) ist nötig um diese zu amortisieren. Dementsprechend hatten die ersten Rainforestation Kleinbauern entweder ungenutzte Landflächen oder verfügten über genügend Einkommen aus anderen Quellen, und das System hat sich außerhalb des Projektes kaum unter den Kleinbauern verbreitet. Für einen Vergleich der Nachhaltigkeit von Anbausystemen ist es wichtig das potenzielle Risiko und die Adoptionsrate mit einzubeziehen.

Nachhaltigkeit ist ein dynamisches, kein statisches Konzept, daher muss sich auch das Konzept der nachhaltigen Landnutzung weiterentwickeln. Diese Studie hat versucht weitere Ergebnisse in Bezug auf geeignete Methoden für diese Weiterentwicklung beizusteuern. Aber, wie bereits erwähnt, um den Fortschritt von Anbausystemen hinsichtlich ihrer ‚Nachhaltigkeit' zu evaluieren ist eine Wiederholung der Erhebung in zeitlichen Abständen notwendig.

8. References

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Appendix 1: Questionnaire

Identification of Household, Respondent and Interviewer

Date and Time (from to) of Interview: __________ Name of Interviewer: ________________

Barangay: __________________________ Municipality: ________________________________

Additional Notes:

Q1. How many people are normally resident in this household? __________

Name/No.	Age (ys)	Sex	Civil status (code)	Relationship to hh head (code)	Education level reached (code)	Main Occupation (code)
				Household head		

Civil status: **1**=married, **2**=single, **3**=widowed, **4**=divorced
Relationship to hh head: **1**=husband, **2**=wife, **3**=daughter, **4**=son, **5**=sister, **6**=brother, **7**=mother, **8**=father, **9**=worker, **10**=grandmother, **11**=grandfather, **12**=other relatives.
Education level reached: **1**=none, **2**=elementary school, **3**=high school, **4**=college, **5**=vocational
Main Occupation: **1**=school, **2**=college, **3**=farmer, **4**=self-employed (business/trade), **5**=informal work, **6**=formal employment

Q2a. Years residing in this place? _____ **2b.** Years of farming? _____ **2c.** Type of farming system practiced mainly? ____

Q3a. Total farm size: ____ ha **3b.** How many parcels cultivated? ____ **3c.** Size of parcels? ___ to ____ ha

Q3d. How would you describe the majority of your land? (in percentage)
very steep: _______ steep: _______ gently rolling: _________ flat: ______________

Q3e. Where is the majority of you land located? (in percentage): lowland ___ upland ___

Q3f. Of this, how much is:

	in ha	Tenure agreement
Owned? (indicate who owns the land _________)		
Rented?		
Lent out?		
Other? (specify)		

Q3g. Of the parcels owned, how did you acquire these parcels?
purchased [ ], inherited [ ], common family land [ ], CARP [ ], other _______________

Q3h. Type of ownership: titled [ ], CSC [ ], tax declared [ ], no formal document [ ], other _______________

Q4. Crop enterprises (please rank in order of importance)

No.	Crop (indicate where and which crops are mixed)[1]	Area planted (ha)	Years used this way	Slope of parcel (code)	Distance of parcel from road	Distance of parcel from home	A&D land or timberland (TL)
	Coconut						
	Rice						
	Banana						
	Abaca						
Root crops							
Vegetables							
Other (specify)							

1: indicate by use of an arrow or other means which crops are mixed, **Slope of parcel: 1**=very steep, **2**=steep, **3**=gently sloping, **4**=flat

Q5. Trees based farming system (if applicable, please rank in order of importance)

No.	Tree species planted	No of trees	Area planted (ha)	Date planted	Slope of parcel (code)	Distance of parcel from road (in km)	Distance of parcel from home (in km)	A&D land or timber-land (TL)	Source of planting material (code)
Fruit trees									
Lumber trees									

Slope of parcel: 1=very steep, **2**=steep, **3**=gently sloping, **4**=flat;
Source of planting material: 1=LSU, **2**=ICRAF, **3**=MOA, **4**=own, **5**=neighbours, **6**=other__________________

Q6. Livestock (including poultry) enterprises beginning with most important

No.	Animal	Numbers	Exotic (tick)	Crossbreed (tick)	Indigenous (tick)	Years of rearing
	Carabao					
	Pigs					
	Chicken					
	Goats					
	Ducks					

Q7a. Area not used for farming: _________ hectares.

Q7b. Why? Conflicts over ownership [ ], long term investment [ ], theft of crop/animals [], fallow [ ] lack of labour [ ], other ____

Q8. What is the soil type on your farm? Clay [ ], loam [ ], sand [ ], silt [ ], other (specify) ____________________

Q9a. Do you have enough land for agricultural activities? Yes [ ], No [ ]

Q9b. If not, how much would be sufficient and what would you use it for? ____

Q10a. In general, how would you describe the fertility of your soils?

Parcel	Very high	High	Medium	Low	Slope (code)
1					
2					

Parcel	Very high	High	Medium	Low	Slope (code)
3					
4					

Slope of parcel: **1**=very steep, **2**=steep, **3**=gently sloping, **4**=flat

Q10b. How would you tell the fertility of your soil?

____

Q10c. What measures do you practice to improve soil fertility?

____

Q10d. Did or do you have problems with soil erosion? Yes [ ], No [ ]

Q10e. If yes, how often does/did it occur, how big was the surface affected and what measures did you take? ____

Q11a. Was there a flood or typhoon in the last 5 years (2001-2006)?

Year	Month	Incidence	Damage (crop)

Q11b. Were you ever short of water for crops or livestock in the last 5 years (2001-2006)?

Year	Month	Crop/livestock

Q11c. What is your main water source for farming? groundwater [ ], surface water [ ], rainfall [ ]

Q11d. Do you have to irrigate? Yes [ ], No [ ], if yes, frequency _______ method _______

Q12a. Which of the following soil and water conservation measures do you practice?
mulching [ ], fallowing [ ], crop rotation [ ], terracing [ ], contour cultivation [ ], other ______

Q12b. What percentage is the area of your farm where you use measures? _________

Q12c. If you do not use any, why not? ____

Q13. Which of the following agronomic measures do you practice?
desuckering [ ], pruning [ ], recommended spacing [ ], other __________________________

Q14. Crop **outputs** for cash crop and own consumption (including lumber/fruits) last 12 months

Crop[1]	Area harvested (ha)	Total produced (units)	Total quantity sold	Price (unit)	Own consumption (units)	No. of harvests/ year	Average yield /harvest	Average profit /harvest[2]
Copra								
Rice								
Banana								
Abaca								
Root crops								
Vegetables								
Fruits								
Lumber/firewood								
Other								

1: indicate by arrows (or otherwise) which crops are intercropped.
2: if they do not know details, ask how much they earn on average per harvest (after deducting costs).

Q15. Livestock output last 12 months

Animal	Product (underline)	Total Produced (Units)	Price per unit	Total quantity sold	Own consumption (units)
Carabao	Meat, milk, manure, rent				
	Meat, milk, manure, rent				
Pig	Meat, manure, piglets				
	Meat, manure, piglets				
Chicken	Meat, eggs, manure, fighting cocks				
	Meat, eggs, manure, fighting cocks				
Goats	Meat, milk, manure				
	Meat, milk, manure				
Ducks	Meat, eggs				
	Meat, eggs				
Other					

Q16a. Which percentage of your farm products are sold on the market? ___________

Q16b. How do you **market** your **major** products?

Product	Way of marketing (code)	Means of transport (code)	Costs for transport per unit	Other costs (ie labour, specify)

Way of marketing: 1=sell on market, **2**=sell to trader, **3**=co-operative, **4**=debt repayment, **5**=other (specify) _________________

Means of transport: 1=no transport, **2**=on foot, **3**=carabao, **4**=tricycle, **5**=multicab, **6**=lorry, **7**=other (specify) _______________

Q17. Type of storage for farm produce: in the house [ ], in the open [ ],
no storage facility [ ], other ________

Q18. Most common crop pests (including trees) and diseases

Pest/disease	Severity (code)	Crop/Tree affected	Method of control	Frequency of control	Name of chemical/ material used

Severity: **1**=Very severe, **2**=Severe, **3**=Mild, **4**=No incidence

Q19. Pre-harvest and post-harvest crop (tree) losses in the last 12 months (including theft)

Crop/tree	Cause of loss	Quantity stored (post-harvest loss only)	Quantity lost (Unit)
Rice			
Banana			
Abaca			
Coconut			
Vegetables			
Root crops			
Fruits (specify)			
Lumber/firewood			
Other (specify)			

Q20. Farm assets of the household

Item	Number	Year bought/build	Price (P/unit)	Estimated life
Farm machinery (specify)[1]				
Storage shed				
Animal barn				
Plough				
Harrow				
Spray pump				
Hoe				

1: i.e. hand tractor, rice thresher, chainsaw

Q21. Do you keep records of inputs and outputs on your farm? Yes [ ], No [ ]

Q22a. Input costs of farming system (for trees refer to Q24d) **excluding labour** for last 12 months

Crop	Type of input/ expenditure (code)	Quantity used	Price per unit	No. of times applied/year	Source of input	Total costs

Type of input: 1=fertiliser, **2**=pesticide/herbicide, **3**=certified seeds, **4**=non-certified seeds, **5**=machinery, **6**=other_______________

Note: ask for biological crop protection and fertilisation as well.

Q22b. Labour costs of farming system (for trees refer to Q24e) for last 12 months

Crop	Activity (code)	Who works (code)	How often /year	Days of work/ year	If wage labour pay/day	Total costs

Activity: 1= land preparation, **2**=planting, **3**=weeding, **4**=harvesting, **5**=post-harvest activities (i.e. copra or abaca drying, specify), **6**=other activities _________________________

Who does task: 1=husband, **2**=wife, **3**=daughter, **4**=son, **5**=sister, **6**=brother, **7**=male worker, **8**=female worker, **9**=grandmother, **10**=grandfather, **11**=male relative, **12**=female relative

Q23a. Input costs of livestock **excluding labour** for last 12 months

Livestock	Input (underline)	Quantity used (Units)	Price per unit	Source of input	Total expenses last 12 months
Carabao	Feed, vet services, other				
	Feed, vet services, other				
Pig	Feed, vet services, other				
	Feed, vet services, other				
Chicken	Feed, vet services, other				
	Feed, vet services, other				
Goats	Feed, vet services, other				
	Feed, vet services, other				
Other	Feed, vet services, other				
	Feed, vet services, other				

Q23b. Labour costs of livestock for last 12 months

Animal	Activity	Who works (code)	How often /year	Days of work /year	If wage labour pay /day	Total costs
Carabao						
Pig						
Chicken						
Goats						
Ducks						
Other						

Who does task: 1=husband, **2**=wife, **3**=daughter, **4**=son, **5**=sister, **6**=brother, **7**=male worker, **8**=female worker, **9**=grandmother, **10**=grandfather, **11**=male relative, **12**=female relative

Q24a. Do you have any trees planted (including fruit trees)? Yes [ ], No [ ]

Q24b. Are your trees DENR registered? Yes [ ], No [ ]

Q24c. Why are you **not** planting any trees? Long term investment [ ], lack of labour [ ], not enough land area [ ] not my own land [ ], other _______________

Q24d. Input costs of tree based farming system **excluding labour** for last 12 months

Tree species	Type of input/ expendi-ture (code)	Quantity used	Price per unit	No. of times applied/year	Source of in-put	Total costs/ year

Type of input: 1=seeds/seedlings, **2**=pesticide/herbicide, **3**= fertiliser, **4**=machinery, 5=other_________________

Note: if costs occurred only once (like barb wire or planting of trees), indicate year in the last row.

Q24e. Labour costs of tree based farming system for last 12 months

Tree species	Activity (code)	Who works (code)	How often /year	Days of work /year	If wage la-bour pay/day	Total costs

Activity: 1= land preparation, **2**=planting, **3**=pruning, **4**=weeding/ring weeding, **5**=thinning, **6**=harvesting (includ-ing cutting of trees, bark removal and trimming of small branches), **7**=post-harvest activities (including drying of logs), 8=other ______________________

Who does task: 1=husband, **2**=wife, **3**=daughter, **4**=son, **5**=sister, **6**=brother, **7**=male worker, **8**=female worker, **9**=grandmother, **10**=grandfather, **11**=male relative, **12**=female relative

Note: if labour costs occurred only once, indicate year in the last row.

Q25. Hours spent with daily farm work on average (indicate how many days a week) Husband _____ Wife _____ Children _____ Relatives _____ Employees ___

Q26. Do you have access to extension advice?

Access to	Details (name of institution)	Payment Status (code)	Cost per year	Frequency of contact (code)	Relevance of advice (code)
Municipal agricultural office					
Academic institutions					
Religious groups					
Others (specify)					

Payment status: 1=paid, **2**=free
Frequency of contact: 1=weekly, **2**=monthly, **3**=quarterly, **4**=half yearly, **5**=yearly
Relevance of advice: **1**=very relevant, **2**=relevant, **3**=not relevant

Q27a. Does any member of your household belong to any organisation? Yes [ ], No [ ]

Q27b. If yes, fill the table below in order of importance for the organisations

Household member (code)	Organisation	Position of responsibility (if any)	Fees paid (period)	Benefits to farming (code)	Type of benefits

Household member: 1=husband, **2**=wife, **3**=son, **4**=daughter, **5**=other _______________
Benefits: **1**=very important, **2**=important, **3**=marginal

Q28. Expenditures over last 12 months

	Cost per week	Cost per month	Cost per year	Who spends (code)
Food				
Fuel/firewood for cooking				
Alcoholics (tuba, beer, rum)				
Smoking				
Education				
Clothing				
Transport				
Water				
Electricity				
Leisure/fiestas				
Lotto/betting/cock fighting				
Medicine				

Who spends: 1=husband, **2**=wife, **3**=son, **4**=daughter, **5**=other _________________

Q29a. Major source of livelihood (in %)? farming _____, business _____, labour _____, other _______________

Q29b. Income from people in the household for the last 12 months

Person (code)	Type of work (code)	Frequency of payment (code)	Amount per period	How many periods?	Income earned
Total income earned					

Person: 1=husband, **2**=wife, **3**=son, **4**=daughter, **5**=other _______________
Type of work: 1=coconut harvesting, **2**=rice harvesting, **3**=sari shop, **4**=fishing, **5**=tricycle driver, **6**=handicraft, **7**=other __________
Frequency of payment: 1=daily, **2**=weekly, **3**=monthly

Q29c. Remittances in the last 12 months

Who sends (code)	How much	How often (code)	Total

Who sends: 1=husband, **2**=wife, **3**=son, **4**=daughter, **5**=others ________________
How often: 1=monthly, **2**=quarterly, **3**=half yearly, **4**=yearly

Q30a. Has any member of your household borrowed for farming purposes in the past **5 years** (including **cash advance**)? Yes [ ], No [ ]

Q30b. If yes, give details in the table below

Source of loan (code)	Who borrowed (code)	When borrowed	Amount	Interest rate	Particular use of loan

Source of loan: **1**=friends, **2**=banks, **3**=informal, **4**=credit associations, **5**=farm supply shop, **6**=trader, **7**=other (specify)
Who borrowed: **1**=husband, **2**=wife, **3**=son, **4**=daughter, **5**=others (specify)

Q30c. If no, give reasons why you never borrowed: fear of interest rate [ ], no credit institutions available [], I cannot afford to repay [ ], I do not need credit [ ], other ________________

Q31a. Do you have any savings? (if yes, list amount) _____________________

Q31b. If not, why not? I have no money left [ ], no savings facilities available [ ], other ____________________

Q32a. Do you have any kind of insurance (health, third party…)?

Kind of insurance	Costs per period	How many years

Q32b. If not, why not: can't afford it [ ], not available [ ], do not trust insurance [ ], do not need insurance [ ], other

____

Q32c. What kind of insurance would you be interested in? __________________________

Q33a. What has been the trend of the following indicators in the past five years?

Indicator	risen	fallen	constant	fluc-tuated
Income				
Soil fertility				
Hh food availability				
Crop pests				
Crop diseases				

Indicator	risen	fallen	constant	fluc-tuated
Animal pests				
Animal diseases				
Crop failure				
Crop yield				

Q33b. Trends in access and qualities of services in the past five years

Type of service	Access				Quality			
	risen	fallen	constant	fluctuated	very good	good	fair	poor
Education								
Health								
Extension advice								
Roads								
Transport								
Market								

Q34a. Distance to the nearest health unit usually visited by your household: _________km or _________hours

Q34b. *Type of health unit:* Hospital [ ], Health centre [ ], Pharmacy [ ], Other (specify) _________

Q34c. How much cost the drugs: Very expensive [ ], Expensive [ ], Fair [ ], Quite affordable [ ]

Q34d. Sickness in the household in the last year

Patient (code)	Disease	Caretaker (code)	Number of days lost by		Cost of treatment
			patient	caretaker	

Patient/caretaker: **1**=husband, **2**=wife, **3**=daughter, **4**=son, **5**=sister, **6**=brother, **7**=grandmother, **8**=grandfather, **9**=other relative

Q35a. Did you have enough food to meet household food requirements in the last 12 months? Yes [ ], No [ ]

Q35b. If not, when and how many months were you short and what did you do?

____

Q36. Selected non-farm household assets

Item	Number owned	When acquired	Price at which it was bought
Television			
DVD/CD player			
Radio			
Electric fan			
Dining set			
Sala set			
Cell phone/landline			
Refrigerator			
Washing machine			
Bicycle			
Motorcycle			
Car/Multicab			
Boat			
Fighting cocks			

Q37a. Distance from household to all weather roads: _____________km

Q37b. Type of road to farm: concrete [ ], asphalt [ ], gravel and sand [ ], trail [ ], other _____

Q37c. Type of road to market: concrete [ ], asphalt [ ], gravel and sand [ ], trail [ ], other ___

Q37d. Distance from house to nearest market _____km, distance from house to nearest input dealer _____km

Q38a. House: own [ ], rented [ ] (indicate amount) __________ or other (specify) __________

Q38b. Wall construction: concrete [ ], hollow block [ ], wood [ ], bamboo [ ]

Q38c. Roof construction: tiled [ ], iron sheets [ ], nipa palm [ ]

Q38d. Toilet condition: flush toilet [ ], watersealed [ ], no toilet [ ]

Q38e. Type of lighting: electricity [ ], kerosene [ ], other __________________________

Q38f. Cooking fuel used: firewood [ ], gas [ ], electricity [ ], plant oil [ ], other ____________

Q38g. Source of drinking water: faucet [ ], deep well [ ], open spring [ ], other (specify) ___

Q38h. Quality of drinking water: very good [ ], good [ ], medium [ ], bad [ ], very bad [ ]

Q38i. Is drinking water: insufficient [ ], sufficient [ ], abundant [ ]

Q39a. Do you expect to be carrying out farming as the main economic activity in the next ten years? Yes [ ], No [ ], Not sure [ ]

Q39b. Do you expect your children to carry out farming as the main economic activity in the next ten years? Yes [ ], No [ ], Not sure [ ]

Q40. What are the major constraints you face?

1.
2.
3.

Q41. What three important things could be done to improve your farm?

1.
2.
3.

Q42. How successful has your farm been? Successful [ ], Very successful [ ], Not successful [ ]

Appendix 2: Photos


Rice terraces with coconut trees


Shifting cultivation field


Coconut trees with abaca (*Musa textilis Nee*)


Bagalunga (*Melia dubia*)


Gmelina arborea

Rainforestation Farming field with abaca (*Musa textilis Nee*)

Rainforestation Farming field

Neighbouring field (to the field above)

Narra (*Pterocarpus indicus*)

White lauan (*Shorea contorta*, approximately 10 years)

Curriculum Vitae

Sonja Vilei was born in 1975 in Ludwigsburg, Germany. After studying Food Business and Nutrition at the University for Applied Sciences in Fulda from 1996-2000, Germany, she moved to Cork, Ireland, to acquire a Masters of Science degree in Co-operative Organisation, Food Marketing and Rural Development, which she finished in 2002, having been to Ethiopia for her Master thesis about “The impact of credit on resource-poor women in rural Ethiopia – a case study of Atsbi-wemberta wereda, Tigray region”.

After her studies she worked for the “bio-food project”: a school project about nutrition and organic agriculture funded by the Federal Ministry for nutrition, agriculture and consumer affairs.

From 2005-2010 she was working as a scientific co-worker at the Institute for Farm Management, University of Hohenheim. During this time she undertook the field work for her PhD study on Leyte, the Philippines (2006-2008); results are presented in this volume. She qualified with a PhD in agricultural sciences in 2010.