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**SOCIO-ECONOMIC CONSTRAINTS
TO RICE FARMERS' ADOPTION OF THE COMMUNITY
TRAP BARRIER SYSTEM FOR CONTROLLING RODENTS
IN RICE-BASED FARMING SYSTEMS
IN THE MEKONG DELTA, VIETNAM**

Thesis submitted by

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STATEMENT OF THE CONTRIBUTION OF OTHERS

This masters research was conducted under the primary supervision of Dr. Alison Cottrell and Associate Professor David King at the School of Earth and Environmental Sciences. Supervision was also provided by two scientists from Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) - Dr. Peter Roebeling (from March to August 2007) and Dr. Ken Aplin (from August 2007 to February 2009).

The project under this study was made possible thanks to the financial support from the John Allwright Fellowship of the Australian Centre for International Agricultural Research.

Financial support for technical trainings in Australia and field works in Vietnam were partially provided by Australian Centre for International Agricultural Research, the Sustainable Ecosystems of the Australia's Commonwealth Scientific and Industrial Research Organisation, and the School of Earth and Environmental Sciences at James Cook University.

March 8, 2009

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DECLARATION OF ETHICS

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlined in the *National Statement on Ethics Conduct in Research Involving Human* (1999), the *Joint NHMRC/AVCC Statement and Guidelines on Research Practice* (1997), the *James Cook University Policy on Experimentation Ethics. Standard Practices and Guidelines* (2001), and the *James Cook University Statement and Guidelines on Research Practice* (2001).

The proposed research methodology received clearance from the James Cook University Human Research Ethics Review Committee (approval number H-2708).

STATEMENT OF SOURCES DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

March 8, 2009

Signature

Date

Dedication

This thesis is dedicated to my grandmother, and is in memory of my father.

They both taught me the value of hard work, patience and love.

Acknowledgements

This study would not have been possible without the fellowship granted by the Australian Centre for International Agricultural Research (ACIAR). I wish to sincerely thank Dr. John Skerritt, Deputy Chief Executive Officer of ACIAR, who encouraged and supported my study, from the application stage of the fellowship. I wish to thank Dr. Simon Hearn for his suggestions and support at the application and proposal development stage of my project, and Ms. Sharon Harvey for her kind help and support during my two-year program.

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Thank you very much.

Abstract

In the Mekong delta region, rodents are one of the major pests that rice farmers need to control regularly using physical and chemical methods. Chemical methods are more commonly used because they are convenient. The Community Trap Barriers System (CTBS) is a new environmentally-friendly, physical rodent control method. Despite being introduced to farmers, the adoption has been slow because the technology requires collective adoption to overcome cost constraints. In this study, collective use of this method was found to be challenging because of two main reasons. First, farmers found it difficult to manage the trap barrier system as a common pool resource. Second, collective use at the field level is constrained by the difficulties to obtain consensus among farmers in the adoption area. Current levels of social capital, the source of collective action, at the field level were found to be in decline when compared with those in the past. The decline is attributed to the changes in relationships between farmers at the field level. Farmers are unable to maintain their traditional networks which were grounded on kin, neighbour, and friendship relations. In addition, social and economic development has improved rural lifestyles but this has resulted in a lack of need for the social capital represented by those traditional relationships, especially for the rice farming practice. The adoption of the CTBS, as well as other collective based technologies will be challenging unless there are efforts to improve social capital at the field level. This may well be best achieved at the local government level because farmers have a strong reliance on the government to facilitate the social capital generation process.

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Chapter 1 – Introduction

1.1 Overview of demographic characteristics and rice production in Vietnam and the Mekong Delta

Rice is one of the most important crops in Vietnam. It is cultivated on 4.2 of the total 5.7 million ha of arable land and plays an important role in the agricultural sector, contributing to 21% of GDP and 30% of total export earnings. Vietnam has achieved an impressive growth in rice production since policy reforms in 1986. According to the International Rice Research Institute (2007), the land area for rice had increased from 5.6 million ha in 1980 to 7.7 million ha in 2000. Much of the growth is due to the expansion of the rice area and to farmers' shifting land from a long-duration, single-cropped to double- and, in some places, triple-cropped short-duration paddy cultivation.

Rice has been the staple food for millions of people over the centuries in Vietnam. Since 1986, Vietnam has emerged as a developing country that has not only regained self-sufficiency in rice production after a devastating war, but has risen to become the world's second largest rice exporter with the Mekong delta and the Red River delta as the major rice bowls that serve both local consumption and export.

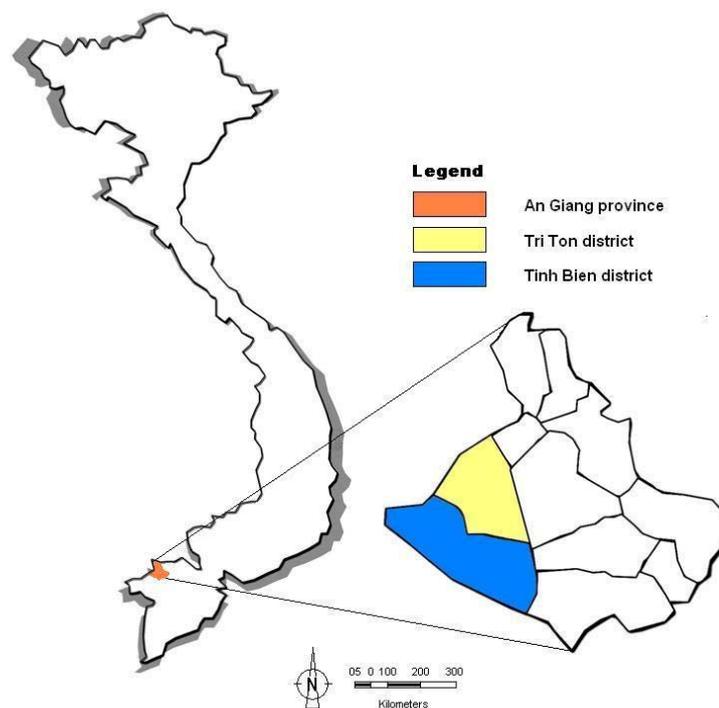
The Mekong River Delta is the source of most of the rice that is exported from Vietnam and has three major cropping seasons: spring or early season, autumn or midseason, and winter - the long-duration wet-season crop. The largest rice area is cropped during the autumn season (1.95 million ha), followed by spring (1.45 million ha). Only a small area is cropped in winter (0.6 million ha). The rice yield is highest in the spring season (5.3 t/ha) and lowest in the winter season (3.3 t/ha). The direct-seeding method is adopted by farmers in this area because it helps reduce labour costs. Fifty-two percent of the rice in the Mekong River Delta is grown in reliable, irrigated lowlands, with the remaining grown under rainfed conditions (IRRI 2007).

An Giang is one of the thirteen provinces in the Mekong Delta region and is home to four main ethnic groups - Kinh, Khmer, Cham, and Hoa (See Figure 1 below). This province is located to the west in the upper reaches of the Mekong Delta and shares a 95-km border with Cambodia. With the exception of the western part of the province, which is hilly, most of An Giang is relatively flat and is criss-crossed by networks of canals, irrigation channels and small rivers.

The two main branches of Mekong, the Hau and Tien Rivers, both flow through the province, constituting dominant geographical features of the area.

An Giang experiences a tropical, monsoon climate with annual average temperatures ranging between 26 and 28°C. There are two distinct seasons, which are the dry season, lasting from December to April, and the rainy season, lasting from May to November. Floods often occur from August to the middle of November. Rice is the main crop of the region with a total cultivated area of around 220,000ha, spanning over three major ecosystems: irrigated and intensive; rainfed and flood prone; and upland. The irrigated and intensive ecosystem makes up approximately 70 percent of the total rice land in the province.

Figure 1 - Map of An Giang province



1.2 Rodents – rice pest and control practices

Rodents are the most important mammalian agricultural pests at the global level. They damage and destroy many crops pre-harvest and are a major pest for grain stored post-harvest (Aplin *et al.* 2003, Rennison & Buckle 1987). They also act as reservoirs for disease throughout the

world (Stenseth *et al.* 2003). Farmers in many parts of the world, particularly those in developing countries, tend to view economic losses due to rats and mice as unavoidable (Posamentier 1997, Singleton *et al.* 1999).

The impact of rodents has been greatly underestimated and generally ignored in the general scientific literature, with a small number of exceptions (Singleton *et al.* 1999). Annual loss of food caused by rodents is estimated worldwide at about 11 kg per person; this value is equivalent to the combined gross national product of twenty-five of the poorest countries in the world (Gwinner *et al.* 1996). In 2001, it was estimated that in Asia alone, just pre-harvest damage by rats removed enough rice to feed about 180 million people for one year. Post-harvest losses alone were estimated to be of a similar magnitude to pre-harvest losses. However, the data are patchy and few studies have been done to understand the impacts of rodents on post-harvest storage of rice in the past decade (Singleton 2001).

Rodent problems in Vietnam

The rodent problem in Vietnam has risen over the past 15 years. In 1998, the total area of crop severely damaged by rodents was more than 600,000 ha (Singleton *et al.* 1999b). In 2001, there were more than 500,000 ha of rice country reported as having pre-harvest damage by rodents to a high level (Singleton 2001). In the Mekong delta alone, the level of rat damage increased steadily over the period from 1991 to 2000 with two peak damages recorded in 1994 and 2000 (Lan *et al.* 2003). The situation was getting so serious that in June 1997 the Vietnam Ministry for Agriculture and Rural Development classified rodents as one of the three most important problems faced by the agricultural sector.

In Vietnam, rodents are believed to be the predominant problem for rice growers in the Mekong Delta (Singleton 2001). In the early 1990s, the problem emerged and controlling rodents upon outbreak usually involved extensive province-wide campaigns. In 1997, a rodent campaign was launched across twenty-two provinces in Vietnam. A rat bounty scheme was applied and around 55 million rats were collected with a total government expenditure of approximately 62 billion VND (equivalent to US\$4.5 million). In 1998, an estimated 82 million rats were killed utilizing bounties and other control techniques. In the province of Vinh Phuc in the north of Vietnam, after the rat control campaign was instigated, more than 5 million rat tails were returned from January to September 1998. In the Mekong Delta, in provinces such as Tien Giang, Dong Thap, and Soc Trang, rodent impact on crops was reportedly because of the improvement and expansion of farming systems (Lan *et al.* 2003). The situation was also worse

in areas close to the border between Vietnam and Cambodia where different cropping times in two countries secured continuous availability of food for rodents, which gave rise to the migration of rodents.

Control methods

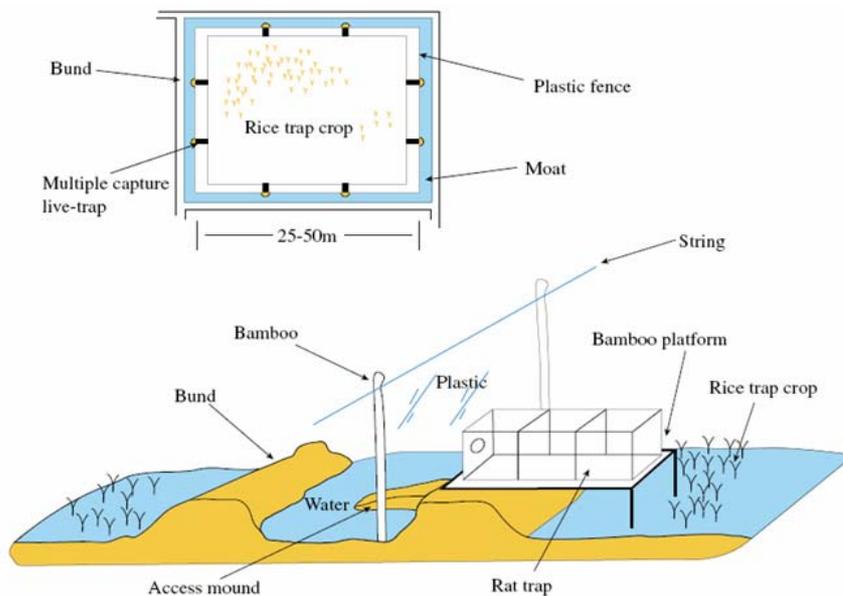
Physical methods have been long recognised as effective methods for reducing rodent impact during post-harvest stages and in intensive animal production units where they damage structures and foul foods. In Vietnam, a variety of methods is used. Physical controls include burrow digging to kill rodents *in situ*, use of live traps, kill traps, hunting by dogs, plastic fences to direct rodent movement, and post-harvest farm sanitation. Other control measures are fumigants, rodenticide chemicals, and biological baits such as Biorat and anticoagulants in both the Mekong and Red River deltas. Zinphosphate (ZnPh), for example, is preferred by farmers in many areas despite this Chinese made rodenticide being prohibited by the government. While the efficiency of baiting using chemical methods is unreliable, rodent poisons are highly hazardous to human health (Sang *et al.* 2003). In the Mekong Delta, electrocution is sometimes used by farmers in remote areas, irrespective of its potential hazard to both humans and domestic animals.

Although the traditional physical methods mentioned above work well at household level (the majority of farming households in the Mekong averages 0.5ha of rice land), they are not effective in cases of abundant populations or rapid outbreak of rats. In developing countries where management actions are often not effectively coordinated, especially over large geographical areas, such ineffective control of rodents can result in reinvasion. These measures are inherently weak because such programmes are only invoked when rodent populations increase and ravage standing crops (Singleton 2003) rather than taking an appropriate use of early tactical management (Brown *et al.* 1998, Redhead & Singleton 1988, cited in Singleton *et al.* 1999). Rodents' characteristics suggest that a bounty scheme is inappropriate for control. Because rodents are highly fecund [each female could deliver three litters per cropping season with each litter size being from eight to 12 rats], and they are extremely mobile across a landscape. Controlling them in a small geographical area does not result in stopping others from migrating. Even though bounty systems are popular in Asian countries, it appears they are ineffective for completely controlling rodents. When outbreaks ensue, often there is not sufficient time to protect the standing crop (Singleton 2003). As such, a non-chemical method that could be used sustainably and cost-effectively is essential as a replacement method.

Technical background to Community Trap Barriers System (CTBS)

A Community Trap Barrier System (CTBS) for rodent control in rice fields is an ecologically based rodent management method (EBRM). It has a small area of early planted rice inside the plastic fence, which acts as a lure crop to attract rodents towards the trap system. Ideally, the lure crop should be planted about 20 days ahead of the surrounding rice fields. Physically, the lure crop has a plastic barrier around it. The plastic barrier is placed along the bund of a rice crop. On the plastic fence, small holes made at equal intervals are prepared to provide entrances to the capture trap suspended on a bamboo structure placed above the water level on the crop side of the fence. A mud mound is made in front of each hole along the plastic fence to provide access to the capture traps. Rats are attracted from an area beyond the CTBS field. This area is referred to as the *halo effect*, or the area of effectiveness, which typically covers 10–15 ha (Singleton *et al.* 1999). One distinct advantage to the CTBS is that no poisons are used although management and labour costs may be higher than in typical baiting systems.

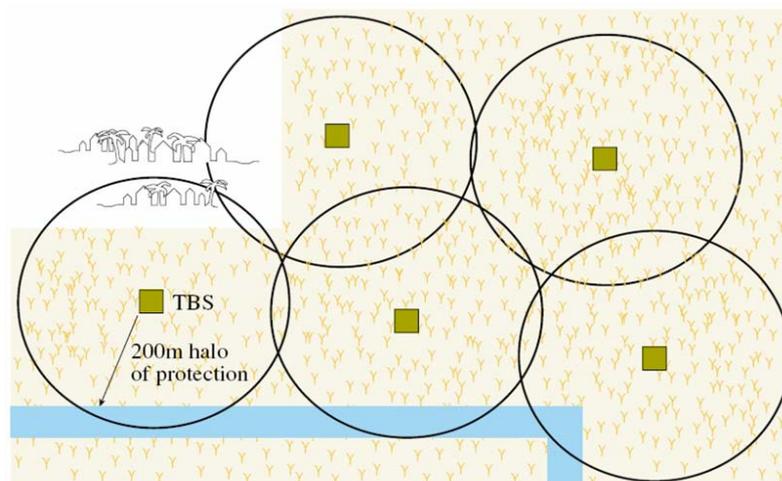
Figure 2 - Placement of a Community Trap Barrier System



Source: ACIAR Research Note No. 26 (available at <http://www.aciar.gov.au/publication/RN26>).

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Figure 3 - Halo effect of combined CTBS



Source: ACIAR Research Note No. 26 (available at <http://www.aciar.gov.au/publication/RN26>).

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According to Aplin *et al.* (2003), not all rodent species have a fixed breeding season. However, most of the pest rodents breeding season seem to have a relationship with the level of access to and the quality of the food. For most major pest species such as *Rattus Argentiventer* (the most commonly found in Vietnam), times for breeding activity in these systems match the growth and maturation stages of the rice crop. By removing adult rats from the local population prior to the onset of breeding activity, the likelihood of population development (from the remaining population) is reduced. According to Aplin *et al.* (2003), empirical studies suggest that a CTBS may be effective in protecting a surrounding area of 10–15ha. However, in large and uniform area, several CTBS units could be placed close to each other to create an overlapping effect.

Why is an Ecologically Based Rodent Management (EBRM) necessary?

Current rodent management practices are not overly effective. They can form a health risk and are not environmentally friendly (Roebeling 2006). According to IRRI, a number of concerns arise with the current use of chemical control methods, which necessitates the use of ecologically based rodent management – “risk to non-target species; the humaneness of its action; high usage patterns conflict with marketing a ‘clean and sustainable’ produce; low efficacy of action” (IRRI 2008, p. 4).

The concept of an ecologically based rodent management (EBRM) came into being to serve as a sound ecological basis for developing management strategies for rodent pests (Singleton *et al.* 1999). Ecologically based rodent management, with a strong emphasis on socioeconomic input, has been an important paradigm for research on rodent management over the past five years in many regions of the world (Singleton 2003). According to IRRI (2008), CTBS could be integrated as part of already on the ground Integrated Pest Management programmes, given their following benefits:

- Promote safety for farmers;
- Ensure profitability ;
- Better Response to population dynamics thanks to stronger focus on biology;
- Be appropriate for rodent management;
- Built on Integrated Pest Management principles; and
- Environmentally friendly, non-chemical control.

However, the CTBS requires a high level of community participation in sharing costs and joint management, especially from those whose fields are located within the CTBS halo effect (Aplin *et al.* 2003, Palis *et al.* 2003). The application of a CTBS is usually up to the decision of one farmer who can decide how and when a CTBS is applied. However, farmers in Southeast Asia, including Vietnam, are typically smallholders. Various social and historical factors may also exist which prevents farmers from working collectively in rodent management, making successful community coordination a potential constraint (Aplin *et al.* 2003). According to Morin *et al.* (2003), studies need to be conducted to identify the constraints to the adoption of the CTBS, especially because a CTBS operates as a common pool resource (CPR) which would lend it to constraints similar to those that other CPRs typically hold. Given these constraints, this thesis is part of the response to this recommendation. It aims also to understand the social and historical factors, which affect the adoption of EBRM in the form of a CTBS in An Giang province in Vietnam.

For the coming presentation, chapter two is the summary of the literature review. It describes briefly how selected theories came into being and how they are integrated to provide a framework for answering research questions. Chapter three is the methodology section. It presents how the study is done, rationale for method selection, data collection and management, and how they are analysed. Chapter four presents the qualitative findings regarding the perception of technological constraints. It also provides a comparative analysis between the findings in this study and those in other parts of the Mekong delta to support generalisation of

findings. Chapter five, six and seven will present analysis of data to support answers to the five research questions. Finally, chapter eight summarises the study findings. It also presents some policy implications, limitations of the study, and suggested direction for future research.

The next chapter will discuss the theories used to construct the theoretical framework, which guides answers to the research questions set forth under this study.

Chapter 2 – Theoretical Foundations for the Research

2.1 Purpose of Literature Review

The purpose of this chapter is to describe the evolution of the theoretical framework, which shaped this study. Three theories are employed to form the framework and set the scope of this study - Diffusion of Innovation, Social Capital and Common Property Resources. Each of the three theories will be discussed and presented as follows: an overview of each theory will be introduced, then the rationale for the theory is outlined, followed by description of how the theory was developed, elements that constitute the theories, criticism of the theories and a summary of the theories. This chapter sets out the manner in which each approach contributes to the research and then identifies how they link together to provide the overall framework for the research.

2.2 Review of Literature

2.2.1 Diffusion of Innovation

Introduction and Rationale

Innovation diffusion is the process by which a new idea is conveyed from developers to intended users, resulting in the adoption of the innovation by the target users. An innovation has its own characteristics. So do the intended users. When studying the innovation diffusion process, it is important that this process be studied in its intended context so that both innovation characteristics and users' characteristics are analysed, and the reciprocal interaction and the environment that enables and/or constrains the adoption process are fully examined. Factors that affect the diffusion process can be analysed and solutions proposed to work around existing or potential constraints to improve the efficiency of the innovation diffusion process.

Success of innovation diffusion is subject to many factors, including social norms, networks, attitudes, beliefs, knowledge, practices and so on. "The adoption of a new idea or practice is not a simple unit act, but rather a complex pattern of mental activities combined with actions before an individual fully accepts or adopts a new idea" (Bohlen 1964, p.268). The more complex an idea is, the more likely the farmers have to change their attitude and belief to receive the timely

information before adopting the innovation. The easier an innovation is for farmers to trial, the more likely that trialled innovation is adopted at a later time (Buttel *et al.* 1990).

In agricultural extension, the main purpose of innovation diffusion is to improve the livelihood of the rural people through introducing and encouraging the use of new agricultural technologies that improve productivity and income. However, not all technologies are put into use by the farmers as expected. The rate at which an innovation is adopted is different depending on the characteristics of innovation, the personal characteristics of the farmers and the local setting under which the innovation process takes place.

Understanding the nature of the innovation diffusion process in agriculture and factors that affect the innovation diffusion process helps predict the likelihood of an innovation adoption. Without a good understanding of how an innovation and users interact in their own context before and during an innovation process, the attempt to transfer an innovation to a target group of users is likely to fail and unexpected consequences may arise as a result. Therefore, understanding of the process of innovation is useful in projecting if a new technology will succeed (Sevcik 2004).

With many achievements in agricultural research and development, many technologies have become available for farmers' adoption. However, there are situations where the farmers do not adopt a technology not because of the non-availability of the technology, but because of the "social, structural, perceptual and financial situations and processes" that prevent farmers from adopting the available techniques (Vanclay 1992). Understanding the reasons for non-adoption from the farmers' point of view is very important for successful technology adoption.

Why research on diffusion of innovation is important for agriculture

Innovation diffusion is a process through which a social change is made. In order for a change to be made, the innovation developer (agricultural scientists in this case) and the intended users (farmers) need to understand each other so as to identify factors that are likely to affect the diffusion process. Understanding farmers can be difficult in many respects. For example, when examining practices or past experience of a farmer, researchers may collect inaccurate information about the farmers' perception or understanding of the technology in question. Asking farmers to recall how much fertilizer they had put on a particular crop two years ago, for instance, may not gain accurate information because of recollection problem. This problem contributes to an accumulation of errors during the exercise of data analysis and the resultant

interpretation and prediction of how an innovation is diffused in a farming community (Rogers 2003).

Another important factor that affects the level of understanding of the innovation diffusion process is the limited access to information related to the social system in which the farmers operate. The lack of resources for research prior to diffusion of innovation and *a priori* assumptions of the farmers' setting on the part of the researchers may limit their understanding about the farmers. In some cases, researchers may assume that farmers need to be held responsible for their action (adoption or rejection of an innovation). These limitations and assumptions were dominant during the 1950s to 1960s because agricultural innovations and extension, then, were presumed to be transferred in a centralised manner (Fliegel 1993), which Rogers (1971) referred to as *classical model*. This model assumes that farmers should uptake the technology because it is good for them and their society. Because of this assumption, the technology transfer from developers to farmers via extension agencies is a planned process in which farmers take a passive role in acquiring the technology. They are assumed to be affected by extension agencies, the media, and farm organisations (Fliegel 1993). This traditional, classical model holds farmers responsible for the result of the innovation diffusion process and overlooks the local context that could justify the way farmers respond to a new innovation.

Several empirical attempts have been made to analyse the above wrong assumptions by researchers in many fields. A strong focus on understanding how the innovation diffusion process could work effectively gave rise to the development of the theory for diffusion of innovation, which has become so popular that it is not only applied in rural sociology as it was originally planned but is also employed in other disciplines including marketing, medicine, education, communication, anthropology.

How diffusion of innovation was developed

A number of studies had triggered the attention of researchers to the area of diffusion of innovation. The first studies in the rural sociological diffusion-adoption tradition that are widely accepted as the grounding studies include works by Hoffer in Michigan in 1942, and Ryan and Ross in Iowa in 1943. These were then followed by Wilkening, Fliegel, Beal, Bohlen, Lionberger, Coughenour, and Rogers (Buttel *et al.* 1990). Of these studies, Ryan and Ross' work on the successful case of diffusion of hybrid corn seed in Iowa state in the United States was often cited as the first empirical innovation diffusion study that influenced the research

methods, theoretical framework, as well as interpretations of students in rural sociology, including other diffusion research traditions (Rogers 1995, p.53).

During the period from 1950 to 1960, the classical diffusion model viewed a farmer as “actor in a farm and local community situation, responding to stimuli concerning what were unquestionably viewed as improvements in agricultural technology” (Fliegel & van Es 1983, p.14). Because of this assumption, the majority of research on diffusion during this period focused on understanding farmers’ decision making from a social psychological perspective. Specifically, they focused on finding the relationship between farmers’ personal and social characteristics and each of the stages of the adoption process so as to predict the likelihood of the adoption of a new technology (Rogers 1962). The attention was also given to farmer’s adoption behaviours, and how the new information was diffused to them (Fliegel 1993).

Because farmers were considered as would-be adopters, they were blamed when they did not adopt an innovation designed for them and these claims were typically associated with farmers’ personal and situational characteristics. When an innovation is planned to target farmers, farmers who are late in adoption or never adopt were viewed as being superstitious, less educated, close-minded and unsophisticated characters (Fliegel 1993). Therefore, types of farmers and situational characteristics were summarised by different authors based on various studies that were largely done in the United States.

Nevertheless, when the appropriateness of a technology is considered in a given situation, the assumption that the technology is good could be also questioned. So could the entire socio-psychological approach to diffusion phenomena. Fliegel (1993) commented that these findings were not the same from different social settings, especially between developing and developed countries. He suggested that operational definitions of variables and descriptive statements about findings made in the United States should be reformulated when research approaches employed in the U.S. was replicated in developing countries.

Overview of “Diffusion of Innovation” theory by Everett Rogers

Several studies have been done to understand diffusion of innovation in various disciplines. The works by Rogers have had the most influence because of his attempt to consolidate the extensive diffusion research literature, his clearly defined concepts, and representation of a long series of middle-range generalisations (Fliegel 1993).

The first edition of the book by Rogers, *Diffusion of Innovation*, published in 1962 in which 405 reports from different fields including anthropology, sociology, and education were analysed to shape the theoretical framework. The editions that followed - from the second to the fifth editions (respectively in 1971, 1983, 1995, 2003), continued to uphold its value as an important framework, confirming and broadening the understanding of the Diffusion of Innovation with more updates on both applied and empirical research.

In the first edition, Rogers, at times, re-analysed data to test the hypothesis not considered by the original investigators, which was very useful for the formation of a sounder theory (Wayson 1963). In the second edition, Rogers (co-authored with Shoemaker) attempted to highlight the cross-cultural similarities, together with differences, in the diffusion of innovations. This is the reason why the title of the book was changed to *Communication of Innovation* to reflect the foci of the book. The third and fourth editions took into account more studies so as to expand the understanding of the diffusion of innovation. In the fifth (also last) edition, Rogers analysed changes related to various diffusion traditions as well as studies of diffusion of new communication technology (the Internet). He also examined the understanding of diffusion networks and results related to testing effects of diffusion interventions using opinion leaders.

The following section summarises the key concepts that have been examined and conceptualised based on several studies since 1940s and presented by Rogers in different editions of his book. The key concepts from Rogers' books were summarised below to pave the way for the examination of constraints associated with the diffusion of the CTBS technology in the Mekong delta of Vietnam by looking into factors that have been empirically considered as potential hindrance to the innovation diffusion effort.

Elements of the diffusion of innovation process

Rogers (2003) defined *diffusion* as the “process by which an innovation is communicated through certain channels over time among the members of a social system” whereas an innovation is “an idea, practice or object that is perceived as new by an individual or other unit of adoption”. Innovation diffusion is a type of communication in which the new idea is expected to be diffused to the target audience to achieve a desired social change in the structure and function of a social system (Rogers 2003, p.6).

The “newness”, as Rogers argued, does not necessarily mean new knowledge because the knowledge may be known to someone who may stay neutral to it. In other words, his or her

attitude has not developed to being either favourable or unfavourable towards the new knowledge. Nor has he or she adopted or rejected it. The “newness”, in Rogers’ definition, is referred to as knowledge, persuasion, or decision to use it (Rogers 2003). Rogers (2003) noted that one should not assume all technologies apply at the same unit of analysis. Different technology has different characteristics, because they are perceived differently by different individuals. This explains how they are adopted at different rates (Rogers 1971, 1995, 2003).

Characteristics of Innovation

Rogers (2003) identified five critical attributes of an innovation that could be used to explain and predict the rate of adoption. They are *relative advantages*, *compatibility*, *complexity*, *trialability*, and *observability*.

Relative Advantage is “the degree to which an innovation is perceived as better than the idea it supersedes” (Rogers 1995, p.212). The perception about the advantage of an innovation is judged in economic terms but it is also equally important perceived in terms of social prestige, convenience and satisfaction. The higher the relative advantage of the innovation is, the more likely the innovation is adopted.

Compatibility is “the degree to which an innovation is perceived as being consistent with the existing values, past experience, and needs of potential adopters” (Rogers 1995, p.224). This means if the innovation is perceived to be troublesome, and it does not fit well with the existing values, customs and habits, practices, and norms of social system of the target users, the innovation is not rapidly adopted.

Complexity is “the degree to which an innovation is perceived as difficult to understand and use” (Rogers 1995, p.242). Some innovations are easy to understand in one social system, but are difficult to understand in other social system. When this is the case, the innovation is less likely or is slowly adopted.

Trialability (referred to as “divisibility” in 1962 edition) is “the degree to which an innovation may be experimented with on a limited basis” (Rogers 1995, p.243). Rogers argued that ideas that could be trialled on instalment plans lead to quicker adoption than those that are not able to be trialled. Ryan and Gross (1943), when studying why a new hybrid corn variety was adopted by 99 percent of farmers in the state of Iowa in only about ten years, also found that farmers who adopted hybrid seed corn had tried the seed before they fully adopted it.

Observability is “the degree to which the results of an innovation are visible to others” (Rogers 1995, p.244). If people can see the results that arise from adoption of a new technology, they can evaluate how it suits them and consider using it.

Given the above attributes, Rogers (2003) concluded that innovations that are more relatively advantageous, more compatible, easier to trial and easy to observe whereas less complex are more rapidly adopted. Past studies have indicated the importance of these five attributes in predicting the adoption rate of a new technology.

Communication Channels

Rogers (1995, p.18) defines a communication channel as “the means by which messages get from one individual to another”. He pointed out that “the nature of the information-exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver and the effect of the transfer”. One of the obvious principles of human communication is that transfer of ideas occurs most frequently between a source and a receiver who are alike, similar, or homophilous. Homophily is the degree to which pairs of individuals who interact is similar in terms of certain attributes such as beliefs, values, education, social status, and the like.

Time

Time is the indicator through which an innovation is considered to be quick or slow in its adoption. Rogers (1995, p.20) argued that time is involved in the diffusion process in the following dimensions: “in the innovation-decision process by which an individual passes from first knowledge of an innovation through its adoption or rejection, (2) in the innovativeness of an individual through its adoption or other unit of adoption - that is, the relative earliness/lateness with which an innovation is adopted - compared with other members of a system, and 3) in an innovation’s rate of adoption in a system, usually measured as the number of members of the system that adopt the innovation in a given time period”.

The Innovation-Decision Process

The *Innovation-Decision Process* is “the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to the formation of an

attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision” (Rogers 1995, p.20).

Rogers (1995) conceptualised this process in five main steps, including (1) knowledge, (2) persuasion, (3) decision, and (4) implementation and (5) confirmation. Rogers (1995) argued one needs to be exposed to the knowledge to get an understanding of what an innovation is about and the benefits it can offer. Then, from a preliminary understanding, they develop an attitude towards the innovation which may be favourable or unfavourable. With an attitude in place, they will decide to engage in the activities related to the innovation – making a trial and finally seeking reinforcement for the innovation-decision he or she had made. During this stage, however, they may undo their decision if a conflicting message about the innovation comes about.

Innovativeness and Adopter Categories

Because of the complex process that one needs to go through, from knowledge to confirmation, adopters, based on the characteristics that they hold in each stage of the process, are classified as “adopters”, “early adopters”, “early majority”, “late majority” or “laggards”. The measures of innovativeness and classification of the system’s members are based upon relative time at which the innovation is uptaken by the adopters (Rogers 1995, p.22).

Social System

Rogers (1995, p.23) defines a social system as “a set of interrelated units that are engaged in joint problems solving to accomplish a common goal”. Members of a social system include individuals, informal groups, organisations, etc. As diffusion of innovation takes place in a social system, it is affected by social structure in various ways. Rogers (1995, p.25) argued that the structure of a social system can “facilitate or impede the diffusion of innovations in a system”.

He argued that the diffusion of innovation was affected by norms, roles of opinion leaders, change agents, type of decision-innovation, and the consequences of innovation.

Social structure and diffusion

Rogers (1995, p.24) defined *social structure* as “the patterned arrangement of the units in a system”, which specifies human behaviour in that system, allowing the predictability for one’s behaviour with a certain degree of accuracy. He elaborated that in a well developed social structure, there is a system of hierarchical positions which allows high-ranking people to order lower-ranking people. In addition to this formal structure, an informal interpersonal network exists that links individuals within that system. These networks could explain who interact with whom, and under what circumstances the interaction will take place.

System norms and diffusion

Norms are “established behavior patterns for the members of a social system. They define a range of tolerable behaviours and serve as a guide or stand for the members’ behavior in a social system” (Rogers 1995, p.26). Norms guide how members in a social system behave in the way they are expected to. Norms operate at many levels – national, religious community, organisation, or villages. As a result, they could be a barrier to an expected social change, and to an innovation diffusion process.

Opinion leaders and change agents

In any social system, there are people who function in the role of opinion leaders. They usually provide advice and information to other people and maintain a high level of credibility. They are referred to as opinion leaders. *Opinion leadership* is “the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency” (Rogers 1995, p.27). In a modern social system, opinion leaders are very innovative. However, in traditional social systems, the opinion leaders may act as indicators of traditional norms and behaviour. They adhere to local values and practices, and are sometimes even strongly against change or external influence. Opinion leaders, however, are sometime influenced by change agents. Once opinion leaders exhibit a level of change that is no longer a tradition in that social system, they may be at risk of losing credibility as well as the level of influence on former followers.

A *change agent* is “an individual who influences clients’ innovation-decisions in a direction deemed desirable by a change agency” (Rogers 1995, p.27). Change agents may encourage adoption of a new idea. They are also the ones who may, in some cases, slow down or even

hold up the adoption of an innovation, which is, in their own opinion, undesirable. Change agents usually work with opinion leaders to enhance the impact of their diffusion activities in a social system. Change agents are typically more educated compared to local people. Their communication may also pose some challenges that affect the diffusion process.

Type of Innovation-Decisions

Innovation could be adopted either by an individual on their own, or by the entire social system. Decisions on adoption of an innovation could be made in three ways:

1. *Optional decisions* are made by individuals regardless of the decision of the social system. This means that an individual makes a decision at their own discretion, which may be different or even against established norms in the social system.

2. *Collective decisions* are those made by individuals through consensus building process.

3. *Authority innovation-decisions* are choices to adopt or reject an innovation made by “a relatively few individuals in a system who possess power, status, or technical expertise” (Rogers 1995, p.29). When a decision of this type is made, an individual in a social system has no way to reject, thus has to implement the decision already been made.

Rogers (1995) argued that optional decisions could be made more rapidly than collective decisions, and that authority decisions generally achieve the fastest rate of adoption of innovations. Despite authority decisions being common in formal organisations, this type of decision could be circumvented during their implementation. It was also noted that the type of innovation-decision for a particular new idea is subject to change over time.

The Innovation - Decision Process

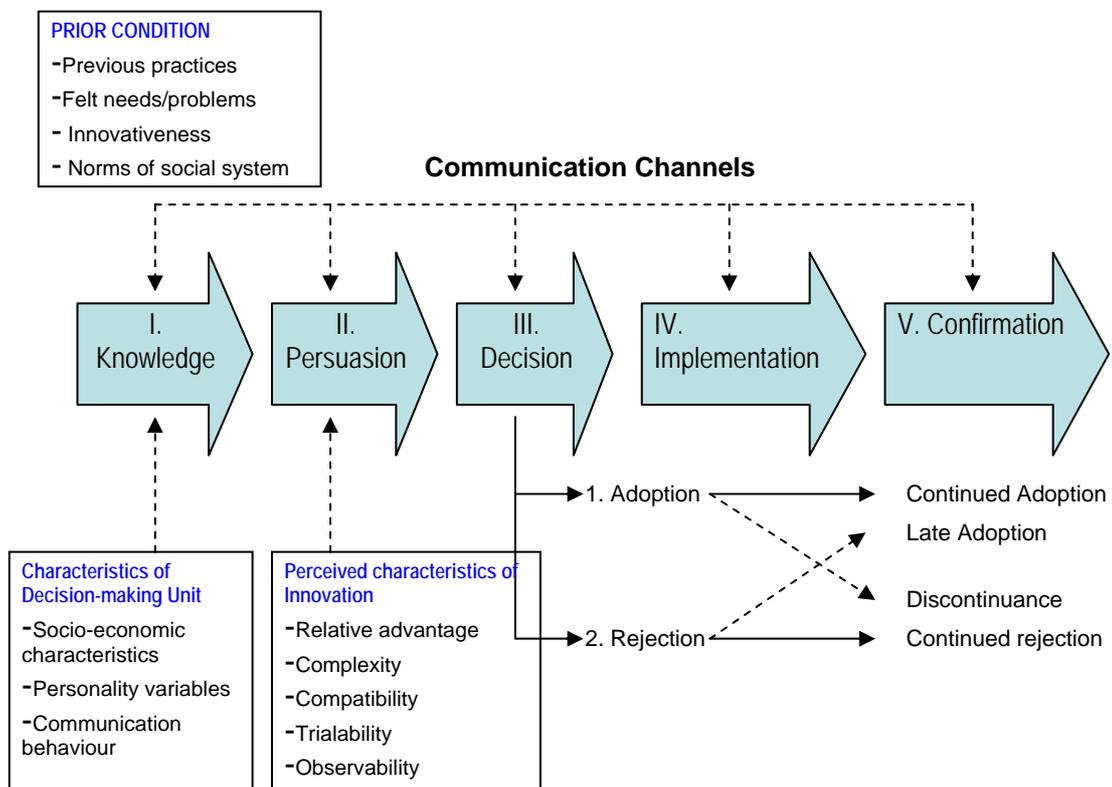
An innovation diffusion process is “the process through which an individual (or other decision-making unit) passes (1) from first knowledge of an innovation, (2) to forming an attitude toward the innovation, (3) to making a decision to adopt or reject, (4) to implementation of the new idea, and (5) to confirmation of this decision. This process consists of a series of actions and choices over time through which an individual (or an organisation) evaluates a new idea and decides whether or not to incorporate the innovation into ongoing practice” (Rogers 1995, p.161).

Model of the Innovation-Decision Process

The traditional adoption model consists of five stages – Awareness, Interest, Evaluation, Trial, and Adoption. This model was postulated in 1955 by a committee of rural sociologists. However, it was later criticised for being too simple and having numerous deficiencies. As a result, a new model of innovation-decision was proposed by Rogers (1995) which includes five stages, namely knowledge, persuasion, decision, implementation and confirmation.

1. Knowledge. This means the individual knows about the innovation and acquires some basic understanding of the innovation in existence.
2. Persuasion. The individual has some forms of favourable attitude towards to innovation (though a decision to take on further step is not made at this stage)
3. Decision. The individual embarks on involvement in the activities (direct or indirect) which lead to a decision to adopt or reject the innovation.
4. Implementation. The individual puts an innovation to use. Implementation involves overt behaviour change as the new idea is actually put into practice.
5. Confirmation. The individual reinforces his decision to adopt the innovation. During this stage, individual could withdraw from his decision to trial if there are conflicting messages around the innovation.

Figure 4 - A model of five stages in the Innovation-Decision Process



Source: Rogers (2003)

Adopters Categories

In addition to the characteristics of an innovation, Rogers (1971, 1995, 2003) categorised people, who are the target groups of an innovation, into five groups of people – Innovator, Early Adopters, Early Majority, Late Majority and Laggards. Each of these groups is characterised by the relative time of adoption in the innovation continuum compared to other objects in the same social system.

By Rogers' definition, *Innovators* are those who like to try ideas. This characteristic stands them out of the rest of their community members. Innovators are also those who have cosmopolitan social relationships. *Early Adopters* are cosmopolites. They possess significant degrees of opinion leadership, and they are most referred to for advice. They are respected by their peers and considered pioneers for new things. *Early Majority* adopt new ideas just before the average members of a social system. This group of people highlights a remarkable adoption level of a new technology among the community and plays an important part in the diffusion process because their adoption of an innovation is based on their deliberate willingness. These people do not necessarily hold a leadership position. *Late Majority* adopt new ideas just after the average members of a social system. They wait until this point in time because there is a need for an economic return of the innovation in consideration and an increasing social pressure. Adoption by these people is done with a sceptical mindset and they usually wait for other members in the community to adopt the new idea before trialling it. It is noted that before the late majority is convinced, the weight of system norms must favour the innovation and peer pressure is necessary to motivate their adoption. *Laggards* are opposite to the innovators and earlier adopters on the adoption continuum. They are the last to adopt. Laggards mainly maintain frequent contact with those who have traditional values or those who share the same viewpoint as to an innovation. They are obviously not for the innovation and they normally uphold deep-rooted beliefs.

Characteristics of adopters

Rogers defines three groups of characteristics of adopters. He first defined these three groups in his first book in 1962 as (1) personal characteristics, (2) communication behaviour, and (3) social relationships. In the second edition in 1971, he slightly changed the groups given that new studies were available to support further examination and standardisation. The new three groups since 1971 are (1) socioeconomic characteristics, (2) personal variables, and (3) communication behaviour.

Socioeconomic characteristics. Rogers (1995) found that there is no difference in age between early and late adopters. Nevertheless, early adopters possess the following properties – more education, more literate, higher social status, greater degree of upward social mobility, larger sized units, more commercial economic oriented, ready to borrow money, and more specialised operations.

Personal variables. Earlier adopters tend to outdo late adopters in having more empathy. They are less dogmatic and have greater ability to deal with abstract concepts, greater rationality, intelligence, more favourable attitude to change, more favourable attitude to education, science, less fatalistic, higher levels of achievement motivation, and higher aspirations for education and occupation, and are ready to take risks.

Communication behaviour. Earlier adopters have more social participation. They are highly integrated with social system and more cosmopolitan. They also have more contact with the change agent, greater exposure to interpersonal communication channels, more access to mass media, seek information about innovations, have greater knowledge of innovations, higher degrees of opinion leadership, belong to modern systems (rather than traditional), and are more likely to belong to well integrated systems.

Criticism of diffusion research

Research of diffusion of innovation has been highly critiqued. Buttel *et al.* (1990) summarised the following key perspectives on diffusion research that began in the 1960s and proliferated in the 1970s.

Characteristics of Farm Practice Adopters

One of the key generalisations based on empirical studies is the positive relationship between the farmers' socio-economic status (which is measured using such information as farm size operated, farm size owned, gross sales, net farm income, total family income..) and their adoption behaviour (cf. Calson & Dillman 1983, Coughenour 1960, Fliegel 1956, Marsh & Coleman 1954). This generalisation was not widely accepted until the 1950s as earlier studies failed to show this relationship.

Social Psychology of Farm Practice Adoption

Wilkening (1949, 1950, 1958) initiated research on what became a major foci, the social - psychology of adoption. Wilkening (1950) identified socio-psychological factors, including farmers' attitude toward religion, education for young boy going into farms, dependence on neighbourhood, and kin ties as factors that were associated with farmers' interest in adopting a farm practice. These results gave rise to an increase in literature on the relations between farmers' adoption of innovation and their characteristics. Rogers (1957) did similar research and found a substantial correlation between social-psychological/personality indexes (including rigidity, change orientation, innovative proneness, adoption self-rating) and an adoption index of new farm practices.

There are, however, some exceptions to the above findings. Earlier studies reported fairly strong associations between value-orientations and farm practice adoption while strength of these associations was found smaller in later studies. Fliegel & van Es (1983) argued that this trend suggested that some historical changes had influenced farmers' adoption behaviour whereas Buttell *et al.* (1990) refuted that these results might be due to the changes in farm structure. After 1960, much social psychological research focused on exploring the cognitive orientation of farmers toward practices of different types. Fliegel (1966) found that complexity of a technology, a reduction in inconvenience associated with farm practice, and trialability of a new technology were the characteristics that affect farmers' adoption behaviour.

Group Influences

Farmers' decisions were found being affected by neighbouring farmers' adoption and advice (Buttell *et al.* 1990). For example, Pederson (1951) reported that Danish and Polish-origin farmers in Wisconsin tended to adopt new farming techniques very differently. Duncan & Kreitlow (1954) found the adoption behaviour of the farmers was affected by the community context. It was also found that the adoption decisions of farmers were affected by the norms of the neighbourhood or community where they live in (Flinn 1970, Marsh & Coleman 1954). In a comprehensive study, Lionberger & Francis (1969) found that farmers were more likely to seek information and advice from influential people rather than early adopters. They argued that two sources of information in their studies played two different roles. While the innovators functioned as messengers that raised awareness for new ideas, others (influential people) were likely to influence decisions to adopt the new technology.

Mass media and other information influences on farm practices adoption

From early on, much of the research tended to focus attention on communication of innovation: the channels (both personal influence and mass media) through which farmers' attitudes towards innovation adoption were affected; how different farmers responded to different communication patterns; and how the types of innovation affected the communication effects (Buttel *et al.* 1990).

The research showed that information was sought by farmers at different stages of an innovation diffusion process, and farmers of high socioeconomic status relied more heavily on agricultural agencies, while lower socioeconomic status farmers relied primarily on their fellow farmers and agribusinesses as their main sources of information (Wilkening 1950).

The use of information and technical advice varied from country to country. Since social structures were different between geographical locations, information flow was also different (Fliegel 1993). For the case of farmers, this information seeking behaviour holds true (cf. Rogers & Meyen 1965 for their study in Columbia).

Conceptualisation of Farm Practice Adoption

Diffusion has not generally been accepted as a single-unit act: rather, it is a process. This is supported by evidence that the average reported time lag between awareness and adoption is 1.54 years (Buttel *et al.* 1990). There have been arguments about how stages of the adoption process should be delineated. However, the suggestion by the Subcommittee on the Diffusion and Adoption of New Farmer Practices (1952), who suggested a five-stage model, is generally followed. Campbell (1966), however, criticised the multi-stage adoption model because of its implied linearity. He suggested a different model organised around dichotomies: problem vs. innovation-orientation, and rational vs. non-rational orientation. He argued that by combining the two schemes of dichotomies, there would be four adoption types in this model because one aspect of this model exists in most decisions about adoption that people would make.

Methodological aspects of adoption research

Many inquiries related to conceptual issues around diffusion of innovation were derived from methodological problems. Most of the attention, however, was given to the discussion on the suitability of adoption scales or indexes (Buttel *et al.* 1990). Rogers (1961) evaluated twenty-

eight different field studies that measured innovativeness. He looked especially into the validity, reliability, internal consistency, and uni-dimensionality of these adoption measures and found the scale reasonably valid, reliable and internally consistent albeit not all scales employed were uni-dimensional. Coughenour (1965), in an attempt to test this tool, however, found inconsistency existing in his research when he tried to assess the reliability of recall data provided by farmers at three different years (using the same survey tool). He noted that survey instruments should be used cautiously to ensure collection of correct data about dates of adoption and appropriate constructing of rank order in estimating rates of adoption.

Rogers (2003) pointed out that one of the weaknesses of diffusion research is the recall data, which were usually obtained through personal interviews. These data were not completely accurate because they depended on correspondents' memory. The ability to recall accurately was also limited when the interview was done at one time, which rendered the information related to the time of adoption of an innovation incorrect. Rogers concluded that one-time surveys could not tell much about the time order and broader issues of causality. He suggested that field experiments be conducted to examine the effect of many independent variables on a dependent variable and that greater use of field experiments be done to avoid respondent recall problems.

Fliegel (1993), in an attempt to review the history of diffusion of innovation research, also pointed out the following aspects that are subjected to arguments. These arguments include:

Gender issues – Understanding of how marital partners arrange farm tasks and decision-making as to adoption of technology was limited and studies on this issue remained peripheral to the mainstream of diffusion research. Most past studies focused on the understanding of decision-making behaviours of male farm operators only (Fliegel 1993). However, when Wilkening & Guerrero (1969) tested the combined effect of both farm husband and wife's aspiration for adoption of improved farm techniques in Wisconsin state (with a sample of five hundred couples), they found that marital partners who had a consensus on the use of a technology are more likely to adopt that technology than those who did not have.

Neighbourhood - Neighbourhood (homogeneous ethnic background) was also found to be significant in the study of Marsh & Coleman (1954) to influence the individual adoption of innovation. Although this study lacked independent measures of individual adoptions, the general idea that locality group differences could influence individual decision had attracted attention in some studies over the years (Fliegel 1993).

Literacy - There were some confronting questions about the role of literacy in diffusion of innovation - a presumption of a positive relationship between the level of education and the degree of innovativeness. Farmers who were categorised as “innovators” were described as relatively high in education while farmers who were slow in adopting an innovation were regarded as “laggards” (the opposite extreme). Farmers in developing countries with limited education were therefore also assumed being laggards (Fliegel 1993).

Social structure and diffusion process - When earlier diffusion research was undertaken in the United States, factors related to farmers’ socioeconomic status was usually incorporated in the research design. Farm size and income, for example, were found being related to adoption behaviour and differences in control over farm resources were found unimportant. However, when a classical diffusion model was applied to a country other than the United States, variability in control over farm resources was found to be more important, and even decisive to the effects of the innovation diffusion (see examples in Rogers 2003). In addition, when it came to investigating the issue of equality, innovation diffusion was found to widen the gap between the higher- and lower-economic status people in a system. This issue had been well recognised in many case studies in Latin American, Africa, and Asia (Rogers 2003).

Pro-innovation bias

In terms of the classic linear models of diffusion of innovation, it is assumed the innovations are always good and farmers should adopt them (Fliegel 1993). Rogers (2003) argued that this tendency is a *pro-innovation bias*. He thought this bias was one of the most serious assumptions that pervaded research tradition without a remedy, which made these assumptions troublesome and potentially dangerous in terms of intellectual sense. It was this assumption that resulted in diffusion researchers ignoring studying why there was an ignorance of innovation and why they underemphasised the rejection or discontinuance of innovations and overlooked the re-invention until the 1970s when criticism of this assumption rose. Rogers (2003) pointed out two main reasons for this assumption – first, most diffusion research was funded by change agencies whose purpose was to promote the use of the innovations they wanted. Second, rejected or discontinued innovation was less likely to be investigated by diffusion researchers.

He suggested that the pro-innovation bias could be overcome by considering the following points: 1) investigate the diffusion of innovation while the process is underway to ensure collection of reliable data, 2) be thoughtful in selecting an area of study - comparative analysis of both successful and unsuccessful cases of innovation diffusion is useful because such a wide

range of innovations helps overcome pro-innovation bias, 3) try to understand individuals' perceptions of innovation and their situation given that personal perception could lead to rejection, discontinuance, or reinvention of the innovation, and 4) study the diffusion of innovation in a broader context. For instance, they would need to examine how initial policy decisions are made about diffusion of an innovation in an individual's system, how the introduced innovation is related to other innovations, and how research and development is to be conducted that leads to the innovation being diffused. Considering these factors, in Rogers' opinion, helps avoid possible pro-innovation bias. Finally, he recommended attempts to understand users' motivations for adopting an innovation be made so as to avoid this kind of bias.

Recent trends

Social structure, equity and diffusion models. Traditional research on diffusion puts the farmers at the centre of the diffusion process. Goss, in his critique published in 1979, argued that traditional systems tended to hold farmers responsible for their actions in adopting an innovation. This is called person-blame causal distribution bias (its alternative is system-blame, where the social structure is held accountable for its problems). This assumption had caused an ignorance of consequences as a result of the diffusion process.

Goss (1979) cited findings from a study by Havens & Flinn (1975) on coffee production in Columbia. In Havens & Flinn's study, it was founded that farmers did adopt a new coffee variety because they had no access to credit and that replacing the existing coffee to plant the introduced variety would not assure their food security during at least three years before the new coffee returned them income. Not all growers had access to credit, as the case study found. As a consequence, after seven years' introduction of the new coffee variety, adopters acquired more land while non-adopters reduced their acreage as a result of land acquisition by early adopters. Goss, therefore, proposed a shift from the traditional socio-psychological approaches to diffusion in the direction of sociological and macro-level approaches so that diffusion research could be able to explore adoption constraints at an individual level. The consequence of technological change, to a certain extent, left both short-term and long-term negative consequences on some farmers. This issue of topic consequences had received substantial attention in recent years (Fliegel 1993).

In terms of individual-blame assumption, Rogers (2003) pointed out that many variables that are related to individual-blame, such as age, education, sex, income, cosmopolitanness, and

mass media exposure, have been used to correlate with the farmers' innovativeness in past diffusion research. System-blame variables such as contact with change agent or access to credit were also brought into the research design. However, Rogers (2003) noted that seldom did diffusion research outcomes mention about the fact that the sources or channels of innovation may be at fault due to failing to provide sufficient information.

As Rogers (2003) pointed out, there are three reasons that account for why individual-blame assumption existed. First, diffusion researchers started their research projects or investigations from the sponsors' point of view. Second, many researchers possibly found it very difficult or impossible to change system-blame factors and turned to focus on individual-blame variables which were subject to changes. Third, individuals were more easily accessible as the objects of study than the system to which the individuals in question belong. The research tools, in addition, were prone to allowing more focus on individuals, rather than on the system being investigated. He commented that individual-level variables are the most appropriate to examine in an innovation diffusion study. However, he argued that this approach is not a complete explanation of the adoption behaviours being examined.

Summary

Diffusion of innovations had traditionally focused on social-economic and psychological characteristics of farmers. Despite many researches confirming the association between farmers' characteristics and their behaviour related to their adoption of an innovation, the association was not found to be consistent from place to place. The inconsistency could be explained by the lack of consideration of the context within which an innovation was diffused. The classical model had its own weakness because it looked only at factors that are individual-blame without looking at constraints that are system-blame.

Fliegel (1993) argued that the consequence of innovation is also very important. However, this factor has not been considered in the past. He suggested the classical model be extended to focus its research on the consequences of diffusion of innovation as a variable that needs to be explained. In terms of resources, the classic model always included resource differentials as antecedents of adoption, though such differentials were not considered important until diffusion studies were done in developing countries. There needs to be a shift in diffusion research from the predominantly micro-level approach to the structural, macro-level approach. In the case of the CTBS, given its need for a concerted effort on the part of farmers and the local governments, the diffusion of innovation for CTBS should take into consideration the whole

farming system as a context that could shed light on adoption behaviours of the farmers as to collective-based agricultural technology.

The diffusion of innovation theory could explain how CTBS could be diffused in the whole diffusion process (from the knowledge acquisition to final adoption). This task could be done by investigating the CTBS constraints in a broader paradigm that captures both individual and system variables while holding them justifiable to the time variable in the diffusion process. This is the advantage of diffusion of innovation theory. Nevertheless, the theory will not be able to provide the means to explain how factors, at both individual and system level, interact in each stage of diffusion to facilitate or constraint the advancement of the technology to the next stage of the diffusion process. Specifically in the case of CTBS, diffusion of innovation theory could not explain why cooperation by farmers to share adoption of CTBS was not possible. This is why another theory is needed to account for this problem. Social capital is one of the key factors that are needed as an enabler for collective action. The next section will explain what social capital is about, and why it is important in this study. To this end, social capital theory will join diffusion of innovation theory to play an important part in the theoretical framework of this study.

2.2.2 Social Capital

Introduction and Rationale

Social capital is a concept that “describes circumstances in which individuals can use membership in groups and networks to secure benefits” (Sobel 2002, p.139). It is used to explain how problems of selfish incentives could be overcome to achieve a mutually beneficial cooperative way of getting things done (Ostrom & Ahn 2003, p. xiv). In the case of CTBS, the benefits that farmers or stakeholders share are having their rice crop protected from being damaged by rodents thanks to the shared use of a CTBS. Social capital implies voluntary cooperation, which is self-enforcing based on informal, unwritten institutions. Voluntary organisations among farmers can help lower the costs thanks to informal transactions, which are not formally sanctioned, and it is not necessary to monitor and enforce all the transactions (Svendsen & Svendsen 2004, p.27).

The concept of social capital could be considered as a step forward to better explain the collective-action theories that were marked by the Logic of Collective Action (Olson [1965],

1971), which was re-emphasised by Hardin in his article “The Tragedy of the Commons (1968). Its presence in a community can lead to collective action (Ostrom & Dolsak 2003).

Social capital does not exist in either the individual or the community. It exists between the individual and the community to which the individual belongs. The merits of social capital, therefore, are that its analytical focus is the pattern of relation between individuals, social units and institutions, not from individual behaviour. The virtue that social capital brings about is its capacity of dealing with complexity where relationships exhibit both cooperation and conflict (Baron *et al.* 2000).

Why Social Capital becomes important recently?

“Social capital refers to the internal social and cultural coherence of society, the norms and values that govern interactions among people and the institutions in which they are embedded. Social capital is the glue that holds societies together and without which there can be no economic growth or human well-being. Without social capital, society at large will collapse, and today’s world presents some very sad examples of this”.

(Grootaert 1998, p.iii)

Grootaert (1998) argued that there already exist three traditional forms of capital - natural capital, physical or produced capital, and human capital. One type of capital that people now recognise as missing to better explain the process of economic growth is social capital. Grootaert (1998, p.1) argued that social capital is related to “the way economic actors interact and organise themselves to generate growth and development”.

Over the past five years, social capital has become an important tool for analytical concepts and policy making within development (Mohan & Mohan 2002). In terms of analysis, researchers have examined the extent to which social capital underpins social development and poverty alleviation programmes. For examples, Brown & Ashman (1996, p.1477) examined thirteen cases of multiparty cooperation across Africa and Asia. They found that “the creation and strengthening of social capital in the form of local organizations and networks is an essential task in building intersectoral cooperation that mobilises and utilises local resources and energies for problem solving”. Bebbington, when considering six localities in the Ecuadorian and Bolivian Andes, found that the common things to the cases of success are the manufacture of high-value products for middle class and elite markets. Another important thing that he found is the “existence of base and federated local organisations, and of external actors who

have networks of contacts with non-local institutions. These two dimensions of local 'social capital' - organizations and networks - play a critical role in helping these localities renegotiate relationships with the market, state and other civil society actors" (Bebbington 1997, p. 189). He argued that the "relationship between indigenous organisations, other actors and the political and economic context is equally apparent in the strategies of these organizations today" Bebbington (1997, p.195).

Ostrom & Ahn (2003) explained the reason why social capital came to the attention of researchers and policy makers because there had been an accumulation of problems related to economic and political development that had reached their limit but were not yet accounted for by previous theories and this unexplained phenomenon needs careful examination. They also said that the social capital approach looks seriously into the causes of behaviour and collective social norms, which help researchers look into the causality among factors in order to better understand political and economical phenomena at the macro level. This is the reason why social capital captures the attention from policy makers, researchers, and development workers.

How is Social Capital developed?

The concept of social capital could be traced back at least to the works by de Tocqueville ([1840], 1945), Hanifan (1920), Jacobs (1961). But perhaps the concept has not been popularised until the publication of the works by Bourdieu (1983, p.249) who defined social capital as an "aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance and recognition, which provides each of its members with the backing of the collectivity-owned capital, a 'credential' which entitles them to credit, in the various senses of the word". In addition to Bourdieu, other scholars such as James Coleman, Robert Putnam also made social capital more popular.

Bourdieu's work, perhaps, initiated discussion and popularised the concept of social capital as a facilitating agent for obstacles to development by looking into the benefits that individuals could have from being a member and from participating in groups and group-based activity. According to Portes (1998, p.3-4) "Bourdieu's definition makes clear that social capital is decomposable into two elements: first, the social relationship itself that allows individuals to claim access to resources possessed by their associates, and second, the amount and quality of those resources".

For Bourdieu, the underlying economic factors are attributable to social processes. He argues that it is the economic interest of individuals (and the potential economic benefit that one expects) that explains the major reason for the group's bounded solidarity, which leads to group formation, and that it is the formation of structural economic organisation which leads to the formation of social capital. He argued that social capital is based only in a practical state, symbolic and material relation of exchanges, and that the amount of social capital that an individual has depends on the extent to which he or she can mobilise a social network, including cultural and economic capital, held by the members of that network.

Bourdieu used social capital as a concept to explain the difference in achievement between people of the same economic and cultural capital. He explained that the resultant difference is attributed to the ability of people who could mobilise the social capital from institutionalised groups such as family, schools, colleagues, circles of expertise for their purpose. Wall, Ferrazzi & Schryer (1998) also noted that social capital, as a means of excluding others from access to resources, becomes the focus of research for those following Bourdieu's concept.

James Coleman is the first person who carried out the systematic conceptualisation of the concept of social capital (Ostrom & Ahn 2003). He was interested in the role of social capital in human capital creation and educational outcomes, thus defining social capital by its function (Narayan & Cassidy 2001). Coleman (1988, p.95), in his empirical work on education, considered social capital as "a resource for action" and is "one way of introducing social structure into the rational action paradigm". Coleman examined three forms of social capital - 1) obligations and expectations, 2) information channels, and 3) social norms. He suggested that the social capital concept be used to explain different outcomes, not only at individual but also at the system level.

To examine social capital, Coleman conducted a longitudinal study in which he examined the difference in terms of academic achievements between high-school students who attended state-owned schools and those who attended Catholic schools. His findings revealed that the drop-out rate among state-school students was much higher than that among students at Catholic schools. He found that frequency of attendance at religious services (which is a measure of social capital) by students of Catholic schools is strongly related to the drop-out rate. He argued: "social capital is the set of resources that inhere in family relations and in community organization and that are useful for the cognitive and social development of a child or young person" (Coleman 1994, p.300, cited in Baron *et al.* 2000). An important insight from Coleman's work is the importance of network closure to the implementation of collective

action. Coleman argued that dense social networks ensure a more effective enforcement of group cooperative behaviour (Sobel 2002). Indeed, the findings of Coleman provoked controversy, but the redeeming factor is that his works had an influence on policy makers since then.

Despite not being the originator of the social concept like Bourdieu and Coleman, Putnam has become its “chief publicist” (Lowndes & Wilson 2001, p.630), who finally unleashed social capital research into its current widespread phase of development after publishing his book called *Making Democracy Work* in 1993 (Ostrom & Ahn 2003). Indeed, Putnam made the concept of social capital globally accessible and policy relevant (Baron *et al.* 2000).

In 1995, Robert Putnam (1995) published the article “*Bowling alone: declining American social capital*” in the *Journal of Democracy*, which reached a broad audience. In the paper, Putnam observed social trends and situations in the United States. He claimed that there had been a dramatic decline in the level of participation in group activities – civic involvement, which was very likely to threaten both the quality of democracy and the quality of life. His suggestion ignited a series of cross-national studies of social capital to understand how trust is created in neighbourhoods and in the transition of economies. *Bowling alone: the collapse and revival of American community*, which was published in 2000, developed the argument discussed in the 1995 article. Putnam pointed out negative effects, unstable democratic institutions, decreased effectiveness at schools, to reduced magnitude of powerful forces that improve collective health and well-being and concluded by calling for action. Although the evidence was strongly based on an extensive data set, cause and effect were confused. Putnam wanted to argue that trends that he analysed were related, but an analytical framework was not available to support these claims. The countertrends were also dismissed casually. The way Putnam argued brought up an impression that measurable declines in group activities cause bad outcomes (Sobel 2002). That is the reason why Putnam’s theoretical and empirical arguments were criticised not only within his own discipline of political science but also in other related disciplines (Baron *et al.* 2000).

Putnam (2000) suggested two terms, known as *bonding* and *bridging*. He drew a distinction between bonding and bridging social capital. While the former explains the relations of homogeneous groups (which could lead to denser networks), the latter refers to relations between heterogeneous groups (which leads to expanding networks). He argued that bridging social capital could lead to a cohesive, well-functioning society. The works by Burt (1992)

showed that with the environment in his study, bridging social capital improved access to information and leads to improved outcomes for the group.

Despite the controversial work, it is observed that for those who agreed with Putnam's arguments, the argument provided them with a passionate grounding for renewing civic involvement. For those who are still doubtful, the arguments remain research questions (Sobel 2002).

Analysis of Social Capital

Definitions of Social Capital

There has been a lack of an agreed-upon and established definition of social capital, combined with its multidisciplinary appeal, which has led to the spontaneous growth of different interpretations of the concept (Grootaert & Bastelaer 2002a). The following definitions were widely typical for social capital:

Bourdieu “The aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationship of mutual acquaintance or recognition” (Bourdieu 1985, p.248)

Coleman “Social capital is defined by its function. It is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors - whether persons or corporate actors- within the structure” (Coleman 1988, p.s98)

Putnam “Social capital refers to features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit” (Putnam 1993, p.35)

Portes “Ability of actors to secure benefits by virtue of membership in social networks or other social structures” (1998, p.6)

Grootaert & Bastelaer temporarily defined broadly social capital as the “institutions, relationships, attitudes, and values that govern interactions among people and contribute to economic and social development” (2002, p.2)

World Bank “Social Capital refers to the norms and networks that enable collective action. It encompasses institutions, relationships, and customs that shape the quality and quantity of a society's social interactions” (World Bank 2008)

WHO “Social capital represents the degree of social cohesion which exists in communities” and that “it refers to the processes between people which establish networks, norms, and social trust, and facilitate co-ordination and co-operation for mutual benefit. Social capital is created from the myriad of everyday interactions between people, and is embodied in such structures as civic and religious groups, family membership, informal community networks, and in norms of voluntarism, altruism and trust. The stronger these networks and bonds, the more likely it is that members of a community will co-operate for mutual benefit. In this way social capital creates health, and may enhance the benefits of investments for health” (WHO 1998)

Portes (1998, p.7) observed: “Whereas economic capital is in people’s bank accounts and human capital is inside their heads, social capital inheres in the structure of their relationships. To possess social capital, a person must be related to others, and it is these others, not himself, who are the actual source of his or her advantage”, as Narayan & Cassidy (2001) argued - an intrinsic characteristic of social capital is that it is relational and it exists only when it is shared.

How social capital is measured?

In developing countries, social capital affects economic development, by facilitating transactions among individuals, households, and groups. Indeed, the effects are recognised in three forms - first, participation by individuals in social networks increases the availability of information and lowers its cost. Second, participation in local networks and mutual trust make it easier for groups to reach and implement collective decisions (which reduce opportunistic behaviours). When a particular behaviour is expected in a social setting, fear of exclusion can induce those individuals to behave in a desired manner. Third, networks and attitudes reduce opportunistic behaviour by community members (Grootaert & Bastelaer 2002).

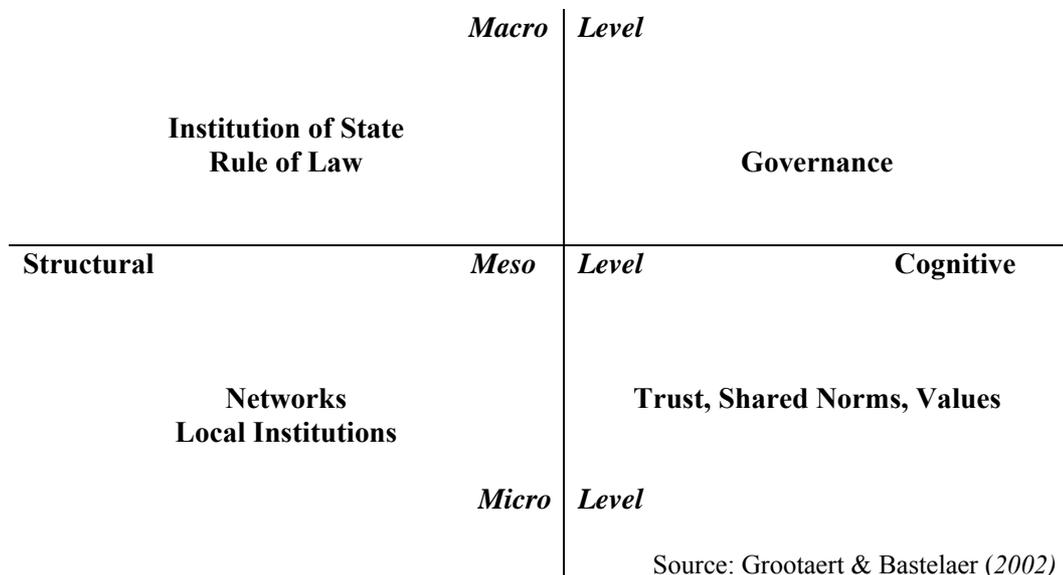
However, because of its internal dynamics, complicated and site-specific interactions, and difference in terms of cultural concepts with regards to norms, trustworthiness and incentives, the social capital of a particular geographical area is hardly captured in evaluation efforts. Consequently, the diversity in social capital is one missing area that theories of collective action failed to capture entirely (Ostrom & Ahn 2003).

Dimensions of Social Capital

Uphoff (2000) describes two main forms of social capital as follows: 1) structural form referring to relatively objective and externally observable social structures, roles, rules, and procedures, and 2) cognitive form - comprising more subjective and intangible elements such as norms, values, attitudes, reciprocity, beliefs and trust. For Grootaert & Bastelaer (2002), these two forms are mutually reinforcing and one can not exist without the other.

The second element that helps distinguish the elements of social capital is the scope, or “the breadth of its unit of observation” (Grootaert & Bastelaer 2002, p.3). There are three levels, namely micro, meso and macro at which groups interact both horizontally and vertically. The micro level is in the form of horizontal networks of individuals and households. This group is associated with norms and values that underlie these networks. The meso level captures both horizontal and vertical relations among groups. This level indicates the interaction between individuals and society. The macro level is manifested in the form of institution and political environments that serve as a background for socio-economic activity.

Figure 5 - The Forms and Scope of Social Capital

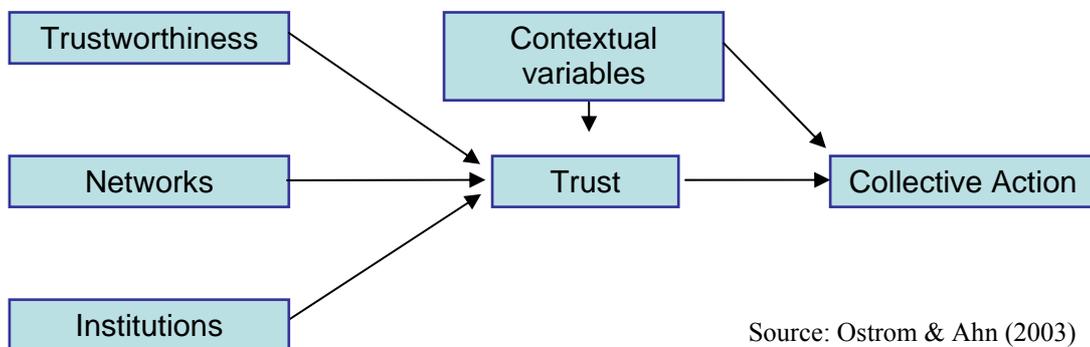


Forms of Social Capital

Collective-action theories failed to fully explain the success and failure of collective action because collective-action, by its nature, is determined by complex configuration of various factors, which were not fully accounted by collective actions (Ostrom & Ahn 2003). Research on collective action that has been done so far could not take into consideration all factors that account for collective action. Therefore, it is necessary to put all factors in a synthesizing context so that it would be easier to understand how collective action is achieved (Ostrom & Ahn 2003). When doing this, social capital shows better shades of meaning to account for such cooperative action.

Social capital, however, takes different forms that contribute to successful collective action. These forms, which include *trustworthiness*, *networks*, *institutions*, almost always enhance trust among actors (Ostrom & Ahn 2003). All these three forms of social capital, if being able to produce trust, could leads to achievement of collective actions (Ostrom & Ahn 2003, Torsvik 2000).

Figure 6 - Forms of Social Capital, Trust, and their Linkages to Achieving Collective Action



Elements of Social Capital

Onyx & Bullen (2000) reviewed literature on social capital. They identified five main domains that are key elements of social capital: 1) trust, 2) reciprocity, 3) social agency, 4) shared norm, and 5) network.

Trust is defined as “the willingness to permit the decisions of others to influence your welfare. Levels of trust determine the degree to which you are willing to extend credit or rely on the advice and actions of others” (Sobel 2002, p.148).

“Trust is the expectation that arises within a community of regular, honest and cooperative behaviour, based on commonly shared norms, on the part of other members of that community. Those norms can be about deep ‘value’ questions like the nature of God or justice, but they also encompass secular norms like professional standards and codes of behaviour” (Fukuyama 1995, p26).

Trust is based on personal experience and ongoing relationships. It is almost central to all discussion of social capital. It is based on a sense of confidence that people have on each other in an expected way. The level of trust is likely to be different even from groups from within a society.

Reciprocity refers to the willingness to help others, even at one’s own cost in an expectation that this kindness will be returned in the future in case of need.

Social agency is a model of positive relationship between agency and communication.

A social norm is a form of informal social control that is commonly understood without being written down. These social norms determine what pattern of behaviour is expected in a given social context. Productivity Commission (2003) stated generalised social norm includes also honesty, abiding by the law, work ethic, respecting elders, tolerance, acceptance of diversity and people in need. It could be further interpreted to be manifested in laws and regulations in some instances. Social norms vary from society to society. They are operational at different societal levels with norms (at group levels) within a society being often stronger.

A network refers to an interlocking network of relationship between individuals and groups. It provides individuals in the network with benefits such as a greater pool of social support when needed and numerous opportunities (Productivity Commission 2003).

In order to build social capital, it is essential to recognise the role that actors play in the context of the community. Leonard and Onyx (2004) stressed that building of social capital is not only

the job of local leaders but is also that of the ordinary people in the community who makes this happen. They also argued that women in the family as well as professional people who play an important role in facilitating the connection of social groups within the community are also decisive players in this process. As far as professionals are concerned, the demonstration of commitment and building of trust is a vital role. Voluntarily contributing to local communication organisations is a sign of such commitment. Breach of trust, however, has a far-reaching effect. Loss of trust could deprive actors of opportunities of trust restoration. In the meantime, it undermines the community commitment when a particular endeavour is needed.

Leonard & Onyx (2004) argued that there is always a need for continuous reproduction and generation of social capital. If this process does not happen, it is very likely that a community would lose its capacity to maintain practical concerns for the welfares of its citizen and compromise the economic and political life of larger community in the long run. However even when the history of cooperation is well known, this pattern does not tell people for sure that previous cooperation could lead to cooperation in the future. Ostrom (1999) argued that social capital does not depreciate with use over time and that in important instances, making use of social capital facilitates its accumulation for future use.

Social capital plays an important role in the management of the commons because it facilitates the consensus building for an agreed plan of action. As human relationships nourish social capital, they should be maintained and built in neighbourhood, community, and workplace. Leonard and Onyx (2004) stressed that the trust, reciprocity, social agency, social norm, and network will not only create strong community, but also generate and maintain stock of social capital.

Sources and Determinants of Social Capital

Identifying sources and determinants of social capital is difficult since there are many factors that influence the way social capital is generated, both the extent and rate. The Productivity Commission (2003, p.13) proposed a conceptual framework based on the concept of social capital defined as a “network of social relations which are characterised by norms of trust and reciprocity and which lead to outcomes of mutual benefits”. This framework was based on the studies by Stone and Hughes (2002) and supported that social capital have a range of determinants and outcomes, which interact each other (cf. Stone & Hughes 2002).

At the individual level, there is argument that having trust on each other causes people to act in a more trustworthy way. Conversely, without trust, a society may be trapped in circles of untrustworthy behaviour that proliferate distrust and untrustworthy behaviour (Productivity Commission 2003, quoting the studies by Cox & Caldwell 2000). At a practical level, the government may have either good or bad impact on the creation of social capital. This depends on how government programmes are designed and coordinated as well as on the overall “footprint” of the government (Productivity Commission 2003, p.14).

Criticism of social capital

Concept validity

Several other researchers argued that the development of social capital could generate both positive and negative outcomes. Mohan and Mohan (2002), when analysing social capital from the perspective of human geography, pointed out that social networks rely on exclusion. Portes (1998, p.15) analysed the negative social capital. He clearly pointed out the reasons why an analysis of social capital is important because, first, it helps “avoid the trap of presenting community networks, social control, and collective sanctions as unmixed blessings”. Second, it helps “keep the analysis within the bounds of serious sociological analysis rather than moralizing statements”. He said that there are at least four negative consequences of social capital that have been identified through recent studies - “exclusion of outsiders”, “excess claims on group members”, “restrictions on individual freedoms”, and “downward leveling norms”.

For the case of “exclusion of outsiders”, for example, Portes (1998) quoted the analysis of case studies by Waldinger (1995), who described the control by white ethnics - descendants of Italian, Irish, and Polish immigrants - over the construction businesses and the fire and police unions of New York. Other examples Waldinger provided include the cases where Korean immigrants took growing control over the produce business in several East Coast cities, case of the traditional monopoly of Jewish merchants over the New York diamond trade, and the dominance of Cubans over numerous sectors of the Miami economy. Waldinger concluded that in each case he highlighted, the social capital, which was formed based on the groups’ solidarity and trust, resulted in their business success. This success, however, indicates the advantage and economic benefits shared among the members but the benefit is confined within the groups and inaccessible to outsiders.

Putnam (2000) suggests that networks and norms of reciprocity are usually good for those inside them as members, but the external effects of social capital can also be negative. Examples of negative effects of dense networks include groups such as urban gangs, NIMBY movements or the Ku Klux Klan. Such negative effects can be assumed being more common in the case of bonding social capital (homogeneous groups) than in the case of bridging social capital (heterogeneous groups).

Methodology for measurement

Narayan & Cassidy (2001) noted that while definitions of social capital are highly different at a general level, including its forms and dimensions, the interpretations of social capital are also diverse at an operational level. As a result, methods used to measure social capital often vary. Ostrom & Ahn (2003) commented that most criticism of social capital is related to the lack of agreement to the establishment of valid and reliable measurement for social capital. However, they argued that researcher, in principle, could measure social capital based on the context of collective-action in question.

Grooart *et al.* (2002, p.4), when discussing in the Forum Series on the Role of Institutions in Promoting Economic Growth initiated by the World Bank, argued that there have been many studies done for human capital, which indicates that no country has reached high levels of development without adequate development of its human resource. However, empirical cases have not yet been made for social capital. Nevertheless, studies of social capital so far have adequately devised assessment tools that could help “understand more thoroughly the nature of existing institutions in client countries and their roles in social and economic development; working with existing social capital, especially people’s associations and organizations, for the design and delivery of projects; and facilitating enabling environments that foster the strengthening of social capital in partner countries”. One of the tools that the World Bank recommended for use to measure social capital is the SOCAT (Social Capital Assessment Tool), which consists of instruments that is designed to measure social capital at community-, household-, and organisation-level.

Potential limits due to local conditions

Onyx and Bullen (2000) said the use of locally generated social capital could not be presumed to be automatically sustainable. They argued that it is because social capital is slow to develop but easy to destroy. It is also subject to deterioration at several levels. There are three reasons.

First, the inter-relation of trust, shared value, transparency and personal ambitions are those that are likely to attack established social capital if awareness or this process is not supported and ongoing action not taken to maintain the social capital stock. Second, at a wider level of the municipality, or rural administrative unit, having access to support from a wide network is essential in mobilizing social capital (Brown 1998, as quoted by Onyx & Bullen 2000). Trigilia (2001) showed an example about intrinsic conflict of interests at local level where the council refused to approve sustainable development plan that is against the interest of the business cycle because most of councillors are businesspersons. Third, social capital always depends on the policy and action at national and global level as this provides an institutional structure on which the local practices is situated.

Summary

Social capital connects individuals through networks, norms, and trust for a shared, mutual benefit. Although social capital is the subject of intensive empirical studies for just more than a decade, it becomes increasingly important in explaining collective action in the context of social, economic and political settings. Ostrom & Ahn (2003) pointed out that theorists of social capital open the discourse on social capital by putting the problems of collective action at the centre of economic and political problems. Collective-action theory (known also as first-generation collective-action models) assumes homogeneous, selfish individuals at its core of explanation. Social capital, which looks into factors including norms and trust, has not been either properly understood or captured in a limited extent in the first-generation collective-action models. Because social capital facilitates collective actions, it could be considered as a step further from the first-generation collective-action models.

If social capital facilitates efficient bargaining, harnessing social capital could provide information that may make additional cooperation possible (Sobel 2002). Groups are able to commit to an institution that provides a sensible way to govern the commons. One should be looking not only for the features of institutions that facilitate good outcomes, but how to arrive at these institutions, and what makes them stable (Ostrom 1990). Different communities have different methods to arrive at their consensus. These methods need to be well fit to the local settings and therefore one should be aware of this sensitivity because arrangements that enable people to put social connections to good work are people-centred (Sobel 2002).

Social capital is an important element for the adoption of the CTBS. However, this element needs to be turned into a specific product that provides a mechanism on which the community

action is based. Successful institutional arrangements by local people are important to ensure sustainable adoption of CBTS. Local consensus and institutional arrangement are important in the case of this study as it forms a foundation on which the collective action is initiated, monitored and maintained based on the local need. The next section provides an overview of a theory known as Common Pool Resources (CPR). This theory explains why a local arrangement for joint action is needed to avoid free-rider problems. Success in adoption of technology that requires collective action will not be achieved unless the free-riding problem could be solved.

2.2.3 Common Property Resources

Introduction and Rationale - Common Property Resources (CPR)¹

“What is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest”

Aristotle (cited in National Research Council 2002, p.8)

“What most definitions have in common is that collective action requires the *involvement of a group of people*, it requires a *shared interest* within the group and it involves some kind of *common action* which works in pursuit of that shared interest. Although not often mentioned, this action should be *voluntary*, to distinguish collective action from hired or corvee labor”

Meinzen-Dick *et al.* (2004, pp.4-5)

Common property has been often regarded as an obstacle to development (Larmour 1997). Successful economic endeavours primarily depend on the ability of people to refrain from personal profitable actions for the sake of the common good. Such collective action problems are characterised by the lack of coincidence of private and social optima because individual actions have externalities on others. The ability to cooperate in collective action problems, such as those relating to the use of common property resources, or the provision of local public goods, therefore determines the economic performance (Bandiera *et al.* 2005).

Why CPR is important?

¹ The terms *Common Property Resources* and *Common Pool Resources* are used interchangeably and refer to the same concept in this study given the nature of the CTBS.

Management of a CPR is a controversial issue. The successful management of the CPR lies at the heart of how the problem of free-riding is solved. Collective action processes are always associated with free-rider problem (Steins & Edwards 1999). “Whenever one person cannot be excluded from the benefits that others provide, each person is motivated not to contribute to the joint effort, but to free-ride on the efforts of others” (Ostrom 1990, p.6).

In agricultural development, collective decisions are increasingly important. Nevertheless, since there are always conflicts in goals and interests of individuals, renegotiation is required to decide whose interests will be given the most weight. A process involving power and negotiation skills is therefore essential (Van den Ban & Hawkins 1996).

Excluding people from benefiting from a CPR is not always easy. In cases where exclusion is costly, people who want to provide a good or service would face potential free-riding or collective-action problem (Olson 1965, cited in Ostrom 2005). “Individuals who benefit from the maintenance of an irrigation system, for example, may not want to contribute labour or taxes to maintenance activities, hoping that others will bear the burden”. “A strong incentive exists to be a free-rider in all situations where potential beneficiaries cannot easily be excluded for failing to contribute to the provision of a good or service” Ostrom (2005, p.24).

Three models that are the most influential to the examination to the management of CPR includes the *The Tragedy of the Commons* (by Hardin 1968), *Prisoners’ Dilemma game*, and *The logic of collective action* (Olson 1965). These three models have been very useful in explaining how perfectly rational individuals can produce under some circumstances (Ostrom 1990).

How CPR models were developed

The Tragedy of the Commons

In his influential journal article published in *Science* in 1968, Hardin suggested that humankind was destined to overexploit the commons unless the freedom to breed was relinquished. Hardin’s model has become a symbol of an environment degradation to be expected if many people continuously use a scarce resource in common (Ostrom 1990). In the article, Hardin provided an example of herders (as a metaphor) whose animals are benefiting from a pasture. As the use of pasture goes on, and as each herder is motivated to add more animals to the

shrinking pasture, each herder incurred a *delayed* cost of deterioration of the commons (the pasture).

“Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit--in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all”

Hardin (1968, p.1244)

According to Ostrom (1990), Hardin was not the first who anticipated the tragedy of the commons. In fact, Gordon (1954), about a decade before the article of Hardin, also described the same dynamic as Hardin. He argued: “Wealth that is free for all is valued by no one because he who is foolhardy enough to wait for its proper time of use will only find that it has been taken by another” (Gordon 1954, p.135).

Common Property Resources in the context of rising grass-roots democracy in developing countries

Hardin’s analysis has been shown by studies as being overly simplified and deterministic, and the theory will have to be revised to take into account new evidence (Feeny *et al.* 1994). There is an ever increasing interest in communal property arrangements related to the resurgence of interest in grass-roots democracy, public participation and local-level planning. Evidence shows that local users have the capacity for self-management and this community based management proved to be more effective than implemented as a result of local government’s exclusive decision making. In such cases, it is more reasonable that local users are entrusted to assume administrative and economic responsibility (Feeny *et al.* 1994). It is also found that government regulation, jointly made with users’ self-management, is a viable option to the management of the commons, because this option facilitates the capitalisation of both local knowledge and long-term interests of users while ensuring harmony in coordination between the demand and users’ level of access to the resources at a potentially lower transaction costs (McCay 1978).

Analysis of Common Property Resources

Property rights – Management regimes

A property can be managed under four basic types of regimes: (1) *open access*, which means the property is free to all people. For this case, rules stipulating how the commons are exploited is not available; (2) *public property* refers to access rights that are available to individuals or groups but are owned and controlled by the state; (3) *private property* refers to tradable rights that are owned by an individual, household, or company. Property users in this case are socially and legally able to exclude others, and (4) *common property* is the case where rules exist to govern access to, allocation of, and control over the CPR. An *a priori* decision-making arrangement is essential in this case for the long-term use of the resource and prevents the common-pool resource from being degraded (Feeny *et al.* 1990, Steins & Edwards 1999a).

Common Property Resources – Characteristics

With the *Logic of Collective Action*, Olson (1965) challenged the foundation of modern democratic thought that groups would tend to form and take collective action whenever members jointly benefited. Olson (1965, p.2) emphasized: "Unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interests*".

Level of analysis

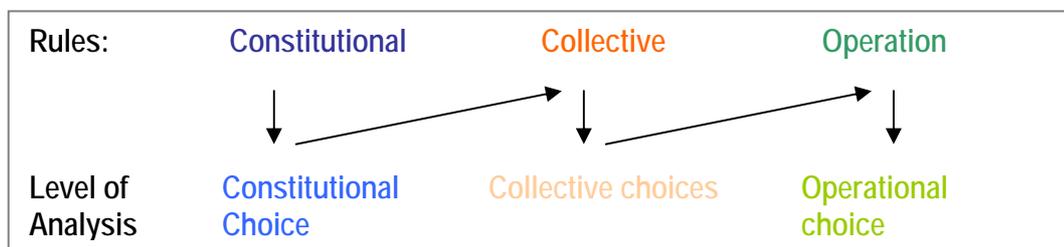
Oliver reviewed many of the efforts to present a model of collective action. He argued that "there is no one 'right' way to model collective action: different models imply different assumptions about the situation and lead to substantially different conclusion" (Oliver 1980, p.1359). Most of the current analysis of CPR and collective-action problems focus on only one level – commonly called *operational level* of analysis. Ostrom (1990) commented that focus on this level was made because analysts assume that rules and technology do not change over time whereas this is not the case. She argued that rules affecting operational choice are made within a set of collective-choice rules that are themselves made within a set of constitutional-choice rule. Individuals capable of self-organisation switch back and forth between operational-, collective-, and constitutional-choice domain.

At these levels, there is a set of rules that is referred to as *institution*. *Institution* determines the eligibility of people who can make a decision within a particular arena – what actions are allowed, what rules will be used, what procedure will be followed, what information will be or not be provided, and what payoffs individuals will be assigned to, depending on their actions.

Institutions could be comprehended as a working rule that needs to be adhered to by people who create and commit to abiding by it (Ostrom 1990).

According to Kiser & Ostrom (1982), it is essential to differentiate the three levels of rules that “cumulatively affect the actions taken and outcomes obtained when using CPRs” (cited in Ostrom 1990, p.52). For Meinzen-Dick *et al.* (2004), it is up to the purpose of collective action that one analyses the phenomenon at an appropriate level - (operational, collective choice or constitutional level) for a particular social unit (individual, group, community, or intra-community, etc.) (See linkages between choices and level of analysis in figure below).

Figure 7 - Linkages between choices and level of analysis



Source: Ostrom (1990)

Collective-choice rules indirectly affect operational choices. These rules are used by appropriators, their officials, or external authorities in making policies – the operational rules – about how a CPR should be managed. Constitutional-choice rules affect operational activities and result through their effects in determining who is eligible and determining the specific rules to be used in crafting the set of collective-choice rules that in turn affect the set of operational rules and the related level of analysis at which humans make choices and take action. The process of appropriation, provision, monitoring and enforcement occur at the operational level. The process of policy-making, management, and adjudication of policy decisions occur at the collective-choice level. Formulation, governance, adjudication, and modification of constitutional decisions occur at the constitutional level (Ostrom 1990).

Framework for analyzing the commons

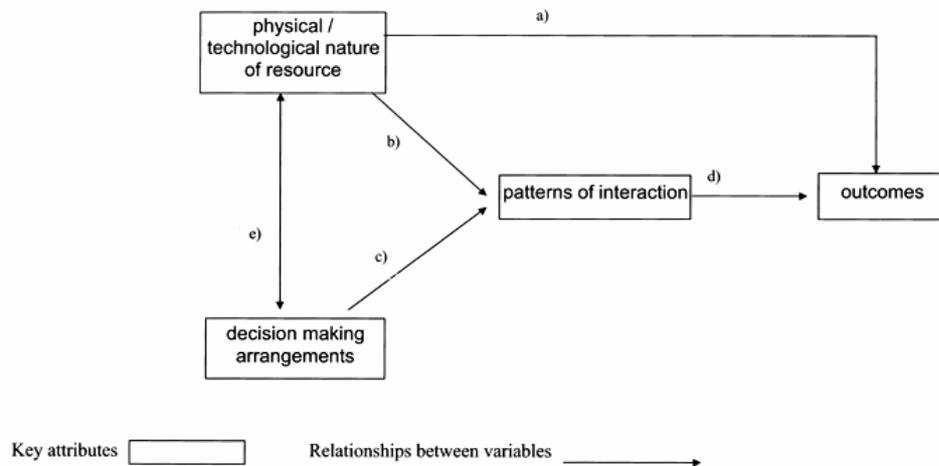
Oakerson (1992) suggested four types of attributes that are shared broadly by the commons in its manifestations. These attributes are:

1. Physical attributes of the resource;

2. Decision-making arrangements (rules), governed by the appropriator relation;
3. Mutual choice and consequent patterns of interaction among decision makers; and
4. Outcomes (consequences).

The following framework was developed by Oakerson and was adopted by the Panel on Common Property Resource Management, organised by the Board on Science and Technology for International Development (BOSTID) at the National Research Council (USA). The framework was developed to aid the collection and assimilation of case-by-case analyses. It is not exhaustive and therefore some other methods need to be used to array information into meaningful sets in order to examine relevant relationships in a particular case. Oakerson (1992) argued that if a consistent method was used by the community of scholars, comparison of different case studies will be enhanced. As this process goes, the framework is subjected to revision to incorporate new experiences. He also recommended that researchers should refer also to the generic framework which was more elaborately developed by Kiser & Ostrom (1982).

Figure 8 - Framework for analyzing the Commons



Source: Framework for analyzing the Commons (Oakerson 1992)

Design principles

Despite the difference in settings among CPR, there were some similarities. Ostrom (1990) pointed out these similarities when analysing the long-enduring CPRs as successful cases in community based management (based on cases studies conducted in different countries). Following this review, Ostrom (1990) came up with a set of design principles that she thought

could constitute a credible explanation of the persistence of these CPRs. These principles affect incentives of appropriators in a way that leads to appropriate commitment in conforming to operational rules devised in their system. The design principles are:

1. Clearly defined boundaries;
2. Congruence between appropriation and provision rules and local conditions;
3. Collective-action arrangements;
4. Monitoring;
5. Graduated sanctions;
6. Conflict-resolution mechanisms;
7. Minimal recognition of rights to organise; and
8. Nested enterprises (for CPRs that are parts of larger systems).

However, she noted that although these principles explain the success associated with the cases that she analysed, more scholarly work need to be done to validate these principles (Ostrom 1990).

Individual, Incentives and Transaction costs

Perceived costs and benefits

People think and weigh benefits against cost and the expected outcome when they consider choice over different options. These perceptions are based on the experience that individuals have about their own community. According to Ostrom, Schroeder & Wynne (1993), at the operational level, when individuals bear costs of replacement and maintenance of particular works, they will continue to invest in maintenance provided that the returns from such investment are greater than the expected costs. Because different people have different incentives (i.e., those involved in infrastructure design and those who are involved in operating and maintenance), coordination for a concerted effort is time consuming and resources is required to make sure monitoring and evaluation is performed once agreement is made.

Williamson (1979) argued that when people consider a choice, they also think of time and resources devoted to establishing and maintaining relationships. Breton & Wintrobe (1982) argued that people also think of the value they attach to establishing a reputation for being reliable and trustworthy. Ostrom, Schroeder & Wynne (1993) assumed individuals are fallible and in line with this, they presume institutional arrangements that an individual uses offer

learners different incentives and opportunities to learn. The knowledge about schemes of institutional design principles on the part of individuals also affects their capacity to change their institutions so as to improve learning and outcomes when repeated failures occur.

Information asymmetry

In terms of information to support decision making, people do not have the same access to information and they also do not have adequate information processing capabilities. Williamson (1975) pointed that when common outcomes require different appropriators to contribute inputs that are costly and difficult to measure, people is very likely to behave opportunistically and it is difficult to foresee this situation as people may say one thing but do the other thing after a decision is made.

Kinship network

Family is considered as an effective institutional arrangement for carrying out numerous transactions. This accounts for the continuing importance of kinship relationships in all cultures and economies (Ostrom, Schroeder & Wynne 1993). The advantage of family as a governing mechanism is its capacity to help limit the opportunistic behaviour, reduce transaction costs and information asymmetries (Ben-Porath 1980).

As people in a kinship share similar family traditions as a generation value, they have a reference point to refer to, which navigates how they behave. Landa (1981) has indicated how trust among Chinese businessmen decreases as a result of distance of their kinship relationships. Common traits such as language, moral standards, code of conduct, and expectations induce low costs in various transactions. Additionally, opportunism is reduced since people within kinship are aware of how success and failure affect the common goals of all people of the same kinship relationship.

Review of empirical conditions that support self-organisation among user groups (steps towards theory development)

Variables

In an attempt to review studies that seek to understand the conditions under which groups of users cooperate to sustainably govern the commons, Agrawal (2001) had summarised

institution-level conditions based on the three works by Wade (1988), Ostrom (1990), and Baland & Platteau (1996) which he considered as *landmark* works. He asserted that these three works, though different in context, concluded, “members of small local groups can design institutional arrangements to help manage resources sustainably” (Agrawal 2001, p.1653). He analysed this factor by looking at the correlation between sets of conditions and the successful management of the resources, which are all positive. He also found that the regularities in the successful management of the resources that the three works analysed fall into one of the five groups of variables, namely resource characteristics, group of users’ characteristics, nature of relationship among users, external factors and authorities (market, state, technology...), and the particulars of institutional regimes.

However, Agrawal argued that Wade, Ostrom, Baland & Platteau limited their analysis to two broad issues - 1) the resource characteristics and 2) the external environment. Resource characteristics, physically, refers to the stationarity and storage. Greater mobility of the resource and storage problem make it more difficult for users to adhere to the institutions. External environment refers to social, institutional and physical environment. He said none of these authors remarked explicitly in their conclusion factors related to demographic issues. In addition, equally small emphasis had been made about local demand pressures. For Agrawal, population dynamics and demographic pressures (whether this is due to migration or local change) could significantly influence the ability of users to create rules to manage the commons.

New technology and state management are also factors that should be taken into consideration. Agrawal (2001) argued that new technology could change power relations as it affects how different subgroups access the resources, and the level of access. In terms of state management, he argued although these authors gave more attention to this aspect than to the issues of market and population, more examination needs to be given to the nature of local states. This is because more and more governments are losing their control of resource management to local users, which prompts the need for a systematic examination of these variables to understand the variations in this relationship as well as how these variations affect the management of the outcomes.

There are also a number of contextual variables other than population, market, state, and technology. However, Agrawal’s preference is for these variables because he wishes to address the nature and the importance of the contextual factors to a partial degree, as he acknowledged, based on available studies that are related to his preferred variables. Nevertheless, he concluded

that these contextual variables should be incorporated into future studies because these variables may affect the impact of the variables in question.

Concerning factors centring on group dynamics, including size, heterogeneity, and poverty level of groups, no consistent pattern on conclusion could be arrived at in terms of its relation to success of the resource management. Adams (2003) argued that existing research has not yet been certain about the relationship of these factors to the sustainability of the management of the commons and that whether the relationship is positive, negative or curvilinear. These factors seem to be subjected to other contextual and mediating factors, with not of all them clearly understood. Ostrom (1987) identified group size and heterogeneity as a theoretical puzzle. She argued that as size of group changes, other variables such as transaction cost, cost for monitoring behaviour, influences on external authorities, and person's share of public goods, also change.

Methodological implications for future research (based on availability of synthesised variables)

Agrawal argued that because the above variables are large in number, future research should consider reducing them by grouping closely related variables into one as corporate index. In terms of sampling, he recommended the use of purposive sampling over random sampling because random sampling is not always applicable for the cases of common resources. Also, purposive sampling allows consideration of theoretically relevant variables. Finally, he suggested future research address three following focus points - 1) postulate causal link through structured case comparison, 2) use a large number of cases purposely selected based on causal variables, and 3) examine the strength and direction of the causal relationship using statistical tests. Suggesting this, Agrawal is optimistic that current scholarship of local institutions would pave the way to construction of the theory of the commons.

Stern *et al.* (2002), in an effort to summarise the scholarship of the CPR since 1985, reviewed relevant key studies in an analytic manner. He pointed out that future research on CPR needs to involve at least four following elements: typologies, contingent generalisation, causal analysis, and Integration of research results.

Typologies

Stern *et al.* (2002) argued that typologies need to be considered to be able to classify central phenomena, the outcomes, and the factors external and internal to the central phenomena. Examples of typologies include the further classification of property right institutions into sub-types, further classification of factors affecting institutional performance into attributes pertaining to resource, users, institutions and even sub-types of these classes, and even further with group heterogeneity. Understanding of typologies would enable researchers to tease out the effect of variables in hypothesised research.

Contingent generalisation

No single institution ensures its expected performance for every case across different social environments. Tang (1992) observed that there was an association between users' heterogeneity and performance in irrigation system, that this association is negative. However, the association was found associated with the schemes that government agencies managed. Such an association, nevertheless, was not found with the case where community directly undertook the management of the commons. Varughese & Ostrom (2001), in their studies of eighteen forest user groups in Nepal, found that heterogeneity could be overcome by the existence of a good institutional design which was crafted by people who spent time and effort to set up the collective-choice mechanism.

Causal analysis

As Agrawal (2001) pointed out, there is a need for research in the future to move from correlational analysis to causal analysis. Kopelman *et al.* (2002) review literature on psychological experiments related to factors that influence the cooperation of people in the management of the commons. He focused his review on such variables as gender, social motives (as differences among individuals), communication, group size, power and status (as social structure). Among the reviewed studies, he noticed two key findings that arise from the works by Dawes *et al.* (1990) who examined the communication effect of participants in a controlled experiment research. The two key findings are: (1) group discussion elicits commitment to cooperation and (2) group discussion enhances group identity and solidarity. From this finding, Kopelman *et al.* (2002) argued that greater clarity regarding causal mechanism is needed to support development of solutions for a real situation of the commons. Stern *et al.* (2002) also agreed that causal models can be useful to practitioners as the modelling helps identify intervention options for expected results. They said that this causal model helps future researchers to move from *correlational* focus to *causal analysis* focus and helps improve

the understanding of the commons by allowing researchers to group variables into underlying constructs and to connect research of the management of the commons to other fields (See the model in Stern *et al.* 2002, p.450).

Integration of research results

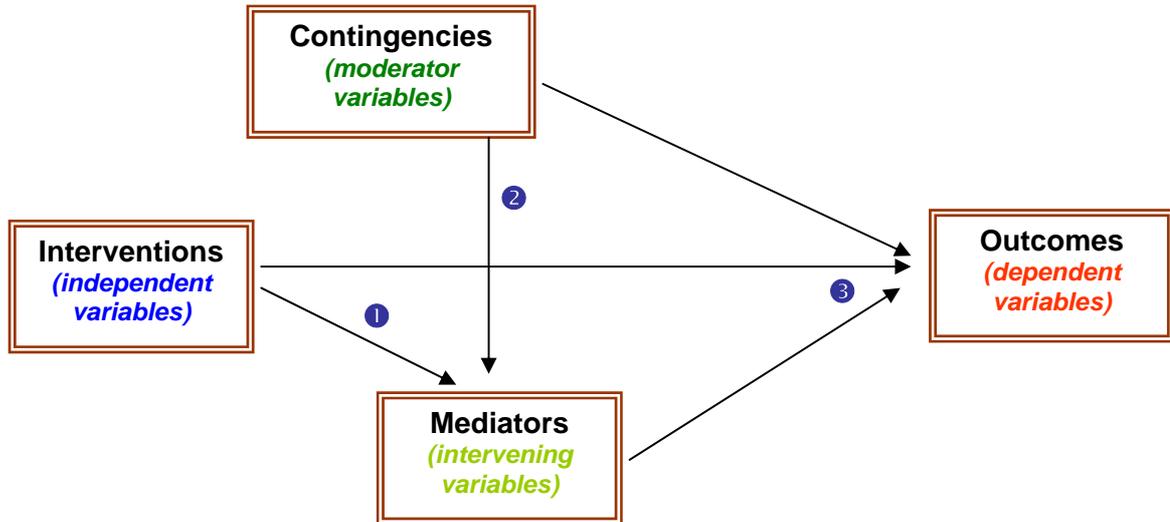
Both control experiment research and case-study based research have their own contribution to the understanding of the dynamics of the management of the commons. The former, with the advantage of a simulated situation, provided the strongest evidence of the case and the effect on relationships but it is difficult to apply in real situation because its external validity leaves room to questions. The latter, despite its virtue of offering deep understanding of realistic settings, could not be generalised because of its uniqueness in terms of context and the non-availability of sufficient cases with similar variables to support strong generalisation (Stern *et al.* 2002).

In terms of multivariate analysis as an attempt to look into causal relation, this option is not also adequate as it is limited by the range and quality of measure variables for all cases in the data sets. Because no research method is definitive, integration of research method as a way to triangulate the findings is appropriate to advance the knowledge (Stern *et al.* 2002).

Towards a conceptual framework

Stern *et al.* (2002) argued that despite Agrawal (2001) presenting a list of variables that are summarised from three works by Wade (1988), Ostrom (1990), and Baland & Platteau (1996), it is very likely that researchers will have to continue to identify variables that are important to understand and control the effect of resource management institutions. Given that, Stern *et al.* (2002) suggested a new conceptual framework for CPR research in which variables listed by Agrawal (2001) are arranged into four broad functional categories based on the possible theoretical relationship, as presented in the following model:

Figure 9 - Schematic causal model showing typical relationship among variable types



Source: National Research Council (2002)

This model suggests three tasks that future research should consider to further understand the causal relationship as denoted as ❶ ❷ ❸ in the model. Specifically,

- ❶ To understand how particular interventions affect the intervening variables;
- ❷ To identify contingencies under which intervening variables become critical; and
- ❸ To understand how intervening variables affect the outcomes.

Stern *et al.* (2002) also noted that the above framework suggests that outcomes of resource management will also depend on a variety of policy variables - not simply on the design of the resource management institutions; as such, there are more ways to achieve the desired outcomes.

Criticism of CPR

Ostrom & Ahn (2003, p.xiv) argued that the theories by Olson and Hardin were not completely wrong and that research on collective action has recently indicated that these theories' arguments are simply representative of limited cases (cf. Feeney *et al.* 1990, McCay 1978, Ostrom 1990).

Dietz *et al.* (2003) argued that Hardin's argument is oversimplified when he claimed that there were only two state-established institutional arrangements (government managed and private property) that could sustain the commons in the long run. They pointed out that there has been evidence that locally invented institutions, managed by communities with support from outside, brought out sustainable management of the resources for centuries despite failure when subjected to rapid change. They also argued in the same manner with Ostrom (1990) that the "herder"- a metaphor used by Hardin in his analysis, would successfully work out a solution to overcome the risk of resources shrinking because of exhaustive use. They noted that in the absence of necessary governance at an appropriate level, natural resources and the environment will be at risk. They analysed two typical examples - inshore fishery management and the protection of the ozone layer, which used to be thought of as would-be failure of management of the commons but turned out being managed. They indicated that the inshore ground fishery in Maine, as an open access, is managed by top-down government without giving local officials and users the right to self-regulate. The governance is, therefore, not credible to users and compliance is low. In contrast, the Maine management of lobster fishery, which is managed by both formal and informal users, gained a high rate of compliance, and this achievement appears to have prevented the exhaustive exploitation of lobsters.

Analysing the failure of the management of the commons at the policy level, Adams (2003) argued that it is the incomplete knowledge and understanding of complex natural and social systems that gave rise to the conflicts because people see resources differently in one landscape and they also perceive different procedures for different conflicts. He further explained that deep understanding of the stakeholders' difference over the management of the commons does not mean that policy negotiation could be made to achieve a win-win scenario. However, the understanding of participants' differences is helpful to consensus making for stakeholders who hold different values, interests and priority over the commons. Like Dietz *et al.* (2003), Adams asserted that policy will always involve choices that are contradicting to deeply held values and beliefs among stakeholders.

Feeny *et al.* (1994) argued that the logic of the argument of "The Tragedy of the Commons" is that private owners or state managers can usually successfully do the resource management because the two property-rights regimes (which belong to them), could provide them incentives to regulate the use in a way that ensures sustainability as opposed to the other two regimes (open access and communal property). Feeny *et al.* (1994) argued that by supporting this argument, Hardin implied that the incentives are implicitly weak or absent in the other two regimes (open access and communal property). They said that Hardin's conclusion follows his

four assumptions relating to 1) open access, 2) lack of constraints on individual behaviours, 3) conditions in which the demand exceeds supply, and 4) resource users who are not capable of altering rules. They said these four assumptions are often applied to actual common property resources because (using the examples of Hardin's herdsmen) there would come a time when pastures were no longer abundant for unlimited share for all animals without conflicts. If this were the case, herdsmen would need to sit together to discuss to agree how the pasture could be effectively used. This means a rule is needed to ensure long-term use of the pasture among the herdsmen. Sugden *et al.* (2003) also agreed that Hardin's model was perceived as a simple choice between two coercive alternatives in managing the commons: centralised government and institutionalised private property.

The nature of the resource is very important which is related directly to the way the resource is managed. In order for a resource to be effectively managed, one needs to understand its nature, decision-making arrangements array, property-right regimes, and the nature of interaction among users and regulators (Feeny *et al.* 1994). Feeny *et al.* (1994) stressed that interaction is one of the important characteristics of the commons situation and suggested these interactions be taken into consideration. They also believed that rules and norms can be socially constructed to regulate people's behaviour and that capacity for concerted social actions could overcome the divergence between individual and collective rationality. They said there has been ample evidence indicating that there are societies that have effectively devised, maintained and adapted communal arrangements to manage common-property resources. This persistence is not an historical accident. It was built on knowledge of the resources and cultural norms that evolved and tested over time.

As a criticism of the post-Olson and –Hardin's arguments, Steins & Edwards (1999b) analysed a case of an Irish fishing community who felt isolated from their fishery because of expansion of commercial salmon farms in their fishing grounds. As a result, they had created common property rights to secure their access to the fishery. Based on empirical studies, they argued that the current approach to collective action in CPR management has a number of shortcomings related to two things. First, it focuses on single-use CPRs. Second, the use of design principles (formulated based on success stories of CPR management) as an *a priori* condition for successful CPR management is not appropriate as it "hinders rather than facilitates CPR research and policies" (Steins & Edwards 1999b, p. 539). In fact, they argued that it is because *a priori* design principles do not bring into consideration "contextual" factors upon CPR analysis, and this "seriously" limits the understanding of collective action processes. Also, it is because 'local resource users will base their decision to cooperate or defect not only on the

expected social and economic costs and benefits generated by the CPR, but will also consider the expected costs and benefits from opting for “alternatives” (Steins & Edwards 1999b, p.543). They concluded that pre-defined conditions for successful collective action fail to address the “complexities involved in the evolution of collective action and hinder the understanding of its dynamic nature” (Steins & Edwards 1999b, p.541).

Given the above argument, Steins & Edwards (1999b) proposed a social constructivist perspective for the study of CPRs which is posited in a wider external environment, focusing on users’ motivations for certain action strategies. They explained that the outcome of CPR management “depends on the way social actors ‘socially construct’ their everyday reality” (Steins & Edwards 1999b, p.539). Thus, the advantage that social constructivist approach could offer is there are no *a priori* assumptions about the nature of collective action; that means there is no pre-defined “success” or “failure” (Steins & Edwards 1999b, p.544). They, therefore, asserted that the design principles identified in CPR theory are not useful “if they are tacitly used as prescriptions for establishing cooperation in CPRM situations”. Nevertheless, they are useful if researchers and practitioners “use them as a starting point for the formulation of questions that help to explain the state of a particular CPR, and if they acknowledge the interdependent relationship between these questions” (Steins & Edwards 1999b, p. 552).

Summary

CPR researchers have contributed greatly to understanding the complicated CPR and have achieved a profound knowledge with regards to the complicated relationship between successful management of the commons and the participants who devise the institutions. Nevertheless, a lot of effort needs to be made to better understand the conditions that affect the success likelihood of the commons management. This includes the employment of methods that validate the causal relationship between institutional arrangements and the endurance of that institution, focusing on verification of variables that are categorised by their functions towards to commons management outcomes (cf. Stern *et al.* 2002).

2.3 Summary and Justification for Theoretical Framework

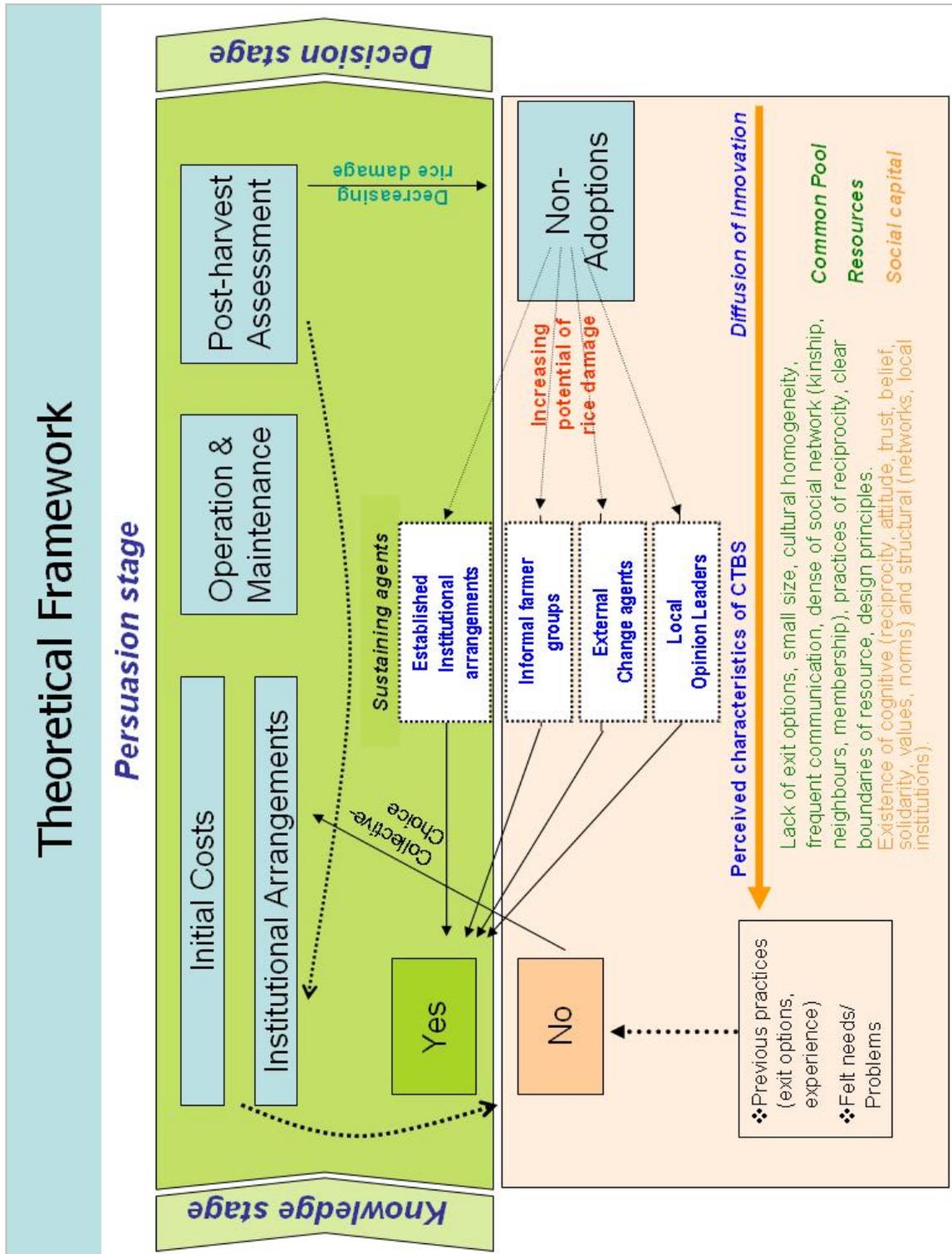
The diffusion of innovation is a “process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers 2003, p.6). When an agricultural technology is introduced to a farming community, it is important to understand how the technology is perceived by farmers at the beginning of the diffusion process. Several

factors inherent to farmers' characteristics, farming system, production characteristics, community cohesion, and the social context have been empirically proven to potentially affect farmers' decisions towards adopting a new agricultural technology. Understanding the potential constraints to the technology adoption process while understanding potential users helps address the problems and develop ways to overcome them.

Previous studies suggested that CTBS was hard to adopt at the community level because the technology is perceived by potential users as a common pool resource and as such, agreement for collective adoption is difficult to achieve. The theory of diffusion of innovation is useful in this study as it offers a framework for better understanding the constraints that take place throughout the diffusion process of the CTBS. Nevertheless, when in-depth understanding of constraints related to the management of the common and collective action is needed, this theory failed to offer an explanation. The theories of social capital and common property resources are useful in this case because they can help assess the success likelihood for the management of the CTBS as a common pool resource and the possibility of achieving a collective action towards joint adoption of the CTBS. Therefore, three theories described above will be employed to address the research questions under this study (See Figure 10 below).

The following theoretical framework outlines how the three theories are combined to address the research problems. Specifically, the *diffusion of innovation* theory will be used to contextualise this study by positing the case study at the appropriate stage of the diffusion process – the knowledge stage and persuasion stage (with focus on the persuasion stage). It will then explore the five characteristics of the technology as perceived by farmers at the persuasion stage to consider the potential constraints that farmers likely encounters when trialling the technology at this stage. Then, the two theories - *Social Capital* and *Common Property Resources*, will be used to examine the potential latent constraints to the adoption of this collective based technology.

Figure 10 - Theoretical Framework for the Research



In the next chapter, the methodology – used to answer the research questions through this theoretical framework, will be presented.

Chapter 3 – Methodology

This research was a case study which was conducted using a mixed methods approach. The following discussion explains why mixed methods were used. It starts with a statement of the research goal and research questions. Then, for each of the method used, its strength and limitations will be discussed, along with how the data was collected and managed for validity and reliability, and how they were analysed. Finally, a discussion on how the findings from this case study (in An Giang province) were generalised to the region (the Mekong delta).

3.1 Research goal and method selection

3.1.1 *Research goal and research questions*

The goal of this study is to examine the socio-economic constraints to the rice farmers' adoption of the Community Trap Barriers System for rodent control in the Mekong Delta of Vietnam. The following five research questions were formulated based on the research goal, and the review of relevant literature. These research questions define the scope of the study, and determine the data sources to be collected and research methods to be used.

1. Is the severity of the rodent problem related to the likelihood of adoption of the CTBS?
2. Will improvement in knowledge, attitudes, and practices of farmers related to non-chemical rodent control enhance the adoption of CTBS?
3. Will the availability of a local subsidy for CTBS establishment increase the likelihood of the CTBS sustainability?
4. Is the existing social capital of the farmers adequate to support the adoption of the CTBS?
5. Are local people able to make institutional arrangements that support the adoption of the CTBS?

3.1.2 *Selection of study site*

Huberman & Miles (2002, p.183) suggested a study site be chosen based on typicality to improve the potential generalisability of the study. If more than one site is used (i.e. in a multi-site design), both typicality and atypicality could be detected through cross-site comparison

(which is not typically achieved in a single case design) (cf. Burgess 1984, Campbell 1979 & Stenhouse 1984). Commenting on multi-site design, Maxwell (2004, p.246) put that multi-site design offers “powerful general explanation” and verifies “causal models suggested by survey data” (cf. Britan 1978, Fielding & Fielding 1986, Miles & Huberman 1984).

As mentioned earlier, this study started with the quantitative dataset that was already available through an ACIAR funded project. Since the data were collected from Tri Ton and Tinh Bien districts of An Giang province (as a sample representing the Mekong delta region), it is reasonable that the qualitative research under this study kept focusing on these two sites. Under this study, Tri Ton and Tinh Bien districts were treated as a multi-site design so that both typicalities and atypicalities with regards to rice production, farming system, rodent infestation, current practices and experience of farmers in rodent management between the two districts could be identified and assessed for consideration of the generalisability beyond the case study.

Design of trial sites

To understand how farmers perceived the constraints of the CTBS, they were asked to trial the technology for a few cropping seasons before commenting on its applicability. A quasi-experiment was set up by scientists from CSIRO and IRRI, whereby sixteen CTBS were set up in two districts (eight in each district) to support trials by farmers. As part of the research design, farmers who participated in the experiment should not have trialled CTBS before. This aims to ensure that they could provide a fresh assessment of the technology without any bias. In this study, farmers who trialled this new technology managed the experiments and were selected as research participants in the qualitative study.

3.1.3 Selection of research methods

Based on results of the quantitative data analysis, data gaps were determined and appropriate methods identified to guide the data collection for this study. The ACIAR’s quantitative dataset comprises a wide range of issues. Nevertheless, it was not sufficient to allow in-depth examination of the issues posed by all five research questions. This study aims to understand the socio-economic constraints of the CTBS. Specifically, it seeks to assess the current social capital stock and the ability of local people to make institutional arrangements to support CTBS adoption. Since the available quantitative data could not address these questions, qualitative methods, which allow in-depth investigation of the issues in question, are appropriate to complement the available quantitative data.

The following section discusses methods that were used under this study. The discussion starts with description of the above quantitative dataset, followed by the review of qualitative methods. Both strengths and limitations of each method will be discussed to show how weakness inherent in each method could be overcome by the adoption of a mixed methods approach. Since quantitative data was available from the ACIAR project in Vietnam, discussion of this method will not be detailed.

Quantitative research

The ACIAR's dataset (n=240) was obtained from a survey designed and run by scientists from CSIRO and IRRI to support an on-going ACIAR funded rodent project in An Giang province. The survey was conducted in September 2006 with the participation of staff from district and provincial Plant Protection Departments of An Giang province. Data entry was done by local staff, and were later coded, cleaned and checked by staff at the IRRI. As a member of the ACIAR rodent project in Vietnam, the investigator of this study was provided access to this dataset for his use under this study. When exploring the dataset, the investigator consulted with the staff of CSIRO and IRRI to better understand the coding of the dataset. In terms of quantitative data analysis, this exercise was undertaken by the investigator to support his thesis.

The quantitative dataset provides a wide range of information, including 1) demographic characteristics of farmers, 2) farm household characteristics, 3) cropping patterns, 4) rodent and other crop pests, 5) knowledge on rodent pest management, 6) farmers' attitudes and beliefs towards rats and rat management, and 7) management practices. It also provides information about community cohesion, cooperation, sociability, and farmers' daily communication channels related to their farming activities, which provided a snapshot of the current social capital owned by the community being studied.

Qualitative research

The following section reviews strengths and limitations of qualitative method as a whole, and reviews the advantages and disadvantages of each qualitative technique used.

According to Ritchie & Lewis (2003), qualitative research is a naturalistic and interpretative method that aims to understand the meanings which people connote through actions, decisions, beliefs, values within their social world. It aims to understand the mental mapping process that respondents use to make sense of and interpret the world around them. Reinharz (1992, cited in

Hakim 2000) stated that qualitative research enables richly descriptive reports of the above concepts. It shows how these concepts are integrated into the frameworks that account for their experiences. Qualitative methods also shed light on the motivations that connect attitudes and behaviour, the discontinuities, or even contradictions, between attitudes and behaviour, or how conflicting attitudes and motivations are resolved, and how a particular choice is made.

There are different techniques in qualitative research that researchers may select. When combined properly, the aggregated techniques provide advantages that not only complement each other but also enhance overall methodological strength. It is up to the research settings, methodological preferences, research design, and research participants that the researchers select techniques appropriate to their study context.

In this study, four qualitative techniques were used, including focus group discussions, key informant interviews, participant observation, and comparative historical analysis. It is noted that participant observation is used in addition to the traditional combination of focus group and individual interview techniques because using this technique, the investigator can take part in real research settings where participant interactions could be observed in a naturalistic manner. This helps the investigator get a better feel of, and understand how people act in their real context.

○ *Focus Group*

Focus groups are group discussions. They help explore a specific set of issues and are useful when researchers need to explore someone's experiences, opinions, concerns, or wishes (Barbour & Kitzinger 1999). Using focus group technique, researchers can create a permissive environment in the group interviews "that nurture different perceptions and points of view, without pressuring participants to vote, plan, or reach consensus" (Krueger 1994, p.6). It also allows researchers "to observe a large amount of interaction on a topic in a limited period of time based on the researcher's ability to assemble and direct the focus group sessions" (Krueger 1994, p.6). Focus group discussion can be used stand-alone, or in conjunction with quantitative surveys and other research methods - most commonly with individuals and in-depth interviews (Morgan 1996).

Focus group discussion is preferred for three major reasons. First, it has "an ability to collect data on a larger range of behaviours". Second, it enables "a greater variety of interactions with the study participants". Third, it brings about "a more open discussion of the research topic"

(Morgan 1997, p.8). This is how emotional dimensions from research participants could be acquired in a well facilitated discussion environment. Despite this, focus group discussion owns some limitations - it relies on participants' data, their interactions with the group, and the facilitation of researcher (Morgan 1997). However, additional use of other research techniques could eliminate these limitations.

- *Individual interview (including key informant interview and informal interview)*

Interviewing is one of the methods that is the most commonly used today in qualitative research (Berg 2007, Denzin & Lincoln 2003, Jones 1985, Kvale 1996, Mishler 1986 & Morgan 1993). Interviewing obtains qualitative data through a social interaction that allows researchers to acquire reported behaviour, attitudes, and beliefs, which contributes to deeper understanding of perspectives or experiences of research participants (Walker 1985). This study used the two following individual interviews techniques.

- *Key informant interview*

Key informants are individuals who have special knowledge, status, or communication skills. They are willing to share their knowledge and skills with the researchers, and are persons who have access to perspectives or observations denied the researchers and they may be long-time residents in the community (Goetz & LeCompte 1984). Key informants are “*key to researcher’s understanding of that culture*” because they help collect information that is hardly accessible to the researchers and help gain a particular understanding of cultural information (Crabtree *et al.* 1993, p.73).

This study used key informant interview to obtain opinions of different stakeholders with regards to the CTBS. It aims to also support the triangulation of data. Despite the above advantages, information from key informant may not be representative. Crabtree *et al.* (1993, p.73) warned that information from key informants may be “multisensorial, contextual, emotional, social, spiritual, and, always, cultural”.

- *Informal interview*

Information from informal interviews could be obtained by asking interviewees during a natural conversation (Melia 1997). In this study, interviews were done in a naturalistic way so that reflections from interviewees over a particular topic issue were not under pressure. This

technique was used with people whom the investigator intentionally met or came across with, including local leaders, farmers, local residents and technical staff.

Despite its advantages, this method could be prone to bias. Possibilities include “distorted responses due to personal bias, anger, anxiety, politics, and simple lack of awareness since interviews can be greatly affected by the emotional state of the interviewee at the time of the interview. Interview data are also subject to recall error, reactivity of the interviewee to the interviewer, and self-serving response” (Patton 2002, p.306). With this advice in mind, efforts were made to stay aware of possible biases that might arise during the conversations.

○ *Participant Observation*

Participant observation is a technique that fits into qualitative research. It is a “method in which a researcher takes part in the daily activities, rituals, interactions, and events of a group of people as one of the means of learning the explicit and tacit aspects of their life routines and their culture” (Dewalt & Dewalt 2002, p.1).

Other values of the participant observation method are that researchers can observe the participants in natural context/settings and may see things they do not report. Maxwell (2005) said that participant observation can enable researchers to infer participants’ perspectives, which is not simply obtained through interviewing. He suggested that this technique could allow inference, better understanding, and triangulation. Nevertheless, a number of things need to be kept in mind when doing this technique. Tashakkori & Teddlie (2003) warned that participants do not always do what they report that they do. Goffman (1959) suggested researchers be prudent when observing participants because people may try to show things they want us to see (frontstage behaviour), rather than what they usually do or say with people close or familiar to them (family members, friends...).

○ *Comparative-Historical Analysis (CHA)*

Combined use of quantitative and qualitative methods, as mentioned above, can enhance the rigor of the findings. Tashakkori & Teddlie stated that combined methods better “answer the research questions”, draw on “better (stronger) inference” and present “greater diversity of divergent views” (Tashakkori & Teddlie 2003, pp.3-15). McDowell & MacLean (1998) also said that when used appropriately, quantitative methods help generalise and are externally valid whereas qualitative methods particularise and become internally valid.

Despite the enhanced rigor achieved with combined methods, when it comes to understanding the causal mechanisms of a particular event, combined methods do not help if data obtained are cross-sectional. Since this study also aims to understand why farmers are less cooperative in rice farming than in the past, understanding the reasons that underlie their current behaviours is essential and as such, a method that is longitudinal by nature can complement the above cross-sectional mixed methods approach.

Comparative Historical Analysis (CHA) can help to achieve this. CHA is a qualitative method and longitudinal by nature. It can be used to explain causal mechanism that leads to farmers' present cooperative behaviours. In this study, CHA was used in addition to the above combined quantitative and qualitative methods in order to improve the understanding of the reason why farmers are currently less cooperative in rice farming.

CHA is broadly defined as a method “characterized by the use of systematic comparison and the analysis of processes over time to explain large-scale outcomes such as revolutions, political regimes, and welfare states” (Mahoney 2004, p.81). In essence, it involves explanation of causal mechanism that produces outcome of interest, analysis of historical sequences, temporal unfolding process, and systematic comparison of similar and contrasting cases in its own context, typically for a small number of cases (Mahoney & Dietrich 2003). According to Lieberman (2001), although CHA does not use offer a common statistical language to describe method and report results as its quantitative counterpart does, such an absence does not mean CHA does not have deliberate techniques. When combined with longitudinal and cross-sectional analysis, CHA offers possibilities of testing theoretical implications (Lieberman 2001).

There are at least three key techniques in CHA that can be used to conduct causal analysis at a macro level – nominal, ordinal and narrative analysis. Each analysis has its own characteristic, strengths and weakness. Selection of one method or a combination of some depends upon researchers' rationale (Mahoney 1999, see Mahoney (1999) for a methodological review of macro-causal analysis techniques). In this study, the technique used for CHA is narrative analysis for within-case causal explanation. Pattern matching was also used for cross-case generalisation (cf. Abell 2004, Campbell 1975 & Yin 1994).

Summary

A mixed methods approach is used in this study. The methods used include quantitative method, qualitative inquiry, and comparative-historical analysis.

3.1.4 Research participants

Participants for quantitative research

Farmers participating in the household survey, totalling 240 households (120 households from each district), were randomly selected from the lists of farmers in the area. In Tri Ton district, farmers from four communes - Vinh Hoa, Vinh Phu, Vinh Quoi and Vinh Thuan were randomly selected. In Tinh Bien district, farmers from six communes - An Bien, Tan Bien, Phu Cuong, Trung Bac Hung, Tay Hung and Dong Hung were randomly selected. It is noted that this household baseline survey was conducted prior to the training of farmers so as to capture the level of knowledge, attitudes and practices of farmers prior to the introduction of the CTBS.

Participants for qualitative research

Participants for qualitative research include farmers who directly trialled the CTBS. These farmers were from Kinh ethnic group that represent the majority of farmers in the Mekong Delta. Apart from farmers as direct participants, representatives from local government agencies, local agricultural extension agencies, plant protection department (both district and provincial levels), local opinion leaders, and farmers in the halo effect were also invited as participants.

It is noted that, under this study, qualitative research was conducted only in the treatment sites (marked with asterisks in the table below) because the qualitative study aims only at farmers who trialled the CTBS and those in the CTBS' halo effect. It is also noted that by the time the qualitative study was conducted in the first field trip, farmers in Tinh Bien district had trialled CTBS for two cropping seasons while Tri Ton, farmers trialled it only once due to unexpected flooding. However, by the second field trip, farmers in Tinh Bien district had trialled CTBS for three cropping seasons and those in Tri Ton had trialled it twice. Therefore, the second field trip allowed collection of more experiences from farmers who trialled the CTBS.

Tri Ton district		Tinh Bien district	
Treatment	Lac Quoi commune	Treatment	An Nong commune
<i>Community Action (CA) alone</i>	Vinh Hoa Vinh Phu	<i>Community Action (CA) alone</i>	An Bien Tan Bien
<i>CA combined with Community Trap Barriers System</i>	Vinh Quoi * Vinh Thuan *	<i>CA combined with Community Trap Barriers System</i>	Phu Cuong *
Control	Vinh Gia commune	Control	Nhon Hung commune
	Vinh Lac Vinh Cau Vinh Hoa Vinh Hiep		Trung Bac Hung Tay Hung Dong Hung //

Note: villages marked with the asterisk (*) denotes study sites where qualitative research was conducted

3.2 Data collection

3.2.1 Data sources

The data used for this study were obtained from both primary and secondary data sources.

For primary data, both qualitative and quantitative data were collected. Qualitative data were collected through focus group discussions, key informant interviews, participant observation, and comparative historical analysis. For quantitative data, the information was obtained through household surveys in which respondents are farmers who grow rice as their family's main income generation activity.

Secondary data were obtained from statistical books, reports from the district People's Committee, district Plant Protection Stations, and provincial Plant Protection Department. Data on rodent captures - recorded in farmers' diaries and synthesised by local technical staff, were also collected. As such, secondary data obtained cover information related to demographic, socio-economic, cultural settings of the study site and rodent management. This information is useful in enabling detailed description of the context under which study was done to allow generalisation of findings at the end of the study.

3.2.2 Sampling

Sampling is a process of obtaining a sample from a population in order to study the characteristics of the sample (subset) so as to understand that of the larger group (population)

(Goetz & LeCompte 1984, Johnson & Christensen 2000). Depending on the research method, the sampling procedures will be different.

Quantitative sampling

A total of 240 farmers were randomly selected as respondents from two districts of Tri Ton and Tinh Bien with half from each district. Respondents are rice farmers, thus those who do not do rice farming were not included in the sampling frame. Quantitative sampling was carried out by staff from CSIRO, IRRI and local staff from Plant Protection Department.

Qualitative sampling

Like quantitative researchers, qualitative researchers can use statistical sampling procedures if the group they study has the same characteristics as the population to which they plan to generalise. Nevertheless, in qualitative research, researchers frequently encounter cases where probability sampling is not appropriate, such as when “only one or a few subsets of characteristics of a population are relevant to research problem”. In such a case, criterion-based sampling is commonly used by qualitative researchers when it comes to choosing a group or a site to study (Goetz & LeCompte 1984, pp.71-73).

The suggestion above is true to this study. Because qualitative research looks into the farmers’ constraints to CTBS adoption, only farmers who trialled the CTBS could tell difficulties that they had experienced. This reality apparently defined these farmers as a subset of the farming community in the study area. Because the trial of CTBS is part of the research design, sampling in this case is limited only to farmers who trialled the technology. The sampling technique is therefore criterion-based.

Depending on the techniques used (focus group discussion, key informant interview or informal interview), the methods for sampling participants will vary.

- *Focus group*

Since study looks into how farmers perceive the constraints of the CTBS technology, only farmers who immediately trial the technology and those whose farm is located within the halo effect of the CTBS were included in the samples. Such a composition will enable investigator to see how farmers in a group interact.

In terms of group size, as a rule of thumb, the number of people in one group could range from six to ten (Morgan 1997, Fink 2003). Under this study, ten groups were recruited (five from each commune of the two districts). A total of 73 farmers sat on ten focus group discussions.

- *Individual interviews*

As for individual interviews, sampling was based on two key criteria – 1) level of knowledge the key informant can provide and 2) their governmental role as the current and potential stakeholders in the agricultural technology diffusion process. In line with this, at commune level, representatives from governmental departments, agricultural technical agencies, and local opinion leaders were invited to participate in individual interview.

One problem associated in the selection of people for key informant interviews is “key informant bias” (Pelto & Pelto 1975, p.7). Maxwell (2005) argued that if only a small number of informants are used to solicit for most part of the data that the study need, or even when informants are purposely selected, researchers cannot make sure the informants’ views are typical.

In this study, to address this potential problem, informants have been selected from different sectors; five governmental bodies and different villages so that their opinions could be obtained as both personal and representative of the agency they are from. A total of 33 individuals were interviewed (18 in the first field trip and 15 in the second field trip).

3.2.3 Data collection instruments

Quantitative survey questionnaire

For quantitative analysis, a household survey questionnaire was used. This questionnaire was developed by the CSIRO and IRRI under the ACIAR funded project. This questionnaire (known as Knowledge, Attitudes, Practice baseline survey) aimed to collect information about the knowledge, attitudes, and practices related to current rodent management practices of the farmers in the study area. The questionnaire was developed based on a literature review of relevant previous studies done in the Mekong delta as well as the Red delta region of Vietnam. It was also tested and revised before field use (See Appendix C for this baseline questionnaire).

Qualitative interview guide

As for qualitative research, semi-structured interview guides were used to collect data. Semi-structured guides were used because they offer open framework, allowing a conversational-styled discussion and enabling more interactions among group members and between researchers and group members. It also enables collection of “rich data” (Maxwell 2004, p.254, cf. Becker 1970).

Stewart *et al.* (2007) suggested two principles that one should follow when developing an interview guide: from general to specific topics or by the topic’s relative importance (from most to least). In this study, the interview guide adopts the former. With this kind of interview, group discussions start with general questions by asking for some farmers’ general comments about the results of CTBS trials and then go into further details to explore other aspects of the trials. This interview guide was also used for individual interviews. However, depending on the roles and responsibilities of the respondents, the interview focus will vary (see Appendices A and B for the interview guides, and Appendix G for the Field Trip Schedule).

Pre-test

The interview guides were developed based on the conceptual framework and the research questions to capture the factors/variables that need to be assessed. Prior to actual use in the field, the interview guides were reviewed by the supervisors of the investigator. The guide was translated into Vietnamese for review and checked by field staff from the Department of Plant Protection of An Giang province to ensure its suitability and freedom from ambiguity. Because of the limited time, no testing of the question guide was made in the field. However, given that the interview structure allowed researchers flexibility to move from one topic to the other, checking of interview guides; both order and wording, were made after the first group discussion.

3.3 Management of data

3.3.1 Note-taking and processing

Dewalt & Dewalt (2002, p.164) suggested that researchers who take notes by hand should transcribe the data into electronic files. Rossman & Rallis (2003) advised researchers to discipline themselves to deal with the data every day and keep a log book for daily activities to

keep information such as the date, time, place, and participants of the activities, attendance to relevant events and maps of the settings. They suggested quiet time during each day of the study to reflect on the activity of the day and to write up field notes.

During the field trip, notes from focus group discussions, individual interviews, and field observation were taken in short form and was expanded while transcribing onto the computer each day. Photo taken during the field trips were also used to assist the observation exercises. Since a local staff from the provincial Department of Plant Protection joined the investigator to assist the data collection, he also assisted the verification of notes on a daily basis.

3.3.2 Bias

Generally, three domains of bias are recognised - those arising from the subject being interviewed, those arising from researchers and those arising from the subject-researcher interaction (Plummer 1983). Fielding and Fielding noted that two main sources of bias that are inherent in qualitative fieldwork is the researchers' tendency to select field data that "fit an ideal conception (preconception) of the phenomenon" and "select field data which are conspicuous at the expense of less dramatic (but possibly indicative) data" (Fielding & Fielding 1986, p.32).

To avoid bias, which is inherent in research design, methods and researcher, the issues of validity and reliability as well as triangulation will be discussed, along with ways to overcome this bias.

3.3.3 Validity/Trustworthiness and Reliability

Smith (1975, p.88) stated: "the goal of science is to be able to generalise findings to diverse populations and times". This goal could not be achieved if the issues of validity and reliability are not properly addressed in any particular research. In quantitative research, the concept of validity and reliability is central to the research results. In qualitative counterparts, more and more attention is being given to this issue since an increasing demand is for qualitative research findings to be generalised to similar cases. Johnson & Christensen (2000, p.207) said that when qualitative researchers mention research validity, they usually refer to it as "plausible, credible, trustworthy, and therefore, defensible".

Validity/Trustworthiness

○ *External validity*

According to Cook & Campbell (1979, cited in Howell 2005), *external validity* refers to the degree to which a causal relationship found between an independent and a dependent variable can be generalised to other people, times and settings. Preissle & LeCompte (1984, p.229) stated: “external validity depends on the identification and description of those characteristics of phenomena salient for comparison with other, similar types. Once the typicality or atypicality of a phenomenon is established, basis for comparison then may be assumed, and results may be translated for applicability across sites and disciplines”.

For qualitative data, Marshall & Rossman (2006, p.42) commented: “Although no qualitative studies are generalizable in the probabilistic sense, their findings may be transferable. A discussion of these considerations reminds the reader that the study is bounded and situated in a specific context. The reader, then, can make decisions about its usefulness for other settings”.

○ *Validity/Trustworthiness in qualitative research*

Qualitative research is subject to other threats, which are worth discussing here. Three concepts of validity, which are associated with qualitative research, are descriptive validity, interpretive validity and theoretical validity (Johnson & Christensen 2000, cf. Huberman & Miles 2002). In this study, attempts were made to use descriptive validity and interpretive validity to assure overall validity of the qualitative data. *Theory validity* was not adopted in this study because it is beyond the scope of the study.

Reliability

Reliability is primarily about use of techniques that ensure consistency in research results even if the study was conducted by people other than the author of the research (Plummer 1983). There is a mutual relationship between reliability and validity, as Weinhardt *et al.* (1998) said - one cannot assess study validity without first establishing the reliability of a measure.

Knodel (1993) suggested that one way to increase the reliability is to ensure data consistency by having several researchers analyse and interpret qualitative data independently to see if disagreement emerges. Another measure to assess reliability is to compare findings across different group discussion sessions. The extent to which the consensus within and across the

sessions helps identify a systematic difference, if any, which indicates the reliability of the information. Kvale (1996, p.235) also suggested researchers (who use interviewing techniques) to avoid using leading questions so as not to “inadvertently influence the answers”.

In this study, information collected was cross-checked between group discussion sessions, with the help of the field assistant at the end of each day. Findings from the first field trip were also verified with research participants and checked against those in the second field trip to ensure reliability.

3.3.4 Triangulation

Triangulation is broadly defined by Denzin (1978, p.291) as "the combination of methodologies in the study of the same phenomenon". The benefits of triangulation rest on the premise that weaknesses inherent in a single method “will be compensated by the counter-balancing strengths of another” (Jick 1979, p.604). “Triangulation is typically a strategy (test) for improving the validity and reliability of research or evaluation of findings” (Golafshani 2003, p.697). Therefore, “good research practice obligates the researcher to triangulate, that is, to use multiple methods, data sources, and researchers to enhance the validity of research findings” (Mathison 1988, p.13) in order to reduce the risks of arriving at systematic-bias conclusions as a consequence of, or limitations associated with a data source or method (Maxwell 2005).

Denzin (1978) suggested three types of triangulation that can be used - data triangulation, investigator triangulation, and theory triangulation. According to Guion (2002), another type of triangulation called *environmental triangulation* could be used since this type of triangulation will help check if spatial and temporal factors such as time, location, settings affect the findings. If the findings remain unchanged under different environmental conditions, the validity is considered as *established*.

Use of triangulation techniques is not mutually exclusive. Therefore, in this study, data triangulation (intra-method) and method triangulation (inter-method) were used.

3.4 Data analysis

The process of analysis of qualitative data (field notes, interview transcript, secondary data, and participant observation) is not basically different from the analysis of quantitative data (Dewalt & Dewalt 2002). There are three key stages that the data analysis will undergo: data reduction, data display, conclusion drawing, and verification (Miles & Huberman 1994).

3.4.1 Quantitative data

Descriptive analysis was done to explore the trends and emerging issues and to help inform the focus and explorative efforts of the qualitative research. Specifically, quantitative data was analysed to obtain insights on the data gaps that qualitative research could fill. Understanding the local situation provided a good opportunity to shape the line and focus of group discussions and key informant interviews. In addition, in areas where quantitative data is not sufficient to enable the answering of the research questions, qualitative research looked further to understand the issues or problems.

Quantitative data analysis in this study was conducted using SPSS[®], version 11.5. Most of the analysis of quantitative data is related to descriptive statistics. Graphs were prepared using Microsoft Excel XP[®].

3.4.2 Qualitative data

Morgan (1997, p.63) suggested three factors that could affect how much emphasis should be made to a given topic – the number of groups that mention a topic, the number of people within each group that mentioned the topic, and the extent to which the topic generated “energy and enthusiasm” among the participants. He stressed that a topic is worth emphasising when there is a combination of all of these factors, which is known as “group-to-group validation”.

Given this suggestion, the data is analysed via thematic analysis with focus on repetitive statements. According to Luborsky (1994), repetitive statements indicate that the discussed issues are of interest to the research participants and these are salient to them (cf. Price 1987). In addition to the above suggestions, this study will attempt to describe in details the research setting, context, and people in the setting so as to enhance both internal and external validity of the qualitative analysis (cf. Barbour & Kitzinger 1999, p.16, Huberman & Miles 2002, p.183).

3.4.3 Causal explanation in qualitative research

Causal explanation is planned at the stages of research design and data collection before data were analysed. Maxwell (2004, p.254) wrote “a detailed, chronological description of a physical process often reveals many of the causal mechanisms at work, a similar description of a social setting or event can reveal many of the causal processes taking place. In a social setting, some of these processes are mental rather than physical and are not directly observable,

but they can often be inferred from behavior (including speech)”. With this in mind, the comparative historical analysis, where possible, will be used to detect the causal mechanisms for relevant research questions.

3.4.4 Generalisability in qualitative research

In addition to the use of multi-site methods, and comparison of the rodent control practices and constraints to adoption of CTBS across cases in the Mekong Delta (to be presented in chapter for), qualitative data collection and analysis will also focus on identifying the typicalities related to rodent control practices and constraints to adoption of CTBS to allow reliable generalisation (cf. Goetz & LeCompte 1984, Guba & Lincoln 1981, Patton 1990 & Schofield 2000).

In terms of the degree to which the generalisation is made, *analytical generalisation* will be used. According to Kvale, analytical generalisation “involves a reasoned judgment about the extent to which the findings from one study can be used as a guide to what might occur in another situation. It is based on an analysis of the similarities and differences of the two situations”. By providing evidence and explicit arguments, researchers can leave the judgement with regards to generalisation claim to the readers (Kvale 1998, p.233, cf. Payne & Williams 2005, Yin 1994).

To make generalisation reliable, Mason (2002) advised that one need to think carefully and strategically throughout the whole research process. With the above suggestion in mind, attempt had been made – from research design, data collection, to historical review of the research settings to enable generalisation from the case in An Giang to other part of the Mekong Delta. To this end, two districts included in the research design, will be treated as the multi-site approach to detect both similarities (typicalities) and differences (atypicalities). This approach was also used in conjunction with thick description of the research settings to make the generalisability using qualitative data reliable.

The next chapter will outline the research setting of this study and present findings on technological constraints as perceived by farmers in the study site following their trialling of the CTBS.

Chapter 4 – Background to Adoption of the CTBS – the History of Rice Farming in the Mekong, the Profile Rice Farming in An Giang and Farmers’ Initial Perceptions of the CTBS

This chapter focuses on providing an historical perspective of rice farming in the An Giang region, a profile of the farmers who participated in the quantitative survey and their rice farming practices, and the farmers’ perceptions (Tinh Bien and Tri Ton - An Giang) of the technological aspects of the CTBS.

4.1 Overview of rice farming in the Mekong delta and An Giang province

4.1.1 Socio-economic background of rice farmers in the Mekong - an historical review

- **Rice farming traditions in the Mekong**

Cultivation of rice is presently done individually, rather than collectively as it used to be in the Mekong delta. Although farmers might argue that collective farming is in general good, they actually do not do it. In the past, rice in the Mekong Delta was collectively cultivated by groups of people who were linked by kin, neighbour and friend relationships. These self-help groups were called *dân công* groups (which mean “mutual aid groups” or “labour exchange groups”). This form of collective rice farming dated back to the time of the French colony (before 1954) but has been abandoned since the early 1990s because of numerous changes related to farming systems.

Mutual aid groups reflect a form of social capital that existed among farmers and among farming groups in the Mekong delta. Historical evidence shows that mutual aid groups had been sustained for several decades tracing back to the time when farmers strongly relied on each other to ensure sufficient labour for rice cultivation and other daily life activities. The long existence of mutual aid, as well as the abandonment of it has many implications. Understanding these implications, and more importantly, the conditions that create and foster collective farming, helps understand how social capital among rice farmers was generated and how it was transformed over time as a result of critical socio-economic and political events. Understanding the reasons for the abandonment of collective farming in the Mekong, in particular, helps understand why farmers currently find it hard to cooperate and their perceptions of the

challenges in the adoption of the CTBS. To obtain this understanding, a brief comparative historical analysis of mutual aid groups is necessary.

- **Historical review**

Life of rice farmers and development of mutual aid groups

This section reviews the history of rice farming in the Mekong. It focuses on the influences of some critical socio-economic and political events on the transformation of the social capital among farmers who participated in mutual aid groups and attempts to understand why such influences existed. To this end, issues related to tenure status, land reform, rural livelihood, and factors related to rice production including production means, rice varieties, and irrigation will be examined.

Rice is the most important crop, not only in Vietnam but also in Indochina. Gourou (1971) wrote that people in Indochina, irrespective of what group they belong to, gave rice top priority in everything they do. However, from the time of French colonisation, rice farmers in Vietnam were primarily tenants of large colonial land owners.

Economic life of tenant farmers:

During the French colonial period, the life of a tenant was very difficult. The family's livelihood depended on the landlord who always found ways to exploit their labour. A typical tenant grew two crops in one hectare of rice land. When the weather was favourable, there would be enough food to feed the whole family. There was seldom food surplus because half of the harvest had to go to the landlord as part of the contract. In no case where the tenant was exempt from paying 50 percent of their production, even in the event of natural calamities (inundation or drought). A tenant, when renting a plot of land for family farming, needed to prepare the soil using their own implements. He had to dig the irrigation, prepare drainage ditches, and set up a hut to stay and to take care of the crop. Buffalo may be bought from the landlord and money may be borrowed, but the interest rate was from 100 to 200 percent (Pham 1985).

Rice and mutual aid groups:

Rice farmers in Southern Vietnam had a long history of collective farming, manifested by the establishment of mutual aid groups to support farmers in their day-to-day farming activities (Kerkvliet & Porter 1995, Kirsch 1997, Pingali & Vo-Tong Xuan 1992 & Wiegersma 1988). Mutual aid groups were organised to enable farmers from different households to help each other in heavy farm work such as land preparation, transplanting, irrigation, and harvesting (Hickey 1964). In the Mekong delta, this self-help practice dated back to the French colonial time (Kirsch 1997), continued during the post-colonial period (Wiegersma 1988), and thrived even during the collectivisation period from 1976 to 1988 and in the post-collectivisation period after 1988 (Pingali & Vo-Tong Xuan 1992).

Mutual help groups are considered a “village institution of loose organization but great importance”, in which “each farmer tends to establish a network of relatives, neighbours, and friends within which he exchanges labour in the course of the rice cycle” (Resources for the Future (U.S) 1971, p.64). According to Hickey (1964), mutual aid in farming is very common among low-income households in the Mekong delta. People who worked in mutual aid teams were normally kin or neighbours who assisted one another in heavy tasks. Normally, this assistance went beyond farm work to non-farm work such as house repairs or building thatched houses, which were very common among poor farmers. In low-wealth families, it was common that “all members are expected to make some direct contribution to the sustenance of the group” (Hickey 1964, p.245).

During the 1960s, apart from participating in mutual aid groups, group members also worked as hired labour for middle-income and well-to-do families to earn additional income. Although some farmers hired out their labour individually, the majority remained in their group led by a labour contractor who was permitted by the village councils to provide such a service. Despite that members of such contracted groups were retained on a voluntary basis, most of them had kin or neighbour relationships and usually remained in the same contract group for several years (Hendry 1964). Mutual aid groups were common among resource-scarce farmers, but were rare among well-to-do families who usually hired labourers to carry out heavy tasks such as harvesting which needed to be completed quickly (Hickey 1964).

Village and Land issues:

- *Colonial period (before 1954)*

In Vietnam, rural communities are organised into villages. Village society represents a timeless social body (Le 1997). During the colonial period, tenant farmers in the Mekong delta were an important class in Cochinchina (the former name of the Mekong delta) and cultivated the greatest part of farmland in this region. During this time, irrigation was one of the heavy tasks that required teamwork. To raise water in one's field to an appropriate level, and then to successive fields (at different levels), teams of scoopers needed to work together (Gourou 1936, cited in Pham 1985). Therefore, mutual aid like this was an important way of enabling rural people to manage their rural affairs (Kirsch 1997).

Extremely large landholdings among the rich, and the tenancy status of poorer farmers resulted in the development of farmers' mutual assistance to overcome farming hardship. Apart from the need for farmers to cooperate in the heavy farming work, they also needed to cope with their landlords to ensure their family subsistence. Pham (1985, p.74) wrote that, over time, "being intolerably robbed and inhumanly treated by the landlords, they began to cheat more and more" such as using landlord's buffalo to work for others to earn extra money. As Griffin *et al.* (2002, p.316-7) suggest, these issues which were related to land inequality entailed the need for association among the poor to "represent and defend their interests".

- *Post-colonial period (after 1954)*

In Southern Vietnam, most land was privately owned and agricultural activities were developed for commercial purposes (Rambo 1973). By 1954 - the end of the French colonial period, approximately 40% of the rice land areas in South Vietnam were held by only 0.25% of the rural population. Large landholdings belonged to French and Vietnamese owners (Pingali & Vo-Tong Xuan 1995).

The concentration of land ownership resulted in an increase in the number of landless labourers and smallholders who hired out their labour to middle and high-income landowners (Wiegersma 1988). Landless labourers usually worked in teams. They were usually not paid until the time of harvest. During the 1960s, because of the differential impact of colonialism, large differences in the distribution of income and power were common in South Vietnam (Wiegersma 1988). However, for villagers, reciprocal assistance among farmers remained

important in rural Southern Vietnam. According to Wiegersma (1988), during the post-colonial period, 75 per cent of villagers in South Vietnam were involved in such type of mutual assistance.

The stratification of peasants in Southern Vietnam was acute because of land concentration (Rambo 1973). The accepted socioeconomic ranking in village society during this time was primarily based on subsistence activities. Land holding size determined whether a person belonged to a particular level in the village, irrespective of whether he was a landowner or a tenant² (Hickey 1964).

Labour exchange continued during the post-colonial stage and was so common that people who worked on labour exchange teams were not paid. They took turn to work in each other's fields on a reciprocal basis. One of the typical mutual works that required high cooperation was the distribution of water for irrigation (Hendry 1964). In the Mekong delta, working in a collaborative manner with farm neighbours to control water levels through manual irrigation had become indispensable.

However, cooperation did not always go smoothly. Disputes over irrigation were common (Hendry 1964) and this problem became more common since the land reform in 1955 (Wiegersma 1988), which brought land to 148,400 family in South Vietnam by 1961 (Salter 1970). Since then, difficulties associated with irrigation emerged as a result of the establishment of private property rights following the land reform (Wiegersma 1988).

Following the land reforms of 1955, by 1970, only a few owners with large landholding remained while owners with small landholdings increased (Salter 1970). Despite land reform, operations of mutual aid groups remained active. In 1971, the second land reform was attempted in Southern Vietnam (known as "Land-To-The-Tiller" land law). This second reform aimed to further reduce land concentration among the remaining landlords. It is noted that by 1970, about 60% of the riceland was still farmed by tenant farmers with each tenant farmer averaging 2 hectares. The rent that they had to pay in secure areas is around 25% or more of their crop. According to Wiegersma (1988), mutual labour exchange remained predominant after the 1971 land reform.

² Low-income groups typically comprise of labourers, shopkeepers, artisans, the unemployed and those involved in petty commerce.

Two main factors existed, that supported the continued labour exchange. Firstly, the land reform in 1971, which specified the maximum area of land distributed to farmers as 3 hectares. Secondly, farmers (tenants) who were cultivating land belonging to other persons were given priority in the land redistribution order. This regulation enabled farmers who used to work together in a mutual group to remain in their network. As well, it was stipulated that persons receiving land distributed under this law could not transfer ownership. This regulation secured land receiver a tenure status, which encouraged their investment in the land to maintain soil fertility.

During the French colonial period, despite concentrated land ownership, almost 100 percent of rice land was farmed by low-income farmers, by 1970, this figure had reduced with 60% of rice land in the Mekong delta farmed by low-income farmers. Wiegersma (1988) noted that there was loss of social cohesion in villages following the first land reform in 1955. However, subsequent to land reform that was undertaken for the second time in 1971, there were no studies that documented the occurrence of mutual assistance. According to Pham *et al.* (2000), by 1975, almost all farmlands were allocated to farmers in Southern Vietnam. Interestingly, despite that more disputes over irrigation following each land reform took place, collective farming tradition via mutual aid groups remained stable.

Labour exchange continued to develop during the pre-collectivisation period before 1975 and during collectivisation in Southern Vietnam from 1975 to 1988, mutual aid groups were even more common (Vo-Tong Xuan 1995). Farmers in mutual aid groups continued to support each other in labour-intensive activities such as land preparation, irrigation, and harvesting because equipment means such as tractors, threshers, water pumping machines, and draft animals, which were originally owned by individuals, were pooled to be collectively managed cooperatives as a result of collectivisation. Kirsch (1997) reported that during the collectivisation period in the Mekong, members of agricultural cooperatives still organised their individual land use through the support of mutual help groups. By 1985 (about 10 years after the collectivisation), 80% of all agricultural households in the Mekong maintained their farming through organised mutual help groups.

Through the collectivisation policy, the government tried to collectivise both land and equipment, which were privately owned. Farmers resisted this. Despite, or perhaps because of, the food crisis following collectivisation, the practice of mutual aid was still abundant irrespective of social, economic and political events. It is also interesting to note that in addition to collective farming via mutual aid groups, local people were also actively involved

in civic construction projects such as road construction, erection of electricity poles, and provinces recognised as highly active for these type of social works are Thai Binh, Nghe An and An Giang (Tran & Nguyen 1995).

Critical times for agrarian reforms that boosted rice production

A series of changes with regard to the way farmers produced rice have occurred since the early 1980s. The most noteworthy event that started to reshape farmers' collective farming is the introduction in 1981 of a new rice production policy called the Contract System which basically shifted rice production from collectivised to household based production. The event was followed by the Land Reform of 1988, which allowed farmers to enjoy a longer-term use of their land and inheritable leases. In 1989, the rice market was liberalised. These events led to countrywide improvements in food production. The reforms on rice market liberalisation policy led to a 30% increase in yields for farmers in both the Red river delta and the Mekong delta (Khiem 1994, cited in Pingali *et al.* 1997).

In addition to infrastructure improvement, new cultivation techniques were increasingly to meet the demand of the new high-yielding varieties. Broadcasting of seed was used in lieu of transplanting. The use of herbicides was more popular and labour requirements at peak times became high (Pingali *et al.* 1997). In 1983, mechanisation in Mekong delta increased with the number of tractors increasing by 60 % and small tractors by 50% compared with the quantity in 1975 (Dao & François n.d.).

When decollectivisation started in 1988, despite mutual labour exchange still being common, increasing need for labour at peak times was common and it was difficult for farmers to find labour given the dramatic changes in the labour market as a consequence of collectivisation (Pingali *et al.* 1997). As labour become scarce, hiring out of labour “has once again become a major component of the rural economy and social structure” (Luttrell 2001, p.533).

The effects of the two land reforms in Southern Vietnam in 1955 and in 1970 have resulted in the concentration of riceland in the Mekong being significantly reduced when compared with the French colonial period. Land distribution has been relatively even since the end of the collectivisation period in 1988 (Jamal & Jansen 1998). However, Dang (1995) observed that after the land reform in 1988, land concentration once again emerged as a major issue in Southern Vietnam (versus Northern Vietnam). For instance, in Thoai Son and Tri Ton district of An Giang province, the magnitude of land concentration was remarkably high. In Thoai Son,

23% of households own two hectares or more. In Can Tho province, Lai *et al.* (2001) also found a huge variation in farm size distribution in Omon district. They observed that large landholdings were with better-off households who were interested in acquiring lands whereas small farmers were selling their lands to settle their debts.

Indeed, with economic development, better-off farmers have bought up farmland and hired local farmers to continue farming on the newly procured land. With the new land law in 1988, farmers “enjoyed the right to use, inherit and transfer the use of land, to rent out the land and to use the land as collateral for loans. Thus land has been commercialised rather than fully privatized” (Griffin *et al.* 2002, p.313). Observing this situation, AusAID (2004) commented: “the landless and near-landless population in the Mekong Delta is significant and increasing, and will have a major impact on the socio-economic development of the region” (AusAID 2004, p.40, cf. Akram-Lodhi 2005).

The above review of the historical events in the Mekong delta since French colonisation has presented the ups and downs of the operation of mutual aids groups established by rice farmers. The mutual aid groups, as a form of social capital, generated and maintained by farmers, were affected by various socio-economic and political events that directly changed the way farmers did rice farming (see Appendix F for summary of these critical events). Despite these critical impacts, this type of social capital has proven durable and been sustained thanks to farmers’ personal networks of kinship, neighbours and friends. However, in early 1990s, a series of changes related to improvement of farming system came about and gradually put to an end to the practice of mutual aid among rice farmer.

Key reasons that account for the abandonment of this long-standing group farming practice are summarised as follows:

1. Changes in farm size due to changes in ownership, which make it difficult for equitable exchange of labour.
2. Relationships between the members of mutual aid groups, which were built on neighbourhood and kinship norms for years, have been compromised because of changes in ownership as a result of land reform in 1993 which led to land fragmentation.
3. Coordination of irrigation by farmers declined because the irrigation system was improved and managed by government cooperatives, and later by government irrigation companies and privately owned irrigation units.

4. Increased use of modern rice varieties which significantly shorten rice growth duration has caused an increased need for farm labour at peak times, making arrangement of labour to support mutual aid teams difficult to achieve.
5. The improved irrigation system provided access to water for a larger land area, resulting in more synchronised farming and which in turn put more pressure on farm labour.
6. Rice market liberalisation by the government after 1988 created more opportunities for rice farmers to pursue their own plans to improve their household economy, especially better-off farmers.
7. Increased need for hired labour during peak times created new work opportunities for poor farmers, increasing rural labour market and challenging commitments from farmers traditionally working in mutual aid groups.

Abandonment of labour exchange from moral economy and political economy perspectives

In addition to the above reasons, the abandonment of labour exchange practice among rice farmers in the Mekong delta region could be explained by two economic approaches at the macro-level, known as *moral economy* and *political economy*. Despite being perplexing, these two economic approaches could be used to justify the abandonment of the mutual aid practices. These two economic approaches are confounding indeed because it is at the cross of the debates over the rational choice theory, the premarket society and modern societies, and the normative standing of the market (Booth 1994). This section does not set out to account for the decline in social capital stock at the micro level (household level) using two contrasting moral economy and political economy approaches. Rather, it tries to explain the diminishment of cooperation among farmers as a result of the intensive and continuous economic development that took place in the Mekong delta since late 1980s.

Before discussion, it is worth reviewing briefly the concept of moral economy. According to Sayer (2000), moral economy approach is characterised by “norms and sentiments regarding the responsibilities and rights of individuals and institutions with respect to others”. This term is usually applied to “societies in which there are few or no markets, hence no competition and law of value, and in which economic activity is governed by norms regarding what people's work responsibilities are, what and how much they are allowed to consume, who they are responsible for, beholden to and dependent on” (Sayer 2000, pp.1-2).

Historical evidence in the Mekong shows that farmers' life was traditionally governed by norms of kinship, neighbourhoods and village norms. According to Scott (1976), farmers in Vietnam were governed by the ethic of family subsistence. As such, to ensure livelihood insurance, farmers had established a mechanism under which the network of kinsmen, friends and neighbours were developed and acted as a backup source of support which was to them when they need - during difficult crop season or when the family experienced economic downturns. Self-help, which is a mode of mutual assistance among resource-poor farming families, becomes a most reliable way to ensure farmers' own family subsistence. Because farmers rely primarily on subsistence activities, their behaviour is risk-averse and maximisation of profit is not their main thrust. In Scott's opinion, this type of society is based on the idea of moral economy.

To further elaborate the argument, Scott disputed that in a farmers' mutual assistance network, kinship and friends are the most reliable source of support since for the majority of cases, a person (farmer) could not rely on his fellow villagers the same way as he does with his near relatives and close neighbours. That person is consequently more obliged to doing what he can for a close relative who needs his support but normally he can only provide his support to the extent within his own resources. For those who live far away from their relatives, assistance from non-kin neighbours is more important than that among kinsmen. Thus, reciprocity with the neighbours is essential to one's daily life activities (Scott 1976).

In the Mekong delta, farmers' social insurance, historically, depended upon kinship, neighbours and friends. This tradition, characterised by the moral economy, had sustained farmers' collective farming, indicative of the establishment of mutual aid groups, which proliferated for a number of decades. During the capitalist period (from 1954 to 1975), life of the majority of farmers in the Mekong were still at or roughly above subsistence level because of the war. Their livelihood had not significantly improved until the enactment of two land reforms implemented in 1955 and 1970 thereby farmers' right to land ownership were recognised, which led to reduced tenancy across the Mekong delta.

Although the moral economy approach holds that earlier societies (pre-capitalist) were integrated through noneconomic institutions (Booth 1994), it is speculated that society modernisation will create markets that would dominate the entirety of society (Polanyi 1957c). This is the intersection where arguments arise among moral and political economists.

Popkin (1979, 1980), who holds the political economy viewpoint, refuted against moral economists. He did not agree with moral economists who assume farmers as being antimarket, more common- than private-oriented, and not interested in commercial transaction. He argued that farmers, then, were creative and indeed they were interested in maximizing economic profits notwithstanding priority was given to family's subsistence. In Popkin's argument, farmers are more self-interested rather common-interested. He commented "cooperative and collective efforts of Vietnamese villagers may be understood as the actions of rational, self-interested individuals" and that it is "unnecessary to assume that collective behavior is evidence of a moral or collectivistic orientation" (Popkin 1976, p.460). Popkin's view was supported by many scholars. Feeny is one of them who commented: "The basic issue is one of individual versus collective rationality and of what motivates the individual's behavior" (Feeny 1983, p.779).

"Modernity both needs morality, and makes it impossible" (Poole 1991, p.x). Despite of individualisation and the decline in tradition, moral based decisions are still important but become harder to be made for the reason that the reactions to common issues are no longer positioned on traditional identities and relations but rather on one's own judgement that involves the evaluations of uncertain life-projects and relations that person is individually responsible for (Beck 1992, Beck & Gernsheim 1995). Similarly, the concepts of responsibilities to other people, including kinsmen, become loosely assumed. There is no implication that a decreased importance of social life emerges but the traditional responsibilities is likely to become conditional, subjecting to critical consideration, rather than being taken for granted as previously hold as a convention or a norm [in the case of kinship] (Finch & Mason 1994).

It seems that the rationale for actions based on moral considerations has become less convincing given the rise of capitalism which, given the growth of markets and individualisation process, releases people from adhering to traditional attachments (Simmel 1978), even when it is noted that they may become more dependent on others.

Sayer (2000, p.5) argued that "as the growth of trade increased the proportion of economic relations with distant others, they adapted their theories accordingly, giving increasing emphasis to more abstract, reason-based notions of justice rather than moral sentiments" and to "self-interest, as a regulator of economic activity".³ He stressed: "while they [some people] still retained a social conception of morality, others did not and liberal thought became increasingly

³ Refer the case of Adam Smith - a Scottish moral philosopher and a pioneering political economist.

influenced by formal conceptions of morality involving self-interested, seemingly asocial individuals, merely respecting each others rights” (cf. Baier 1994).

The above arguments indicated that there is an existence of both moral and political economy in a society. The most noteworthy thing is which economy is predominant at the time when examination of the economic behaviours of the people belonging to that society is made and from which point of view. If a fair approach is taken to account for the current situation in An Giang, the decline in social capital which is manifested by the decreased willingness in farmers’ cooperation reflects a transition from moral to political economy which gives rise to the diminishing stock of social capital as its consequence from this inevitable development process. The twilight in cooperative behaviours of farmers in An Giang, straddled between the self-interest and the collective benefits, with possible generalisation to farmers in other part of the Mekong delta, is similar to what Sayer (2000, p.12) observed: “moral sentiments and arguments regarding economic activity, rights and responsibilities, continue to affect advanced capitalist societies, although their influence is frequently limited by system forces: the moral economy is in retreat on some fronts and advancing on others”.

The discontinuance of mutual aid among rice farmers has some important implications on the constraints to promotion of the CTBS technology. Before discussing the contemporary situation in An Giang, it is necessary to provide a profile of the farmers who participated in the quantitative survey and the qualitative interviews.

4.1.2 Farmers’ profile and characteristics of rice cultivation practice in An Giang

The quantitative survey was conducted in the districts of Tri Ton and Tinh Bien in An Giang province. A basic profile of the farmers was constructed and compared to determine if there were any significant differences between the farmers from the two districts who participated in the survey (Table 1).

Table 1 - Profile of participating farmers from Tinh Bien and Tri Ton

Category	Tri Ton district		Tinh Bien district		<i>t</i>	<i>Z</i>	<i>p</i>
	Mean (<i>median</i>)	n	Mean (<i>median</i>)	n			
Age (years)	31.15 (27)	120	30.95 (27)	103		-0.098	0.921
Education (grade)	28.15 ^(a)	120	29.01	103	-0.189		0.850
Experience (yrs)	17.49	120	20.57	103	-2.112		0.036*
Yield kg/ha	6276.62	120	5871.08	99	1.736		0.084
Grown area (ha)	2.97	120	2.79	103	0.352		0.725

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

- a 28: a rank coded to indicate graduation from primary school.
 p indicates the level of significance
 * significant at <.05

Note: The *t*-test was used to compare mean value between two districts for variables of *education, experience, yield* and *cultivated area*. Man-Whitney *U* test was used to compare the median for *age* variable given one-sample Kolmogorov-Smirnov Test for normality obtained at $p>0.05$.

Data from the above table shows that farming experience was the only one out of the five characteristics subjected to comparison that was statistically significant. Although farming experience was statistically significant, a difference of approximately 3 years is in reality not of concern. Given this similarity, the data collected from two districts were merged to one data set to improve the statistical power. The following section presents descriptive statistics from the merged data set.

■ Farmers' Profile

The main household traits of the farmers participating in the household survey are presented in Table 2. Most farmers (70%) were younger than 50 years and the highest education obtained was primary level (70%), followed by secondary education level (19.8%). Only 4.7% of the total respondents reached as far as high school level⁴.

A typical farmer's family averaged five members. Most farmers had, on average, 19 years experience in farming. Within the family, in terms of educational achievement, the husbands tended to have had a slightly higher level of education as compared to their wives. While the husbands averaged grade five, their wives averaged grade 4⁽⁵⁾.

Table 2 - Basic profile of farmers in the study sites (n=223)

Characteristics	Mean	Mode	Range	SD
Age (years)	46.049	43	70	12.276
Household size	4.744	4	13	1.704
Number of children	2.886	2	9	1.664
Farming experience (years)	18.9	20	58	10.892
Time allocated to farming (m/ year)	6.977	6	11	2.016
Membership in local organisations	2.222	1	5	1.717
Education level (*)	2.350	2	3	0.650

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

* Coding is as follows: 0:No schooling, 1: Preschool education, 2: Primary school, 3: Secondary school, 4: High school, 5: Vocational school, 6: University

⁴ Primary school: Age 6-10. Secondary school: Age 11-14. Highschool: Age 15-17.

⁵ Mann-Whitney *U* Test: $U=13615$, $Z=-2.68$, $P<0.05$. ($M=25.48$, $SD=8.531$, $min=0$, $max=63$, coded for college level)

- **Rice farming system**

Landholding and tenure

Most farmers (96.5%) owned their rice lands. The remaining 3.5% rented fields and worked as tenants. Thirty percent of households own less than 1 hectare of riceland (of which slightly more than 30% owned less than 0.5 ha). Larger landholdings were common in the study site with 42% of farmers having from 1 to 3 hectares, 15% owning from 4 to 10 hectares and 4 percent having very large landholdings, spanning from more than 10ha up to 27ha. Most farmers (96%) interviewed had their land located in low-lying areas. The following table summarises landholding size of interviewed farmers, grouped into nine categories of sizes.

Table 3 - Landholding distribution (n=226)

Area group	Frequency	Percentage	Descriptive statistics	
<0.5	22	10%	Mean	2.97
0.6-1	44	19%	Median	1.90
1.1-2ha	62	27%	Mode	1.00
2.1-3ha	38	17%	Standard deviation	3.93
3.1-4ha	21	9%	Variance	15.50
4.1-5ha	7	3%	Range	26.82
5.1-6ha	15	7%	Minimum	.18
6.1-10ha	9	4%	Maximum	27.00
>10ha	8	4%	Mean	2.97

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Crops and varieties

The main crop of 99% of farmers in the study sample was rice. Only a very small proportion grew cucumber as a cash crop for additional income. Four modern rice cultivars were grown by the majority of farmers. The most common varieties reported (in descending order) included IR50404, AG24, OM2514 and IR64. Of these four varieties, IR50404 was the most preferred (81%). Farmers' criteria for selecting a variety included yield, suitability to soil, economic value and pest susceptibility. Varietal selection on the basis of season was not considered as important as yield and suitability to farmers' farmland.

Labour division, work location, work time allocation

Of the total household work force (n=767) available from surveyed households, 39% spent full time farming, 4% did farming part-time, 7% worked as wage labourers, others were engaged in services such as tailors (3%), government employees (2%), and retailers (2%). It is also noted

that as much as 31% (almost all farmers' wives) do housework. The remainder did retail service, handicraft and raising livestock (around 5%) and are schoolchildren (8%). Within a family, husbands and wives had a very clear pattern for division of family work – while husbands worked to earn family income by taking care of the crops and are more social oriented, their wives are more home oriented - doing housework.

In terms of work location, 95 percent of the total workforce (n=508) from surveyed households worked in their village of residence. The remaining 5% worked in the city or in the neighbouring villages.

Farmers are involved in farming activities during the year, especially during the cropping seasons. The majority of them, on average, are busy for 4 to 9 months a year for their farm work.

Table 4 - Typical time allocation for agricultural activities (n=268)

<i>Farming duration</i>	<i>Percentage</i>
1-3 months	3%
4-6 months	46%
7-9 months	41%
10-12 months	10%
	100%

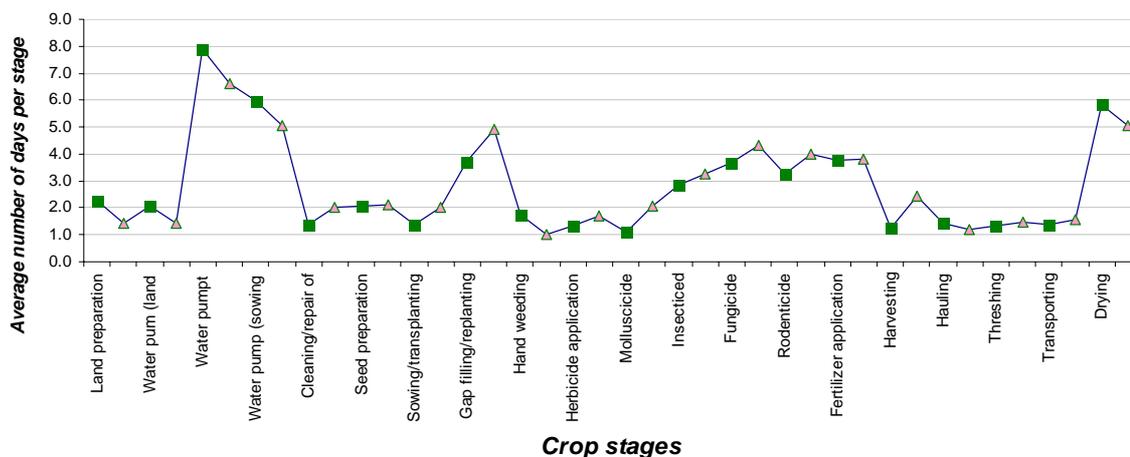
Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Labour in rice production - family versus hired

In virtually all stages of a cropping season, farmers need external labour to support their limited family labour in carrying out the inherently heavy work of rice cultivation (Chart 1). Farmers who live in the neighbourhood or in a neighbouring commune are normally hired. Heavy farm work they are expected to do include such tasks as dike repair, sowing, replanting of young rice (to replace plants failing to survive after sowing), pest control, harvesting, threshing, and transporting of produce.

The heavy tasks, as indicated in mean values in the Chart 1, only show a modest need for external labour. In the cases of large landholdings, owners hire as much as a hundred persons to assist them in replanting, transplanting, water pumping, spaying of pesticides, harvesting and drying. Threshing and transportation of ripened rice, which used to be done by hired labourers or farmers in the same mutual aid group, are now undertaken solely by hired service.

Chart 1 - Labour distribution - 2006 Summer-Autumn season (Family vs. Hired Labour)



Legend: ■: family labour ▲: hired labour.

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Most of the hired labours needed throughout the growing season are male, except for the harvesting stage where more females are employed. Large landholders may hire up to 70 female labourers to conduct the harvesting.

Farm resources

Machinery and tools that support rice cultivation are very common among the households surveyed. Common farming equipment and machinery include two main items - water-pumping machines (62 units) and pesticide sprayers (183 units). Motorcycles are also very popular in the countryside these days with 140 units reported. Boats are also common in this flood-prone area, reportedly available to 37 households. Fishponds and drying courts are available only to well-to-do households. There are 8 household with drying courts and 11 with fishponds.

In terms of livestock, 40 households keep a total of 86 cows, ranging from 1 to 7 animals per household. Thirty-one households reported raising pigs, with each household totalling from 1 to 20 animals. Duck raising was limited to only three households, ranging from 15 to 1,200 ducks. Only nine households keep chickens, ranging from 10 to 50.

Access to sources of financial capital

It is common for the farmers in the study sites to use their own savings as the main source of capital for rice production (39%) (Table 5). Buying agricultural inputs on credit from local shops is very popular among farmers and is considered a type of capital that farmers can rely on. Thirty nine percent of farmers reported buying agricultural inputs on credit, which they ranked second as a source of rice farming investment after personal savings. Loans obtained from the bank are ranked as the third most common source of capital for rice production (17%).

Table 5 - Sources of capital used for agricultural inputs for rice production

Source for Input	Number of responses	Percentage (n=223)
Saving	168	39
Input Supplier	167	39
Local Bank	74	17
Family member	11	3
Leaser	10	2
Cooperative	1	0
Other	1	0
Wholesaler	0	0

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Banks available in the district to support agricultural production include Bank for Agriculture and Rural Development, and the Bank for Social Policy. Private banks are available only at the provincial level, and lend farmers money but collateral such as Land Use Permits or the like may be required for borrowers.

Cropping pattern

In terms of rice cultivation, there are potentially three cropping seasons in the study site. However, two crops a year are the most common. In some areas, only one rainfed terrace crop is possible per year.

There are two main seasons – the winter-spring and summer-autumn (from late 2005 to early 2006). The survey data reveals that the total area of rice cultivated remained unchanged for two reported cropping seasons⁶, suggesting that farmers have a reliable access to irrigation. The autumn-winter cropping season, which comes after the summer-autumn crop, is limited to some small areas that are located out of the reach of annual inundation from the Mekong River.

⁶ *t*-Test: $t=0.065$, $p>0.05$

Table 6 - Rice Cropping Pattern in 2006

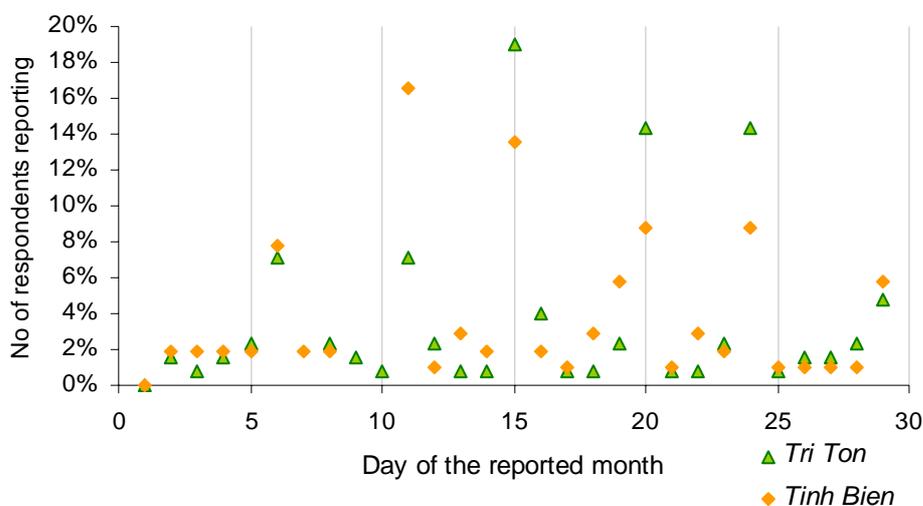
Name of Crops	Month of planting	Month of harvest
Winter-Spring (n=225)	Nov – Dec (56.4%-37.8% reporting)	Feb – Mar (53.3%-35.6% reporting)
Summer-Autumn (n=226)	Mar – Apr (23.9-72.1% reporting)	Jun – Jul (23.5%-72.1% reporting)

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Time for planting

The time for planting (sowing) does not appear to be consistent for the region (Chart 2). While most farmers reported that they started their sowing in the middle of the month, others started at other times in the month. Farmers explained they had to rely on the irrigation scheme coordinated by local irrigation units which are typically privately owned enterprises.

Chart 2 - Date of sowing in the first month of Summer-Autumn season (n = 229)



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Irrigation

Over the three potential cropping seasons from 2006 to 2007, a total of 4,225 ha in An Nong commune of Tinh Bien district were grown with rice (Table 7). Half of this area was irrigated by privately-owned irrigation units, the remaining 47% was irrigated by government-owned irrigation cooperatives (Table 8). A small proportion of 3% was rainfed. In Lac Quoi commune of Tri Ton district, 4,344 ha were dedicated to rice cultivation over the three recent cropping

seasons and all of these areas were irrigated by privately-owned irrigation units. No rainfed cultivation was reported.

Table 7 - Total irrigated rice areas (ha) by seasons and by sources

Districts	Winter-Spring 06-07			Summer-Autumn 2007			Autumn-Winter 2007		
	Private owned units	Government owned units	Rain-fed ⁽⁷⁾	By private owned units	By government owned units	Rain-fed	By private owned units	By government owned units	Rain-fed
Tri Ton	37,101	0	0	36,347	0	2,315	0	0	2,765
Tinh Bien	13,421	1,421	0	13,421	1,421	5	0	1,145	4,027

Source: An Giang Plant Protection Department.

The above figures can be summarised by source of irrigation as follows:

Table 8 - Total irrigated rice areas (ha) by irrigation sources

Districts	By private owned units	By government owned units	Rainfed
Tri Ton	93.5%	0.0%	6.5%
Tinh Bien	77.0%	11.4%	11.6%

Source: An Giang Plant Protection Department.

Rice Yield

The yields of the two cropping seasons differ from each other⁸. Although the average yield for the summer-autumn 2006 is smaller than that of the winter-spring 2005-06, the range of yield of the former is larger than the later. In addition, the farmer's yield ranges from 3,000 to 6,000 kg per hectare, making up a larger percentage than that of the latter. The data also show that the cultivated area between two seasons is not different from each other⁹.

⁷ Areas irrigated by farmers themselves by pumping water from canals adjacent to their fields are included in the groups for rainfed areas.

⁸ Man-Whitney U Test: U=12646.5, Z=-8.822, P<0.01 (M=5481.26, SD=1754.32, min=250, max=13,269)

⁹ Man-Whitney U Test: U=25384, Z=-0.029, P>0.05 (M=2.97, SD= 3.93, min=.18, max=27)

Table 9 - Rice yield by cropping season (in hectare)

	Summer-Autumn 2006	Winter-Spring 2005-06
Mean	4,894	6,070
Median	5,000	6,285
Mode	6,000	6,000
Range	13,019	9,750
Minimum	250	250
Maximum	13,269	10,000

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

The most common rice yield achieved per hectare ranges from 3 to 7 tons (Table 10). It also appears that the Winter-Spring season resulted in a higher yield than the Summer-Autumn season.

Table 10 - Rice yields (by season and yield level)

Yield of Summer-Autumn 2006			Yield of Winter-Spring 2005-06		
ton/ha	Frequency	Percentage	ton/ha	Frequency	Percentage
<1	4	1.8	<1	6	2.7
1.1-2	6	2.7	1.1-2	4	1.8
2.1-3	9	4.1	2.1-3	9	4.1
3.1-4	35	15.8	3.1-4	4	1.8
4.1-5	74	33.3	4.1-5	20	9.0
5.1-6	56	25.2	5.1-6	57	25.8
6.1-7	25	11.3	6.1-7	65	29.4
7.1-8	11	5.0	7.1-8	41	18.6
8.1-9	1	0.5	8.1-9	12	5.4
>9	1	0.5	>9	3	1.4
Total	222	100	Total	221	100

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

The next section of this chapter will examine the constraints that farmers in An Giang province experienced when trialling the CTBS. This examination will reveal the reality of current cooperation among rice farmers as a consequence of the abandonment of the labour exchange system.

4.2 CTBS constraints in An Giang

Rogers (2003) refers to the stage when users try out a new technology as the *persuasion stage* which is the period during which potential users assess five characteristics of a technology - *relative advantage, complexity, compatibility, observability and trialability*.

Qualitative research was used to investigate farmers’ perceptions of the CTBS. For the purposes of this discussion, the issues of social capital and the ability of local community to make institutional arrangements for successful management of the CTBS are placed in Roger’s framework under *complexity and compatibility*, as shown in Figure 11 below.

For purposes of clarity, the analysis below combines *complexity* and *compatibility* into one dimension, which will be explored in this study. This combination is made because these two characteristics are interchangeable and supplementary in the way farmers articulate their perception of the effectiveness of the CTBS. The issues of *trialability* and *observability* will also be integrated into the discussion on the advantage of CTBS given its positive relation with the technological advantage. Given the above scheme of analysis, the presentation below is structured under two main headings 1) *relative advantage*, and 2) *complexity (with compatibility integrated)*.

Figure 11- Focus of qualitative research as posited in the diffusion of innovation framework

<i>Diffusion of Innovations theory</i>	
A model of five stages in the Innovation-Decision process	
1. Knowledge	
2. Persuasion (5 perceived characteristics of CTBS technology)	
Relative Advantage (1)	<ul style="list-style-type: none"> ▪ To examine the perceived benefits of CTBS & perceived constraints
Complexity (2) Compatibility (3)	<ul style="list-style-type: none"> ▪ To examine the perceived disadvantage of CTBS and problems in farmers’ cooperation (<i>Social Capital theory</i>) ▪ To examine the possibility of achieving collective action of farmers through consensus and capacity of local community in establishing institutional arrangements for adoption of the CTBS (<i>Common Property Resources theory</i>)
Observability (4)	
Trialability (5)	
3. Decision	
4. Implementation	
5. Confirmation	

Note: Bold text (in italic) indicates the theories that are used in this study, shown in the hierarchy of the Diffusion of Innovation theory.

4.2.1 Relative Advantage

Key benefits perceived by farmers following some CTBS trials

In general, farmers who directly trialled the CTBS are pleased about the technology's effectiveness. The trap system did attract rats from the fields around. Even untargeted animals such as snakes, and amphibians, were occasionally trapped. The captures, apart from being an indication of CTBS effectiveness, were also used as food that was shared among farmers of the same CTBS working group. When they had meals, friends and neighbours were also invited to join.

Farmers found that damage to the crop areas around the CTBS is lesser than that located far away from the CTBS (beyond the halo effect). About 60% of the halo affect was free from rat damage (as estimated by the farmers).

Farmers' preliminary observations

Using CTBS, farmers found additional use of rodenticide was not necessary. They argued that rodenticide is only effective for on the spot treatment and is useless when applied during the wet season. Farmers reported that they currently use rodenticide which is usually mixed with used lubricant and placed around the field. This kind of bait is poisonous so that amphibians such as frogs which prey around the area get killed. In addition to the direct affect of CTBS on crop protection, farmers also noticed the environmental benefits they enjoyed, including the safety to water sources, humans and animals.

Farmers reported that the capture of rodents maintained a good crop yield and ensured food security. However, there was no rat capture during the seedling stage, which was different from their usual experience because farmers believe that rodents are attracted by rice seed at the sowing stage. Farmers claimed that rodents usually come to the eat rice seed that the farmers sowed. However, rice seed inside the CTBS did not seem to function as an attractant to rodents as the farmers expected. This observation led farmers to understand why minor damage was still found in the halo effect of the CTBS at the seedling stage of the lure crop. Nevertheless, they reported that CTBS started to show its effectiveness when the lure crop reaches the booting stage.

Although rodents caught from the CTBS were used as additional food, they were not considered additional income because the small quantity of captures and irregular availability makes selling difficult despite the fact that rodents are a favourite food for most farmers in the Mekong delta.

In terms of economic benefits, rough estimation by farmers revealed that CTBS is more cost-effective than plastic fences which farmers typically used in rodent outbreaks. Farmers could not make an accurate cost and benefit calculation because they do not know the costs of the materials and labour.

4.2.2 Complexity & Compatibility (Factors that influence farmers' attitude towards adoption of the technology during the persuasion stage)

Obstacles perceived by farmers

Group management

Farmer groups, which were set up to manage CTBS, were not committed to checking and maintaining CTBS irrespective of agreements being made prior to the establishment of the trap. They did not visit the trap sites to collect captures despite that it was their turn to do. Some group members explained because rodents were not abundant at the times of CTBS trials, they did not feel there was a real need to do that. That was why their commitment diminished.

Preparation of lure crop

Farmers believed that only aromatic rice such as Jasmine could attract rats. Preparing young jasmine is time-consuming and requires certain skills. In addition, farmers need to spare a plot of land to produce the lure crop. They also need to move this crop from the nursery into the CTBS trap when the Jasmine reached about 15 days of age. As a result, preparation of Jasmine lure crop was perceived very troublesome if farmers were expected to do this by themselves. Transplanting of lure crop is also unfamiliar to most young farmers who currently do seed broadcasting. In addition, it will take typically from 100 to 110 days for Jasmine to ripen. As a result, the harvest of Jasmine may not fall at the same time for the harvest of the main crop. Also, farmers believe Jasmine is susceptible to brown planthopper (BPH) (a common pest in rice) which may affect the yields of Jasmine and the main crop if control actions were not timely.

Attitude, Knowledge and Practice (in the opinion of CTBS trial farmers)

Generally, it is difficult to get farmers to agree on a collective course of action in agricultural activities even if the cost related to collective work is subsidised. When it comes to making an investment in farming, farmers preferred having the investment made on their own field. In the case of rodent control using CTBS, farmers want the CTBS to be located in their own field in order to have direct benefits from it.

Farmers usually complain if their contribution to collective activity does not work. When this is the case, it is difficult to convince them to do similar things again. This is why farmers think carefully about the result before they agree to do something collectively. In the majority of cases, convincing farmers to do collective activities requires local government involvement.

Following the CTBS trials, it was noted that farmers do not share an understanding of how a CTBS works, especially the concept of CTBS halo effect. This explains why they preferred having CTBS on their own rice field. In addition, farmers have different ways for assessing rodent infestation levels. Factors such as farm size, experience, availability of labour and finance, field history, and their forecast of rodent infestation typically determine how they controlled rodent in their fields. Therefore, they usually argued they prefer making their own decisions related to the rice production that happens on their land.

Farmers tend to observe agricultural trials of their fellow farmers. If the trial was successful, they would take further considerations. If the trials failed, it is very difficult to convince them. It is noted that during the time of the CTBS trials, since rodent infestation did not emerge as a major problem; little attention was paid to the operation of the CTBS.

Farmers do not take preventive rodent control measures. This is because managing rodents involves costs. As such, rodents are only controlled when the situation worsens and damage to the standing crop becomes inevitable. When this is the case, costs incurred from rodent control are usually high due to large amounts of rodenticide being used and plastic fences being erected to keep rodents away from the crops¹⁰.

¹⁰ This has a behavioural implication - farmers are very afraid of brown planthopper (BPH). Whenever they find BPH on the field, they usually spray insecticide immediately to kill them. Fungi diseases are also very detrimental to rice if not properly treated. However, farmers do not take much care of this because they do not think these diseases threaten their crops (told by technical staff of Tinh Bien).

Some farmers' key comments during CTBS operation:

- Untimely removal of captures from the traps, which might dispel other rodents from coming close to traps.
- Live traps in the CTBS system were stolen.
- The paths to the holes of live traps were not properly arranged to facilitate rodents' running.
- Lure crops were eaten by buffalo and occasionally birds.
- Rodents still damaged fields around CTBS before they reached the CTBS.
- Captures were removed from the traps by professional rat catchers who went to the field early in the morning (well before the farmers came).

Farmers' characteristics (in the opinion of local opinion leaders):

Farmers' ideas are very different from each other. They may agree in one meeting but may change or make no further commitment. Farmers normally do not trust group based work. In general it is difficult to invite farmers to local meetings. If the meeting is beneficial to them, they would come. Otherwise, they are hesitant to attend. Poor farmers usually do not contribute money to local fund raising campaigns but they tend to support agreement of the majority.

Examination of factors that may constrain farmers' attitudes towards adoption

Group size and group composition

Farmers said the size of a farmer group required for a CTBS might vary as it is up to the number of individuals who are interested in participating in a CTBS working group. However, a group with fewer members is perceived to be more advantageous given that there is less difference of opinion. In terms of group composition, farmers reported it would be good if farmers who know each other well or those who have good relationships participate in the same group. Kinship based groups are also seen as an advantage for collective adoption of CTBS since people from the same kin group trust each other.

Farmers indicated that one of the advantages of kinship is that decisions need to be a consensus of all members. Individual preferences can be overridden by the majority opinion in a kinship group. However, farmers noted that kinship-based adoption is also governed by the prestige of the person who is expected to make a decision.

Transaction costs and opportunity cost

Opportunity costs, defined as the value of any resource, such as commitment of time or efforts, when put to its best alternative use (Doll & Orazem c1984), is not perceived a hindrance to farmers who have directly trialled the CTBS. Farmers said once they are interested in doing one thing collectively, transaction costs are not perceived as a hindrance. When this is the case, individual efforts such as time commitment, travel fuel, would be borne individually without complaints. Daily field visits, in the case of CTBS for example, would be part of the routine work that farmers do and would be considered worthwhile. Opportunity costs, however, will be perceived considerable during off-farm seasons when some farmers may spend their time doing other work and other travel to other areas to work as seasonal hired labour.

Yield of lure crop

Farmers reported that they lost, on average, 30-40% of yield from the lure crop as a result of pests but, the benefits in protecting a large rice area was perceived being higher than this loss.

Labour (requirement for establishing, maintaining, and monitoring the trap system)

During the CTBS trial period, labour devoted to the establishment of the CTBS was not considered as an obstacle to farmers who directly trialled the CTBS. However, trap maintenance appears to be challenging when rodent pest turned out to be no longer problematic to participating members. When this is the case, group commitment is threatened. Farmers said despite arrangements being made at the beginning of the crop whereby group members would take turns to check the trap, the members gave up their commitment in the following weeks, leaving the maintenance job to CTBS managers. The reduced commitment, in their opinion, was due to loss of interest arising from the limited number of captures during the first week. When this is the case, the opportunity costs were perceived to be high and farmers would turn away from their commitment to go back to their own business.

Farmers also postulated that maintenance of a trap system would be difficult if farmers in the halo effect do not live in the same hamlet or communes. Also, in case where hired labourers attend the field more frequently than field owner, commitment to trap maintenance will become challenging. This would affect the interest in CTBS of the group as a whole.

Irrigation for lure crop and collaboration with irrigation coordinating unit

Irrigation was mentioned as a key obstacle because the timing for irrigation varies from field to field, which would affect the cooperation among farmers who share the same halo effect. Local statistics shows that almost all cultivated riceland in Lac Quoi commune of Tri Ton district (4,344ha for 3 crop seasons per year) were irrigated by private-owned irrigation units and in An Nong commune of Tinh Bien district, half of the total land cultivated (2,060ha) were irrigated by private-owned irrigation units.

Farmers reported many farmers in their commune were not pleased with the private-owned irrigation agents who charged high irrigation fees which were not commensurate with the quality provided¹¹. They added that irrigation timing typically does not fit the farmer's schedule. Negotiations between farmers and private irrigation agents were hardly made because private-owned irrigation units set up their own irrigation plan without appropriate consultation with farmers. When it rained, water pumping was usually ignored although irrigation may have been scheduled with a particular household. Farmers said because of such a service, trust in private irrigation agents was eroded among farmers whose fields are upstream.

Equity (related to shape of the halo effect)

At the time of this study, when a CTBS was established, farmers preferred having the CTBS in their field. This is due to the misunderstanding of farmers about how a CTBS functions. They did not have a clear idea about the halo effect which is the key concept of the CTBS method. Farmers still found damage to crop in the halo effect area which led farmers to believe that the CTBS did not provide a full protection of the crop. Group members who still had their crop damaged by rodents, therefore, had a reason to withdraw from the group.

Ranking of key adoption constraints

Constraints perceived by farmers, as presented above, include the difficulties in arriving at a consensus, maintenance, equity, irrigation, preparation of lure crop. In farmers' opinions, local governments should take a lead role in the adoption of this collective based technology. Local government agencies should take the helm in this initiative. In farmers' opinion, the local agencies that could mobilise farmers' participation in using CTBS include the communal

¹¹ The irrigation fee (based on per hectare rate and is charged by private irrigation service at the time of the survey - August 12, 2007) is equivalent to the monetary value of 80 litres of diesel plus 300kg of rice

People's Committee and the Farmers' Association. Of these two agencies, the Communal People's Committee was considered more effective than mass organisations in this regard.

4.3 Comparisons with previous studies

Palis *et al.* (2003) reviewed farmers' perceptions of CTBS following some trials in Soc Trang and Tien Giang provinces (in the Mekong delta). Palis *et al.* (2003a) also reviewed the use of CTBS in all trial sites in Vietnam, including Bac Lieu province (Mekong delta) and Vinh Phuc province (Northern Vietnam). Most of the key constraints to the adoption of the CTBS found in other provinces in the Mekong delta were also found in this study in An Giang province. The following discussion identifies the key constraints.

Perception of cost

Farmers are inclined to calculate the cost of the CTBS based on the rice area within the CTBS fence, and not on the basis of the whole halo effect. This calculation suggests two things that should be considered in future CTBS trials. The reason why farmers tend to calculate the cost-benefit of the CTBS based on the total area within the CTBS trap is because they do not have a clear idea of the size of the halo effect, which is typically from 15-20ha in size is 200m in radius with the center of the halo effect being the CTBS trap. In An Giang, despite farmers being provided training on how a CTBS works, including its halo effect, when asked, farmers could not give an appropriate answer. This lack of understanding resulted in the fact that farmers could not make an accurate assessment of the cost-benefit of the CTBS, thus, they tend to focus their calculation on the CTBS trap only.

When trial farmers did not have a clear understanding of how the CTBS works, especially its halo effect, they could not highlight the key benefits of the CTBS to their farm or house neighbours. If a trial farmer is a local opinion leader, failure to explain how a CTBS works and how cost-effective the new technology is would leave his fellowmen questions and doubts with regards to the effectiveness of the CTBS. Cooperation for a shared use of the technology would, therefore, become more challenging. In addition, failure to articulate an approximate halo effect (using the radius of the effect as a proxy) will make the identification of potential users difficult. The issues of free-riders would be very likely to emerge (cf. Morin *et al.* 2003, Palis *et al.* 2003, Russell *et al.* 2003).

CTBS cost, as indicated in the quantitative survey, appears to be one of the key obstacles to community wide CTBS adoption. This perception was found particularly among farmers who have not trialled the CTBS method. In the study in An Giang, CTBS managers said they could bear the cost themselves because the cost is lower than that typically incurred at the times of rodent outbreak. In addition, investment in CTBS is worth being made rather than giving up their crop to rodents.

Palis *et al.* (2003a), when reviewing results in provinces with CTBS trials, found that farmers believed that when rodents were collectively controlled, the control action was more effective than individual control practices. This belief was also found in An Giang as both quantitative survey and qualitative study indicated.

Perceptions of labour requirements

Labour was not perceived as a difficulty for farmers who directly trialled the CTBS in An Giang. Transaction costs and opportunity cost were also not perceived significant. Farmers doing CTBS trialled explained that visiting field is part of their daily routine; therefore, capture and trap check could be easily done as part of field observation. However, the commitment to trap maintenance by other group members was not made. When this is the case, the maintenance job was left to CTBS managers who had to check the CTBS because the trap is located on their land. Farmers' interest on the CTBS is, therefore, affects how they assess opportunity cost.

Perception of irrigation

Farmers found synchronised irrigation difficult to achieve given irrigation is currently coordinated by private-owned units who aims for profit rather than service quality. In addition, there are cases where a particular field is identified as the most suitable location for a CTBS but this location, historically, had late access to irrigation water (given its upstream or elevated position). Such situations will affect group coordination and effectiveness of the CTBS.

Production of lure crops

Devoting a small area in the field for the lure crop was not perceived problematic in An Giang was well as in other provinces in the Mekong delta. However, the production of a lure crop using Jasmine to effectively attract rodents was perceived troublesome in An Giang. Farmers

reported they could not afford a place to set up a nursery at their home to prepare the lure rice given the lack of land. Also, a lot of time, effort, and technical skills need to be put in producing the lure rice which was perceived difficult for farmers.

Pest effects on the lure crop yield

Although pests that affect the lure crop were reported, this issue was not perceived significant by the farmers in An Giang. Farmers said that partial loss of lure crop to some pests is acceptable given the high value that jasmine rice could return. Farmers added if CTBS was adopted and shared by a group, group members can share this loss. This statement was repeated in all group discussions in the qualitative surveys.

Awareness of impacts on the environment

Palis *et al.* (2003a) found that in places where farmers trialled the CTBS, there has been an increase in farmers' awareness about the negative environmental effects of rodenticides. This change in attitude was not clearly found for the case of An Giang where farmers trialled the CTBS for just one or two crops.

Prospects for adoption

All farmers who directly trialled CTBS in An Giang stated that they were pleased with the performance of the CTBS despite the fact that low abundance of the rodents at the times of trial resulted in few captures and loss of interest on the part of group members. They forecast that farmers who own more than two hectares of riceland could adopt the CTBS method given that the benefits outweigh the investment costs. They added that farmers who own large ricelands would have more incentive to use CTBS to protect their crops because crop failure, if happen, could result in unsettled debts.

Palis *et al.* (2003a) found in the case of Cai Lay and Cai Be district of Tien Giang province that farmers with more than one hectare of riceland and those whose field were usually threatened by high rodent invasion said they would adopt CTBS. In Bac Lieu, farmers who were satisfied with the CTBS trials indicated that they would organise farmers into groups to continue the use of the CTBS at their own cost. But there were no cases where farmers apply CTBS on their own.

In Binh Thuan province, CTBS was first introduced in 2001 during the rodent breakout. The introduction of the CTBS was appreciated by farmers and local government, and the technology was replicated from the originally planned one district to eight districts. However, after rodent was put under control, CTBS was no longer used as a preventative rodent control measure (Le 2003). In the case of Soc Trang, Palis *et al.* (2003a) found despite commitments by farmers, no adoption was found.

4.4 Conclusion

The constraints to CTBS adoption as found in An Giang were similar to those experienced by farmers in other localities in the Mekong Delta, as well as other parts of Vietnam where CTBS was trialled. The technological constraints, typically, are high costs, difficulties in maintenance, lack of reliable access to synchronised irrigation, lack of finance to initialise the adoption, and challenges in getting farmers at farm level to cooperate to share the use of CTBS. Although constraints such as initial cost and synchronised irrigation could be solved if arrangements were made by local government, the challenge, in the long run, appears to be how to promote long-term group-based adoption. This enterprise rests on the farmers' willingness to cooperate and the ability of local stakeholders to make institutional arrangements towards collective adoption of the CTBS. This undertaking is an indirect constraint and is not easily observable. Investigation and analysis, therefore, need to be made to better understand the nature of the constraints. These important issues are captured in the five research questions which this study attempts to answer. In the next chapter, the first three research questions will be addressed.

Chapter 5 – Farmers’ Perceptions of Rodents as a Pest, and the Methods of Control

This chapter attempts to answer the following three research questions:

- RQ1 Is the severity of the rodent problem related to the likelihood of adoption of the CTBS?
- RQ2 Would the availability of a local subsidy for trap establishment increase the likelihood of long-term adoption of the CTBS?
- RQ3 Would changes in knowledge, attitudes, and practices of farmers related to non-chemical rodent control enhance the adoption of CTBS?

According to Rogers (2003), when it comes to adopting a new technology, factors that potential users would consider before trialling a new technology are users’ *previous practices*, their *felt needs* for using the new technology, the nature of the current problem (in relation to the new technology), and their *innovativeness* and *social norms*. In line with this theory, in the case of CTBS technology, farmers would consider if the CTBS was a more effective rodent control practice than those that farmers currently use. Farmers will weigh up to see if the rodent problem could be better solved using CTBS as a stand-alone method, or as part of their rodent management strategy. They would also think about what their peers think about the CTBS. Finally, they would consider if the CTBS was interesting to them and worth trying.

The issues of rodent pest severity and its relation to the likelihood of CTBS adoption was raised under this study because the severity of crop damage caused by rodents influenced the way farmers controlled rodent pests. Evidence from previous case studies has shown that when the magnitude of crop damage was tolerable, not much effort was made in controlling rodents. This is a matter of minimising production costs, labour savings and opportunity costs. Nevertheless, if a crop was seriously threatened, manifested in widespread damage or local destructive areas, action would be taken, both from individual efforts, to collective controls as part of government campaigns, which involves a wide range of relevant stakeholders.

Before the relationship between rodent problem severity and the likelihood of the adoption of the CTBS is discussed, it is important to understand the farmers’ current rodent management practices. Specifically, it is essential to understand the current knowledge, attitudes and

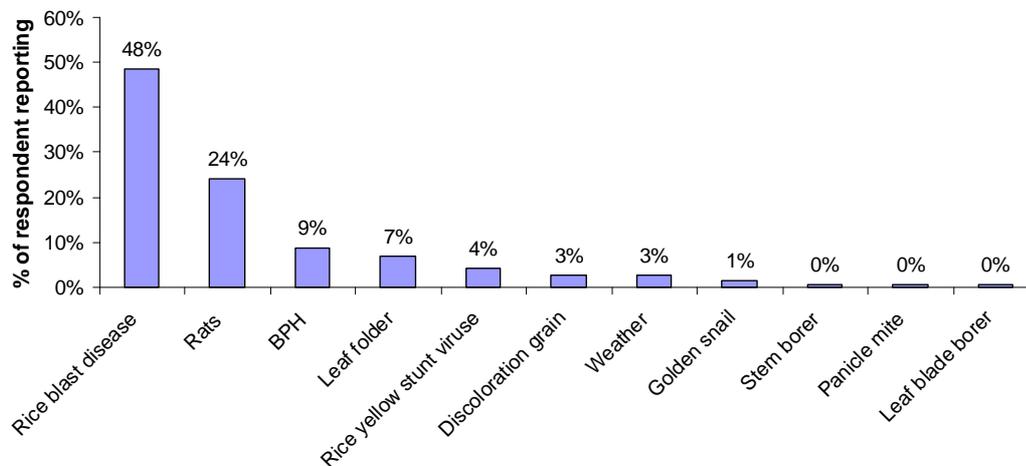
practices (KAP) of farmers concerning rodent management. The following section will examine the perceptions of farmers in An Giang of rodents as a crop pest, their attitudes and beliefs about rodent management success, and their current rodent control practices.

5.1 Background

■ Rodents as a Crop Pest

Of the eight pests reported as troublesome to rice crops (at the time of survey), rodents (rice field rats) were identified as an important pest to rice crops - second to rice blast disease (which is a very common disease in rice in the Mekong Delta). Brown Plant Hopper (BPH), which was also very common in rice and is endemic, was ranked as the third important pest at the time of the survey. The following chart shows ranking of the importance of pests to rice at the time of survey (see Appendix C for the questionnaire used to collect data for this chapter).

Chart 3 - Important pests associated with rice crops (n=221)



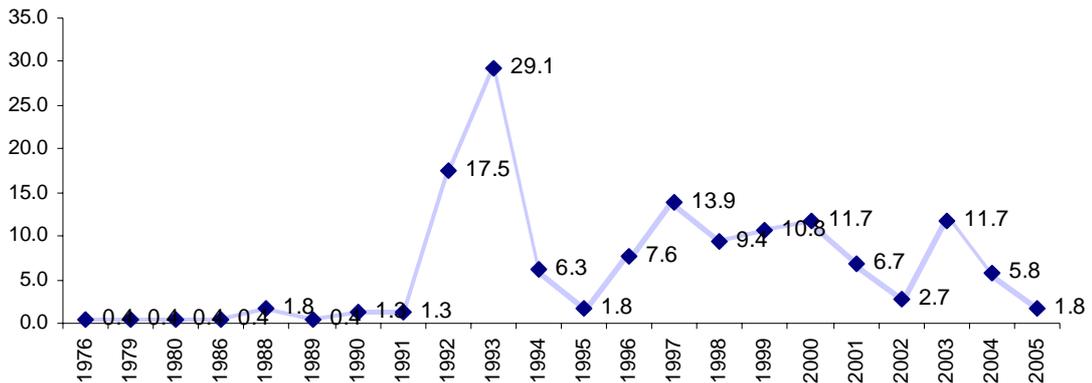
Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

The ranking of a pest and the severity of damage to rice crops was traditionally based on damage signs caused by rodents which farmers recognised through field observations, including observation of rodent runways, their burrows, bunds, newly damaged areas on rice plants, loss of seedlings, and their droppings. These signs are the most common ways that farmers use to recognise the population dynamics of rats in the farmers' rice landscape.

Despite the fact that severity of crop damage varies from season to season, and from year to year, 70.3% of farmers reported regular presence of rodents in their fields, 27.5 occasionally,

and 2.3% rarely. This observation suggests that rodents were not evenly distributed through a commune or landscape. Factors accounting for this variation may be habitat preference, food availability. Farmers were also asked to recall previous times when rodent outbreaks occurred. Given that recall information may not be accurate, the chart below can only be taken as indicative.

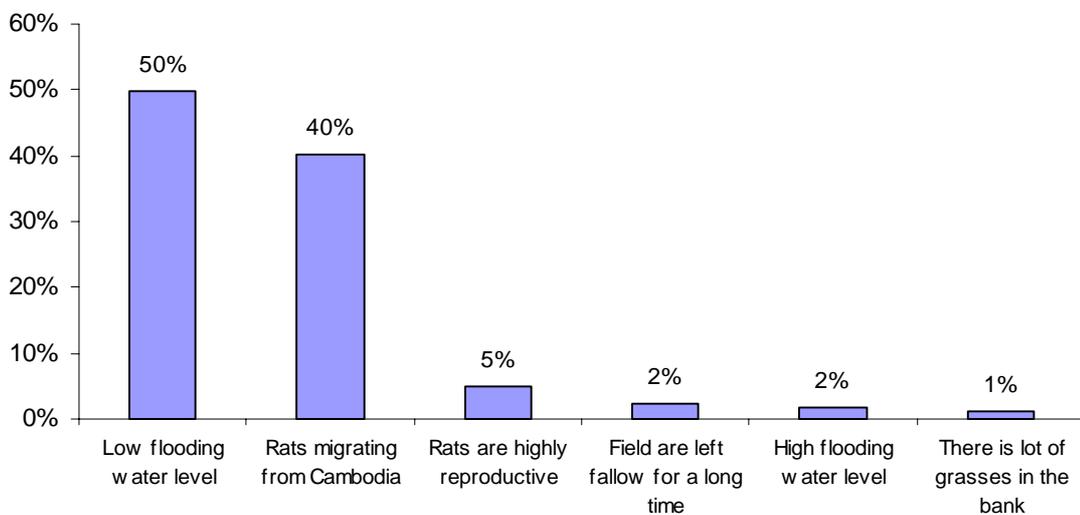
Chart 4 - Rat outbreak as recalled by farmers over years (% of respondents agreeing)



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Farmers believed there were many reasons that explained the fluctuation of rodent populations. Reasons included firstly, annual flooding of the Mekong river which causes rodents to migrate between rice farming areas and secondly, migration of rodents from the Cambodian farming region which was provoked by the different timing of the rice crop season which necessitated the movement of rodents in search for food (see Chart 5).

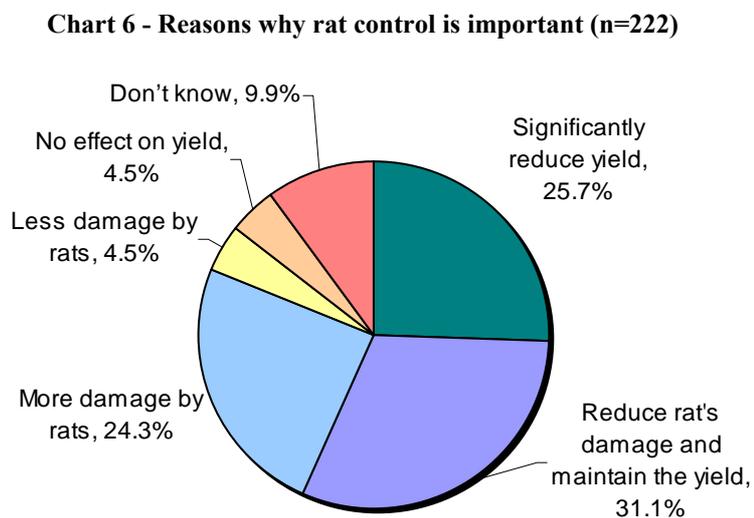
Chart 5 - Reasons for high rodent abundance (agreed by percentage of farmers)



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

- Farmers' Attitudes and Beliefs about Rodent Management

Virtually all farmers (98%) stated that it is important to keep rodents under control. However, when asked to give the reasons why rodent management is important, only 81% gave reasons as indicated in the pie chart below.

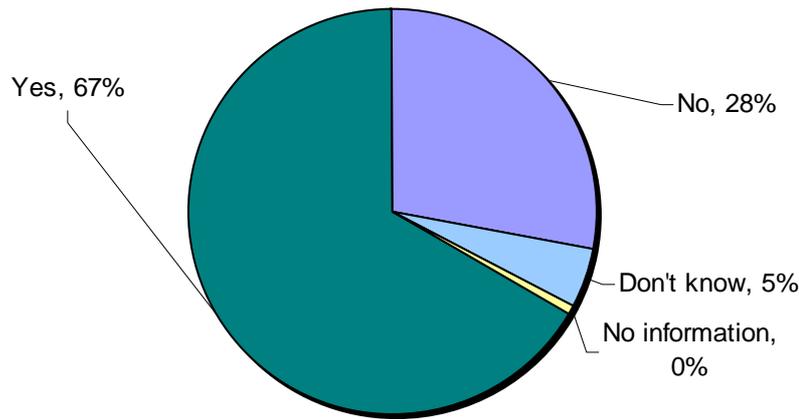


Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Eighty one percent of the respondents believed rodent management was necessary. The reasons they gave included serious damage to their crops which leads to reduced yield. This situation was perceived to be worse in recent times. The remaining respondents (19%) did not think rodent management was necessary. Nine percent stated that they did not find rodents a problem while the remaining ten percent said they did not know why rodent control was necessary. This pattern of attitudes suggests that farmers do not hold the same attitudes towards rodents as pests and towards the necessity for controlling them.

In addition, and interestingly, of the total respondents who were asked if rodents were controllable, only 67% believed so, 28% did not think so, and the remaining 5% said they had no idea.

Chart 7 - Are rodents controllable? (n=222)

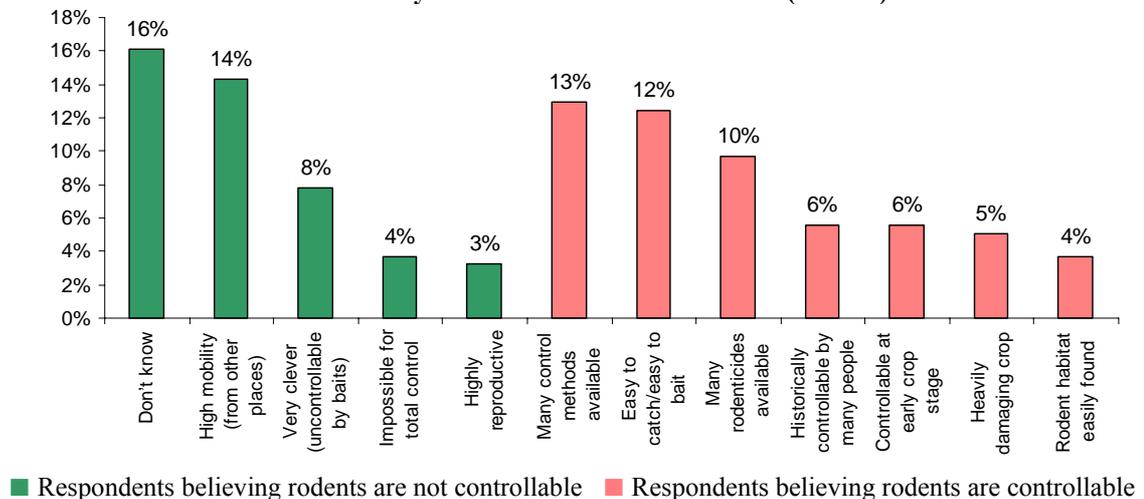


Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Over half (55%) of farmers gave reasons for their beliefs that rodents are controllable. The remaining 45 percent gave reasons that explained their beliefs why rodent control is hardly possible. Reasons for each group were indicated in the chart below. For farmers who did not think rodents are controllable, a wide range of reasons were given - they did not know how to control rodents (16%), they thought rodents were highly mobile (14%), rodents were clever (8%), it is impossible for humans to totally control them (4%), and rodents are highly reproductive (3%).

Nevertheless, for farmers who thought rodents were controllable, reasons they gave included 1) various methods were available for adoption (13%), rodent could be easily trapped using baits (12%), a wide range of rodenticide is available (10%), rodents are controllable, historically (6%), rodents can be controlled at the early stage of the crop (6%), and control could be done since it is easy to locate rodent habitats (4%).

Chart 8 - Why rodents are difficult to control (n = 217)

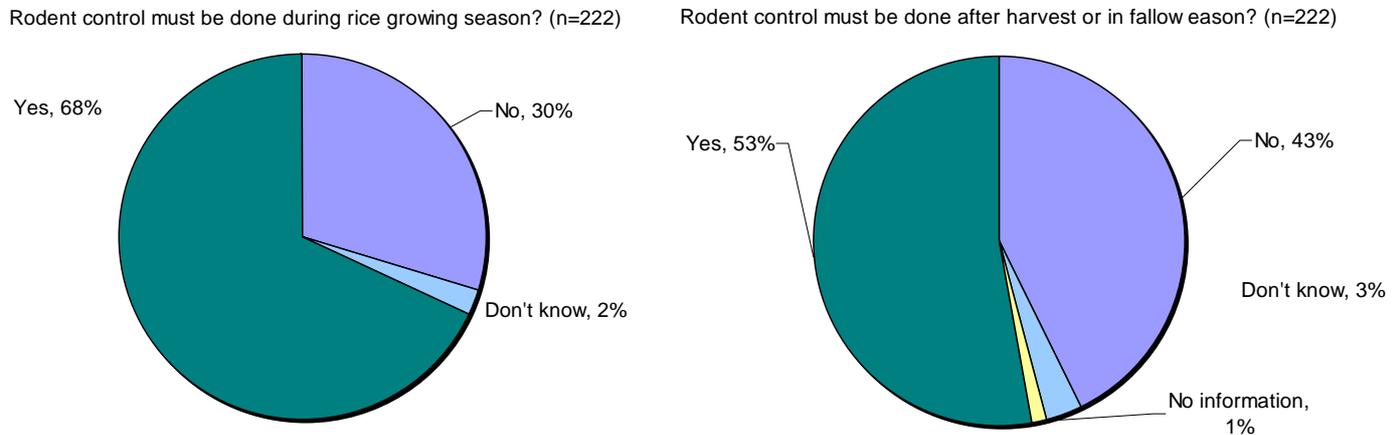


■ Respondents believing rodents are not controllable ■ Respondents believing rodents are controllable

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

In terms of the right times for control, two-thirds of respondents (68%) said rodents can be controlled during the cropping season. However, when asked if rodents should be controlled after the harvest and during the fallow, 53% of farmers agreed.

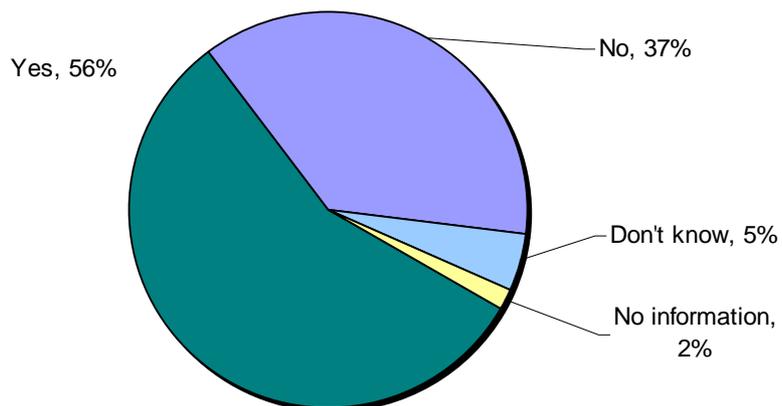
Chart 9 - Differences in timing for rodent management (n = 217)



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

In terms of the effectiveness of rodent control on crop protection, over half (56%) agreed that rodent management helped maintain crop yield. However, about one third of respondents (37%) argued that they did not believe rodent management contributes to maintaining crop yield (Chart 10 below).

Chart 10 - Does rodent control contribute to maintaining rice yield?

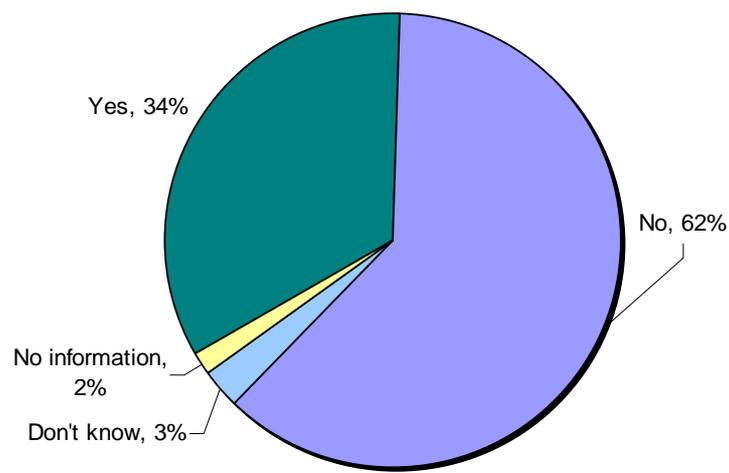


Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Despite respondents believing that controlling rodents maintains crop yield, only 54% of them could give a specific reason. Only 62% of farmers, who did not believe controlling rodents helped maintain crop yield, could give a specific reason.

From the above data, it is apparent that although there were differences in belief, virtually all farmers (98%) agreed that rodent control would be more effective if it was implemented by all farmers at the same time. In addition, when asked about farmers' attitudes about the threat of rodenticide to humans, animals and the environment, only 34% agreed. The remainder did not agree or did not know about the relationship between rodenticides and their impacts on humans, animals and the environment.

Chart 11 - Is chemical rodenticide safe for humans, animals and the environment? (n = 222)



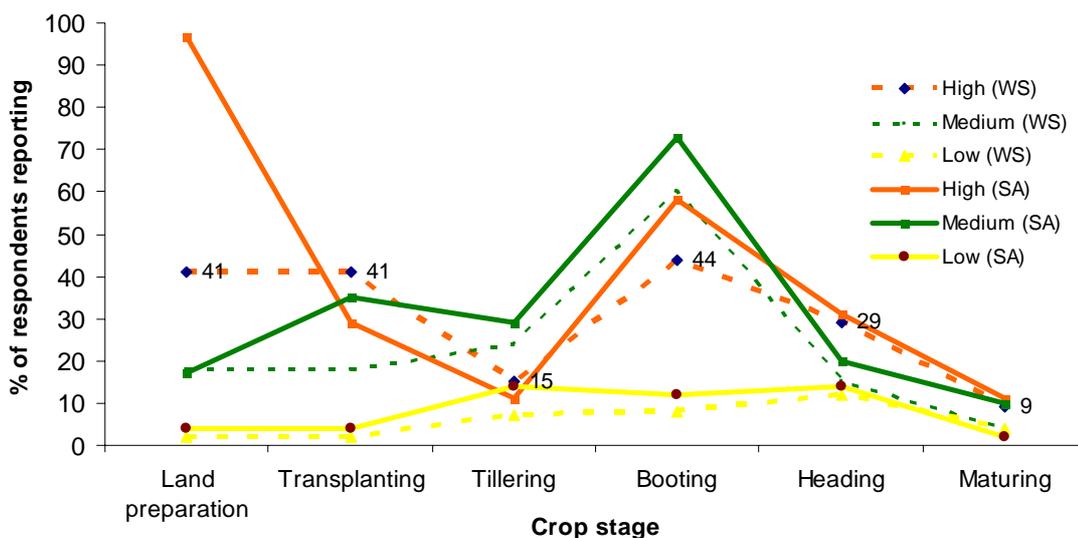
Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

The above pattern of information indicates a remarkable difference in the attitudes of farmers towards rodents and the necessity for rodent management. This may explain the differences in their rodent management strategy, which is individually decided. The following data explores this issue in more detail.

- Rodent management practices

Farmers control rodents at different stages in a cropping season. Generally, they tended to focus their control actions at land preparation, transplanting (sowing), and booting stages, as the data collected over two most recent cropping seasons indicates (Chart 12). This control practice appears to be similar for two different cropping seasons. The pattern of the information indicates that most farmers had similar levels of priority for rodent management for each stage of their crop.

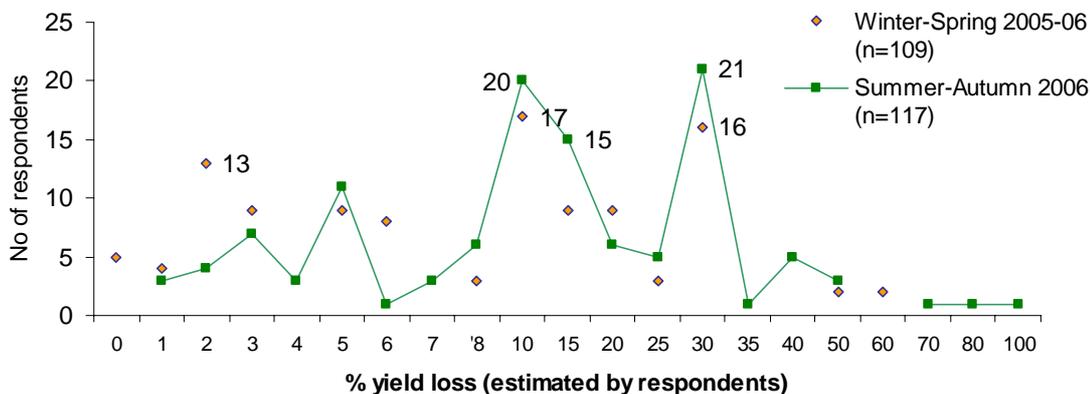
Chart 12 - Control priorities (Winter-Spring and Summer-Autumn seasons 2005-06)



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Loss estimates over the two reported seasons typically ranged from 2 to 30% with more damage claimed in the summer-autumn season because rice was cultivated over a larger area during this season. The chart below shows the estimated loss of the two adjacent cropping seasons.

Chart 13 - Estimated rice loss because of rodents (n = 117)



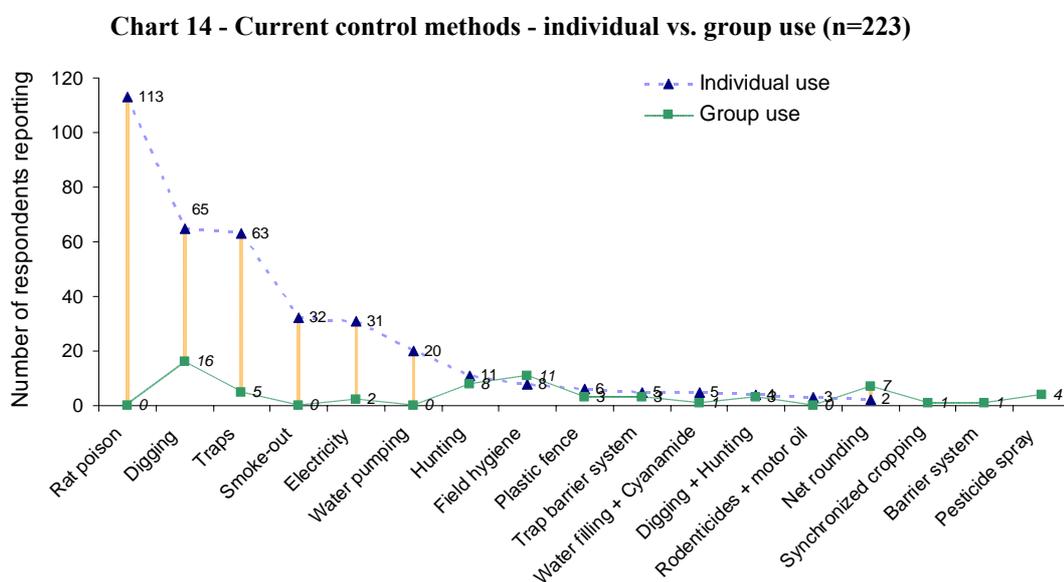
Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

In terms of rodent control methods, rodenticide mixed with baits and laid along runways or in proximity to rodent habitats, was reportedly the most common method to manage rodents. Other popular measures included digging up of burrows, traps, smoking-out, electrocution¹²,

¹² Electric wires are hang around the paddy field with power on at night time to kill rodents that touch the wire.

water pumping, hunting, field sanitation after harvesting, and plastic fences (in the case of rodent breakout). Electrocutation was still being used in some remote fields during high rodent season despite governmental warning.

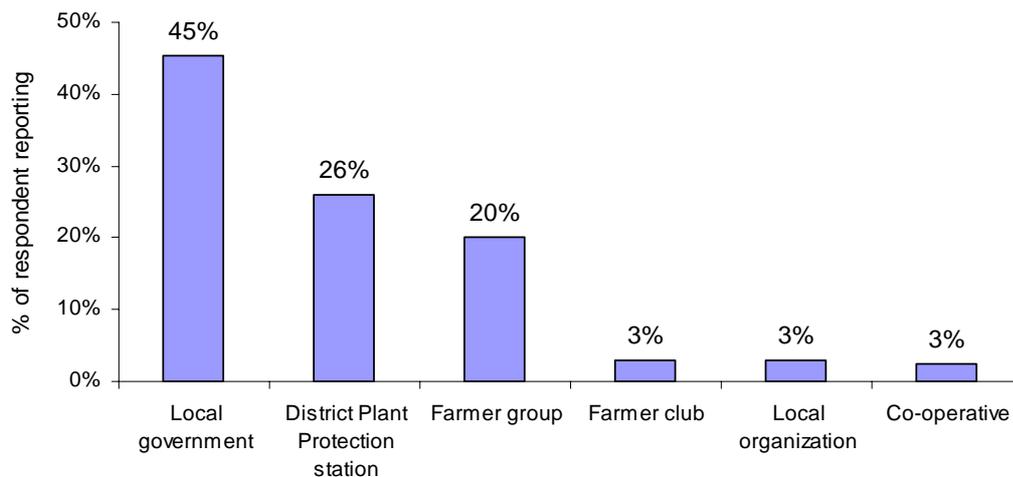
Typically, rodent control was implemented individually rather than collectively. Common methods individually used include baits, live traps, kill traps, and digging of burrows. Methods collectively used include field sanitation and hunting, which were usually organised by local government or local plant protection stations. As indicated in the chart below, the orange dot-lines indicate the differences between the modes of rodent control used by individuals compared with those used by groups.



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

For collective rodent control, it was reported that local government and the district plant protection stations were the primary agencies who took the initiative to mobilise farmers' collective action. It was noted that local farmer based organisations, such as agricultural cooperatives, appeared to play a very limited role in organisation of community activities related to agriculture. In the past, especially during the collectivisation period in Southern Vietnam (from 1976 to 1988), local agricultural cooperatives were entrusted by the government to facilitate rice production activities (such as irrigation coordination, provision of agricultural inputs, purchase of rice produce during the Contract 100 period). However, these agricultural cooperatives presently did not seem to play a similar role in mobilizing farmers' collective activities.

Chart 15 - Organisers for collective rodent control (n=222)



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Farmers reported that they decided which method they should use to control rodents for most of the cases based on their own experience and other external sources of advice such as their partners, extension staff, television, radio, trainers and traders of agricultural inputs.

The above data indicates a clear pattern of how farmers think about and deal with rodent problems. Even though virtually all farmers stated rodent management was important, less than half of them did not think rodent control maintained the crop yield. Additionally, the need for control actions depends on the extent to which crop was threatened by rodents. However, at the individual level, farmers made their own assessments, which may be different from one to one, which affects their degree of participation in local campaigns at the field, commune, district, and provincial level.

5.2 Rodent pest severity and CTBS adoption likelihood (Research question no.1)

Previous case studies conducted in the Mekong Delta indicated that local governments took active part in mobilizing and coordinating collective rodent control activities in the event of rodent outbreaks or high-level crop damage. Rodent outbreak or high-level crop damage were typically announced when rodent infestation became widespread and threatened crop loss over a large geographical area. When this was the case, campaigns which were funded by local government and plant protection departments, were organised to implement collective rodent control activities including burrow digging, dog hunting, field clean-up. Seldom did farmers organise rodent management in groups. It was also observed that when crop damage was local or patchy, individuals suffering the damage took their own control action.

At the field level, rodent management practice differed from farmer to farmer. This was reflected in the way they conducted their control action during the cropping season. Farmers, in fact, relied on their own experience to control rodents in their own fields. This experience was not the same for every farmer because the experience was accumulated from different crop damage scenarios such as different damage levels and damage history, which were site specific. The availability of labour, financial resources and farm size also influenced farmers' decisions in how rodents were controlled. These differences at the field level definitely have important implications to the adoption of CTBS.

When CTBS was introduced for first trials in some provinces in Vietnam, in places where severity of rodent-induced crop damage was high, grassroots agencies, especially communal People's Committee and local farmers responded actively to the trials of CTBS. With the technical support from local plant protection agencies, the trials were highly successful.

As a custom, farmers were expected to adopt CTBS following their trials, especially when there are rodent outbreak or when rodent infestation is high. However, because no outbreak had happened since those trials, there was no evidence about how the trial farmers responded to the adoption of CTBS. However, it was observed that any farmers who already trialed the CTBS (as strongly supported by the case in An Giang, as well as in Tien Giang, Soc Trang, Bac Lieu, Binh Thuan and Vinh Phuc), found CTBS more cost-effective than other individual control practices. For farmers who have large landholdings (more than 10ha), they indicated that they would apply CTBS using their own finance (in the case of high rodent abundance). Although this was good feedback from the potential users, individual use of CTBS is seldom found. This evidence suggests that in order for CTBS to be adopted at community level, local farmer-supported agencies and government need to take a more active role in mobilizing and encouraging trial and use of the CTBS.

- **Elements that could facilitate decision making on collective based adoption**

Adoption of a new technology is based on two main preconditions - the calculation of the benefits of new technology over current practices; and the nature of the associated problem that drives the interest in shifting to using the new technology (Rogers 2003).

For the case of rodent control in Vietnam, as the data show, the decision to take collective rodent control action on the part of local government is by and large governed by the magnitude of crop damage. Accurate assessment of rodent damage is very difficult at the

village, district, provincial, or national level because of patchy rodent damage (Singleton 2003). This leads to the situation where individual farmers prefer making their own decision when it comes to rodent management (as indicated in Chart 14 above).

At the moment, when farmers categorised pest infestation severity as medium or low (normally when damages are patchy), their response to collective action was low or absent. When this is the case, individual control was most preferred and individual farmers were responsible for their own control action. When this is the case, the response to the call for collective action is weak, especially when collective action was expected in the absence of funding. In some cases, even when subsidies were available, interest among target groups was low, and there was no response from them if monitoring and encouragement from local government is absent.

Local government and farmers usually referred to the pest severity level as *outbreak*, *high*, *medium* and *low*. This categorisation is a rough estimate and therefore does not indicate what the situation looks like and how rodent infestation is likely to develop. The lack of terms to describe the level of rodent infestation affects the government's appeal for a response from the whole farming community. Farmers would, therefore, be in a dilemma and do not know which types of control action – individual or collective, should they take to save their crops.

In the case of An Giang, at the beginning of the crop season, CTBS group members all found the CTBS useful and opportunity costs were not perceived as a hindrance to members' commitment to CTBS monitoring and maintenance. However, as the crop matured with fewer and fewer signs of rodent damage, members' interest would decline and group responsibility (despite agreed upon at the beginning of the crop) gravitated towards CTBS managers who has to manage the CTBS since it is located on his land. This situation indicates that as the need for control of rodents diminishes, commitment goes.

In summary, the above evidence suggests that farmers had different responses to rodent severity. In the event of rodent outbreak or high-level damage, collective action was taken. However, when rodent severity is low, interest in rodent control declines. Rogers (2003) described this situation as the *felt need* of the technological users. For the case of CTBS, it is important that the differences in the felt need among individual farmers should be minimised and the demand for using CTBS should be matched with the situation of the field. To achieve an agreement for voluntary collective rodent control, it appears that the difference in farmers' opinions, attitudes, and beliefs need to be minimised. A widely accepted early warning system

for rodent infestation may be needed to support the decision making for the whole farming community – at both individual and collective level.

5.3 Availability of subsidy and CTBS adoption likelihood (Research question no.2)

Both quantitative and qualitative data revealed that the costs of the CTBS materials are of great concern to farmers, especially small-landholders. For this project, it was found that after the trial stage, farmers are expected to bear the costs to use the CTBS themselves. Farmers had indicated that they would use CTBS at their own cost when rodents were abundant. However, this was not the case for most of the areas where CTBS was trialled in An Giang, and other part of the Mekong delta because rodent infestation does not seem to threaten farmers' crops since the introduction of the CTBS.

In Binh Thuan, there was one case where an agricultural cooperative used its own funds to cover the CTBS costs in two cropping seasons following an outbreak in 2001. However, when rodent abundance was low again, the use of CTBS was discontinued. In Bac Lieu, after the trials, up to fifty CTBS sites were set up in different districts from 2000 to 2002, and millions of VND were spent on CTBS and other rodent control methods using governmental funding (Palis *et al.* 2003a). However, there was no individual or group adoption of CTBS following these trials because of low rodent abundance.

To enable the adoption of CTBS, it is important that plans and mechanisms that promote use of CTBS be established. While small farmers expect partial financial support to set up CTBS, large landholders and better-off opinion leaders could be encouraged to pioneer CTBS adoption at their own cost to continue to confirm the effectiveness of the CTBS. To give an impetus for the adoption process, technical support from local technical agencies such as plant protection stations should be readily available. Also, forecasts by local plant protection stations in association with farmers from the potential CTBS halo effect should be undertaken to ensure both technical agency and local farmers share the same level of understanding with regards to rodent infestation level. If this could be achieved, trial and adoption on the part of farmers will become possible.

In short, although finance availability appears to promote the use of CTBS, especially for localities where CTBS is introduced for the first time, finance has many implications for sustainable adoption of the CTBS. Given the growing emphasis on the participatory approaches and local sense of ownership, financial planning to support CTBS adoption should be flexible

and each community needs devise their own extension plan for the CTBS, taking into consideration the participation of the potential users to reach a wide consensus. A fixed approach to financial contributions by participants would not be appropriate because cooperation among farmers, social norms and farm neighbour relations differ from field to field.

While availability of finance generally determines the use of the CTBS, this factor is related to the level of rodent pest infestation. For instance, when rodent infestation level is high (at the outbreak level), farmers are more likely to spend money in control action, and/or to take part in collective rodent management campaigns promoted by the government. When rodent infestation level is high, local government is also willing to allocate fund for rodent management. However, if rodent infestation is at a medium level, government may not release their fund, and farmers, in this case, are also expected to protect their crop at their own cost. If this scenario is left *as is*, the use of CTBS at the collective level would not be possible.

The role of local government and local plant protection department are very important when rodent infestation is at the medium or low level. One step to promote the participation of relevant stakeholders, especially farmers in the community, is to get all stakeholders to develop a joint plan of action with regards to collective rodent management. This plan of action needs to specify the roles, level of contribution, and participation of the relevant stakeholders, and the degree of contribution from each stakeholder need to commensurate with each level of rodent infestation. To achieve this, a reliable early warning system need to be jointly developed and agreed by all stakeholders before it is put into use to support the response scheme as opposed to each rodent infestation level. While the success of this undertaking depends on how well the local government and plant protection departments facilitate this participatory process, it is anticipated that without this joint exercise to achieve a community wide support and consensus, the promotion of CTBS will be challenging.

5.4 Knowledge, attitude and practices of farmers about non-chemical rodent control and CTBS adoption likelihood (Research question no.3)

Rogers (2003) places the knowledge stage ahead of any other stages in the innovation diffusion process. In the case of CTBS, farmers would not trial this technology if they had no idea of how a CTBS works to protect their rice production. Farmers' sound understanding of CTBS is very important to the long-term adoption of the CTBS. The level of success in providing new

knowledge to farmers depends on how farmers acquire it, how they compare the new knowledge with their existing one, and how they transform it into a new attitude and practice.

In this study, to assess the current general rodent management knowledge of farmers versus the best rodent control practices, ten questions were asked (see Appendix C for these questions). Responses to each question included three options – yes, no, and maybe. To obtain an aggregate score for each respondent, a correct answer was designated a score of 3 and an incorrect answer a 1. Respondents who did not know the correct answer may randomly choose “yes” or “no”, or they may be careful enough to choose “maybe”. To correctly assess the knowledge of farmers, response of “maybe” was assigned a score of 1 (which is used to assign an incorrect answer). Given this scoring scheme, the maximum score that a person could accumulate is 30 and the minimum is 10. The frequency of scoring was as follows:

Table 11 - Test scores on rodent management knowledge (by range)

Score range	Frequency	Percentage (n=223)
24-30	126	58%
20-23	73	33%
10-19	19	9%
	218	100%

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

The above frequency indicates that almost 60 percent of respondents could answer 75% of the test questions correct, suggesting that more than half of them had a good understanding of the general best rodent management practices. However, good knowledge did not automatically lead to adoption of good rodent management practices.

The evidence in An Giang and Binh Thuan showed that for groups that hold regular member meetings to review CTBS activities, their members had a better understanding of CTBS and developed stronger belief in CTBS as compared to groups that did not give meetings. In a similar way, it was found that farmers who directly trialled the CTBS had a greater confidence in the performance of CTBS than those who simply observed the technology on the field. Nevertheless, it is noted that knowledge of CTBS alone does not necessarily lead to adoption. In fact, it simply functions as a factor that moderates the relationship between adoption likelihood and crop damage severity.

From the case of An Giang, training on technical knowledge of CTBS is not necessary and sufficient to lead to farmers’ adoption of this technology. Farmers need understand more about

rodent habitats, rodent biology, and rodent population so that they can see how these factors affect the effectiveness of their current individual rodent control practice. They would need to also understand more about their rice landscape, which not only consists of their own field, but their farm neighbours' fields. If this knowledge could be appropriately provided, farmers would be able to verify and validate the new knowledge. This would mean there will be chance for them to change their attitude in favour of collective rodent management.

Vanclay (2004) reminded that economic benefits are not always the main forces that drive farmers to adopting a new technology. Therefore, the role of the local agricultural agencies at both district and provincial level is extremely important in facilitating the trial and adoption of the CTBS given their role in providing technical support. The continuous assessment of how farmers acquire new knowledge and their change in attitude helps ensure a higher likelihood for the adoption of the CTBS. As part of the effort in training farmers, follow-up technical support, ideally during and after each cropping season, is important to make sure new knowledge encourages farmers to try out, especially during the process when new experience about CTBS is formed to complement their indigenous knowledge.

5.5 Conclusion

Adoption of a new technology is a “socio-cultural process” in which individual farmers digest the information they have received in a deliberate manner, considering various factors (Vanclay 2004, p.214). During this process, farmers (as potential users) will also interact with other farmers until the new idea or concept becomes a norm of good farming practice (Philip & Gray 1995). For the CTBS, as this diffusion processes initiated, efforts need to be made to achieve a joint agreement among stakeholders about matters related to financial contributions which form part of the overall decision process that involve the adoption of CTBS. In addition, since the knowledge of the technology function as an enabler for changes in attitude and commitment to using CTBS at the collective level, it need to be properly provided to ensure least difference in knowledge and technology understanding among stakeholders. Whatever the situation it may be, both finance and knowledge appears as potential constraints to the adoption of CTBS technology. Indeed, both of them, as the above analysis indicates, moderate the relationship between adoption likelihood and rodent pest severity. Given their vital roles, both need to be appropriately addressed during the very first stage of stakeholders planning process so that these constraints could be jointly and effectively removed from the planned innovation diffusion process.

Chapter 6 – Existing Social Capital

This chapter attempts to answer the research question: *Is the existing level of social capital of farmers in An Giang adequate to support the adoption of the CTBS?*

This chapter is a discussion about the social capital of farmers in the Mekong Delta. Where possible, both qualitative and quantitative research will be combined to support interpretation.

There are a number of definitions for the concept of social capital. The lack of an agreed-upon definition may derive from difference in empirical foci of various dimensions of social capital on which the definitions are grounded. Despite this fact, social capital is commonly described as including trust (social trust), norms (of reciprocity), and networks (memberships) that facilitate collective action for mutual benefits.

The above dimensions of social capital are typically categorised in two forms. The structural form facilitates collective action for mutual benefits based on roles and social networks that already exist, enhanced by rules, procedures and precedents. The cognitive form, manifested by norms, values, attitudes, and belief, acts as factors that encourage people's participation in collective action for mutual benefits. These two forms of social capital complement each other. Structural social capital exists in the way people are connected through their networks to support a particular purpose. It is, therefore, externally observable and modifiable in one way or another. Cognitive social capital, however, is not easily visible, and is reflected in people's attitudes and actions and is difficult to change (Krishna & Uphoff 2002).

Social capital is an intangible construct (Uphoff 1999). Empirical referents, which are relevant to one culture, may become irrelevant in other cultures because of different manifestations of social capital in different cultures, resulting in considerable implications for the way social capital is measured (Krishna 2002). The difficulties in measuring social capital are furthered by the lack of consensus on how social capital should be measured (Fukuyama 2001).

A lot of effort has been made by researchers to develop methods that measure social capital at micro level. The Social Capital Assessment Tool - SOCAT, which was developed by the World Bank, is the one that has been intensively and extensively tested for years across countries, and is designed for assessment of the social capital at household-, community- and organisational-

level. There are also many other studies that have assessed social capital considering site-, culture-, and issue-specific perspectives using different methods - quantitative, qualitative or combined methods (see, for example, Falk & Kilpatrick 2000, Larsen *et al.* 2004, Lochner, Kawachi & Kennedy 1999, Narayan & Cassidy 2001, Onyx and Bullen 2000).

Social capital is manifested in people's relationships (Coleman 1988, Portes 1998). To possess social capital, a person must have connections with other people because it is the people he or she is connected to who are the source of their advantage (Portes 1998). It is not the purpose of this study to fully assess the social capital of the farmers. The aim is to make a preliminary assessment of the existing social capital among farmers in An Giang province so as to assess the constraints to and the likelihood of the adoption of the CTBS technology which requires collective efforts. To this end, assessment of social capital will be made by examining farmers' rice production at household level and group level so as to understand the relations that farmers maintain with other people in their community to support their rice farming.

Both quantitative and qualitative analyses are employed to answer this research question. Quantitative analysis will consider three domains: 1) farmers' social trust - indicated through farmers' daily communication and interpersonal relationships; 2) farmers' information networks that support their rice farming; and 3) norms of reciprocity and solidarity. The qualitative analysis will complement the quantitative analysis by examining farmers' perceptions of their community's social cohesion, their attitudes towards public activities, their support for other local people who encounter daily life difficulties, support they are likely to have from other people when they are in difficulties, and their farm neighbourhood relations. The following questions, which are based on the work by Krishna & Uphoff (1999), Grootaert & Bastelaer (2002), Grootaert, Narayan, Jones & Woolcock (2004), were used as guide questions in the qualitative study to understand social support that farmers could have in their own community.

1. In your opinion, is your community united compared to other communities around here?
Are there conflicts between people/families in the community?
2. If you need to work to construct, for example, a school, a road, etc., does everyone participate or only a few?
3. If someone poor in the village gets sick, does the community help with the cost of medicine, hospitalisation, etc.?

4. If a poor family needs help or support in repairing/building a house, or needs food during a flood, are there any families within the community who are willing to help? How are people in the neighbourhood involved?
5. Is irrigation well coordinated to ensure timely and equal irrigation? Are there any complaints over irrigation fees? If there are, how are these complaints solved? Who is involved in the solution process?

Discussion of these elements will take the following steps. First, the rice farming practices of individual farmers will be examined. This aims to assess the degree to which farmers can produce rice on their own without resorting to support from other people in the neighbourhood or their kin. In other words, this examination seeks to understand the extent to which the farmers are self-reliant in their rice production. Second, farmers' relationships with people outside of their households will be assessed to determine the collective life of farmers related to their rice farming. It is noted here that the understanding of the community life of farmers will further the understanding of the degree of self-reliance on the part of farmers in their rice cultivation.

Third, examination of the farm neighbour relationship dynamics at CTBS sites is undertaken to understand if social capital exists at farm neighbourhood (field level). Factors that are believed to facilitate the formation of and to sustain productive social capital will be examined. Then, the issues of changes in norms, trust and reciprocity at the field level will be discussed *vis-à-vis* those participating in mutual aids groups to see if there is any changes in social capital among farmers at the field level.

Fourth, mutual aid groups – a model of collective rice farming manifesting a form of social capital in the past, will be reviewed, based on both historical data and farmers' memory to further understand the current level of social capital. To determine if there has been a change in social capital, comparative historical analysis is conducted to examine the conditions that contribute to changes in social capital at two selected periods of times – the time when mutual aid groups were prevalent, and the present time. Comparison in this manner will assist in making causal and descriptive inferences (Mahoney & Dietrich 2003, Mahoney 2004). This comparative analysis is achieved by examining social, economic, cultural, and political factors that have historically influenced social capital among mutual aids groups. To further strengthen the arguments using this analysis, the concept of moral and political economy, which was studied for the case of Vietnam, was reviewed to account further for the transformation of social capital among the farmers in the Mekong.

Finally, factors such as change agents, local opinions, and farmers' informal networks will be discussed to see if these factors could be leveraged to improve the social capital to support the formation of institutional arrangements for the adoption of the CTBS. The following section will start the analysis and discussion with the examination of farmers' rice production at the household level.

6.1 Household level

6.1.1 Rodent control practices

Farmers reported that all rodent control taking place in their fields is based on their own experience and decisions. However, there are other sources of advice that they reportedly referred to for the purposes of rodent control. These sources were reported as having no influence on the farmers' decision on how and when rodent should be controlled ($\chi^2 = 12.125$, $df=2$, $p=0.002$).¹³ Rodent control practices using their own experience indicates that farmers are confident in the way they manage rodents in their own fields and that controlling rodents using current practices is acceptable to them.

6.1.2 Communication channels

Although farmers reported that they rely on television, farm neighbours and house neighbours (in descending order) for their general agricultural information updates, when it comes to daily agricultural update, they tends to consult their relatives, house neighbours and farm neighbour for advice (see sources of information marked the asterisks in Table 12 below).

As found in other studies, farmers in other provinces in the Mekong tend to rely on their own experience to make a decision related to use of an agricultural technique. Van Mele *et al.* (2001) found in their 1998 study in Can Tho, Dong Thap and Tien Giang provinces in the Mekong delta that 71% of farmer reported that they relied on their own experience when using pesticide to protect their mango crops. Extension staff and neighbours are also reported as sources of advice in their study, but are considered less important. In Can Tho (the capital city of Mekong delta), farmers were found to rely mainly on their own experience whereas in the smaller provinces of Dong Thap and Tien Giang, pesticide sellers were more often reported by farmers as advice providers. The fact that farmers use their own experience suggests that

¹³ p values are insignificant for other reported sources of advice (including farmers partners, extension staff, mass media, training knowledge, agri-input suppliers).

farmers have more and more access to the information they need to support their decision making in agricultural production. This also indicates that as farmers are more confident in their experience and self-learning, they prefer making individual decisions (for their own fields) to collective decision.

Table 12 - Sources of information that farmers tend to use for daily agricultural update

Sources of information	Chi-square value	p	Notes
Relatives	11.703	0.019*	
Friends	5.105	0.276	
House neighbour	10.764	0.029*	
Farm neighbour	10.853	0.028*	
Television	5.327	0.255	AF
National radio	16.750	0.002**	AF
Pamphlet	5.468	0.242	AF
Local newspaper	5.327	0.255	
Agroservice/cooperative	1.333	0.248	AF
Plant Protection stations	4.892	0.298	AF
Agricultural extension stations	16.190	0.003*	AF

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

Note: AF: Assumption Fails - when the number of cells (with counts of expected frequency less than 5) exceeds 20% of total cells in the contingency table (Francis & SPSS Australasia 2004). All variables above have four degrees of freedom.

*: significant at $p < 0.05$. **: significant at $p < 0.01$

6.1.3 Farmers' confidence:

It was expected that farmer's ability to make general decisions in their daily life would be highly and positively correlated with their experience, farm size, produce quantity, crop yield, age and formal education¹⁴. Quantitative analysis, however, shows that of these factors, only education was found to be associated with farmer's ability to make daily decisions albeit this relationship was relatively weak ($G=0.215$, $p=0.038$).¹⁵

The result suggests that there could be other factors that are more fundamental to farmers' ability to make daily decisions. More investigation will be made in the next section on farmers' social relations to see if there are any relationships existing between farmers' ability to make daily decisions and their social relations.

¹⁴ Before the test was done, data for these variables were recoded into groups to avoid skewed frequency distribution across the groups, and to ensure representative-ness for each group level.

¹⁵ $G=0.103$, $p=0.209$ for age, $G=0.053$, $p=0.555$ for experience, $G=0.003$, $p=0.972$ for rice area owned, $G=0.08$, $p>0.05$ for total production quantity, $G=0.058$, $p=0.622$ for yield level.

6.1.4 Labour availability

Quantitative data shows that most farmers hire local labourers to support their rice cultivation. Depending on farm size, hired labour may range from a few to tens of labourers. In the cases of large landholdings, farmers may hire up to a hundred labourers to support their farm work throughout a cropping season. There were no cases where farmers reported they exchange labour with other farmers. The availability of hired labour reflects the fact that there is a labour market and that many farmers are now no longer dependent on the traditional sources of labour (neighbours, kin, friends) as they were in the past. This reality suggests that farmers are now in a better economic position as compared to the past – they can afford hired labour to maintain their cultivation.

6.1.5 Production inputs and equipment

Most farmers reported they have the basic tools to support their rice cultivation. Motorcycles and boats are available in many households. Heavy works such as ploughing, threshing and produce transport can be contracted through local services. Reliance on manual workers for heavy work is remarkably reduced compared with the past.

6.1.6 Capital for agricultural inputs

Personal savings were primary source of capital that farmers used to finance their rice production. In addition to this, in-kind credit is another source of finance that most farmers in An Giang as well as in other part of the Mekong delta currently use. Agricultural inputs such as seeds, fertilizers, pesticides and the like are normally purchased using in-kind credit, which is available from most local shops. Payment does not need to be made in cash until harvest when farmers have cash from selling their produce. Interest rates charged for this credit-in-kind typically vary from 0 (for some products) to 10 percent per month¹⁶, and these rates of interest are acceptable to farmers.

Apart from the above two major sources of finance, borrowing money from family members is one way farmers may resort to for their rice production. However, borrowing like this is only occasional given that most agricultural inputs can be purchased on credit. It is also noted that in addition to the above sources, farmers reported they may be able to borrow money from banks, which are usually located in the district township. Although loan application protocols with

¹⁶ Interest rate charged to farmers by local suppliers varies from 0-10% per month (mean=2.3, mode=3, SD=1.184).

local banks are much easier, farmers seldom borrow money from bank for seasonal production unless multi-year investment is needed. There were no cases where farmers reported that they borrowed money from neighbours or relatives for their rice farming, which suggests that farmers are at the moment more financially stable in their rice farming than they were in the past. Indeed, the credit market is growing locally in the Mekong delta region, which makes financial services easily accessible to more farmers at the commune level. This releases farmers from reliance on traditional sources of support such as kinship, friends or house neighbours.

Summary

The examination of the above factors, which include farmers' current rodent practice, communication channels, farmers' confidence, labour market, production inputs and credit access suggests that farmers are more independent in their rice production when compared to the past. Apart from these factors, other supporting evidence that suggests farmers' increasing independence in terms of rice production is their improved household economic status (given that more farmers have more farm assets, motorcycles, boats, farm machineries, savings...to support their rice farming). The independence of farmers means that they are less and less dependent on their traditional support networks of kinship and neighbours, which they used to rely on during the time of mutual aid groups. In the next section, social relations that support farmers' farming and their other social activities will be examined at the group level.

6.2 Group level

6.2.1 Communication channels and its relations with farmers' ability to make daily decision

Half of the farmers in the study said that they are able to make decisions that affect their daily life activities (15.4% said they always, 36.2% said they almost always). For the remainder, 46.6% said they are sometime able to make decision, 1.4% said they hardly make, and 0.4% said they can never. Most of them also perceived their village as a highly united community. There is a strong and positive association between these two factors - the ability to make daily decisions and the perception of strong social cohesion, which suggests that the more cohesive the village is perceived, the more likely the farmers are able to make a daily life decision ($G=0.574$, $p<0.01$).

However, when it comes to daily decision making, farmers appear to rely on their personal networks. People in this personal network include farmers' relatives ($G=0.308$, $p=0.004$,

n=147), and their friends ($G=0.429$, $p=0.000$, $n=179$)¹⁷. One could think that farmers assess their social cohesion based on how they perceive their personal networks. However, quantitative data shows that there is no relation between these two factors¹⁸.

Despite farmers having daily contact with a wide range of people who help farmers update their agricultural knowledge - friends, house neighbours, and relatives (in descending order), when it comes to daily decision making, farmers tend to consult their relatives and friends in whom they may have more trust, and with whom they feel more comfortable to make a request.

The above pattern of farmers' channels of communication suggests that friends and relatives are important to supporting farmers' daily decision-making, not house neighbours and farm neighbours that farmers reported as their daily contacts for agricultural technological update or for other general purpose. In addition, it is noted that the face-to-face information channels on which farmers rely to update their daily agricultural knowledge, house neighbours and farm neighbours, seem to play a more important role than farmers' siblings do, which suggests that farmers' siblings are probably not living nearby. If this is the case, then it is clear that spatial relations (the proximity of residence) play an important role and accounts for the high frequency of farmer' face-to-face communication with their house and farm neighbours.

It is also noted that despite most respondents rating their village's social unity as high, there is no relation between this rate and the priority order in their personal communication channels¹⁹. Overall, it could be said that relatives and friends account for the ability of farmers to make daily life decisions, while house neighbours, farm neighbours, and relatives are responsible to farmers' daily agricultural updates. Siblings appear less important in these two aspects – daily decision-making and agricultural information update possibly because of spatial separation.

6.2.2 Sources of information that are related to farmers' rodent knowledge

To determine if farmers acquired rodent management experience from the channels they reported, their knowledge scores on good general rodent management practices are used to

¹⁷ $G=0.122$, $p=0.203$, $n=163$ (for house neighbour) & $G=-0.126$, $p=0.141$, $n=170$ (for farm neighbours). Friends are persons whose utility functions are positively interdependent. The well-being of one person is somehow valuable to his friend. This is to say one considers himself better off when his friends are "wealthier, happier, more secure, or more respected". (Uphoff 1999, p.222)

¹⁸ Partial correlation shows that the association between farmers' ability to make daily decision and the degree to which they assess the social cohesion of their village ($r_s=0.399$, $p<0.01$) becomes even higher when controlling for "relative" ($r_{relatives}=0.424$, $p<0.001$) and "friends" ($r_{friends}=0.428$, $p<0.001$).

¹⁹ Gamma values are very low and statistically insignificant ($G=0.062$, $p=0.561$ for relatives, $G=0.006$, $p=0.944$ for friends, $G=-0.193$, $p=0.056$ for house neighbours, and $G=0.065$, $p=0.486$ for farm neighbours). Other mass media and agricultural extension sources are not statistically significant.

check if a relationship exists between the level of farmers understanding of good rodent management and their priority ranking for the sources of information they use for daily agricultural update²⁰. The results reveal that farmers with high knowledge score tend to rely on friends as their main channel for information update, though the relationship is relatively weak. ($G=0.266$, $p<0.005$).

Television, which is reported as farmers' most preferred channel of information, does not appear to be more important than farmers' friends when it comes to information exchange on rodent management. Farmers reported that local plant protection stations and agricultural extension stations were those who provided them with knowledge on crop protection, plant diseases, but these providers do not appear to be related to their knowledge score for good rodent management practices.

Also, no relationships were found between the rodent management knowledge score and demographic factors such as farmers' years of schooling, farming experience, age, number of trainings attended last year, which suggests that farmers mainly rely on their hands-on experience as far as rodent management is concerned. The quantitative data show that 79.6% of farmers reported that they relied on their own experience to select appropriate rodent control methods that are suitable to their fields, which explains why individual rodent control is preferred to collective measures.

From the above analysis, it is clear that farmers rely on different groups of people in their personal networks for different purposes. In other words, they make choice in selecting the channel of information that suits their purpose. For example, relatives, friends, house neighbour, farm neighbours, siblings, TV, radio, plant protection stations, and agricultural extension stations were chosen for general agricultural knowledge, but friends tended to be contacted for rodent management knowledge update, and relatives and friends for daily decision making.

In all cases, as the data show, farmers' relatives (kinship based), farm/house neighbours (neighbourhood based), and friends (personal networks) are the most common sources of information that farmers in An Giang rely on. These channels of support appear to be more important to farmers than other locally available sources such as publications, radio,

²⁰ A correct answer is assigned a score of 1, incorrect answers to 0. Given this, farmers who answer all 10 questions correctly is assigned a score of 10. Farmers in the sample are grouped into three groups based on their score results (1-3, 4-6, and 7 to 10).

agricultural extension stations, plant protection stations, community leaders, local clubs, and television.

In summary, information related to rice technologies is important to farmers' production. Farmers indicated that they know how to select the appropriate information channels to update their rice cultivation knowledge as well as to support their daily life decision making. Farmers' preference of a particular channel indicates their trust and reliance on that channel. Their preference for certain information channels, depending on their purpose, indicated that they are not dependant on a single source of information. They can make their own judgment, at least in the information aspect.

6.2.3 Kinship

In the survey, farmers were asked if they have a farm neighbour as their relative. If there is any, how far is the relative's farm from their farm. As shown in the table below, farmers are not likely to have a farm neighbour as their kinsmen. Despite that kinsmen are more likely to occur in 100m and 500-1000 intervals, the small likelihood of a farmer having kin-farm within a distance of 200m (radius of a typical halo effect) affects the opportunity of encouraging adoption of CTBS based kinship.

Table 13 - Odds ratio (kin/non-kin)

Distance (in metres)	100	200	300	400	500	500- 1,000	>1,000- 5,000	>5,000- 10,000
Odds (<i>kin</i>)	0.452	0.077	0.037	0.043	0.004	0.476	0.244	0.011
Odds (<i>non-kin</i>)	2.212	12.947	26.895	23.091	264.000	2.099	4.096	87.333
Odds ratio (<i>kin/non-kin</i>)	0.204	0.006	0.001	0.002	0.000	0.227	0.060	0.000

Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

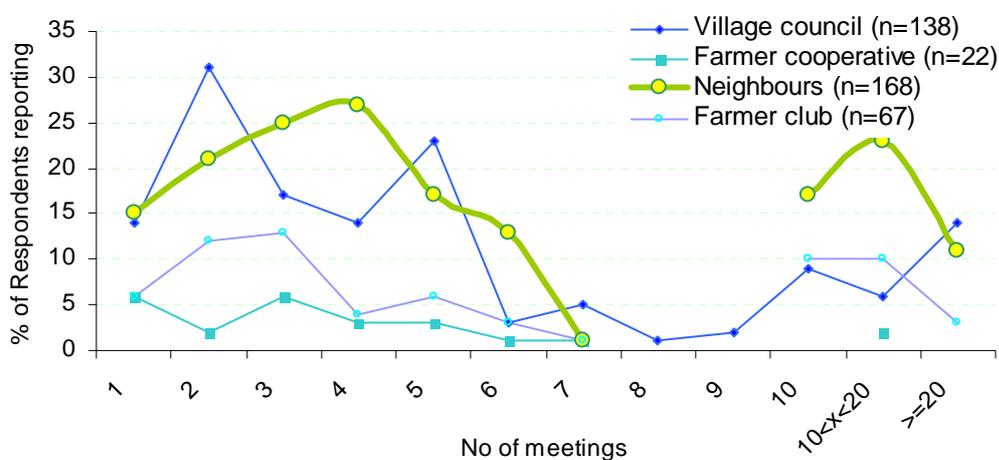
The above data indicate that the spatial separation of kinship (as a result of family separation following marriage or land heritage) reduces the role and the importance of kinship to a farmer's rice production at the present time. Kinship used to be part of a farmer's extended labour force that supports his rice cultivation. Today, with the growing geographic separation, migration, waged labour market, access to credit, a farmer's dependence on his kinship to support his farm work is no longer existent. Although kinship is important in other aspects of a farmer's social life - supporting their daily life activities (especially in difficult situations) and in family relationship, it is no longer important to farmers' rice cultivation (as a labour force).

6.2.4 Associational involvement/membership

When people interact within associational activities, social trust, norms of reciprocity and social networks are promoted. These are achieved through face to face interactions that help people develop trust with people beyond their usual acquaintances thanks to positive outcomes (Diez de Ulzurrun 2002).²¹

In An Giang, associational activities of farmers are reflected in their involvement in local social activities, including their participation as members in informal farmers' groups and governmental mass organisations such as Farmers' Association, Youth's Union, Women's Union, Farmers' Cooperative. Of the total of 223 respondents asked, only 14% claimed their membership with at least one of the above associations. In terms of the frequency of the participation in local meetings, respondents said they were more involved in local meetings that were organised at village or hamlet level, as indicated in the following chart for the frequency of meetings in the year of 2006.

Chart 16 - Associational Life via Local Meetings in 2006



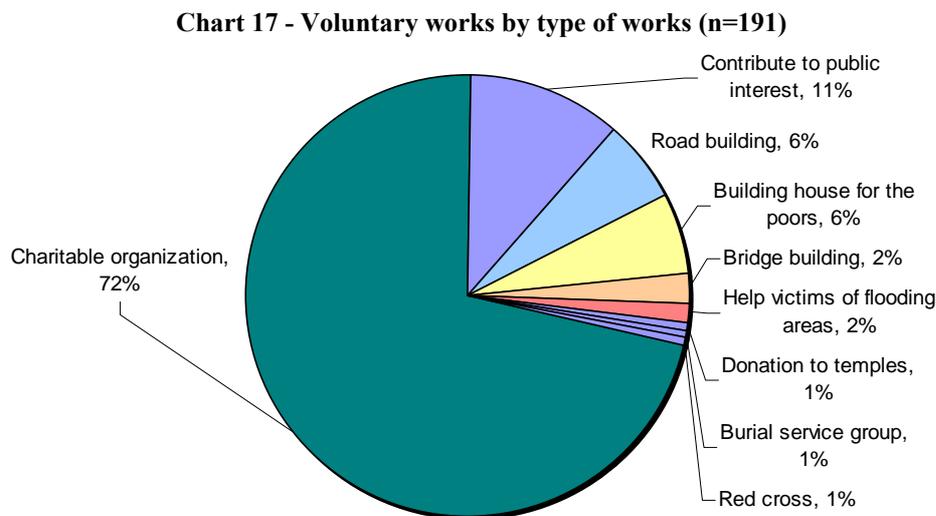
Source: ACIAR Rodent project in Vietnam, Baseline household survey 2006.

From the chart, it is apparent that farmers tend to participate in neighbour- and hamlet-level meetings more frequently than government meetings (Farmers' Cooperative). It is noted that none of respondents reported their involvement in meetings conducted by Farmers' Association

²¹ See also Fukuyama (2001) for his description of the concept of overlapping radii of trust, and Grootaert (1999) for the spillover effects of local social interactions on household welfare in Indonesia.

except some meetings with farmers' clubs which are typically managed by Farmers' Association.

In terms of voluntary works, when asked if farmers worked in their village or their neighborhood for the benefit of the community in the past year, 83% of them (n=174) reported they did. Interestingly, of these collective works, 72% reported they devoted their time and effort to charitable works. Public works, road construction, building house for the poor are also part of their volunteer works but only make up a small proportion (Chart 17 below).



Source: CSIRO-IRRI-PPD-WV ACIAR rodent project in Vietnam, Baseline household survey 2006.

The limited participation in government-organised meetings reflects the fact that farmers may not be invited to these meetings, or they did not find these meetings beneficial and did not participate. Meanwhile, it is noted that government meetings were not frequently given because of their limited resources (both finance and staff). Farmers' Association is a governmental mass organisation structured from commune to Central levels. Despite its large scale, the one at the commune level is typically staffed with only about five people who are expected to manage from hundreds to thousands of its members. Other large organisations, such as Women's associations and Youth' Union are also typically staffed at a similar level and are also expected to manage a large membership. Although these organisations occasionally provide training to their members, the organisation of such events depends heavily on fund allocation from governmental budget.

There were very small numbers of female farmers participating in this survey and there were no cases where these female farmers claimed their membership with local Women's Union. Mass

organisations such as Farmers' Associations, Women's Union, and Youth' Union are present throughout Vietnam and exist from the central to commune level²². While these organisations frequently contact part of their members, their support to their whole memberships depends significantly on governmental funding. Organisational membership like this "seems to be linked to a more participatory and informed political culture" (Diez de Ulzurrun 2002, p.497). However, as Lan *et al.* (2006, p.518) commented "These mass organizations claim large memberships throughout Vietnam, although their actual impact on household welfare remains open to question. Despite their mandate to represent and protect member interests, they are more often used as tools to disseminate and promote state policies".

Farmers' official membership of local organisations related to their farming is very limited. This situation is similar in other parts of the Mekong region given the same government system. Farmers' clubs, which are mainly based on farmers' interests, are also not common in An Giang. Some farmers' clubs were set up to support the activities of some governmental programmes. However, when these programmes close, unfolded activities could not be maintained as a result of funding shortage. It also appears that farmers do not have a strong demand for establishing specialised networks to support their agricultural activities.

6.2.5 Norms of reciprocity

Social norms are principles that guide individual behaviours based on shared beliefs about how individuals should behave in a particular situation (Fehr & Urs 2004). Social norms are typically *unconditional*. Even when they are conditional, they are not "future-oriented", and more importantly, they are shared by people whose approval or disapproval of them, to a certain extent, sustains them (Elster 1989, p.99).

The concept of norms is based on three dimensions - expectations, values, and behaviour (Axelrod 1986). Elster (1989, p.100) suggests that people are predisposed to adherence of norms because of their tendency to avoid the "feelings of embarrassment, anxiety, guilt, and shame" that they may suffer when going against norms. According to Coleman (1990), the need for a social norm arises in situations where the actions of individuals affect other people around them, or when "actions cause positive or negative side-effects for other people" (Fehr & Urs 2004, p.185).

²² The hierarchy (in bottom-up order) typically starts from commune, to district, province and central level. There is an unofficial level that usually exists under the commune level – hamlet level, which is usually referred to as "tổ" (group), led by a "tổ trưởng" (group head).

In An Giang, norms of reciprocity in labour exchange among households were very common before the 1990s. The norm was so strongly adhered to that seldom were there cases where a group member broke the rules because a breach would result in exclusion of them from their group which, in turn, impairs their own prestige and risk their own rice cultivation as a result of labour sanctions imposed by other group members.

Although the norms for mutual aid groups were strict, flexibility was allowed for alternative labour arrangement. For example, if one group member unexpectedly engaged in other business and could not help other members as arranged, notice could be made in advance so that replacement labour could be arranged. When occasion serve, labour or an equivalent form of support could be returned. It is noted that there was no strict requirement for an exact return of the number of hours working. However, farmers in the group were expected to provide a fair exchange of labour to ensure group sustainability.

Despite decades of existence, these norms are almost presently absent as a consequence of the growing disintegration of relations at the farm neighbourhood level due to changes related to improvement of the farming system, and some social, economic and political factors. The establishment of norms, the level of conformity to norms and the longevity of norms are governed by numerous factors that are context specific which Ostrom (2000, p.148) referred to as “contextual variables”. These contextual variables are different in each social setting, and while some encourage cooperation, others discourage it (Ostrom 2000).²³ These variables will be discussed at further length in the next chapter where the issue of institutional arrangements to support collective adoption of the CTBS are assessed and discussed.

6.2.6 Social Trust

Social trust plays an important role in developing a civic culture (Putnam 2000). It reduces transaction costs in economic activities (Torsvik 2000), and is considered as an indicator for social relations in a country and potentially affects the way social capital is formed in that country (Dalton *et al.* 2002). It is sometimes used as “the best or only single indicator” to measure social capital (Delhey & Newton 2003, p.94).

²³ Ostrom (2000, p.148) described proposed contextual factors that are extensively tested empirically. These are type of production and allocation function; the predictability of resource flows; the relative scarcity of the good; the size of the group involved; the heterogeneity of the group; the dependence of the group on the good; common understanding of the group; the size of the total collective benefit; the marginal contribution by one person to the collective good; the size of the temptation to free ride; the loss to co-operators when others do not cooperate; having a choice of participating or not; the presence of leadership; past experience and level of social capital; the authority to make binding rules; and a wide diversity of rules that are used to change the structure of the situation

Trust is defined as “confidence in the reliability of a person or system, regarding a given set of outcomes or events, where that confidence expresses a faith in the probity or love of another, or in the correctness of abstract principles” (Giddens 1990, p.34). Two broad approaches of trust exist. The first approach holds that trust as a property pertaining to individual characteristics - either as one’s personality or socio-demographic features (education, age...), whereas the second claims social trust as a property of social systems, not that of an individual (Delhey & Newton 2003).

Trust is an important asset that contributes to the generation of social capital. Whether it is formed from individuals (as an individual property) or from the interactions with others (as a result of experience of social interactions), it is important to understand how trust comes into being to induce the mutual benefits to an individual, and to the network or community to which that individual belongs.

Uslaner elaborated *trust* at the individual level as follows: “there are different types of trust. Putting faith in strangers is moralistic trust. Having confidence in people you know is strategic trust. The latter depends upon our experiences, the former does not” (Uslaner 2002, p.4). Generalised trust is grounded on moralistic trust. People learn about generalised trust from their parents. This type of trust is basically shaped earlier in their life. Particularised trust, on the contrary, is grounded on the concept of strategic trust. Uslaner (2002) observed that particularised trust is generated from social interactions between people who share a particular value during adulthood, when people interact with friends, or become a member of a social group. He stressed: “particularized trust is faith only in your own kind” and that “strangers are suspect and are presumed not to be trustworthy” (Uslaner 1999, p.6).²⁴ However, in terms of civic engagement, he noted that people with particularised trust also participate in civic life, but extending trust to groups that are different to them on a particular value is not likely, and this reality tended to create divergence among groups.

The concept of social capital is primarily concerned with trust from a collective perspective, which views trust as the value that members of a particular network maintain to enable them to achieve mutual benefits. Since the social capital in this study is examined from the view of that which facilitates collective action, social trust is therefore considered in this study as a product

²⁴ Generalized trust exists with those who believe that most people are trustworthy. They are predisposed towards participating in community works and generally optimistic about the future. For them, the exercising of reciprocity and the lack of trustworthiness in some people they know, do not matter to their participation in collective works. Particularised trusters, on the contrary, have faith only in their own kind. They are suspicious of people who are different from them and hold a narrow view of moral community. (Uslaner 2000, cf. Uslaner 2002).

that is collectively generated from the social development process in which farmers, local governments and other relevant stakeholders participate. To this end, in this study, trust will be examined through farmers' daily interactions and through historical events that may have certain influence on their social trust. The next section will discuss the issues of social trust based on farmers' daily interaction with their house neighbours, kinsmen, friends; farm neighbours; their communication network; their trust in local government; and their consensus building practices.

6.2.7 Trust among Farmers

House neighbours, kinship and friends

In the Confucian tradition, trust is fostered among family and friends while caution with strangers is taken (Dalton *et al.* 2002). In the Mekong delta, the concept of family is broad, including not only one's spouse and children, but also brothers, sisters, parents, grandparents and possible other close kin (uncles, aunts...). The concept of friends, however, typically refers to people with whom one has a special relationship. The "special" implies a high level of acquaintance and trust that a person holds with someone who is outside of his/her immediate family and is usually non-kin. In the case of the Mekong, when the survey was conducted, the concept of friend was found to refer also to house neighbours, to non-close kinsmen, and sometimes to partners with whom farmers have business relationships. Because the concept is not well defined, the interpretation of data related to this notion is made carefully.

Neighbours and friends, in addition to kinship, have played a very important role in farmers' lives since the time of the French colony (as discussed in Chapter 4). The neighbourhood constitutes a social norm that was commonly referred to as "*tình làng nghĩa xóm*" (neighbourhood sentiment), popular among poor farmers. The building of a neighbourhood is deeply rooted in farmers' culture in the Mekong delta and is passed down from generation to generation. "Children, who followed their parents to a neighbour's field to work in mutual aid groups, played and went to the same school, had developed their friendship and neighbour relationship that last till their adulthood" (Huan 2007, pers. comm., 22 December²⁵). This is because "children are socialized to societal norms and values, in large measure, through family interactions" (Hirschman & Loi 1996, p.229).

²⁵ Personal communication with Huan, NT who is a rural development practitioner and is also a resident from Tien Giang province of the Mekong delta.

House neighbour relationship is an indicator of social cohesiveness at the neighbourhood level. Generally, it was observed that neighbour relationships are very strong in An Giang. The neighbourhood is where farmers come to exchange information, and where young children can be sent to when adults go to the fields. Neighbourhood is important in the sense that apart from the spatial relations that affect daily interaction, neighbourhood is a source of support when relatives or friends are not readily available. The neighbourhood is also the place where farmers exchange farm information, have a chat, or share a simple meal made from food collected from their fields. More importantly, neighbours are those one can come to ask for emergency support. In cases where relationships with neighbours are good, money can also be borrowed for particular work.

When it comes to making daily decisions, kinsmen and networks of friends appear to play an important role²⁶. With the exception of cases where house neighbours are also siblings or relatives, sensitive matters such as money borrowing, disclosure or seeking consultation about specific family's issues is limited to within farmers' own networks. Mutual labour exchange among neighbours no longer exists despite some reported cases where mutual help is still maintained thanks to good neighbourhood relations. However, despite neighbourhood cohesiveness appearing to be the same when compared to the time when mutual aid groups were still active, there has been a decline in the level of openness, support, or reliance between house neighbours. As the farmers explained, with overall household economic improvement, the openness and comfort in communication has reduced. As one farmer explained, only three or four of the original ten farmers in the neighbourhood remain. However, as previously noted, farmers are very keen on doing charitable works. The degree of participation in charitable work varied between farmers; those with limited financial resources contributed with efforts and time while those who are better-off made in-kind or financial contributions. Donations of rice after harvest are more now common because motorboats are available in many communes and these means of transport could be used to collect rice donations during the harvest season. However, it is noted that farmers' donations, despite being aimed at people in need, are preferred to go to the people with kin relations, no matter how remote the relationship may be.

Farm neighbours

Farm neighbour relationships have experienced significant changes compared with house

²⁶ Though the composition of the friend network is not known, the frequent report of this channel indicates that farmers place a high trust on their friend network (which supports them in addition to their kinship network).

neighbour relationships. These changes are attributed to land related issues including selling and buying which has contributed to the increase in land concentration (gravitating to better-off peasants). Land concentration is a growing problem in the Mekong and this is the main reason for the disruption of traditional relationships of farmers at field level. From the analysis of operation of mutual aid groups, it is apparent that collective rice farming was originally based on kin, house neighbour or friend relationships. Although no implications are made about the negative affects of the land reforms on the agrarian structure as a consequence (though this is a common case in other countries in economic transition), land law is directly related to the abandonment of collective farming (among other changes). Relationships at the field level were hard to maintain when changes in land ownership took place. Increasing land concentration leads to increasing fragmentation of human relationship at field level and farmers who acquired land outside of their homeland are seen to be alien to local farmers. The situation where farmers are both house neighbour and farm neighbour are now rare. This calls into question the likelihood of success in building trust and cooperation among farm neighbours. The evidence about communication practice and mutual support at the farm neighbourhood level will be discussed in the next chapter to provide more clarity about social trust at the level of farm neighbourhood.

6.2.8 Trust in government

Historical evidence suggests that farmers trust in government had declined in the past. One clear example of this decline in trust is farmers' strong resistance to government collectivisation efforts when this initiative was introduced to the Southern Vietnam in 1976, a year after reunification of the country. The government's collectivisation effort tried to change the established farming practices in the Mekong, and limit farmers' entitlements to both land and production inputs. Resistance arose because the majority of farmers in the Mekong had already acquired land ownership prior to 1975 country liberation as a result of two land reform initiatives implemented by the government of South Vietnam. In addition, there was already a widespread adoption of modern rice technologies which resulted in higher crop yields. This productivity would be constrained if farmers were organised into agricultural cooperatives as part of the collectivisation effort, and which dissolved mutual aid groups. Also, a well-developed private enterprise economy existed and the government's strict control of the economy after taking over South Vietnam resulted in some food crises (Pingali & Vo-Tong Xuan 1995).

Historical records have shown that farmers in the Mekong resisted the governmental collectivisation effort so strongly that the progress of collectivisation was not measurable. By a decade later in 1986, only less than 6% of farmers belonged to agricultural cooperatives (Pingali & Vo-Tong Xuan 1995). Other distrust that farmers hold towards the government also stemmed from the changes in rights to land use that took place during mid-1990. Conflicts arose between farmers and states agencies that appropriated villagers' fields because government land regulation specified that the land belongs to all *the people* but is managed by the state. Conflicts mounted to the point where demonstrations and even hatred of farmers towards the government were publicly indicated (Kerkvliet 2006).

Although the above problem no longer exists, certain impressions remain in farmers' minds about the idea of collectivisation and land reform that affected their farming, especially among farmers who experienced these events. Recent changes in government policies have restored farmers' trust through the practice of grassroots democracy degree since 1998. This new government effort aims to create mechanisms through which citizens are able to participate in local development activities and to supervise some government activities related to local development programmes. Despite these efforts, corruption, bureaucracy and farmland planning and fluctuation of rice prices are still taking place, continuing to challenge the trust of farmers towards local governments (cf. UNDP 2006). As farmers in An Giang clearly stated, they believe only in leaders who are actively involved in solving their difficulties. Issues such as irrigation fees, irrigation water coordination, and the ability of local government to solve these problems to their satisfaction are still farmers' matters of concern. Uslander (2002, pp.7-8) argued that "trust in government reflects whether people have favorable impressions of the people in power and the institutions of the government, as well as whether they agree with the policies of the incumbent regime". If trust is not placed on local government, generation of social capital is still open to question.

6.2.9 Networks of communication

"Networks, which are patterns of social exchange and interaction that persist over time, are widely regarded as important manifestations of social capital, whether they are formal or informal" (Uphoff 1999, p.219). In the case of farmers in An Giang, farmers' network were examined through the channels through which their daily communication is implemented to support their need for information, whether it is for general purposes, for agricultural technology knowledge updates, for produce marketing, or for their associational life including their participation in formal and informal local networks.

Information channels

Farmers vary in their preferred information channels. Farmers who rank high on impersonal sources of information (television and radio) tend to rank low on personal sources of information such as relatives, friends, house neighbours, and farmers neighbours. Those who rank high on relatives and friends ($r_s = 0.355$, $p < 0.01$) rank low on farm neighbours and television. Those who rank high on friends tend to rank low on farm neighbours ($r_s = -0.220$, $p < 0.01$), television ($r_s = -0.437$, $p < 0.01$) and radio ($r_s = -0.620$, $p < 0.01$). Those who rank high on farm neighbours rank low on relatives ($r_s = -0.396$, $p < 0.01$) and friends ($r_s = -0.220$, $p < 0.01$) (See Appendix D for correlations between priority rankings by farmers of their information channels).

Closer examination reveals that relatives and friends are ranked higher than neighbours, local extension agency, radio and print publications (pamphlets, books, leaflets...). Also, farmers tend to rely on kinship and friends (traditional sources of information) for their decision making rather than on farm neighbours, house neighbours, governmental agricultural technical agencies (plant protection stations, agricultural extension stations), publications (newspaper, books, pamphlets, leaflets), and mass media (television and radio). It is also clear that farmers have little reliance on government channels such as local leaders, farmers' associations, and agricultural cooperatives for their general agricultural information updates whereas television emerges as a new favourite source of information among medium and better-off households, which outranks traditional sources of mass media such as newspaper and radio. Television also becomes more common as a reliable source of information than traditional interpersonal sources (kinship, neighbours) for medium- and high-income groups. The selection of information channel, as the analysis reveals, suggests that farmers can now select information sources that fit their own purposes.

6.2.10 Consensus building

When a collective action is needed, farmers reported that they required the facilitation from communal People's Committee or Farmers' Association. Farmers indicated that they found it hard, in general, to reach a consensus among themselves, especially for works related to agricultural activities. In the case of the CTBS, farmers who directly trialled the CTBS are not confident that they could successfully convince their farm neighbours to join them in the shared adoption of the CTBS. They also appeared reluctant to conduct negotiations with their farm neighbours to achieve a required agreement.

Farmers found that arriving at a consensus among them is very challenging, and that their fellow farmers do not typically have a strong and long-term commitment to an agreed set of actions. Reasons include farmers' different ideas and preferences for decision making over the issues that happen within their own field. In addition, other issues such as farm ownership, farm size, unsynchronised irrigation, disagreements over maintenance of irrigation channel and irrigation time, and negotiation for a path in fields to transport the product home was perceived as hindrances to the consensus building efforts.

At the field level, it is clear that farmers no longer depend on their traditional source of support (house neighbours, farm neighbours and even kinsmen) in their rice farming. The need to cooperate in rice farming seems now to be irrelevant for them, especially when the issues of financial contribution are involved. Farmers acknowledged that they are now more individual oriented in terms of rice farming than they were before, though they confirmed that the value of kinship and neighbourhood remain unchanged.

6.2.11 Social cohesion and factors that may influence its formation

Although it is not the aim of this study to assess the level of social capital in general, the relationship between farmers' perception about their social unity (as a proxy measure to social capital) and such factors as family size, age, education, experience, wealth, participation of local people in activities for mutual benefits, farmers' ability to make daily decision was assessed. The question "How would you rate the social unity of this village or neighbourhood?" give a 5-level ordinal response, including very bad (scored 1), bad (scored 2), normal (scored 3), good (scored 4), and very good (scored 5).

Ordinal regression was employed with the dependent variable being the ordinal response and independent variables being those mentioned above. The ordinal logistic regression result revealed that only one variable – "the ability of farmers to make daily life decisions", is statistically significant, explaining the three response levels of the dependent variable (scored 2, 3, and 4)²⁷ (see Appendix E for summary of statistical results). The significant independent

²⁷ Given the parsimony principle governing the building of the ordinal regression model, only variables similar to those used in Krishna and Uphoff (2002) were brought into the model to ensure better outcomes. (cf. Chen *et al.* 2004).

Continuous variables of age, education, farming experience, total cropping areas owned, and number of participation by farmers in community related activities were grouped before bringing into the model to decrease the number of cells with zero value as found in the trial models with ungrouped continuous data, which may affect the accuracy chi-square test for model fitting (Agresti 1990). The grouped variables were treated as continuous data.

variable holds a positive regression coefficient, indicating that farmers who rated higher levels of their ability to make daily decisions were likely to rate higher on the level of social unity.²⁸

Nevertheless, within the context of this study, the findings indicated that demographic and wealth characteristics of households do not explain the social cohesion level as perceived by farmers. The emerging finding from this analysis is the relationship between the ability of farmers to make daily life decision and farmers' perception of their social cohesion.

6.2.12 History

Putnam (1993), when analyzing social capital among three regions in Italy, argued that development in central and northern Italy was faster than southern Italy. This is because the former enjoyed a higher level of social capital, and that the economic development in the north and centre had a century-long endowment of social capital. History did matter to the formation of social capital in Putnam's argument. De Blasio & Nuzzo (2006), when assessing the relationship between current economic performance and current social capital using the regional data on social capital that Putnam collected for his 1993 works, also found similar finding. Krishna & Uphoff (2002, p.118), in their study with sixty-four villages in India, found that history influenced the formation of social capital but it is "not a strong determinant of social capital, because local factors produce substantial variations".

Krishna (2007) found that social capital changes over time. Nevertheless, it was noted that four factors were found to account for the growth of social capital in his study – 1) self-initiated organisations on the part of local people, 2) rules facilitating self-management of collective business devised by people themselves, 3) good local leaders available to assist people in setting-up the organisation and relevant rules, and 4) appropriate structure and local agency exist to facilitate this process. In the case of An Giang, comparative historical analysis reveals that the social capital, manifested by mutual aids group, was stable for decades regardless of the social, economic, and political ups and downs. The reasons why this form of social capital lasted for a long time was because mutual aid schemes were initiated by the farmers themselves. This form of self-help was also consolidated by the unwritten rules that are associated with trust, norms, and networks which were strongly supported by kinship, friend, and house neighbourhood relationships.

Complementary Log-log model was found to be the best model given the test of "parallel lines" assumption was satisfied. These results are therefore used for the interpretation.

²⁸ It is noted that this statistical result confirms previous findings about the relationship between social cohesion and the ability of farmers to make daily decision making, using gamma test.

Summary

Despite changes in farming support networks, and later in norms of collective farming, it is clear from this study that farmers maintain both generalised trust and particularised trust. While generalised trust helps them maintain their social responsibilities such as sharing with people who are less fortunate and are beyond their own networks (kinship, neighbours and friends), particularised trust is maintained to ensure the smooth operation of the mutual aid groups. Although mutual aid groups no longer exist, generalised trust remain unchanged within farmers' own networks without which, farmers would not be part of the family and community structure. Nevertheless, despite the persistence of particularised trust, there has been a decline of some dimensions of this kind of trust. However, the social cohesion - at the neighbourhood and village level - appears to remain unchanged (at least in the way farmers perceived). Generalised trust still exists between house neighbours despite the abandonment of mutual assistance rice farming, house building or repairing.²⁹ Farmers keep participating in neighbourhood meetings, especially for charitable works. It is encouraging to see that factors such as wealth, education, age, farming experience and household size do not influence the way social cohesion is perceived. It is good to see that the more decisive farmers could be in their daily life, the higher they perceived of their community's social cohesion, and the stronger their household economy is, the more active they become involved in activities that help people in difficulties.

The implementation of two land reforms before 1975, the adoption of land laws in the late 1980s and market liberalisation in the early 1990s have provided farmers with stability in production. In addition, crop productivity has improved given the improvement in agricultural systems, including irrigation, drainage systems, access to high-yielding varieties, crop intensification, and mechanisation. Along with these improvements, another change took place, in terms of rice production relations, which radically changed the way farmers support each other in rice farming. With improvements to rice farming, and the overall rural economic improvement, farmers became less inter-dependent. This situation was exacerbated by increasing land fragmentation, which disrupted kin group relations. Relationships at the field level which were traditionally nourished by the values of kinship and house neighbours have been diminished by the appearance of new farmers who are not local. The consequence of this process is the discontinuation of the decades-long relations among farmers in mutual aid groups. As a consequence, despite the existence of the above social values, today's farmers are

²⁹ Building of houses these days requires skilled labour while not every farmer is a good mason. The abandonment of this type of neighbourhood support does not necessarily means degraded neighbourhood relationships.

more self-interested and more rational. Farmers today prefer making own's decisions related to their own farming. Group-based farming becomes unnecessary and if attempted, this collective farming practice is difficult to achieve. Norms of reciprocity that existed in the past and sustained collective farming no longer exist. Despite the collective benefits that CTBS could offer, farmers were not confident that they could convince their farm neighbours to participate.

Dalton *et al.* (2002) examined the changes in social capital in Vietnam. They found that social modernisation has an impact on the social trust both within one's family and interpersonal social networks. This impact varies significantly between the Northern, Central and Southern regions in Vietnam, and among different groups of people. However, although social capital was found being changed as a result of social modernisation (basically in terms of priority given by individuals to their own social settings), the traditional values of family and community remain. It is worth noting here that although farmers' livelihoods have improved in general, and more farmers are more economically stable, there are others who remain poor or are even poorer due to economic shocks. The economic improvement at the household level does not affect social cohesion at the present time. However, this situation might be changed given the increasing wealth gap in the current face of open economy. An institution and collective efforts need to be made to maintain social cohesiveness as well as the well-being of the rural community as a whole.

6.3 Conclusion

The examination of factors that manifest the current stock of social capital in An Giang has been undertaken at both individual and group levels with a view to understand the current dilemmas of cooperation among farmers, especially cooperation among farm neighbours at the field level. Although it is very difficult to assess the dimensions of trust as compared to the assessment of the network and norms of reciprocity, some conclusions can be made as to whether the current stock of social capital is sufficient to facilitate the adoption of the CTBS that require collective action at the farm neighbourhood level.

From the above analysis, it is apparent that social capital at the field level is not adequate to support the adoption of the CTBS. Going back to the rice farming history of the farmers in the Mekong delta (as reviewed in Chapter 4), it is clear that farmers used to help each other in rice farming. There was, then, very good relationship among farm neighbours because this relationship is supported by the high need for mutual help the kin and friend relationship. Farmers of today do not have such a good relationship at the farm neighbourhood level (as the

data analysed above indicated). Increasing land fragmentation does not warrant the relationship building among farmers at the neighbourhood level. In addition, their current farming practice is very much different from that in the past. If they used to rely on their kin and friends for labour to support their rice cultivation, they do not need such a support at the present time, given that there are a growing wage labour market and increased access to credit and credit in kind (for agricultural inputs) which ensure the independent rice production.

With regard to social trust, there has been a decline in this regard, not only between farmers and their house neighbours, farm neighbours, but also between them and the local government. The lack of trust on government's capacity to facilitate consensus building for farming community appear to be a potential constraint to the pathway to adoption of the CTBS. Without the trust on government, farm neighbourhood relationship could not be improved, which means the adoption of the CTBS would be challenging if collective CTBS adoption is pursued.

The current stock of social capital at both farm neighbourhood level and community level was low at both structural form (networks) and cognitive form (trust, norms) as compared to that in the past when mutual aid groups were predominant. The solutions to restoring social capital locally will require a government response in developing a new participatory institution to restore social capital to support collective action. It is very likely that while a new and effective institution needs to be urgently devised, efforts to restore trust among stakeholders (governments and farmers) needs to be made at the same time. Uslaner (2000, p.590) reminded us "trust is a form of social capital, one of the building blocks of a civil society. But like any other form of capital, you have to make an initial investment to create new resources. And the various forms of social capital—trust, social networks, and civic engagement—are not interchangeable. Trust comes first...And when trust is in short supply, so will be commitment to others, cooperation, and compromise". Indeed, when the stock of social capital declines, it needs to be reactivated. If trust is as important as Uslaner (2000) argued, it is even more meaningful and vital to the diffusion of an innovation because lack of trust would discourage the adoption of an innovation. Because trust is reflected in actions, interventions need to be taken with deliberate consideration and care.

Chapter 7 – Local Capacity for Institutional Arrangements

This chapter addresses the research question - *Are local people able to develop institutional arrangements that support the adoption of the CTBS?*

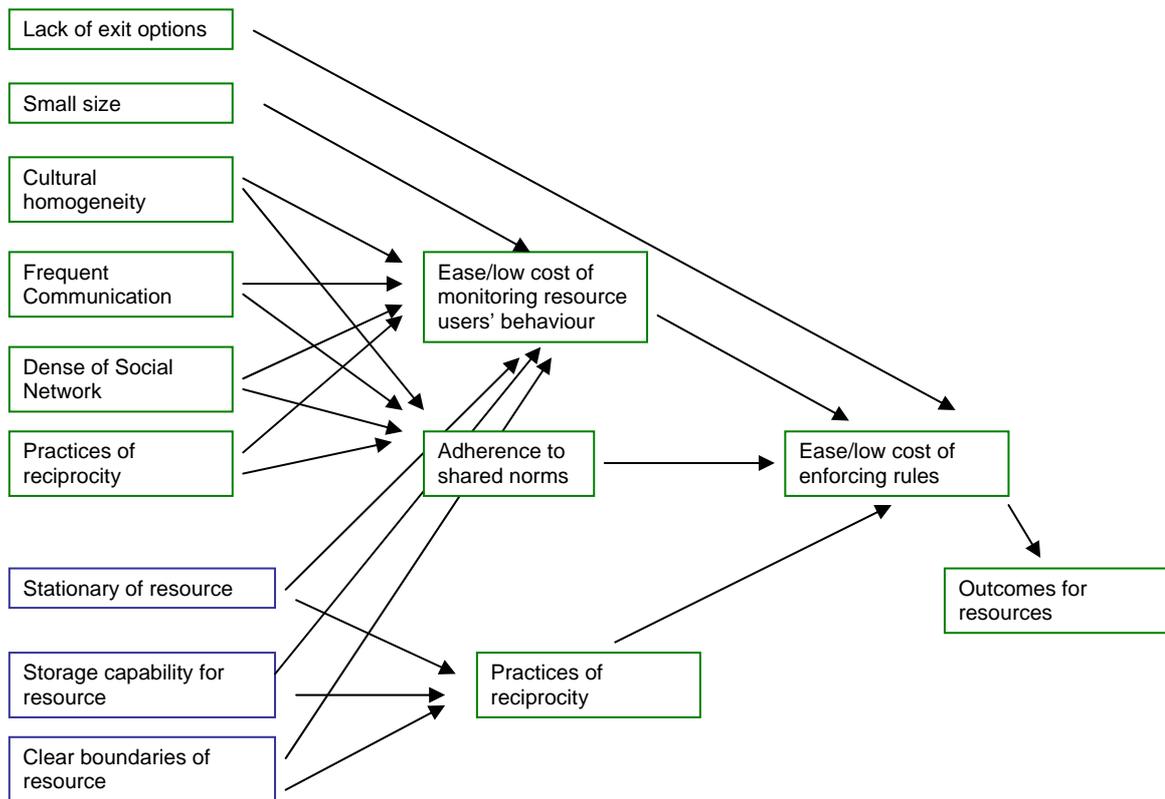
The CTBS requires participants to think and behave as though the CTBS is a ‘commons’ resource. Commons resources require institutional arrangements for effective management. Institutional arrangements are rules that "are potentially linguistic entities that refer to prescriptions commonly known and used by a set of participants to order repetitive, interdependent relationships" (Ostrom 1986, p.5). Individuals, governed by these rules, will be able to opt for particular actions as specified in a set of actions permitted considering their present incentives. These rules or conventions are changeable at will and by changing the rules, incentives and the way they relate to each other affects the way participants manage their resources (Tang, S.Y. 1991). The way institutional arrangements are established depends on various contextual factors. According to Edwards & Stein (1999, p.195), these contextual factors are “varied, complex and dynamic”.

In order for the CTBS to be adopted as a ‘de-facto’ common-pool resource, an institutional arrangement, based on the consensus of farmers and relevant stakeholders, needs to be made to ensure long-term adoption. Common Property Resource (CPR) theory has identified various factors (variables) that affect the successful management of a common-pool resource. Agrawal (2001) identified variables that affect the success of CPR institutional design based on his review of three important studies by Wade (1988), Ostrom (1990), and Baland & Platteau (1996) (cf. Chapter 2). In an attempt to advance this understanding of CPR from correlation to causation, Stern *et al.* (2002) grouped these variables in a schematic causal model that postulates the interactions between costs of monitoring/enforcement and groups of factors including resources characteristics, resource users’ characteristics, and outcomes of resource management institutions. According to Stern *et al.* (2002, p.449), this model is consistent with CPR related evidence available so far. Also, it allows assessment of importance ranking among the variables and helps researchers establish causal relations.

The variables that Stern *et al.* (2002) grouped under this model include: *users characteristics* which include lack of exit options, small size, cultural homogeneity, frequent communication, dense of social network such as kinship, neighbours, memberships, and practices of reciprocity;

and *resource characteristics* which include the stationary nature of resources, storage capacity and clear boundaries to the resource (see Figure 12 below). These two groups of variables, users' characteristics and resource characteristics, affect the resource management outcomes indirectly by influencing the costs of monitoring and enforcement.

Figure 12 - Schematic causal model postulating ways that cost of monitoring and enforcement mediate between characteristics of resources and resources users and outcomes of resource management institutions



Source: National Research Council (2002)

In this chapter, the above variables will be examined based on both the qualitative and quantitative data. The examination was done first to see if each variable appears as an advantage or disadvantage in the model suggested by Stern *et al.* (2002). Causal explanation based on this model will then be made to see how these variables affect the costs of monitoring and enforcement of the CTBS as common-pool resource, thereby affecting resource management outcome. The advantage of using this model, as Stern *et al.* (2002) pointed out, is that it helps identify possible ways to intervene to obtain the desired effects on management of the resource. This is how the research question has been approached.

7.1 Examination of variables that affect the outcome of CTBS management

Characteristics of users

- *Lack of exit options*

There are more than ten methods for rodent managements that are currently used by farmers in An Giang, and other provinces in the Mekong delta. These current methods have proven their effectiveness, and they are widely accepted by farmers across the Mekong delta. Given the availability of a wide range of rodent control methods, farmers can select methods that are most suited to their own farming and pest situations. In the face of this situation, it is apparent that there are always options for exit for the farmers.

When a new method for rodent control is introduced, if the new method does not out-perform existing ones in terms of the relative advantages, farmers are likely to continue with the methods which they are already familiar with. The CTBS method is new to the farming community in An Giang. To the farmers, CTBS is not the only method that can be used to control rodents. Therefore, if CTBS is not better than the existing methods, in the sense of relative advantage, it is hard to justify its use. When the CTBS were first trialled, it was perceived to be complicated. Because farmers have exit options, the CTBS currently can not outdo other currently used methods.

- *Small size*

When it comes to group formation, the smaller the group, the more likely consensus within the group can be achieved. For a property deemed as a common-pool resource, small size of user group eases and lowers the cost of monitoring resource users' behaviour (cf. Stern *et al.* 2002). In the case of CTBS method, each CTBS typically provides a protection halo of 15-20ha. This halo effect normally covers an area of ricefield owned by a group from ten to twenty households. If all of these households join a CTBS user group, this group size appears reasonable to the farmers despite their belief that small size is better.

- *Cultural homogeneity*

An Giang province is home to Kinh, Khmer and Chinese people. However, most of the farmers are Kinh and those who are Khmer usually farm in their own cultivation area. This cultural

issue is therefore not perceived as a constraint to the cooperation among farmers as opposed to factors discussed earlier. However, as farmers noted, groups comprising both local and non-local farmers would be difficult for users' meetings and the maintenance of the CTBS. This issue, thus, needs to be considered when a proposed area of halo effect is likely to have both local farmers and non-local farmers.

- *Frequent communication*

Generally, in places where land fragmentation is not extensive and farmers are local residents, communication is frequently maintained among farmers with adjacent fields (usually on a daily basis). In the fifteen CTBS trial sites included in this study, the CTBS managers were found to have their fields located adjacent to their relatives', siblings', house neighbours'. Because of this good relation, the communication among them was daily maintained³⁰. There were also a small proportion of CTBS managers whose fields are located next to non-local farmers' fields. For these cases, including cases where adjacent fields are owned by farmers who are not house neighbour but living in the same commune, communication is not maintained daily but weekly. Interestingly, it was found that when communication was maintained daily, help among farmers was more likely to occur³¹.

Despite this, help among farmers whose lands are adjacent to each other has become less common when compared to the past because the current practice is that farmers have to take care of their own field with almost no support from their house neighbours, farm neighbours, relatives, siblings or friends. Only 34 of the total 84 (32%) farmers whose land is adjacent to the CTBS managers' still maintained mutual help with the CTBS managers.

In brief, communication frequency as found from CTBS trial sites, as well as household survey indicates that most local farmers who live near their farms made daily field visits, while those living far way from their fields (out of the community) made fewer field visits (usually weekly). The difference in communication frequency (daily vs. weekly) among the farmers, especially those in the same CTBS protection halo has implications to the way farmers communicate, monitor, and maintain the activities of the CTBS. Because this problem can not be avoided at all times, it needs to be carefully addressed once a group is established to share a CTBS.

³⁰ Closer examination reveals that daily communication is the most common with house neighbours, followed by relatives and then siblings.

³¹ Chi-square = 12.533 with d.f.=1, p<0.001, n=79.

- *Density of social networks (kinship, neighbours, membership of local organisations)*

Quantitative data revealed that the social networks of the people in the study site are very limited. Membership of government agencies such as Farmers' Associations, Women's Union, and Farmers' Clubs are very small. In terms of kinship, the data indicate that the likelihood of farmers having kin within the size of the halo effect is almost absent. This makes consensus (relying on kinship) difficult to achieve. Also, despite good house neighbourhood, these neighbours do not always have their farms located close to each other.

- *Practices of reciprocity*

The practice of reciprocity, help in rice farming activities among households in the same farm neighbourhood, is very limited and even absent when compared with the past when mutual aid groups were common. The practice of reciprocity in rice farming is at the moment only found among a minority of farmers who attach great importance to relatives, friends, siblings, house neighbour and farm neighbour relations.

At the fifteen CTBS demonstration sites, only one-third of farmers whose farms are adjacent to the CTBS managers helped each other in daily farming. Help, however, is not intensive but confined to simple acts such as observing neighbouring farm to see if pests exist, or in sharing farming experience.

The practice of reciprocity has diminished since the introduction of agricultural mechanisation (see Chapters 4 & 6) which eliminated the need for labour exchange for heavy farm work. In addition, increasing availability of wage labour, increased use of high-yielding rice varieties and expanded irrigation systems had shortened rice cultivation times, making rice farming more pressing, and increasing labour requirements at peak times. Also, land concentration and fragmentation also contributed to abandonment of collective rice farming practices.

The way rice is cultivated has changed, and so have human relations at the farm neighbourhood level. This disturbance is added to by increasing independence on rice farming, thanks to the availability of services such as agricultural inputs, micro-credit. All of these factors had made cultivation of rice less dependent on human labour than before. The practice of reciprocity is now only maintained among friends, neighbours, or between large landholders and their frequent wage labourers. Data from CTBS trial sites indicate that of the total fifteen CTBS

managers, nine said the on-farm human relations are the same as before, while the remaining said this relation has undergone a considerable decline.

Characteristics of resource (CTBS)

- *Stationary status of the resource*

The stationary status of a resource contributes to the ease of common-pool resource management. CTBS, however, is not stationary as it is subjected to relocation to the field which best fits the halo effect. During the trial stage, it was found that farmers tended to prefer having the CTBS set up on their field. This preference came from farmers' individual interest to have CTBS on their field to, at least, protect their rice inside the CTBS closure. This preference suggests that farmers have not yet fully understood the function of CTBS, leaving room for individual interests to arise.

The location of the CTBS cannot be left in a fixed location for many cropping seasons. The reason arises from two issues – technical requirements (to achieve the best effect of the trap), and the interest of individual farmers (in having the trap on their own field). When promoting CTBS, it is important to realise this disadvantage so that effort could be made to ensure all farmers within a halo effect share the same understanding of how the CTBS works. Without this, personal interest and technical requirements may emerge and loss of interest in one individual is very likely to ignite disagreement among group members, which eventually leads to the abandonment of the trap. It is important to also note that there is a need for an external agent to regularly monitor the operation of the CTBS - primarily to facilitate consensus making and to nourish long-term commitment to cooperation among farmers in the same user group. Unless good understanding of the CTBS and trust are built among members in a user group, the lack of stationary nature of the CTBS cannot be overcome.

- *Storage capacity*

Like most resources, the CTBS cannot be exploited indefinitely because the materials such as plastic, steel trap, bamboo stakes are degradable. Although materials required for a CTBS typically can stand for two cropping seasons, all CTBS components need to be regularly checked and maintained. Any components of the trap that do not function properly should be immediately replaced to keep the whole system working at all times. If maintenance fails, longevity of the whole CTBS is compromised.

The possibility of a CTBS malfunctioning is very likely if good monitoring of the resource is not carried out or maintenance is not promptly conducted. Although CTBS managers who visit the field daily could check the defects (such as broken mounds, collapse of fence, loosening of wires, and even loss of the trap), the repair needs to be made immediately with the support from group users. In case where replacement of any CTBS components is needed, spare parts and labour should be available timely to avoid abandonment of the trap. Spare parts that can be locally made need to be available at all times. Financial resources to procure the additional material also need to be available to enable prompt maintenance of the trap system.

- *Clear boundaries of the resource*

The CTBS typically provides a halo of protection to the surrounding fields within a radius of 200m (calculated from the trap system). This halo effect, however, may vary between dry and wet season (Singleton *et al.* 1999). Because of this, it is difficult to define a clear-cut radius for a halo effect. Morin *et al.* (2002) noticed that lack of a definition of an effective halo could result in free-riding problems, which leads to loss of interest on the part of the group users. This disadvantage needs to be foreseen, and training and mobilisation need to address this issue.

7.2 Causal explanation

Having examined each of the above variables, explaining the causal effect using the model of Stern *et al.* (2002), it becomes clear that when treating the CTBS as a common-pool resource, the resource characteristics, including the lack of the stationary nature of the resource, storage capacity, and clear boundaries of resource do not support the easy monitoring of the resource users' behaviour and the practices of reciprocity. This disadvantage, in turn, does not contribute to easy enforcement of rules for the management of the CTBS.

Using the above model, it is clear that only two (*small size & cultural homogeneity*) out of the total six users' characteristics theoretically support the *ease/low costs of monitoring and enforcement* of the CTBS. These two characteristics are also the only ones of the potential four users' characteristics that support the *adherence to shared norms* (which in turn supports the *ease of monitoring resource users' behaviour*). It is clear from this study that *frequent communication* is only maintained among house neighbours, relatives, and siblings, and this reality poses challenges to the interactions in which farm neighbours are non-local. The *density of social networks* is also low (Chapter 6), resulting in reduced mutual support among neighbouring farmers at the field level.

In addition, the *practice of reciprocity* is almost absent. In brief, three factors, namely, *frequent communication*, *density of social networks* and *practice of reciprocity*, do not favour the *ease of resource monitoring* and *adherence to shared norms*, which, in aggregate, affects the *ease and cost of enforcing rules*. What is more, it is clear from this research that farmers use a range of methods to control rodents, providing farmers with *exit options*. All of the above disadvantages, examined from the CPR perspective, indicate that the CTBS (as a common pool resource) is challenging for farmers to manage.

The lack of favourable conditions that facilitate management of the CTBS (as discussed above) suggests that an institutional arrangements need to be made to overcome these disadvantages. Institutional arrangements cannot have any influence on the resource characteristics but could exert a desired impact on users' characteristics through the improvement of communication, networking, training, if a well designed intervention strategy is in place.

The above model is helpful for practitioners to identify possible interventions. However, it is "partly speculative and incomplete" (Stern *et al.* 2002, p.449). As the model indicates, variables on the left of the model do not contribute directly to the outcomes of resource management. In fact, it is the *ease/low cost of monitoring resource users' behaviour*, *adherence to shared norms* and *practices of reciprocity* that directly affect the common management outcome. These factors, therefore, need to be taken into consideration when devising institutional design since these features are "more amenable to institutional solutions" (Stern *et al.* 2002, p.451). According to Stern *et al.* (2002), the possible propositions and variables, as identified through the literature, can be arranged into four broad functional categories, and placed in a conceptual framework that are more representative because of their possible theoretical relationships, as shown in the four groups below (See also Figure 13 below):

Interventions (independent variables)

Institutional arrangements regarding resource base (e.g., property rights regime for resource, simplicity of rules, graduated sanctions, accountability of monitors, coordination with institutions at other scales or in other regions)

Other institutional arrangements (e.g., development, tax, investment policy, political representation rules)

Technology choices (e.g. decision to adopt new monitoring technology)

Contingencies (moderator variables)

Resource system characteristics (e.g., size, boundaries, mobility of resource, storage, predictability)

User characteristics (e.g., size, boundaries, social capital, leadership, heterogeneities, prevalence of honesty, interdependence, poverty).

Relationship between characteristics of resources and users

Institutional forms at other scales and in other regions (e.g., state support for local rules, nesting of institutions, international regimes)

Available technology (e.g., cost of technology for exclusion, monitoring)

Integration of resources base into global markets

Mediators (intervening variables)

Adherence of users to shared norms

Ease/cost of monitoring users' behaviour

Ease/cost of monitoring state of resource

Ease/cost of enforcing rules

Users' understanding of rules and sanctions

Outcomes (dependent variables)

Sustenance of the resources system (sustainability)

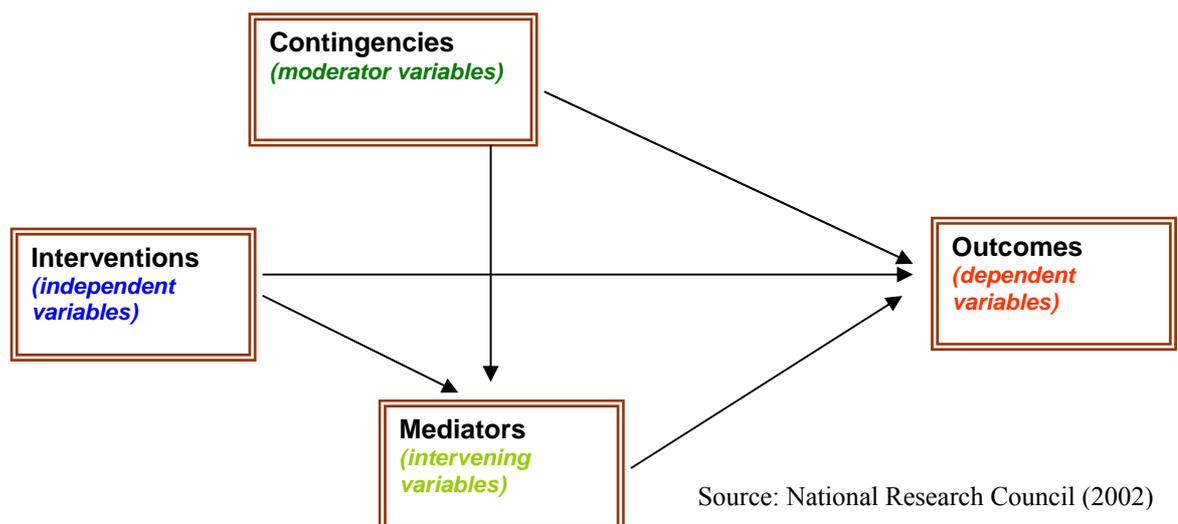
Durability of resource management institutions

Economic output of the resource system (e.g., productivity, efficiency)

Distribution of the economic output (equity)

Democratic control

Figure 13 - Schematic causal model showing typical relationship among variable types



Grouping in this manner, the *ease/low cost of monitoring resource users' behaviour, adherence to shared norms, and practices of reciprocity* (intervening variables) that directly affect the

common management outcome become central factors that mediate efforts towards achieving a successful management of the common whereas the resource system characteristics and users characteristics functions in a moderating role (moderator variables) that affects directly the outcomes and indirectly via intervening variables.

The most noteworthy in this generalised framework is the important role that interventions (independent variables, mainly from potential stakeholders of the common) play in contributing to success of the management of the commons. Stern *et al.* (2002) argued that this framework suggested that outcomes of resource management depend on various policy variables, not simply only on the way the resource management is devised. This indicates how important policy interventions or institutional arrangements are in the pathway to achieving a desired outcome for the management of the common.

The development of an institutional arrangement through which successful management of the commons could be achieved is important to ensure long-term adoption of the CTBS. Given that farmers are more independent in rice farming and less favourable to collective actions, it is important that collective-based farming activities such as CTBS be promoted to restore the sense of community and enhance the existing stock of social capital. If collective action can be regularly maintained with high participation, the cooperation among farmers could be improved, as Uslaner (2002, p.27) reminds us “collective events have the potential to redefine our sense of community in the way that individual experiences don’t”.

7.3 Conclusion

When examining CTBS technology under the Common-Pool Resources framework, it become clear that the characteristics of CTBS do not support the practices of reciprocity and the ease and low cost of enforcing rules, which would unfavourably affect the management outcome of the CTBS. Although CTBS characteristics cannot be changed, CTBS user’s characteristics could be modified to achieve a desired CTBS management outcome. To achieve this, proper interventions need to be carefully designed and consistently implemented. Under this study, a number of users’ characteristics appear noteworthy. These include equality, practice of reciprocity, leadership, social capital, frequent communication, membership, honesty and interdependence. This list of factors is not exhaustive for the case of CTBS; nevertheless, they are the issues that farmers were concerned about.

Within the scope of this study, the first three factors - equality, practice of reciprocity, and leadership need to be addressed as key principles that facilitate the pathway to adoption of the CTBS. These three factors are vital for a number of reasons. First, ensuring equality of benefits among CTBS users could assure long-term adoption of the CTBS. Commenting on this issue, Paul *et al.* (2002) said this factor is, in fact, an allocation rule that can boost users' willingness to comply with the rules that were devised for the management of the commons. Indeed, if the CTBS benefits are equally shared among members, group cooperation is more likely to continue. If equality is not assured, members are very likely to go back to using their current practice.

Second, in relation to equality, the practice of reciprocity can affect the existence of equality. The practice of reciprocity, in the case of CTBS, is embedded in the corporate responsibility that every member of the user group is expected to assume. Members' responsibilities can include financial contributions, joint monitoring/maintenance of the trap system, and attendance at group meetings and trainings. Failure to fully adhere to this informal group norm may result in abandonment of commitment. As the evidence during the trials indicated, when members of users group did not adhere to reciprocity –failing to regularly monitor and maintain the CTBS while others continue their commitment, individual interest quickly declined. Experience of cooperative behaviour is very important to farmers' consideration of their cooperation for new collective action. As such, the promotion of CTBS deserves special attention to this issue.

Third, leadership is very important. Any users' group needs a group leader to coordinate group activities and monitor the enforcement of rules. Group leaders also act as contact points through which external interventions (from local government or technical agency) can be made. Evidence from An Giang showed that if a group leader did not have strong leadership as well as good interpersonal skills, external interventions were needed to rectify group problems. It is also noted that in areas where farm neighbours are both local and non-local, daily interactions were not frequent and experience sharing was rare. This certainly leaves no room for neighbour relations and leadership to develop. Indeed, farmers lack skills to work in groups and to facilitate to achieve consensus among them. This shortcoming could be overcome if local governments and technical agencies participate as moderators to help farmers improve their skills, thereby their social capital, particularly at the farm level. In addition, when local governments do this, they would build trust from farmers.

In brief, CTBS is a collective-based method. It requires considerable commitment and contribution. If appropriate institutional arrangements to address the technology characteristics do not exist, the adoption of the CTBS would become challenging to the farmers. In concluding this chapter, it is argued that unless the practice of reciprocity, in any form, becomes a norm among farmers again, cooperation necessary for the adoption of the CTBS would be hard to achieve. As a common-pool resource, the conditions under which CTBS become the most attractive to farmers need to be further examined. Specifically, conditional factors need to be operationalised to support farmers as well as other local stakeholders in their decision-making.

The adoption of CTBS would undergo a long social process through which several factors need to be considered to obtain a desired outcome. The interaction of these factors will be addressed in an integrative manner in the next concluding chapter.

Chapter 8 – Conclusion

This study aims to understand the farmers' socio-economic constraints to adoption of the CTBS, using the diffusion of innovation theory as the theoretical framework. Five research questions were raised when this framework was examined, necessitating the employment of two additional theories – social capital and common pool resources, to acquire a more thorough understanding of the technological constraints that the farmers faced when they trialled the CTBS. Both qualitative and quantitative methods were used to answer the research questions (as detailed in the preceding chapters). In this concluding chapter, the main constraints associated with the use of CTBS found by this study are summarised. Potential answers to the five research questions are identified, and assessment of the potential for the adoption of the CTBS done. General limitations with regards to the research methods and other relevant factors inherent in this study will be discussed, along with presentation of some policy implications and considerations for future research and extension of collective based agricultural technology in the Mekong delta of Vietnam.

8.1 Main constraints to the adoption of the CTBS and summary of answers to the research questions

This study, including previous ones conducted in other parts of the Mekong delta, and in some provinces in Central and Northern Vietnam, shows that the CTBS is a cost-effective and environmentally friendly rodent control method for rice based farming systems. Despite these advantages, the CTBS faces challenges in upscaling to community-wide use given the absence of farmers' consensus over the joint adoption. It is widely recognised that consensus in sharing the cost and responsibility among farmers, especially among farm neighbours, is vital to adoption upscaling because through shared use, farmers of small landholdings would overcome the financial constraints which they typically face when applying a new technology on their own. Although financial difficulties are not the case for farm operators of large landholdings, it is the case for the small landholders, who make up the majority of the farming population in An Giang and the Mekong delta. Constraints to adoption of CTBS were found primarily at the persuasion stage of the innovation diffusion process when farmers have to assess the applicability of the new technology based on their experience, trials, and perception.

From this study, these constraints could be categorised into two broad domains - direct and indirect constraints. Direct constraints, which typically include high initial establishment costs, labour mobilisation, labour intensity, difficulties in monitoring, maintenance of the trap system, preparation of lure rice, crop synchronisation and so on, could be easily observed. They are reasonably easy to identify and resolve with some short-term arrangements. Indirect constraints, including reluctance of farmers to cooperate, lack of support from and capacity of local government to help farmers achieve consensus and commitment to technology adoption, are not immediately obvious. These latent factors have some complex and long-term implications to the adoption of CTBS technology, in particular, and collective based agricultural technology, in general. In this study, examination of these difficult-to-observe obstacles was found embedded in the existing social and farming system. These obstacles need to be thoroughly investigated before removal of them from the innovation diffusion process could be realised. Findings from the study indicate that solving the problems appears to require a considerable length of time, commitment and strategic interventions. The major latent constraint to the adoption of the CTBS is the lack of local capacity to establish necessary institutional arrangements for successful management of the CTBS and of the use of their current stock of social capital to address the collective actions.

As examined in chapter seven, the CTBS, as a common resource, lends itself to the limitations that are inherent in resource characteristics and user' characteristics, which are typically associated with any resources recognised as common property. These shortcomings would unfavourably affect the ease and low cost of monitoring CTBS users' behaviours, adherence to shared norms, and practices of reciprocity, which, in turn reduce the ease and low cost of enforcing the management rules over the shared use of the CTBS. Therefore, CTBS is very likely to be subjected to free-riding. To enhance success likelihood for the sustainable adoption of the CTBS, from the perspective of the common-pool resource theory, both resource and user characteristics should be in favour to the ease and low cost of enforcing the management rules over the use of the CTBS. Because of technical requirements, it is impossible to change CTBS characteristics. Nevertheless, users characteristics (rice farmers in this case) can be modified to achieve the desired outcome in the management of the CTBS. To improve users' characteristics, rice farmers need to have an abundant stock of social capital (so does local government) to facilitate collective action, especially among farm neighbours. The current stock of social capital among farm neighbours, however, is insufficient to produce necessary collective actions. This unfavourable condition, plus availability of numerous rodent management methods (as exit options), all decreased farmers' felt need for trialling and adopting the CTBS method. Even supposing exit options are not a constraint, the lack of stock

of social capital necessary to achieve community-wide consensus for CTBS adoption remains a considerable constraint. In other words, the shared norms (of reciprocity), social trust, and networks among farmers, which are essential to enable collective action in favour of the CTBS, do not exist.

Analyses from previous chapters have shown that there has been some decline in values of the above underlying factors (shared norm, social trust, and networks). Rice production is easier for farmers today. They are no longer dependent on their traditional sources of support, which came from their farm, house neighbours, or their kinsmen, and have a wide variety of services that are available locally to support their rice production. Historical evidence indicated that the abandonment of labour exchange practice originated from a series of changes related to government efforts in agricultural systems improvement such as irrigation improvement, use of improved variety, increased mechanisation. With the implementation of new land laws, land concentration emerged as a problem, affecting the relationships of farmers in the field. With expanded rice production, need for wage labour increased but resulted in increased labour shortages. These changes, at the macro level, were furthered by rural economic development, which improved farmers' living standards, their access to information and technology, access to agricultural services (micro-credit, credit-in-kind). The improvement in rice production services, however, resulted in increasing independence for the rice farmers. All these socio-economic changes had put an end to the decade-long tradition of collective farming.

Closer examination of the current stock of social capital of the farmers, especially at the farm level, revealed that the current rice farming network and reciprocity in daily rural life has been dramatically changed. For instance, although house neighbour relations appear unchanged, mutual help grounded on these neighbour relations is no longer undertaken by farmers. A similar observation can be made about social relations at farm neighbourhood level, which is a direct consequence of land fragmentation (selling) and concentration (acquiring). At the community level, despite a general perception of highly cohesive or well-connected community, farmers' traditionally strong social networks (including house, farm neighbours and kinship) are no longer pivotal to their rice farming. Kinship, a traditionally strong and important farm support network, has declined in its role, also because of increasing land fragmentation, which geographically displaces kin groups. Although consensus is still believed to be possible through kin groups, this no longer holds true in most cases. Given this situation, consensus building to facilitate CTBS adoption, based on kinship networks, is therefore a challenge. In addition, given the increased land fragmentation, personal relations among farmers at the field level is no longer the same as it used to be. An increasing and commonly

found phenomenon is that current farm neighbours are not house neighbours or kinsmen – something that was common before 1975. Human relationships at the farm level are less cohesive as a result of a social change. This would ultimately influence the adoption of the CTBS.

With regards to the relationship between local people and government, indicated by the level of trust that farmers have in local government, the level of trust has declined, which indirectly leads to reduced stock of social capital in the Mekong as a whole. This situation is a consequence of events that happened in the past but appropriate attention to maintaining social capital had not been given on the part of the local governments. Collectivisation campaigns in the Mekong following the unification in 1975, for instance, are typical examples of conflicts between local governments and farmers over farmers' land and farm equipment ownership. Despite recent efforts by government to increase trust of farmers through implementing democratic practices, dialogue between local government and farmers still faces impediments over a number of rural issues, rendering consensus building difficult³².

In addition to the above constraints pertaining to common-pool resources and social capital, knowledge about CTBS was found to be very important to developing farmers' beliefs about, and reliance on the new technology. This knowledge need to be provided and updated regularly. In addition to knowledge maturity, the knowledge that farmers already acquired needs to be strengthened through practical experience, observation, and exchanges between farmers who trial it. Knowledge only induces a decision when users see how the new technology works and how the broader community responds to it. Regular discussion of technological trials will help reinforce farmers' individual and collective knowledge. When knowledge is owned collectively, there will be more interaction and more peer pressure among farmers, which induces a need for collective adoption of the new knowledge. While knowledge is found an important factor that contributes to the adoption of CTBS, it was not found to be a single factor that leads to adoption of the CTBS.

³² In addition to the above explanation about decline in social capital, this phenomenon could be explained from both moral and political economy perspective. Although these two economic schools are quite confronting in terms of explaining farmers' behaviour in cooperation in rice farming, it appears from this study that farmers are both economic maximisers and committed to collective benefits. From this study, there were no strong evidence found to explain a prevailing economic behaviour of farmers – whether they are for their own benefits or for collective benefits. However, if there are collective goods, they are more oriented to farmers' kinship and house neighbours than any other relationships. However, it is also important to acknowledge that farmers in An Giang, despite the social changes, still adhere to the traditional value of neighbourhood, kinship and collective based activities such as charitable activities, indicative of a moral economy. This well balanced behaviour seems to continue to make moral economy and political economy confronting in explaining the life of farmers in the Mekong delta.

In this study, finance was also found to be a factor that constrains the adoption of the CTBS, especially for small landholders. However, it is not possible to say how much money the farmers would need to contribute to gain the benefits from a shared use of CTBS given their varied demand for the CTBS from the individual point of view. A sustainable use of CTBS requires farmers to achieve a consensus that is based on the need of group or community. This consensus needs to be made based on reliable rodent pest forecasts so as to reduce differences in knowledge, attitude and practices of individual farmers so as to support community wide agreement.

In summary, the constraints to the adoption of the CTBS are latent within the social structure. Resolving them is not a simple task. Relevant stakeholders, including farmers, local governments, external change agents, networks of informal farmers' groups, and local opinion leaders, need to play an active role in moderating the likelihood of the adoption of the CTBS. For this case study, the external change agents in the form of the plant protection departments, extension agencies and local governments, emerge as promising stakeholders who can facilitate the establishment of a mechanism that can assist collective decision making towards adoption of the CTBS. An early warning system for forecasting rodent outbreaks, developed in a participatory manner using both local and scientific knowledge would facilitate stakeholders' decisions to establish a sustainable scheme for adoption of the CTBS. However, the early warning system needs to be developed along with the implementation of a capacity-building programme to increase local stakeholders' capacity in conducting consensus-building exercises. If these two undertakings are undertaken simultaneously, the adoption of the CTBS is likely to be increased.

In short, all the above potential obstacles should be carefully addressed, not only during the persuasion stage of the diffusion process, but ideally during the very first stage - the knowledge stage, of the diffusion process so that preliminary planning activities, undertaken through extension projects, can help identify and address appropriately potential constraints to enhance success likelihood.

In terms of *trialability* and *observability* which are identified in the diffusion of innovation theory as being essential for adoption of innovation to occur, it was found in the case the CTBS that the trialability and observability of the CTBS did not necessarily lead to the adoption of the technology because of the constraints described above.

8.2 Policy implications

The above discussion indicates that when a technology is introduced at the persuasion stage, the *relative advantage* of the technology, the *compatibility*, *trialability* and *observability* should not be taken for granted as being supportive to technology adoption on the part of the farmers. This study shows that the latent disadvantages (classified as *complexity*), for the case of CTBS, are related to common-pool resource management and social capital among farmers, including trust of farmers on local government. These disadvantages appear as the major constraints to the diffusion of the CTBS. Therefore, an appropriate policy needs to be in place and local government need to be more involved in solving the existing constraints related to social capital among farmers.

In addition to the above, the following factors need to be considered before the extension of CTBS is planned in future extension activities.

Local leaders and local opinion leaders

The building of social capital is a long-term process. This process is primarily based on efforts from within the community. Local leaders are critical to the success of the building of social capital. They act as a guidepost that stimulates challenges and guides the thinking and action of community members. Evidence in An Giang suggested that farmers are likely to act upon advice from leaders who “roll up their sleeves” and sort out problems that farmers face. Leaders who only provide “lip service” and maintain a distance from farmers will likely fail to convince them.

Local opinion leaders in An Giang have their own networks, which are typically based on the convenience of geographical locations – neighbours and kinship. They are regarded as being knowledgeable, economically stable and play an important role in knowledge sharing. However, they are playing a diminishing role given the increased access to information in rural area. Nevertheless, this does not mean opinion leaders take no role in agricultural extension activities. In areas where farmers are of low economic status and have no access to television, newspapers, technical bulletins, or receive limited agricultural extension services, local opinion leaders play an important role and this should not be underestimated.

External change agents

In this study, the agency that is responsible for technology extension can be considered to be the external change agent. The plant protection department, as a change agent in this context, would be expected to help local farmers and local government to devise clear and widely accepted institutional arrangements, and the early warning system for rodent pest to support decision making. External change agents may include non-governmental organisations that support in finance and local capacity building. Although no non-governmental organisation (NGO) is available to support the farms in An Giang, this type of support needs to be actively sought by local leaders. NGOs can help facilitate the social capital building process. First, they can provide funding to support the implementation of local projects. Second, they can facilitate the awareness raising effort for a particular purpose through training activities. Finally, they can help improve grass-roots democracy through local open forums, which promotes local participation and the sense of ownership. Pavey *et al.* (2007) commented that external change agents could help local people in building their capacity to address change and establish governance mechanisms that support the broader community.

Synergy from stakeholders

There are some optimistic prognoses for the revitalisation of social stock in An Giang and the Mekong delta region given the decades' long tradition of moral economy that had existed. A synergy needs to be developed particularly between local government and farmers at the community level through appropriate institutional arrangements strengthened by the existence of appropriate policy at regional or national level to ensure regional and national level efforts stay aligned. If this could be achieved, formation of institutional arrangements that reconnect people, especially at farm neighbourhood level is likely. In line with these efforts, it is important to realise that social capital will not be automatically increased and maintained without any designed arrangements. Periodical assessment of the stock of social capital is worth being done to ensure that interventions are timely to maintain high level of success for local collective based actions.

Communication strategy

A good communication strategy, which addresses the rodent problem and establishes a forum to enable farmers' on-going discussion, is essential to promoting adoption of CTBS. Heong & Escalada (2005) commented that the knowledge gap between farmers and scientists is wide.

This typically leads to farmers' inefficient management of the resources, resulting in decreased profit and pollution of the environment. They suggested that a mass media approach is an essential component of upscaling the communication of scientific information and one could start with a single intervention message. Once preliminary success is achieved, the communication could be intensified using an incremental approach in which more heuristics could be added to the messages. However, in order for a mass communication plan to succeed, there must be a commitment and support from local people. Heong *et al.* (1998) noted that success could only be achieved when one could match local partners' priorities to the project goal. When communication is successful, the message would be fed back into policy development, which facilitates the institutionalisation of the message (cf. Heong *et al.* 1998, Heong & Escalada 2005, and Walgrave *et al.* 2008).

8.3 Limitations and future research

Methodology

This study has some methodological limitations. The quantitative study, despite being comprehensive in addressing the topic issues, was not constructed with the view of testing any social theories that might be applicable. In this case, the quantitative study served as the impetus for identifying theoretical approaches that might be relevant - an approach usually undertaken by qualitative, exploratory methods. Future quantitative research should take into consideration of the theoretical approaches that may warrant investigation.

Generalisation using qualitative research is based on logical reasoning. Causal explanation using qualitative data has its own limitations. Although the method provides a causal relationship between adoption likelihood and rodent pest severity, it cannot specify the impact that each moderating factor has on this relationship (albeit relative ranking of individual moderator could be established).

The investigator, as a non-local person, had some difficulties in data collection, despite the fact that more information was provided in the second field trip given enhanced local familiarity. This limitation poses some hindrance in the planned understanding of some aspects of study, especially trust of local people on the government.

Future research

In this study, examination of social capital, as embodied in mutual aid groups in the Mekong delta have been reviewed, from its origin to proliferation and diminishment. Although examination was done to understand how it transformed through critical socio-economic and political junctures since the French colony, it still leaves behind, without adequate account, the mechanism by which social capital flourished. As indicated with the historical evidence, the reason why mutual aid groups developed was demand driven. The demand was, historically, very strong because rice farming is the subsistence activity for every family in the Mekong delta then. The implications for future research would, therefore, be to confirm whether the generation of social capital depends on some set of conditions that give rise to the critical need for cooperation. If this were true, would it be possible to create a similar mechanism that is institutionalised to initialise the generation of social capital to the level that mutually benefit the community?

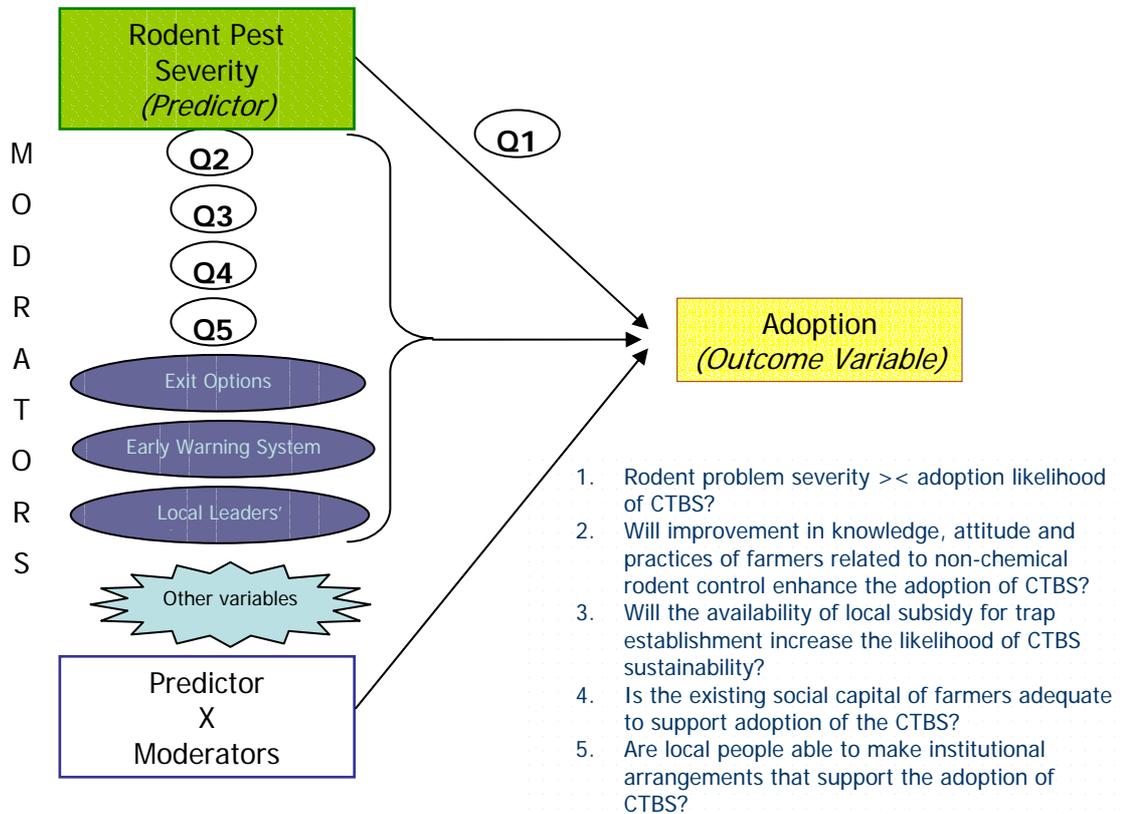
The primary approach that examines the major constraints of this study, thereby establishing the relative importance ranking of each constraint against the adoption pathway, is a causal explanation approach using qualitative research methods. The methodological success is of in-depth examination of the major constraints to the adoption of CTBS technology. Although this approach provides reasonable causal arguments pertaining to the extent to which each constraint factor accounts for the adoption likelihood and about whether interaction exists between these factors, the method confirms only the pathway of dominant constraints to adoption, which was hypothesised under this study's theoretical framework. Future research could consider testing this model by employing sophisticated quantitative modelling methods, incorporating into the model variables including stock of social capital, potential CTBS users' characteristics, level of KAP (as intervening variable), the availability of funding (as binary or ordinal data), the lack of exit options, availability of early warning system and the local leaders' competence to confirm the validity of this model. In testing this, it is important to consider the local context with regards to the history and the cultural features of the study site in question. The local context may hold social particularism which would escape the measurement of social capital, thus rendering the prediction less powerful. In connection with this, considering the context of rural modernisation where farmers are becoming more rational in their decision-making, it is important to measure social capital at both cognitive and structural levels to ensure that the measurement of social capital is valid and reliable.

The ability to model this framework will be useful in predicting the likelihood of adoption of CTBS in a particular farming community where CTBS is introduced for the first time. This conceptual moderating framework (as described in the diagram below) could be useful in exploring the likelihood of adoption of other agricultural technologies that require community action. If this effort could be done, useful information could be generated which could help inform the both national and provincial strategy regarding agrarian policies that rely on farmers' consensus. Within the effort of upscaling the use of CTBS in the Mekong delta, the understanding of factors that are potentially influential to the adoption could be detected. A practical diagnostic tool could be developed for use at the preliminary stage (stakeholders analysis) of any CTBS diffusion project, to increase project's success likelihood.

In connection with the above suggestions, the five research questions that this study attempted to answer could be used as variables in future research to develop a prediction model for the adoption of CTBS. This task would include establishment of constructs for variables such as social capital, and potential users' characteristics. These variables would be likely to be a composite index that would then need to be tested for its validity and reliability in the context of the Mekong delta prior to inclusion into the prediction models.

Figure 14 - Model for future research

(After the Moderating Framework by Barron & Kenny 1986)



Note: Q: question

In addition to the model suggested, it is noteworthy to examine further factors that could affect the formation of social capital. This investigation aims to understand under which conditions the creation and mobilisation of social capital will be affected so that policy interventions could be developed to maintain the stock of social capital.

Historical dependence – this is one factor that was controversial in previous studies. Putnam (1993), for instance, indicated that history has an influence on the future formation of social capital in Italy. The work by Krishna (2007) (in addition to Krishna & Uphoff 2002) noted that historical dependence accounts only in part for the change in social capital between his 2004 and 1997 studies. He noted that other local factors had existed which changed social capital in the study villages over time. Future research in the Mekong delta, therefore, should look into whether or not the labour exchange tradition would have a good influence on the generation of

social capital among farmers at the present time. If this were not the case, would policy interventions to improve the existing social capital at structural form improve the social capital stock in the way that contributes to the success of management of the commons?

Moral economy versus Political economy – there is a crossroad at which moral economy versus political economy meet. However, it is not the aim of this study to examine at great length farmers' cooperative behaviour under these two economic schools. However, it is necessary to make a cursory investigation of farmers' cooperation under this perspective to detect any potential hindrance. Suppose farmers were more rational these days given increased economic independence and lack of desire towards collective goods, it is worth considering this behaviour to see if it has either moderating or mediating effects on the adoption of CTBS. If this aspect is scrutinised, it is very likely that exit options would become a confounding factor.

Wealth stratification – examination for the association between the perceived community cohesion and economic status of farmers in An Giang was conducted under this study for exploratory purposes but no association was found. A question could be posed about whether or not farmers of the same economic status in An Giang would have the same response to collective goods as farmers who live in a metropolitan city of the Mekong. An alternative hypothesis is whether farmers of higher economic status are more likely to support collective goods than those who belong to a lower economic status group or vice versa.

8.4 Conclusion

The findings from this study as well as previous ones have indicated that despite economic and environmental advantages that CTBS can bring, diffusion of CBTS in An Giang as well as in other part of the Mekong delta region can not be assumed to be taken for granted through traditional agricultural extension practice. Given the social constraints as summarised above, long-term commitment and strong interventions are essentially needed from local government. Effectiveness in such interventions will depend on how well the intervention strategy is devised to address the difficulties related to farmers' management of the CTBS as a common-pool resource as well as their ability to facilitate consensus building for joint CTBS adoption. In this study, financial constraints, especially among poor-resource farmers, were found to influence the CTBS adoption likelihood. Since finance matters for the poor, contribution from potential poor CTBS users should be discussed and solved in a participatory manner. Flexibility in contributions (i.e. labour in lieu of finance) should also be considered to maximise farmers' participation and consensus within groups. In this study, it was also found that the provision of

CTBS knowledge to farmers through training did not automatically leads to community-wide technology adoption. Therefore, training should be followed with social and technical interventions and support to aid the translation of training knowledge into behaviour change in favour for the CTBS.

It is also clear from this study that there is a relationship between rodent pest severity and CTBS adoption likelihood. Nevertheless, this relationship is not always positive in the sense that the more severe the rodent pest is, the more likely the adoption of CTBS is. In fact, this relationship is moderated by some important latent factors, including stock of social capital and characteristics of potential CTBS users. Without addressing these latent constraints, the community-wide adoption of the CTBS remains challenging. Since farmers have different attitudes and actions to rodent control, decisions related to how rodents are controlled are more individually made. To move forwards to collective decision making with regards to rodent management, a mechanism for collective decision-making needs be established. An early warning system for rodent pest severity, which is widely accepted by farmers based on both indigenous and scientific knowledge, appears to be the common voice that facilitates discussion towards consensus and collective action for rodent management. To achieve this, local government and technical agencies need to take the lead in establishing this early warning system through open dialogues, discussions, consensus building for collective adoption. Rogers (2003) commented that practices and social norms act as prior conditions to adopting new knowledge. Therefore, if cooperation is not a social norm and practice, the extension of CTBS to more rice farming communities will remain challenging. A strategy and long term commitment from stakeholders, especially local leaders, are essential to developing the pathway to CTBS adoption in the short run and generation of social capital to create a more cooperative and cohesive rural community in the long run.

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Appendices

Appendix A

INTERVIEW GUIDE (Group discussions with farmers) (For Field Trip No.1)

1. Introduction

Give an explanation

Good morning. My name is _____ and this is my colleague _____. I am graduate student from the JCU. Thank you for coming. A focus group is a relaxed discussion.....

Present the purpose

We are here today to talk about your experience in trialing the CTBS. The purpose is to get your perceptions of how the technology works, what are the advantage and disadvantages, and how disadvantages in the technology adoption could be overcome?

I am not sharing information, or to give you my opinions. Your perceptions are what matter. There is no right or wrong or desirable or undesirable answers. You can disagree with each other, and you can change your mind. Please feel comfortable saying what you really think and how you really feel.

Discuss procedure

I (and my colleague....) will be taking notes so that we do not miss anything you say. As you know everything you say is confidential. No one will know who said what. We solicit your opinions in order to find ways to make the technology more adoptable. Therefore, your opinions are very important to this process.

Participant introduction

Now, let's start by everyone sharing their name.

Rapport building

2. Interview

2.1 RELATIVE ADVANTAGE

- *What are the key benefits that you have found after trialing the CTBS?*
- *Of these benefits, which have you found the most remarkable that could affect your adoption decision in a near future?*
 - **Reduced potential crop damage** (both pre- and post-harvest) → Maintain potential crop yield, income, food security
 - **Additional incomes** from captured rat
 - **Benefit–cost** (cost-effective)
 - **Neighborhood** enhanced
 - **Environmental-friendly** (water contamination, non-target species...)

2.2 COMPLEXITY & COMPATIBILITY

(Factors that influences farmers' attitude towards adoption of the technology at Persuasion Stag)

2.2.1 GENERAL OBSTABLES:

- *What problems/obstacles have you faced in trialing the technology?*
- *What problems/obstacles do you think the most difficult to overcome? Why?*
 - **Group size** (what is the optimum one?)
 - **Groups composition** (homogeneity >< heterogeneity): local membership, kinship, neighborhood
 - **Cost** (transaction costs)
 - **Opportunity cost** (is this a significant constraint?)
 - **Production difficulties** (establishing a small area for the trap crop weeks before the main crop, in harvesting/threshing rice from the trap crop, etc...)
 - **Pest** (can result in low yields in the trap crop)
 - **Labour** (requirement for establishing, maintaining, and monitoring the system)
 - **Irrigation for lure crop** and collaboration with irrigation coordinating unit
 - **Equity** (related to shape of the halo effect?, varied rat damage between farms?, and between years? Lower yields within the halo effect? Availability of construction teams?)
- *How do you rank the identified key adoption constraints?*
- *How do you solve them to adopt the technology?*

2.2.2 EXISTENCE OF CONDITIONS THAT FACILITATE COOPERATION

- ***Given the technology requires group action, pre-existing ability to cooperate is vital. What do you think about the social cohesion in the community?***
 - **Social Capital** (cooperation, trust, reciprocity, solidarity, norms, neighborhood)
 1. In your opinion, is your community united compared to other communities around here? Are there conflicts between people/families in the community?
 2. If you need to work to construct, for example, a school, a road, etc., does everyone participate or only a few?
 3. If someone is sick, does the community help with the cost of medicine, hospitalisation, etc.?
 4. If a poor family need help/support in repairing/building a house or need food during a flooding, is there any family within the community that is willing to help? How people in the neighbourhood are involved?
 5. If the irrigation is well coordinated to ensure timely and equal irrigation? Are there any complaints over irrigation fee? If there is, how these complaints are solved? Who are involved in the solving process?
- ***If a consensus is needed, who (in the community) usually initiates the discussion?***
- ***Through which mechanism are actions (following consensus) done to ensure sustainability?***
- ***How is the agreed list of actions monitored?***
- ***Can you tell any case stories (if any) for both success and failure related to implementation of a consensus?***

2.2.3 COMMITMENT ATTITUDE TOWARDS COOPERATION FOR THE CASE OF CTBS

- ***How do you assess the possibility to achieve an institutional arrangement for a CTBS? (cooperation between stakeholders including farmers, local organization, government, technical extension agencies, costs)***
- ***How farmers group arrive at a consensus for CTBS use?***
- ***Who should be responsible for initiating the consideration of technology use when needs arise?***

2.2.4 COMMITMENT ATTITUDE TOWARDS ACHIEVING INSTITUTIONAL ARRANGEMENT FOR THE CTBS

- ***What conditions/arrangements specific to CTBS do you think necessary to exist to assure group action take place?***
 - **Institutional arrangement** (local ability; facilitation skills, support from technical extension staff and local government, mass organization)
 1. Clear definition of members, boundaries of halo effect to be managed,
 2. Clear set of rules and obligations that fit local conditions;
 3. Members collectively be able to modify rules to changing circumstances;
 4. Adequate monitoring systems in place,

5. Enforceable sanctions, preferably graduated to match the seriousness and context of the offense;
6. Effective mechanisms for conflict resolution; and
7. Organization (if not empowered or recognized by government authorities, should at least not be challenged or undermined by those authorities)

- *What factors that may influence your decision to adopt the technology*

2.2.5 EXISTENCE OF OTHER RELEVANT HUMAN FACTORS THAT MAY CONSTRAIN THE ADOPTION

- Communication?**
- Family? Neighbourhood?**
- Opinion leadership?**
- Extension service** (availability, quality, frequency)

2.3. TRIALABILITY

2.4. OBSERVABILITY

3. Closure

Though there were many different opinions about _____, it appears unanimous that _____. Does anyone see it differently? It seems most of you agree _____, but some think that _____. Does anyone want to add or clarify an opinion on this?

Is there any other information regarding your experience that you think would be useful to share?

Thank you very much for coming today. Your time is very much appreciated and your comments have been very helpful.

Appendix B

QUESTIONNAIRE (Use for farmers who directly manage CTBS experiments) (for Field Trip No.2)

How many rice farms that are located adjacent to your current CTBS farm as farm neighbour? _____

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6
Estimated farm size	Number of sào? _____	Number of sào? _____	Number of sào? _____	Number of sào? _____	Number of sào? _____	Number of sào? _____
Please tick to select the type of relations you have with your respective farm neighbours	Non-local <input type="checkbox"/> In the same commune except house neighbourhood <input type="checkbox"/> House neighbour <input type="checkbox"/> Relatives <input type="checkbox"/> Son/Daughter or siblings <input type="checkbox"/>	Non-local <input type="checkbox"/> In the same commune except house neighbourhood <input type="checkbox"/> House neighbour <input type="checkbox"/> Relatives <input type="checkbox"/> Son/Daughter or siblings <input type="checkbox"/>	Non-local <input type="checkbox"/> In the same commune except house neighbourhood <input type="checkbox"/> House neighbour <input type="checkbox"/> Relatives <input type="checkbox"/> Son/Daughter or siblings <input type="checkbox"/>	Non-local <input type="checkbox"/> In the same commune except house neighbourhood <input type="checkbox"/> House neighbour <input type="checkbox"/> Relatives <input type="checkbox"/> Son/Daughter or siblings <input type="checkbox"/>	Non-local <input type="checkbox"/> In the same commune except house neighbourhood <input type="checkbox"/> House neighbour <input type="checkbox"/> Relatives <input type="checkbox"/> Son/Daughter or siblings <input type="checkbox"/>	Non-local <input type="checkbox"/> In the same commune except house neighbourhood <input type="checkbox"/> House neighbour <input type="checkbox"/> Relatives <input type="checkbox"/> Son/Daughter or siblings <input type="checkbox"/>
How often do you contact them in daily conversation or experience sharing?	Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Seldom <input type="checkbox"/> Never <input type="checkbox"/>	Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Seldom <input type="checkbox"/> Never <input type="checkbox"/>	Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Seldom <input type="checkbox"/> Never <input type="checkbox"/>	Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Seldom <input type="checkbox"/> Never <input type="checkbox"/>	Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Seldom <input type="checkbox"/> Never <input type="checkbox"/>	Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Seldom <input type="checkbox"/> Never <input type="checkbox"/>
Do you often ask these farm neighbours for their support in your rice production?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes <input type="checkbox"/> No <input type="checkbox"/>

Generally, do you often ask these farm neighbours for their support in your rice production?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Suppose that you urgently need money (i.e 50 and 100 thousand VND), whom would you approach to borrow?	<ul style="list-style-type: none"> ▪ House neighbours <input type="checkbox"/> ▪ Relatives <input type="checkbox"/> ▪ Son/Daughter or sibling <input type="checkbox"/> ▪ Farm neighbours <input type="checkbox"/> 	

For how many crops with CTBS experiments have you managed so far? _____

How many training course on CTBS have you attended so far _____

Did you frequently share your experience in rodent management using CTBS with your farm neighbours?
Yes No

If yes, how many farm neighbours have you shared your own experience on CTBS with? _____

In your opinion, how do you generally assess the importance of house relationship in your daily life?

Very important important Neutral Not important Absolutely not important

Why?

How do you generally assess the importance of establishing and maintaining the relationship among farm neighbours in your commune

Very important important Neutral Not important Absolutely not important

Why ?

How do you generally assess the relationship among farm neighbours within your commune?

Very good Good Normal Not Good Not very good
Why?

How do you generally assess your relationship with your farm neighbours?

Very good Good Normal Not Good Not very good
Why?

When “dân công” (labour exchange) was still popular, the relationship among farm neighbours was very good, especially that among members within a labour exchange group. How do you rate the change in farm neighbour relation between then and now?

Much better Better The same Worse Much worse

Please provide the key reasons and explain

In your opinion, who (in your community) is the best agent that could help improve the relationship among farm neighbours?

Communal People's Committee Communal Farmers' Association dân Village board

Others (Please provide details)

Thank you for your participation.

Appendix C



KNOWLEDGE, ATTITUDES AND PRACTICES & SOCIO-ECONOMIC SURVEY



Australian Government
**Australian Centre for
International Agricultural Research**

IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE

Purpose of the survey: This project aims at aiding farmers in providing solutions for the sustainable management of rats. To this end, we need to obtain a proper understanding of farmers' attitude towards rats and their control in agricultural crops, particularly in irrigated rice production. We would like to ask you for some time to share with us your thoughts, experiences and current practices regarding rat management.

Respondent # _____ Interviewer _____

Name of farmer _____ Date of Interview _____

Hamlet/Village _____ Commune _____

District _____ Province _____

I. Background Information

1. What is your Ethnic (Ethnolinguistic) Group?

2. How many people are there in your household?

(Household members are defined as family and non-family members living permanently in the household and taking food from the same kitchen)

3. How many children do you have?

4. How many of your brothers/sisters live in the commune?

5. Name your brothers/sisters who are farm neighbors and indicate their distance to the farm household:

1. Name: _____ Distance to brother's/sister's farm: _____ km

2. Name: _____ Distance to brother's/sister's farm: _____ km

3. Name _____ Distance to brother's/sister's farm: ____ km
 4. Name: _____ Distance to brother's/sister's farm: ____ km
 5. Name: _____ Distance to brother's/sister's farm: ____ km

6. How many years have you spent in farming?

7. Which non-government (non-paid) community/village organizations are you member of, what position do you occupy and how many members are there in the organization?

Organization	Position occupied	Number of members in organization

8. What (paid) local government positions do you occupy? Specify if elected or appointed.

Position	Elected or appointed ¹

Note: 1 = elected, 2 = appointed.

II. Socio-Economic and Demographic Characteristics

Can you give us some information on the members in your household that live within as well as outside the hamlet, and that are over 10 years old?

Household member name	Relation to head of household ¹	Sex	Nearest distance to household member's farm (km)	Civil status ²	Age (yrs)	Education (grade)	Occupation			
							Type ³	Time allocated (%)	Location	Average income ⁴ (VD/year)
Head of household							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
Spouse							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
Children 1.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
2.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
3.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.

Household member Name	Relation to head of household ¹	Sex	Nearest distance to household member's farm (km)	Civil status ²	Age (yrs)	Education (grade)	Occupation			
							Type ³	Time allocated (%)	Location	Average income ⁴ (VD/year)
4.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
5.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
Others: 1.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
2.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.
3.							1.	1.	1.	1.
							2.	2.	2.	2.
							3.	3.	3.	3.

Notes: ¹ Relation to head of household: 1=Wife/husband, 2=Son/Daughter, 3=Son/Daughter-in Law, 4=Brother/Sister, 5=Other (specify):

² Civil Status: 1=Single, 2=Married, 3=Widow/Widower, 4=Separated, 5=Other (specify):

³ Occupation types: 1=Farmer, 2=Wage laborer, 3=Government official, 4=Other (specify):

⁴ If wage laborer, ask wage per day and number of days per month to estimate average income per month.

III. Farm Household Characteristics and Cropping Pattern 2005 – 2006

In this Section we will ask you some questions about the characteristics of the farm household as well as the cropping pattern in the year 2005-2006.

Resource availability: Can you give us some information on the capital resources (like land, livestock, machinery and structures) you have got available in your household at this moment?

Item	Availability		Age (yrs)	Value when bought (1000VD/unit)
	Number	Unit		
Farm land: - owned (from parents)				
-owned (bought)				
- borrowed				
- leased (rent)				
- other:				
Livestock: - cows				
- ox / buffalo				
- pigs				
- chicken				
- ducks				
- other: _____				
Machinery/tools: - plow				
- rice dryer				
- plough mills				
- drum seeder				
- water pump				
- motor bike				
- boat				
- machete				
- other: _____				
- other: _____				
Fixed assets: - pig pen				
- poultry shelter				
- rice drying area				
- shed				
- storage				
- fish pond				
- store / shop				
- other: _____				

Note: For land, machinery and fixed resources, please ask for the value at the time of purchase. For livestock resources, please ask for the current value.

Farm cropping pattern: Can you give us some information on the cropping pattern for the year 2005-2006 (2005 winter-spring crop, 2006 summer-autumn crop and 2006 other crop)?

Parcel No.	Area (ha)	Elevation ¹	Tenure Status ²	Crop		Date of planting (dd/mm)	Date of harvest (dd/mm)	Total production		Price / kg (VND)	Would you plant it again? (Y/N)	Why (not)?
				Name ³	Variety			Quantity	Unit			
Winter-Spring crop (2005-2006): _____ -2005 to _____ -2006 – 1 st crop (Crop 1)												
P1												
P2												
P3												
Summer-Autumn crop (2006): _____ -2006 to _____ -2006 – 2 nd crop (Crop 2)												
P1												
P2												
P3												
Other crop (2006) : _____ -2006 to _____ -2006 – intermediate crop (Other crop, optional between Winter-Spring and Summer-Autumn crop)												
P1												
P2												
P3												

Notes: ¹ Elevation type: 1=High, 2=Medium, 3= Low
² Tenure status: 1=Owner-cultivator, 2= Share-tenant, 3=Leasehold (fixed rent), 4=Other (specify): _____
³ Crop name: 1=Rice, 2=Cucumber, 3=Cabbage, 4=Spinach, 5=Other (specify): _____

In case you planted Jasmin rice variety, in what year did you first start planting Jasmine rice variety (year)? _____

Product disposal: Can you give us some information on what you did with your farm produce in the year 2005-2006? Did you sell it, store it and/or keep it? Did you use it to pay creditors or land lease? Note that farm produce not only includes the crops identified in question III-2 (like rice, cucumber and cabbage), but also includes livestock (like cows, pigs, chicken and ducks) and other products (like eggs and milk).

Item	Other products				Livestock				Crops / Rice varieties											
	1	2	3	4	1	2	3	4	Winter-Spring ²			Summer-Autumn ²			Other ²					
									1	2	3	1	2	3	1	2	3			
Product type																				
Total production: - Quantity																				
- Unit																				
Farmer's share:																				
1- Sold:																				
Quantity (units)																				
Price (VD/unit)																				
Product Outlet: - type ¹																				
- distance (km)																				
2- Stored to sell later:																				
Quantity (units)																				
3- Kept for home consumption:																				
Quantity (units)																				
4- Kept for seeds:																				
Quantity (units)																				
Paid to creditor in kind:																				
1- Payment for inputs																				
Quantity (units)																				
2- Payment for irrigation																				
Quantity (units)																				
Amortization/Leasehold fee:																				
Quantity (units)																				
Other (specify): _____																				
Quantity (units)																				

Notes: 1 Type of outlet: 1=Government, 2=Retailer, 3=Millers, 4=Cooperative, 5=Other (specify): _____

2 Please refer to question III-2 for definition of different cropping seasons.

Labor and input use in the 2006 Summer crop: Can you give us some information on the labor requirements and levels of input use in the 2006 Summer crop? Please refer to the largest plot only! Area (ha) ____

i) How much and what types of input did you use on the largest plot in the 2006 Summer crop? Also, how much did the input cost and where did you obtain it?

Input	Application (number) ¹	DAS ²	Brand name	Input use		Price (VD/unit)	Source ⁴
				Quantity	Unit (kg or l) ³		
Seed							
Fertilizer	1.						
	.						
	.						
	.						
Insecticide	1.						
	.						
	.						
	.						
Herbicide	1						
	.						
Molluscicide	1.						
	.						
Fungicide	1.						
	.						
	.						
	.						
No times pumping (land preparation to before sowing)				For each pumping (LP), Average No of days			
No times pumping during crop care (from sowing to harvest)				For each pumping during crop care (sowing - harvest), Average No of days			
No times pumping during crop care (from sowing to before boosting)							

Notes: 1 Application number: 1=first application, 2=second application, etc. 2 DAT=Days After Sowing

3 If unit in quantity is given in bags, ask number of kilograms (kg) per bag. If quantity is given in bottle, ask number of liters (l) or (ml) per bottle.

4 Source: 1=Owned, 2=Purchased from shops, 3=Exchange with co-farmers, 4=cooperative Other(specify): _____

ii) How much family and hired labor did you use on the largest plot in the 2006 Summer crop? Also, where did you get it from and how much did it cost?

Activity	Family/exchange labor				Hired labor					
	Total No of Days/activity ¹	Average No of males Working / day	Average No of females Working / day	Average No of Hours per day	Total No of Days/activity	Average No of males Working / day	Average No of females Working / day	Average Hours per day	Wage (VD/day)	Contract wage (VD/activity)
1. Land preparation										
2. Water pumping during land preparation to before sowing										
3. Water pumping crop care (from sowing to harvest)										
4. Water pumping (from sowing to before boosting)										
5. Cleaning/repair of dikes										
6. Seed / preparation										
7. Sowing / Transplanting										
8. Gap filling/replanting										
9. Hand weeding										
10. Herbicide application										
11. Molluscicide application										
12. Insecticide application										
13. Fungicide application										
14. Rodenticide application										
15. Fertilizer application										
16. Harvesting										
17. Hauling										
18. Threshing										
19. Transporting										
20. Drying										

Note: ¹ Total no of days = Total no of applications (pumping) for each activity (refer to #5 i) X average no. of days per application (pumping) for each activity.

1. **Access to sources of financial capital:** Can you give us an *estimate* on how you financed your variable production costs (e.g. planting, fertilizer, pesticides and harvesting costs) in the 2006 Spring crop?

Also, can you give us an *estimate* on how you usually finance capital investments, like for example the purchase of machinery/tools and fixed assets? Please refer to Question III-1 for examples of machinery/tools and fixed assets!

Finally, can you give us an *estimate* on the rate of interest you pay for the use of these sources of finance? Please indicate interest rate *and* loan period!

Source of finance	Variable input costs			Capital investment costs		
	How did you finance variable input costs in the 2006 spring crop? (% total variable input costs)	Interest rate (%)	Period (months)	How do you usually finance capital investment costs? (% total investment costs)	Interest rate (%)	Period (months)
1. Savings						
2. Family members						
3. Borrowing from any persons outside family						
4. Private supplier (to be paid at the end of harvest)						
5. Credit loans (through People's Committee or Agri Cooperative)						
6. District bank						
7. Other: _____						
Total	100%			100%		

IV. Rodent and Other Crop pests

In this Section we will ask you some questions about insect and animal pests that you have experienced in crop production.

1. What are the main factors that limit crop production on your farm? (rank them in order of importance):

Crop ¹	Main factor ²	Estimated crop loss (%)		
		Winter-Spring	Summer-Autumn	Other/Intermediate

Notes: ³ Crop name: 1=Rice, 2=Cucumber, 3=Cabbage, 4=Spinach, 5=Other (specify):

² Main factor: 1=BPH, 2=Rats, 3=_____

2. What is the most important rice pest to control?

3. How do you assess rat damage in your rice crop?

Note: Do not provide/show options to farmer!

- | | | | |
|---------------------------|--------------------------|----------------------|--------------------------|
| i) Unearthed plants/seeds | <input type="checkbox"/> | vi) Run-ways | <input type="checkbox"/> |
| ii) Visual observation | <input type="checkbox"/> | vii) Cut seedlings | <input type="checkbox"/> |
| iii) Droppings | <input type="checkbox"/> | viii) Damaged plants | <input type="checkbox"/> |
| iv) Burrows | <input type="checkbox"/> | ix) Others (specify) | _____ |
| v) Tracks | <input type="checkbox"/> | | |

4. How do you describe the occurrence of rat damage in your rice crop? Choose one of the following:

Regular Occasional Rare

If not already stated in Question IV-1, what is the estimated yield loss? _____ %

5. Can you remember any specific years in the past when there were very high rat numbers? Which years? And why do you think it happened?

Year	Reason

6. Do you know if there is more than one species of rat present on your farm, and where do you predominantly find them?

Rat species ¹	Location ²

Notes: ¹ Rat species: 1=_____, 2=_____, 3=_____, 4=_____
² Location: 1=Field, 2=Store, 3=_____

V. Knowledge on Rodent Pest Management

In this Section we will ask some questions regarding your experience in rodent management.

1. Planting almost at the same time (within a span of two weeks) can reduce rat population.
yes no maybe
2. The practice of fallow (no crops planted) almost at the same time can reduce rat population during the following crop.
yes no maybe
3. Cleaning on farm and surroundings areas (general hygiene including village gardens) can reduce rat population.
yes no maybe
4. Wide width of paddy bunds (>30 cm) can reduce rat population.
yes no maybe
5. Small width of paddy bund (≤ 30 cm) can reduce rat population.
yes no maybe
6. Individual rat control action is best to control rat damage because farmer has option when and where to conduct rat control.
yes no maybe
7. Community rat control is best to control rat damage because it is done at the same time.
yes no maybe
8. Community rat control for 2 continuous weeks at the early stage of the rice crop (before the tillering stage) is most effective in reducing rat population.
yes no maybe
9. Community rat control at anytime of the cropping season is most effective in reducing rat population.
yes no maybe
10. Community rat control at a specific stage of crop is most effective in reducing rat population.
yes no maybe

VI. Farmers' and Beliefs towards rats and rat management

In this Section we will ask you some questions regarding your opinion and beliefs about rats in general and rat management in particular.

1. Do you believe that:

Item	Yes	No	Don't know	Why?
1. Controlling rats is important?				
2. Rats can be controlled?				
3. Rat control must be done during rice growing season?				
4. Rats have to be controlled after harvest or in the fallow season?				
5. Chemicals used to control rats are safe (for humans, other animals and the environment)?				
6. By controlling rats, a farmer can increase his rice yields?				
7. Rats can cause severe yield losses?				
8. Rats can be only controlled if farmers work together with other farmers at the same time?				

2. Do you eat rats?

yes no

If yes, why: _____

If no, why not: _____

If yes, do you buy rats?

yes no

If no, why not: _____

3. Do you believe that rats carry diseases?

yes no maybe

If yes, what are those diseases:

4. Do you know somebody who got sick due to rats?

yes no maybe

If yes, who: _____

VII. Rat management practices

In this Section we will ask you some questions about rat management practices in general and in rice production in particular.

1. Rat control in fields. What methods do you use to control rats in the field, when and how often do you apply them, what do they cost, and how effective are they?

Rat control method ¹	Applicati on method ²	No of applns			Cost per applic ation ³ (VD)	Household labor use per application			No of rats caught			Rank effectiveness of control method ⁵	Rank preferred control method ⁶	Reason for preference ranking	
						Total No of days	Average no of persons in household working per day								Average no of hours per day
		Male	Female	DX			HT	OT							
		D X	H T	O T											

- Notes: ¹ Rat control method: 1=Synchronized cropping, 2=Hunting, 3=Barrier system, 4=Trap barrier system, 5=Traps, 6=Digging, 7=Field hygiene, 8=Rat poison, 9=Smoke out, 10=_____
- ² Application method: 1=Individual, 2=Farmer group, 3= Community, 4=Contractor, 5=_____
- ³ Cost per application: Please place dash (-) if not applicable.
- ⁴ Household labor use: Please place dash (-) if not applicable.
- ⁵ Effectiveness ranking: 1=High, 2=Medium, 3=Low
- ⁶ Preference ranking: 1=highest preference, 2=second highest preference, 3=third highest preference, etc.

2. At which stage of the cropping season do you control rats?

Stages	How many times/days (number)			Number of application (number)			At what stage is rat control most effective ²			Why it is most effective?
	C1 ₁	C2 ₁	C3 ₁	C1 ₁	C2 ₁	C3 ₁	C1 ₁	C2 ₁	C3 ₁	
Land preparation / Pumping										
Transplanting										
Tillering										
Booting										
Heading										
Maturing										

Notes: ¹ Crop (see Question III-2): C1=Winter-spring crop, C2=Summer-autumn crop, C3=Other crop

² Effectiveness: 1=High, 2=Medium, 3=Low

3. At which stage/season of CROP (not rice) growth, is rat control most effective?

Crop name: _____ Stage: _____ days after sowing / transplanting

Crop name: _____ Stage: _____ days after sowing / transplanting

Crop name: _____ Stage: _____ days after sowing / transplanting

4. If group/community control method, who organized the group/community effort to control rats?

Organizing party	Please tick box
Local government	
Farmer group	
Extension staff from PPD	
Other (specify): - _____	
- _____	

5. What do you do with the rats caught?

Allocation caught rats:	%	Price (VD/rat)
- Throw out		
- Consume		
- Sell		
- Other (specify): _____		

VIII. Collective Action and Cooperation

In this Section we will ask some questions about your involvement in community activities over the last year.

1. In the past year, have you worked with others in your village/neighborhood to do something for the benefit of the community? yes no

2. If yes, what were the three main such activities last year? Was participation in these voluntary or compulsory? Were there cash contributions? If yes, how much?

Activity	Type of participation ¹	Cash contribution		Number of persons involved in activity or in %
		VD	Duration covered	
1.				
2.				
3.				
4.				
5.				

Note: ¹ Type of participation: 1=Voluntary, 2=Compulsory

3. In the past year, how many times have you attended any of the following meetings?
 - i) Village local government meeting
(PC) _____
 - ii) Hamlet local government meeting

 - iii) Farmer association meeting

 - iv) Farmer club meeting

 - v) Other (specify): _____

4. All together, how many times in the past year did you or anyone else in your household participate in community related activities? On average, what percentage of total households in the community participated in these community related activities?

IX. Sociability, Social Cohesion, and Inclusion

1. How would you rate the social unity of this village/neighborhood (circle)?

1	2	3	4	5
Very bad	Bad	Normal	Good	Very good

Comments:

1. _____
2. _____

2. In general, in your daily living, to who do you usually talk to or interact with? Where and what is the usual topic of discussion?

3.

Who¹ (Person number)	Relationship²	Where³	Usual topic of discussion⁴

Note: ¹ Who: 1=person number one, 2=person number two, 3=person number three, etc.

² Relationship: Write down multiple relationships if applicable, e.g. house neighbor and a friend;

³ Where do you usually talk 1=house neighborhood, 2=farm, 3=coffee shop, 4=_____ etc

⁴ Topic: :1=crop production, 2=purchase of inputs, 3=marketing of produce, 4=_____ etc

3. How many times in the past year did you participate in a family/village/neighborhood festival or ceremony (please **specify** - like wedding, funeral, religious festival, etc.)?

4. Do you often make decisions that affect your everyday life (circle)?

1	2	3	4	5
Never	Hardly ever	Sometimes	Almost always	Always

X. Information and Communication

Finally, we would like to ask you some questions regarding the sources of information that you use in your daily production decisions.

1. What are the five most important sources of information for agricultural technologies and markets?

Please rank top 5, where 1 is highest, 2 is second highest, ... and 5 is fifth highest.

Source of information	Agricultural technologies (rank top 5)	Market e.g. product and input prices (rank top 5)
Relatives		
Friends		
House neighbors		
Farm neighbors		
Television		
Radio		
pamphlet		
Community or local newspaper		
National newspaper		
Community bulletin		
community bill boards		
Farmer cooperative		
Groups or associations		
Community leaders		
PPD		
Ag extension staff		
NGOs		
Other (specify): _____		

2. In general, compared to five years ago, has access to information improved, deteriorated or remained about the same?

Improved

Remained the same

Deteriorated

Why? 1. _____

2. _____

3. What kind of farm-based training have you attended in the past year?

Name of course / training	Topics covered	Duration of training (days)

Thank you very much for your time!

Appendix D

CORRELATIONS MATRIX

		Number of times	Relative s	Friends	House neighbors	Farm neighbors	Television	National radio	Pamphlet	Community or local newspaper	National newspaper	Community billboards	Local radio	Agro-service cooperative	Groups or associations	Community leaders	PPD	Ag extension staff	NGOs	Other
Number of times	Correlation Coefficient	1.000	.008	.037	.139	.153	-.208(**)	.002	.004	.141	-.866	.	.	.577	-.592	.	-.249	-.219	.000	.
	Sig. (2-tailed)	.	.933	.654	.111	.062	.010	.992	.985	.661	.333	.	.	.423	.293	.	.178	.163	1.000	.
	N	178	118	147	132	149	153	44	21	12	3	0	2	4	5	2	31	42	6	0
Relatives	Correlation Coefficient	.008	1.000	.355(**)	-.084	-.396(**)	-.433(**)	-.236	-.703(*)	-.631	.	.	.	1.000(**)	.	.	-.399	-.489(*)	.	.
	Sig. (2-tailed)	.933	.	.000	.353	.000	.000	.304	.023	.254	.	.	.	.000	.	.	.073	.046	.	.
	N	118	147	131	125	115	127	21	10	5	1	0	0	3	3	0	21	17	2	0
Friends	Correlation Coefficient	.037	.355(**)	1.000	.134	-.220(**)	-.437(**)	-.620(**)	-.445	-.444	.	.	.	.	1.000(**)	.	-.055	-.318	.866(*)	.
	Sig. (2-tailed)	.654	.000	.	.111	.008	.000	.000	.064	.454	.	.	.	.	.000	.	.790	.081	.026	.
	N	147	131	179	143	145	156	36	18	5	1	0	2	3	3	0	26	31	6	0
House neighbors	Correlation Coefficient	.139	-.084	.134	1.000	-.125	-.357(**)	-.732(**)	-.097	1.000(**)	.	.	.	.	.	.	-.234	-.366(*)	.	.
	Sig. (2-tailed)	.111	.353	.111	.	.154	.000	.000	.764	.000	.	.	.	.	.	.	.230	.043	.	.
	N	132	125	143	163	131	143	23	12	4	1	0	0	3	2	1	28	31	2	0
Farm neighbors	Correlation Coefficient	.153	-.396(**)	-.220(**)	-.125	1.000	-.272(**)	-.614(**)	-.395	-.010	.	.	.	1.000(**)	.648	1.000	-.293	-.454(**)	.866(*)	.
	Sig. (2-tailed)	.062	.000	.008	.154	.	.001	.000	.204	.983	.	.	.	.	.237	1.000	.131	.005	.026	.
	N	149	115	145	131	170	147	32	12	7	1	0	2	3	5	2	28	36	6	0
Television	Correlation Coefficient	-.208(**)	-.433(**)	-.437(**)	-.357(**)	-.272(**)	1.000	.326(*)	.084	-.284	.577	.	.	.	-.500	1.000(**)	-.299(*)	-.131	1.000(**)	.
	Sig. (2-tailed)	.010	.000	.000	.000	.001	.	.035	.724	.370	.423	.	.	.	.667	.000	.046	.366	.	.

		Number of times	Relative s	Friends	House neighbors	Farm neighbors	Television	National radio	Pamphlet	Community or local newspaper	National newspaper	Community billboards	Local radio	Agro-service cooperative	Groups or associations	Community leaders	PPD	Ag extension staff	NGOs	Other
	N	153	127	156	143	147	193	42	20	12	4	1	2	1	3	3	45	50	4	0
National radio	Correlation Coefficient	.002	-.236	-.620(**)	-.732(**)	-.614(**)	.326(*)	1.000	-.452	-.094	.	.	.	.	.	.	-.699(*)	.054	.	.
	Sig. (2-tailed)	.992	.304	.000	.000	.000	.035	.	.309	.860	.	.	.	.	.	.	.036	.849	.	.
	N	44	21	36	23	32	42	50	7	6	1	0	0	1	1	1	9	15	0	0
Pamphlet	Correlation Coefficient	.004	-.703(*)	-.445	-.097	-.395	.084	-.452	1.000	.	1.000	.	.	.	.	.	-.083	-.816(*)	.	.
	Sig. (2-tailed)	.985	.023	.064	.764	.204	.724	.309	.	.	.	.	.	.	.	.	.859	.025	.	.
	N	21	10	18	12	12	20	7	25	1	2	1	0	0	1	0	7	7	2	0
Community or local newspaper	Correlation Coefficient	.141	-.631	-.444	1.000(**)	-.010	-.284	-.094	.	1.000	.	.	.	.	-1.000	.	-.286	-.763	.	.
	Sig. (2-tailed)	.661	.254	.454	.000	.983	.370	.860	.	.	.	.	.	.	1.000	.	.534	.133	.	.
	N	12	5	5	4	7	12	6	1	15	1	1	0	1	2	1	7	5	0	0
National newspaper	Correlation Coefficient	-.866	.	.	.	.	.577	.	1.000(**)	.	1.000	.	.	.	.	.	.	.	.	.
	Sig. (2-tailed)	.333	.	.	.	.	.423	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	3	1	1	1	1	4	1	2	1	4	1	0	0	0	0	2	2	0	0
Community billboards	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0
Local radio	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	2	0	2	0	2	2	0	0	0	0	0	2	0	0	0	0	2	0	0
Agro-service cooperative	Correlation Coefficient	.577	1.000(**)	.	.	1.000(**)	.	.	.	.	.	.	.	1.000	.	.	.	.	.	.
	Sig. (2-tailed)	.423	.000	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	4	3	3	3	3	1	1	0	1	0	0	0	4	0	0	1	0	0	0
Groups or associations	Correlation Coefficient	-.592	.	1.000(**)	.	.648	-.500	.	.	-1.000	.	.	.	.	1.000	.	-1.000	.	.	.
	Sig. (2-tailed)	.293	.	.000	.	.237	.667	.	.	1.000	.	.	.	.	.	.	1.000	.	.	.
	N																			

		Number of times	Relative s	Friends	House neighbors	Farm neighbors	Television	National radio	Pamphlet	Community or local newspaper	National newspaper	Community billboards	Local radio	Agro-service cooperative	Groups or associations	Community leaders	PPD	Ag extension staff	NGOs	Other
	N	5	3	3	2	5	3	1	1	2	0	0	0	0	6	0	2	1	0	0
Community leaders	Correlation Coefficient	.	.	.	.	-1.000	-1.000(**)	.	.	.	.	.	.	.	.	1.000	1.000(**)	.	.	.
	Sig. (2-tailed)	.	.	.	.	1.000	.000	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	2	0	0	1	2	3	1	0	1	0	0	0	0	0	3	3	1	0	0
PPD	Correlation Coefficient	-.249	-.399	-.055	-.234	-.293	-.299(*)	-.699(*)	-.083	-.286	.	.	.	.	-1.000	1.000(**)	1.000	.741(**)	.	.
	Sig. (2-tailed)	.178	.073	.790	.230	.131	.046	.036	.859	.534	.	.	.	.	1.000	.	.	.000	.	.
	N	31	21	26	28	28	45	9	7	7	2	0	0	1	2	3	52	24	2	0
Ag extension staff	Correlation Coefficient	-.219	-.489(*)	-.318	-.366(*)	-.454(**)	-.131	.054	-.816(*)	-.763	.	.	.	.	.	.	.741(**)	1.000	.	.
	Sig. (2-tailed)	.163	.046	.081	.043	.005	.366	.849	.025	.133	.	.	.	.	.	.	.000	.	.	.
	N	42	17	31	31	36	50	15	7	5	2	0	2	0	1	1	24	56	0	0
NGOs	Correlation Coefficient	.000	.	.866(*)	.	-.866(*)	1.000(**)	.	.	.	.	.	.	.	.	.	.	.	1.000	.
	Sig. (2-tailed)	1.000	.	.026	.	.026	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	6	2	6	2	6	4	0	2	0	0	0	0	0	0	0	2	0	6	0
Other	Correlation Coefficient	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix E

INDEPENDENT VARIABLES ASSOCIATED WITH RATING OF SOCIAL UNITY (based on the Complete Model with the Complementary Loglog Link)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Thres hold	[I1 = 2]**	-2.437	1.015	5.769	1	.016	-4.425	-.448
	[I1 = 3]**	1.560	.740	4.439	1	.035	.109	3.011
	[I1 = 4]**	3.338	.772	18.701	1	.000	1.825	4.851
Locat ion	FREPARTI	.000	.002	.022	1	.882	-.004	.005
	R.AREAHA	-.022	.044	.264	1	.608	-.108	.063
	A2	-.027	.068	.153	1	.695	-.161	.107
	A3	-.072	.074	.961	1	.327	-.216	.072
	EDU.GRP	.148	.143	1.067	1	.302	-.133	.428
	AGE.GRP	-.108	.099	1.212	1	.271	-.302	.085
	EXPE.GRP	.073	.108	.459	1	.498	-.138	.284
	YIELDGRP	-.083	.166	.251	1	.616	-.410	.243
	AREA.GRP	.019	.077	.062	1	.803	-.131	.170
	DECISION**	.758	.135	31.323	1	.000	.493	1.024

** very highly significant at $p < 0.001$

Notes on results:

Outcomes for the ordinal regression for the selected model which is Complementary Log-log (Cloglog link function):

- **The model fitting statistic**, chi-square ($\chi^2 = 621.069$ with d.f. of 590 and $p = .182$), model with the cloglog link indicated that the observed data were consistent with the estimated values in the fitted model.
- **Test of Parallel Lines** with chi-square result ($\chi^2 = 26.710$ with d.f. of 20 and $p = .144$) indicated that no significant difference exists with corresponding regression coefficients over response level of dependent variables. The model assumption of parallel lines was not violated with the selected cloglog link model.
- **The three pseudo R squares**—McFadden (.115), Nagelkerke (.238) and Cox and Snell (.206).

The model was also run with Logit Link. The Parallel Lines Test failed. Therefore the model using Complementary Log-log Link was used.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	403.170			
Final	356.782	46.388	10	.000

Link function: Complementary Log-log.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	621.069	590	.182
Deviance	356.782	590	1.000

Link function: Complementary Log-log.

Pseudo R-Square

Cox and Snell	.206
Nagelkerke	.238
McFadden	.115

Link function: Complementary Log-log.

Test of Parallel Lines(c)

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	356.782			
General	330.073(a)	26.710(b)	20	.144

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a The log-likelihood value cannot be further increased after maximum number of step-halving.

b The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.

c Link function: Complementary Log-log.

Appendix F

TIMELINES FOR MAJOR EVENTS RELATED TO LAND REFORM, LAND LAW, AND CHANGES IN AGRICULTURAL POLICY THAT INFLUENCED THE RICE PRODUCTION AND MUTUAL AIDS IN THE MEKONG DELTA, VIETNAM

Year	North	South	Impacts	Mutual aid trends	Study site
1930				Estimated at least 1,035,000ha (45% of total cultivated area) farmed by tenants	Note: estimation based on total area of land owner by large landholders
1945	Independence			Mutual aid - an important way of enabling rural people to manage their affairs, based on family, kin, friends..	
1953	Land Reform Law and redistribution started				
1954	Collectivisation policy initiated			75 per cent of villagers in South Vietnam involved in mutual assistance.	
1956-58	Collectivisation – Phase 1 - formation of work-exchange teams				
1955				Estimated at least 40% of Mekong rice land farmed by tenant	Note: estimation based on total area of land owner by large landholders
1955		1 st Land reform. Objectives: a) abandoned lands back to cultivation; b) landlord-tenant relation regularized, rents reduced, tenure	326,276 ha allocated to around 800,000 tenant farmers	Problems with irrigation management because of land rights	

Year	North	South	Impacts	Mutual aid trends	Study site
		provided; and c) riceland holding limited, excess lands expropriated to redistribute to tenants.			
1958-60	Collectivisation – Phase 2 - establishment of low rank cooperatives				
1960-72	Collectivisation – Phase 3 - advancement of cooperatives from low rank to high rank				
1966		IR8 first introduced. Come with tech package for inorganic fertilizers, pesticide, rodenticide...			
1968		IR8: 1% adopted			
1970		2 nd Land reform (Lands not directly cultivated by landowners expropriated (with compensation) & distributed free to farmers.. Farm tenancy, land sublease by middlemen eliminated. Communal riceland redistributed	1.3 million ha allocated to over 1 million farmers		
1975	Country reunification	IR8: 33% adopted			
1976		Collectivisation replicated in the South	1976-81: a sharp decline rice in production in southern provinces. Irrigation improvement started	sharing of labour became more common (sinse production means pooled to collective farms) Xuan, 1995)	
1977			27,520 tractors available to support 30-40% of farm land		

Year	North	South	Impacts	Mutual aid trends	Study site
1978	Economic recession				
1980			Additional 608,300ha irrigated		
1981	<i>The Contract System</i> initiated				
1985			Additional 309,800ha irrigated		
1983			Big tractors increased by 60%. Small tractors increased by 50% compared to 1975		
1986	Doi Moi policy		< 6% of Mekong Delta farmers belonged to agricultural cooperative		
1988	land assignments to individual farmers		Compared to the period of collectivization, the number of oxen and buffaloes, assorted engines, threshers, and insecticide sprayers, has increased from 1.3 to 2.5 times. Agricultural extension is 2- 3 times faster than before 1981(remarkable provinces: Bac Thai, An Giang and Can Tho (Tran Thi Van Anh)	Local people again active in civic projects like road construction and erecting electricity lines. Provinces noteworthy in this regard are Thai Binh, Nghe An and An Giang (Tran Thi Van Anh).	
1988	<ul style="list-style-type: none"> Decollectivisation started Land law released (land use right 10-19 years, right to inheritance and transfer 		Land concentration emerged Individual ownership of machinery again allowed in Southern Vietnam → Increased use of labour-saving equipment		
1989	Foreign Investment Law		Rice market liberalization		

Year	North	South	Impacts	Mutual aid trends	Study site
1992	published Constitution revised (private land ownership approved)				
1990			Additional 387,600ha irrigated		
1993	Land Law (land use right extended to 17-20 years for annual crop and 50 yrs for perennial crops. Transferable; exchangeable, inherit, lease, and used as collateral (peasant households again recognized as autonomous economic units)		2.1 million ha of irrigated and rainfed under high-yielding varieties		
1994	Labour Law released		Additional 429,800ha irrigated		
1998			Total: 1,735,500ha irrigated labour availability at peak times very difficult		

Appendix G

FIELD TRIP SCHEDULE

Timing	Activity
25 July:	Field trip to Vietnam
26 July – 5 Aug:	Prepare for field trip to An Giang province. Confirmation of logistic arrangements with field support staff
6 - 14 August:	Conduct field trip to An Giang and Ho Chi Minh City
18-21 September	Conduct additional field trip to observe the rodent control campaign locally launched at the end of cropping season
16 Aug -10 Oct:	Qualitative and quantitative data analysis (combined with self-learning of SPSS, quantitative and qualitative data analysis method, and writing up draft report for data analysis report, revision of literature review).
13 October:	Go back to Australia
15 - 19 October:	Attend John Allwright Fellowship workshop in Canberra
20 October:	Return to Townsville, prepare field trip report for submission; prepare annual progress report as required by JCU for submission

Interview schedule:

The time for data collection was suggested by the Department of Plant Protection of An Giang province five months in advance. The selection of time for data collection is important because it ensures participants availability at the discussion sessions. Given this, interviews were not conducted until the farmers harvested the crop. However, the disadvantages of interviewing farmers after the harvest raise some of the concerns about the information quality. Emotional stage of farmers after the harvest might affect the way they report in the discussion (see also Patton, 2002:306). Therefore, data triangulation should be carefully done.

Below is the interview timetable that was adopted in the field trip.

Date	6 Aug 2007	7 Aug 2007	8 Aug 2007	9 Aug 2007	10 Aug 2007	11 Aug 2007
Location		<i>Tri Ton</i>	<i>Tri Ton</i>	<i>Tri Ton + Tinh Biên</i>	<i>Tinh Biên</i>	<i>Tinh Biên</i>
Morning	Travel (Phan Thiết – Long Xuyên)	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD,	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD,	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD,	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD,	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD,

Date	6 Aug 2007	7 Aug 2007	8 Aug 2007	9 Aug 2007	10 Aug 2007	11 Aug 2007
Location		<i>Tri Ton</i>	<i>Tri Ton</i>	<i>Tri Ton + Tinh Biên</i>	<i>Tinh Biên</i>	<i>Tinh Biên</i>
		informal discussion	informal discussion	informal discussion	informal discussion	informal discussion
Afternoon		+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD, informal discussion +Team wrap-up, Personal reflection, write up notes	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD, informal discussion +Team wrap-up, Personal reflection, write up notes + notes	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD, informal discussion +Team wrap-up, Personal reflection, write up notes + notes	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD, informal discussion +Team wrap-up, Personal reflection, write up notes + notes	+ FG 1 + interview with opinion leaders, representative from People's Committee, Farmers Association, District DARD, informal discussion +Team wrap-up, Personal reflection, write up notes + notes